Partners in Progress
WHEAT

Wheat Research at OSU 2009

Supported by the

Oklahoma Wheat Commission

and the

Oklahoma Wheat Research Foundation

Oklahoma State University
Division of Agricultural Sciences and Natural Resources
Oklahoma Agricultural Experiment Station
Oklahoma Cooperative Extension Service

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Partnerships Enhance Wheat Research

Partners in Progress – Our long-standing partnership with the Oklahoma Wheat Commission and the Oklahoma Wheat Research Foundation is a valuable asset for Oklahoma State University's wheat research and Extension programs. The partnership not only provides partial funding for our research programs, but it also provides valuable input from producers that helps to keep our research programs focused and relevant. It is truly one of the best examples of the Division of Agricultural Sciences and Natural Resources working in a cooperative relationship with commodity groups to achieve common goals. Partial funding for our research and Extension programs comes from wheat producers through the check-off program. We have been and continue to be accountable for the use of these funds.

The *Partners in Progress Wheat Research Report* is one of a series of annual reports from DASNR highlighting research results and impacts of funded projects. This information is utilized throughout the year in educational wheat programs and is distributed to Oklahoma wheat producers to keep them up-to-date on the latest research findings. The research contained in this report has been directed as closely as possible to meet the needs of Oklahoma wheat producers.

At the beginning of each section is a summary of accomplishments for fiscal year 2008-2009. The narrative that follows explains in more detail the progress made during the year.

The long-term continuous support of our wheat research programs from the OWC and the OWRF has allowed our faculty to make significant progress toward the common goal of keeping Oklahoma wheat farmers competitive in regional, national, and international markets. This support makes us truly *Partners in Progress*.

Clarence Watson,
Associate Director
Oklahoma Agricultural Experiment Station
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Oklahoma State University Division of Agricultural Sciences and Natural Resources Mission Statement

The Mission of the Oklahoma State University Division of Agricultural Sciences and Natural Resources is to discover, develop, disseminate, and preserve knowledge needed to enhance the productivity, profitability, and sustainability of agriculture; conserve and improve natural resources; improve the health and well-being of all segments of our society; and to instill in its students the intellectual curiosity, discernment, knowledge, and skills needed for their individual development and contribution to society.

Working Together to Accomplish More

Partners in Progress WHEAT

Several years ago, in a business class at Oklahoma State University, a college professor placed the acronym TEAM on a blackboard during one of his classes. Written beside the acronym were the words that spelled out TEAM—Together Everyone Accomplishes More. This past year, Oklahoma wheat producers have had their challenges with the serious drought and late freezes that severely impacted the outcome of the 2009 wheat crop. Looking ahead, if we can work together as a TEAM, the possibility of accomplishing greater things to benefit everyone in the wheat industry has a much better chance of becoming a reality. Producer dollars invested into the check-off continue to fund research for finding better ways to create a more resilient wheat plant producing more while needing less.

We continue to fund technologies that help release varieties focusing on better end use value for the milling and baking industries, while also requiring fewer inputs from the producer. The OSU Wheat Improvement Team is composed of scientists, at OSU's Division of Agricultural Sciences and Natural Resources. The goal of the division is to develop highly adapted winter wheat cultivars with marketable grain quality. Scientists at OSU continue to place emphasis on leaf rust, soil borne mosaic virus, aphids and tolerance to low-pH, A1 toxic soils. In the future, research conducted at OSU in the areas of variety research for greater yield potential and baking qualities will allow producers in our area the ability to expand new markets for Oklahoma wheat.

The goal is to create a quality and consistency that milling industries around the world will find valuable. In working with researchers and scientists, we are seeing more result-based opportunities that help promote the different qualities of our product to more places around the world. The Oklahoma Wheat Commission continues to build a strong extensive network of contacts in foreign markets to create better price structures for the producer.

Quality starts with the seed placed into the soil. In order to have a product good for the end game, we must remember that good quality also has to start from the beginning. The research summarized in this publication is made possible by collaborations from the Oklahoma Wheat Commission, Oklahoma Wheat Research Foundation, Land Grant Institutions and the United States Department of Agriculture.

Oklahoma wheat producers have always faced challenges and adversity—that is nothing new. We continue to use producer check-off dollars to fund new technologies allowing producers to be more competitive. We hope by releasing new wheat varieties that increase producer yield and quality, we can create more marketing opportunities for the Oklahoma wheat farmer.

By working together as a TEAM, we can create a quality product that meets the needs and expectations of both foreign and domestic milling industries to ensure the existence and effectiveness of customer confidence. This will allow Oklahoma wheat farmers the ability to build more market share by having a product the world demands. Together Everyone Accomplishes More in the wheat industry by being *Partners in Progress*.

Mike Schulte, Executive Director
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Genetic Improvement and Varietal Release of Hard Winter Wheat

Wheat Improvement Team

2008-2009 progress made possible through OWRF/OWC support

- Identified four candidate varieties worthy of preliminary or continued foundation seed production and potential release, pending final data analysis and quality testing:

  OK05526, KS94U275/Endurance

  OK05212, OK95616/Hickok//Betty

  OK05511, TAM 110/2174

  OK03825-5403-6, Custer*3/94M81
- Delivered wheat yield and phenology data to more than 8,000 Oklahomans through the *2009 Wheat Seed Book* distributed by the *High Plains Journal* to all Oklahoma subscribers. The Oklahoma Wheat Commission was recognized as a funding agency on the cover of this publication.
- Provided timely electronic information to Oklahoma wheat growers, consultants, farmers, and Extension educators and researchers through 25 issues of the *Plant and Soil Sciences Extension Newsletter* and eight Wheat Disease updates.
- Sequenced a 16,000 base-pair DNA strand from each of Jagger and 2174, and then identified a single base-pair discrepancy that accounts for about one-third of the difference in leaf rust reaction observed between Jagger and 2174 in the field. This base-pair difference formed the basis for constructing a perfect gene marker heretofore never discovered, but fervently pursued, in the global wheat research community.
- Selected and advanced breeding materials with adult-plant resistance to leaf rust based on three or more nonrace-specific genes. Some lines may also harbor genes for adult-plant resistance to stripe rust.
- Rapidly expanded the crossing of winter type adult-plant resistance genotypes and synthetic derivatives with highly adapted genotypes from the region.
- Developed adapted winter wheat synthetic derivatives for further multi-location testing and selection as potential breeding stocks.
- Classified the reaction of more than 1,500 experimental lines from multiple states for reaction to the wheat soilborne mosaic virus (WSBMV)/wheat spindle streak mosaic virus (WSSMV) complex, including a subset of 340 advanced OSU lines subjected to an enzyme-linked immunosorbent assay for resistance to WSBMV, WSSMV, or both. This ongoing screening process ensures resistance to WSBMV/WSSMV in OSU varieties at a rate of about 95 percent.

- Implemented rapid, highly specific diagnostic tests to differentiate symptoms caused by barley yellow dwarf virus (BYDV), wheat streak mosaic virus (WSMV), high plains virus (HPV), and Triticum mosaic virus (TrMV). Information from these tests was applied immediately to guide selection for field tolerance to BYDV.
- Classified the seedling reaction of approximately 400 OSU advanced experimental lines to leaf rust, powdery mildew and tan spot. These results were used in addition to, or in lieu of, field reactions recorded under natural infection in 2009. Consequently, resistance to leaf rust in OSU candidate materials is quite strong, and resistance to powdery mildew is ramping up. However, resistance to tan spot needs further selection pressure.
- Continued developing a field nursery to evaluate the reaction of OSU advanced lines to tan spot.
- Confirmed the absence of Karnal bunt in 52 wheat samples from 14 counties in Oklahoma.
- Identified primary synthetic wheat accessions with excellent resistance to greenbug.
- Demonstrated reduced fly infestations, and thus increased field tolerance, among OSU advanced lines (OK05511, OK05526) and available varieties (Duster, Centerfield) in the presence of natural populations of Hessian fly.
- Documented the frequency of Hessian flies in major wheat growing regions of Oklahoma.
- Demonstrated substantial and useful variation in coleoptile length among OSU advanced lines, both when germinated in the presence or absence of water-deficit stress. One line highly adapted to drier areas of Oklahoma, OK05511, was found to possess the ability to germinate and rapidly produce a longer coleoptile in artificial drought stress conditions.
- Continued to serve as the only source for critical information such as coleoptile length, high-temperature germination sensitivity and dual-purpose adaptability of new wheat varieties.
- Applied an optimized method of measuring dough extensibility among OSU advanced lines.
- Incorporated three new laboratory procedures for discriminating more accurately among experimental breeding lines for end-use quality or functionality of the grain. These predictive tests combine measurements of dough elasticity and the ability to recover elasticity (recoverability), dough extensibility and gluten quality.

Oklahoma's Wheat Improvement Team (WIT) is well into its second decade of discovering genetic solutions and creating greater economic opportunities for Oklahoma's wheat producers. Nine OSU faculty form a cohesive team that combines fundamental and applied components of genetic research to achieve a common goal—that is, to move the entire chain of Oklahoma's wheat industry forward with the infusion of new, improved varieties. Scientists on the WIT are **Brett Carver**, wheat breeding and genetics; **Liuling Yan**, Quantitative Trait Loci (QTL) discovery and genomic technology; **Jeff Edwards**, information exchange and systems research; **Bob Hunger** and **Art Klatt**, wheat pathology and development of disease-resistant germplasm; **Kris Giles** and **Tom Royer**, Hessian fly diversity and resistance; **Bjorn Martin**, drought resistance; and **Patricia Rayas-Duarte**, cereal chemistry.

The 2008-2009 season produced yet another bumper crop of advanced lines from which to choose OSU's next wheat variety. We are now closely examining the performance history of four candidate varieties as a preliminary stage to name one or two lines for release approval by the Oklahoma Agricultural Experiment Station (OAES) in early 2010. Some of the most notable features of this pool of elite lines include dual resistance to two biotypes of Russian wheat aphid, stacked resistance to both greenbug and Hessian fly in a genotype that actually complements—not duplicates—the adaptation pattern of Billings (released by OSU in 2009), and extraordinary tolerance to acidic soils.

In this report, more can be read about these and other significant breakthroughs such as the discovery of an infinitesimal but crucial difference in DNA sequence between 2174 and Jagger that accounts for their divergent leaf rust resistance patterns. Other breakthroughs include improved precision in discerning resistance to multiple viruses such as barley yellow dwarf virus and wheat streak mosaic virus, ramping up synthetic derivatives as experimental lines on a variety-development track, and the development of new protocols that enable the WIT to identify experimental lines with improved breadmaking quality.

Information Exchange and Systems Research

Jeff Edwards
Plant and Soil Sciences

The information exchange component of the WIT continued to focus on timely delivery of relevant information to the Oklahoma wheat farmer. This was accomplished through a variety of delivery methods and information outlets. Timely information was delivered to Oklahoma wheat farmers through 25 issues of the *Plant and Soil Sciences Extension Newsletter* in 2009, and the e-mail distribution list for this publication continues to grow. Wheat variety trial results were again published promptly, which allowed farmers and seed producers to make well-informed decisions regarding seed purchases. To expand the readership and visibility of this publication, we partnered with *High Plains Journal* and distributed the *2009 Wheat Seed Book* to approximately 8,000 subscribers in Oklahoma. This partnership will be continued in 2010, as it increases our impact by providing timely information to a large number of stakeholders and recognizes the OWC and OWRF as funding agencies for the program.

Research efforts in 2008-2009 continued to focus on collecting and interpreting data that Oklahoma wheat farmers can use directly in their operations. At the time of this report, the WIT is in the process of analyzing three years of no-till versus conventional till data from the El Reno site. Preliminary analysis indicates that no-till and conventional till grain yields are similar between the two systems, but forage yields are lower in the no-till system. In addition to variety yield data, data was provided on coleoptile length, strength of post-harvest dormancy, and date of first-hollow-stem arrival on the newest wheat lines released in the southern Great Plains. The goal with continuing these investigations is to help farmers avoid problems before they start.

Wheat Pathology Research and Development of Disease Resistant Germplasm

Bob Hunger
Entomology and Plant Pathology

Crucial to developing improved wheat varieties for Oklahoma is the recurrent assessment of breeding materials for reaction to diseases including leaf rust, the WSBMV/WSSMV complex, powdery mildew, tan spot and septoria. This testing is conducted either in the greenhouse, the field, or both. The serological enzyme-linked immunosorbent assay (ELISA) is used to test advanced OSU lines with more precision for the presence of WSBMV and WSSMV. These results are critical to determine if a line is resistant to one or both viruses. Testing of seedlings in the greenhouse for reaction to leaf rust, powdery mildew, tan spot and septoria also is conducted to further define the disease reactions of OSU advanced lines.

Understanding the disease reaction under field conditions is most effective in developing new varieties; therefore, OWRF funds were used to further develop a field protocol to test advanced lines for reaction to tan spot. This is part of an ongoing doctoral research project of Kazi Kader, who is jointly funded by the OWRF and the OAES. In addition to developing a procedure to test for reaction to tan spot in the field, Kader's research is contributing to an understanding of the virulence of different isolates of the tan spot fungus, *Pyrenophora tritici-repentis*.

Often plant viruses co-infect wheat plants and produce symptoms that cannot be visually differentiated according to the causal organism. One example common to the OSU wheat improvement program is co-infection of wheat by WSBMV and WSSMV. In such an instance, the ELISA is used to determine which virus is present, as this helps to identify experimental lines with resistance to either or both viruses. This capability has already impacted the OSU wheat improvement program favorably, given the vast majority of released varieties over the past 10 years carry resistance to both WSBMV and WSSMV. However, future testing is needed as parental materials are continually introduced and may not feature resistance.

A potentially similar scenario could develop with precision testing for reactions to barley yellow dwarf virus (BYDV), wheat streak mosaic virus (WSMV), high plains virus (HPV), and Triticum mosaic virus (TrMV), as all of these viruses can co-infect wheat and cause similar symptoms. During this past year, OWRF funds were used to develop the capability to test for these four viruses by ELISA and by the more sensitive procedure called reverse transcription polymerase chain reaction (rt-PCR). Rt-PCR detects the nucleic acid of the virus and is more sensitive than ELISA in detecting and differentiating multiple virus infections within the same plant sample. Jen Dominiak-Olson in the Plant Disease and Insect Diagnostic Lab conducted these tests last year. Brian Olson, who was recently hired as a technician in this program, also has the ability to conduct these tests.

Results from an rt-PCR test conducted in 2009 are depicted in

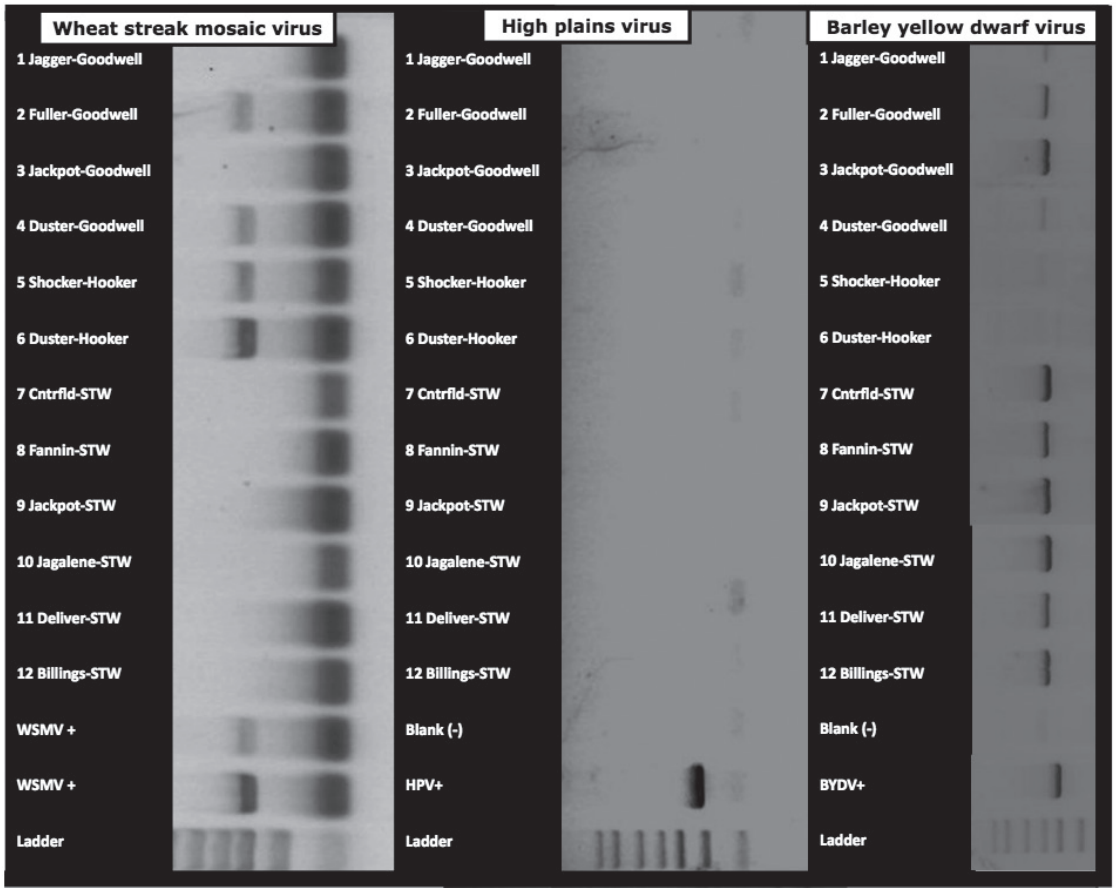

Figure 1. Detection of wheat streak mosaic virus (WSMV), high plains virus (HPV), and barley yellow dwarf virus (BYDV) using polymerase chain reaction (PCR) technology. The "ladder" at the bottom of the page indicates the size of the isolate nucleic acid. Immediately above the ladder are positive and negative controls for the three viruses. Above that are samples 1 to 12 that were tested for presence of WSMV, HPV and BYDV.

Figure 1 and Table 1. In this test, 12 wheat samples were tested for the presence of WSMV, HPV, BYDV and TrMV. Results were used to identify the viruses responsible for symptoms in these plants. Moreover, information from these tests was applied immediately in 2009 to guide selection in an opportunistic way for field tolerance to BYDV.

Funds provided by the OWC supported the testing of the 2009 Oklahoma wheat crop for the presence of Karnal bunt. Results from this testing were used to certify that Oklahoma wheat was produced in areas not known to be infested with Karnal bunt, which allowed Oklahoma wheat to move freely throughout the marketplace.

Art Klatt
Plant and Soil Sciences

Germplasm development in the OSU wheat improvement program has two recurrent areas of focus described here: 1) incorporate stable and durable leaf and stripe rust resistance into adapted winter wheat backgrounds

Table 1. Summary of testing 12 wheat varieties for presence of wheat streak mosaic virus (WSMV), high plains virus (HPV), and barley yellow dwarf virus (BYDV) using the enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR). Note the absolute agreement between the two tests for detection of virus presence. PCR testing of samples for Triticum mosaic virus (TrMV) was not conducted because the test was not available at the time.

		ELISA Results				RT-PCR Results		
No. and variety	*Location*	*WSMV*	*HPV*	*BYDV*	*TriMV*	*WSMV*	*HPV*	*BYDV*
1. Jagger	Goodwell	NEG	NEG	POS	NEG	NEG	NEG	POS
2. Fuller	Goodwell	POS	NEG	POS	NEG	POS	NEG	POS
3. Jackpot	Goodwell	NEG	NEG	POS	NEG	NEG	NEG	POS
4. Duster	Goodwell	POS	NEG	POS	NEG	POS	NEG	POS
5. Shocker	Hooker	POS	NEG	NEG	POS	POS	NEG	NEG
6. Duster	Hooker	POS	NEG	NEG	POS	POS	NEG	NEG
7. Centerfield	Stillwater	NEG	NEG	POS	NEG	NEG	NEG	POS
8. Fannin	Stillwater	NEG	NEG	POS	NEG	NEG	NEG	POS
9. Jackpot	Stillwater	NEG	NEG	POS	NEG	NEG	NEG	POS
10. Jagalene	Stillwater	NEG	NEG	POS	NEG	NEG	NEG	POS
11. Deliver	Stillwater	NEG	NEG	POS	NEG	NEG	NEG	POS
12. Billings	Stillwater	NEG	NEG	POS	NEG	NEG	NEG	POS

for Oklahoma, and 2) transfer useful genes—especially genes for improved drought tolerance, heat tolerance, and resistance to tan spot and the rusts—from synthetic wheat into adapted winter wheat. The spring wheat breeding program at CIMMYT has generously provided primary synthetic hexaploid (cultivated durum x *Ae. tauschii* [goatgrass]) wheat lines and advanced breeding lines with adult-plant resistance (APR) to leaf rust and stripe rust. Crosses between local winter wheat materials and these introduced materials have been made for the last nine years. Materials derived from these crosses are in the final stages of testing and evaluation.

Advanced winter wheat lines with APR to leaf rust based on multiple, nonrace-specific genes were tested for grain yield performance at multiple locations in the state. The majority of these materials contained the APR genes *Lr34* and *Lr46*, plus one or, in most cases, two additional APR genes of unknown designation. In addition, many of these advanced lines may have two or more APR genes for stripe rust resistance. If these materials have high-yield potential and acceptable quality, they could lead to varieties with a more durable type of rust resistance, which would be highly beneficial to wheat producers of Oklahoma.

More than 200 new crosses were made to synthetic wheat germplasm during the 2008-2009 crop season, including a large number of crosses to a collection of winter synthetic lines recently introduced from CIMMYT. Progenies derived from these crosses (i.e., synthetic derivatives) may provide new sources of genes for rust resistance, aphid resistance, enhanced drought tolerance, improved green-leaf retention, and better resistance to many of the minor diseases, especially tan spot. Synthetic derivatives are being evaluated in preliminary and advanced yield trials for overall adaptation and end-use quality.

For the last two to three years, an increasing number of crosses has been made between winter-type derivatives from the program (including advanced materials with adult-plant resistance and materials derived from synthetic crosses), and locally adapted germplasm from the region. The ultimate objective is to further improve the adaptation and quality of the derived materials while maintaining the desirable genes that have been introduced from spring wheat and synthetic wheat. The priority given to this crossing scheme will increase during the next crossing cycle.

A regional cooperative nursery near San Antonio, Texas, continues to serve as a selection site primarily for leaf rust resistance. All introduced materials are screened in south Texas before being used as parents, and early-generation populations are evaluated under severe rust pressure at this site. All advanced materials described here, and all experimental breeding lines designated for statewide yield testing, are evaluated in this nursery to confirm rust resistance.

Characterization of Hessian Fly Diversity and Resistance

Kris Giles and Tom Royer
Entomology and Plant Pathology

We continued to survey natural Hessian fly populations in Oklahoma and assess the ability of the WIT to provide a genetic defense to those populations. Our overall objective is to identify sources of Hessian fly resistance and make those sources available to the OSU wheat improvement program. During the growing season, we collected Hessian fly pupae from across the major wheat growing areas in Oklahoma. As in previous years, populations were sporadic in most locations. However, fields near Apache showed extremely high densities on susceptible wheat, but populations were difficult to detect in north central Oklahoma. As observed in previous years, higher densities were most common in or near continuous no-till wheat fields and in fields planted early for grazing. Pupae were sent to Kansas State University and USDA-ARS in Indiana for biotyping and are awaiting confirmation of the Great Plains biotype (GP). Initial data indicate that biotype GP continues to be common in Oklahoma.

In two replicated studies, the reaction of advanced experimental lines (OET3 – the same trial evaluated by Jeff Edwards at other sites) to natural fly populations near Braman and Apache was evaluated. The natural fly infestations near Braman were extremely low. More than 2,500 tillers were dissected, and a total of only 11 flies was documented. The Hessian fly resistant variety Duster had the highest yields in Braman, but this was likely due to tolerance to soil acidity prevalent at this location. As in previous years, the Apache site had high natural fly infestations (nearly 8 flies per tiller), but because of the early-spring freeze, yield data could not be collected. Even without yield data, these heavy

Table 2. Cumulative Hessian fly larvae + pupae per tiller (1st + 2nd generation) for experimental lines tested in the Oklahoma Elite Trial 3 (OET3) in Apache, 2008-2009.

Entry	*Flies / Tiller*
Duster	0.0
OK06114	0.1
OK05204	0.2
OK04315	0.2
OK05903C	0.2
OK05128	0.2
OK05511	0.2
OK04111	0.2
Centerfield	0.4
OK06618	0.5
OK06729	0.6
OK05526	0.8
Fuller	2.7
Chisholm	2.8
OK06029C	3.3
Jackpot	3.5
OK04525	4.2
Billings	4.6
OK05742W	4.6
OK Bullet	4.9
Deliver	4.9
OK06617	5.0
STARS 0601W	5.3
OK Rising	5.3
Endurance	5.5
Pete	5.8
OK01420W	6.3
OK05312	7.2
OK05212	7.8
OK05711W	7.9
LSD	2.6

infestations provided critical biological data for documenting Hessian fly resistance and advancements in the wheat breeding program. In Apache, the cumulative average infestation ranged from 0 to 7.9 flies per tiller (Table 2).

As expected, Duster showed the lowest infestations, but several experimental lines had extremely low numbers of flies that survived, indicating relative resistance to fly populations in Oklahoma. The partially resistant variety Centerfield continues to perform well under high-fly pressure. The moderately resistant experimental lines, OK05511 and OK05526, were tagged this year as candidate varieties for further review and preliminary foundation seed increase. Currently, Oklahoma producers have resistance options for Hessian fly, and future breeding efforts look promising.

Stress Physiology

Bjorn Martin
Plant and Soil Sciences

Breeding for increased coleoptile length is important for wheat producers in the Great Plains region where moisture is a recurring problem during planting. A longer coleoptile allows deeper planting, which maximizes the chance of developing roots finding water. For that purpose, 50 advanced experimental lines from the OSU wheat improvement program were evaluated for the length of the fully extended coleoptile. At that time, we measured germination percentage and the percentage of germinated seeds that had reached full coleoptile length by the end of the two-week test period. Seeds were tested either in water or in 3 mM PEG to simulate drought stress conditions. The advanced lines were tested in two rounds: 1) a set of 30 entries in the 2009 OET3, and 2) a set of 20 entries from the 2009 OET2. Each entry was replicated six times in each of the two treatments.

In the test system, 20 seeds of the same entry were sandwiched between two strips of germination paper. The strips were rolled into loose rolls with the seeds close to one end. Each replication consisted of 30 (OET3) and 20 (OET2) rolls placed on end (seeds at lower end) in a plastic tub. After water or PEG solution was added to the tubs, they were placed in a cold room for four days and then into a dark growth chamber set at 24 C for two weeks. Measurements were taken at the end of the two weeks.

In the OET3 round, OK06729, OK05204, Endurance, OK05511 and Centerfield produced the longest coleoptiles under artificial drought stress (PEG treatment) at 79.5 mm, 66.3 mm, 64.7 mm, 64.3 mm and 63.2 mm, respectively (Figure 2). OK05511 and OK05204 remain as candidate varieties at the time of this report. The

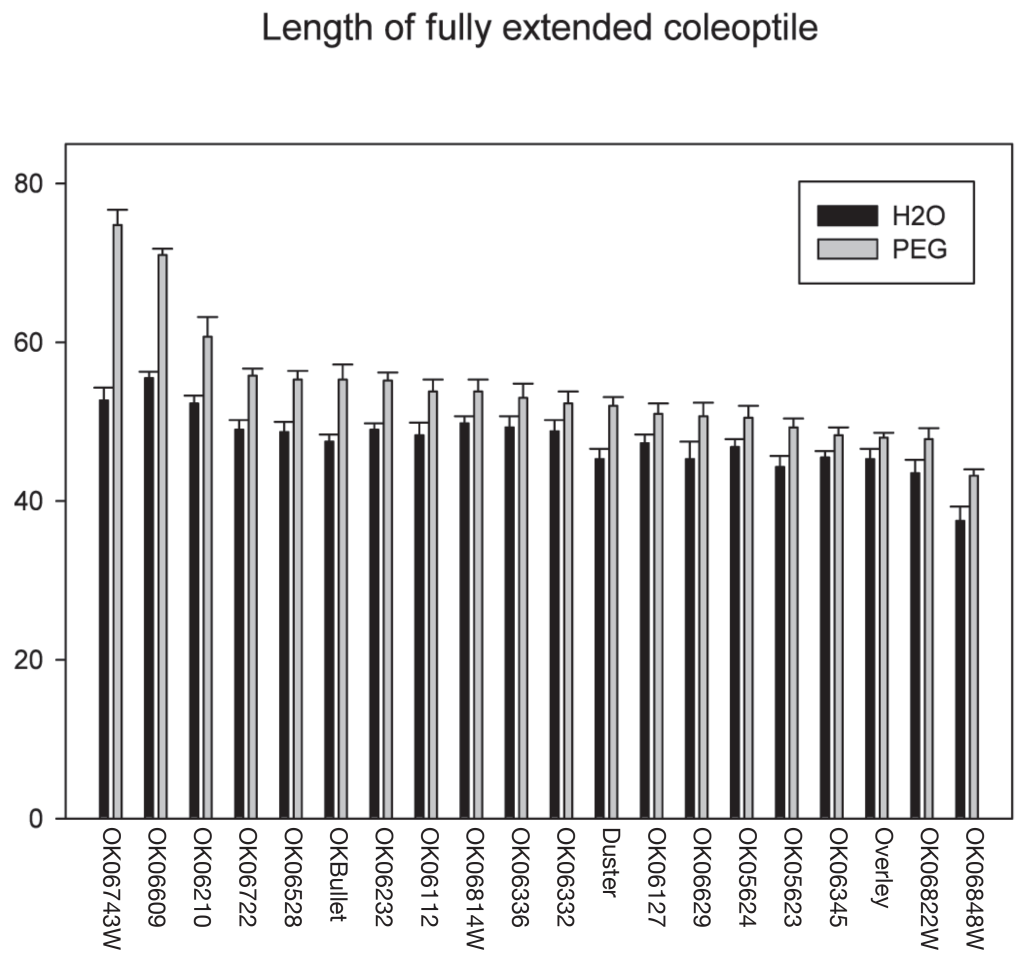

Figure 2. Length of the fully extended coleoptile for 30 entries in the 2009 OET3 (top) and for 20 entries in the 2009 OET2. Germination occurred in either water or 3mM PEG (artificial drought stress treatment), and measurements were taken after two weeks.

shortest coleoptiles in PEG belonged to OK05212, Pete, Billings, OK Rising and OK05742W (sister line of OK Rising) at 50.3 mm, 50.2 mm, 49.5 mm, 48.5 mm and 46.8 mm, respectively. OK05212 is a promising, high yielding advanced line currently under foundation seed increase, pending submission of a proposal for release by the OAES.

In the OET2 round (containing less advanced experimentals), OK06743W, OK06609 and OK06210 had the longest coleoptiles in PEG at 74.8 mm, 71.0 mm and 60.7 mm, respectively. Overley, OK06822W and OK06848W had the shortest coleoptiles at 48.0 mm, 47.8 mm and 43.2 mm, respectively. Coleoptiles were actually longer in PEG than in water in both experiments. For example, the coleoptile lengths of the longest entries in each experiment, OK06729 (OET3) and OK06743W (OET2), were 79.5 mm and 74.8 mm in PEG but only 63.8 mm and 52.7 mm in water.

Germination percentage varied widely in the PEG treatment, from 68 percent to 94 percent in the OET3, and from 70 percent to 93 percent in the OET2. In water germination percentage varied from 88 percent to 99 percent (OET3), and from 82 percent to 96 percent (OET2). The five entries with the greatest germination percentage in PEG in the OET3 were Chisholm, OK05128, OK06729, Duster and Centerfield. The entries with the lowest germination percentage were OK05212, OK04525, Pete, OK Rising and Billings. The three entries with the highest germination percentage in PEG in the OET2 were OK06528, OK06345 and OK06609. The three entries with the lowest germination percentage were Duster, OK06743W and OK06814W. This trait showed less consistency than coleoptile length, evidenced by the reversal in rank position of Duster, a check common to both experiments.

Of those seeds that germinated in OET3 in PEG, 53 percent to 87 percent reached full coleoptile length depending on genotype. In water, the range was 78 percent to 99 percent. In OET2 in PEG, the range was 56 percent to 88 percent, and in water 61 percent to 88 percent. In the OET3 in PEG, OK05204, OK06729, OK06114, OK05511 and OK06029C had the greatest percentage fully extended coleoptiles, and OK05711W, OK04525, OK04111, Billings and OK Rising had the smallest percentage. In OET2 in PEG, OK06528, OK06609, and OK06822W had the greatest percentage of fully extended coleoptiles, while OK06814W, OK06743W and Duster had the smallest percentage. The combined results indicate experimental lines OK06729 and OK05511 had the most desirable characteristics for early stand establishment under drought stress conditions. OK06729 has since been removed from further advancement though it continues to be used extensively as parent material in the hybridization program. As mentioned above, OK05511 is a candidate for release and, based on yield trials, has shown best adaptation to southwest Oklahoma and dryland areas of the Oklahoma panhandle.

Cereal Chemistry

Patricia Rayas-Duarte
Biochemistry and Molecular Biology

The importance of gluten proteins cannot be overestimated. Gluten is formed from glutenin polymers having a wide distribution range in molecular weight. Glutenin polymers are often related to the variation that occurs in rheological and bread baking properties. At this time, the scientific community does not fully understand how individual glutenin genes control the quality of wheat varieties. A better understanding of the effect of individual alleles on quality parameters is required to target quality-related components for breeding purposes and for end use. One of the objectives in the 2008-2009 funding cycle was to evaluate the influence of individual alleles of low-molecular-weight (LMW) glutenin subunit (GS) genes on wheat quality by using the intact-kernel elastic properties analysis.

Among the glutenin polymers are LMW-GSs, which account for about 30 percent of the total protein mass and about 60 percent of the total glutenins. These proteins appear to have a pronounced effect on dough viscoelastic properties in both bread wheat and durum wheat. Despite their abundance and important effect on dough and bread, LMW-GSs have received limited research attention compared with the high-molecular-weight (HMW) GSs. This is due to the large number of allelic variants at genetic loci controlling production of LMW-GSs and the difficulty in identifying them when using one-dimensional sodium dodecyl-polyacylamide gel electrophoresis.

During this reporting period, the WIT analyzed the HMW-GS and LMW-GS fractions from 45 experimental lines across two advanced line nurseries conducted in 2008. This set of genotypes showed wide variation for HMW-GS and LMW-GS composition. Two HMW-GS *Glu-A1*alleles (1 and 2*), six HMW-GS *Glu-B1* alleles (7+9, 7+8, 7, 6*+8*, 17+18, 20x+20y), and two HMW-GS *Glu-D1* alleles (5+10, 2+12) were identified. Alleles at the HMW-GS *Glu-A1* locus were almost equally represented by *Glu-A1-1* (53 percent) and *Glu-A1-2** (47 percent). The most diversity was found at HMW-GS *Glu-B1*, with the most common alleles being 17+18 (34 percent) and 7+8 (30 percent). The HMW-GS *Glu-D1* allele 5+10 (93 percent) was the most common, as might be expected in a wheat improvement program focused on dough strength.

Among the LMW-GS loci, five *Glu-A3* alleles (a, c, d, g, h), six *Glu-B3* alleles (d, e, f, g, h, i), and five *Glu-D3* alleles (a, b, c, d, e) were identified. Among the most common alleles of Glu-A3 were c (51 percent) and a (38 percent). Allele *Glu-B3i* (29 percent) was most common at the *Glu-B3* locus, followed by *Glu-B3g* (22 percent) and *Glu-B3f* (20 percent). Alleles found at the *Glu-D3* locus were predominately a (21 percent), b (21 percent), c (29 percent), and d (19 percent). It is difficult to assign a positive or negative effect to the end-use properties based on individual allele expressions. The most effective comparison is to consider the HMW-GS genotype.

Unfortunately in this set of samples, there were no common expressions of HMW-GS and LMW-GS alleles, except for the following samples. OK03825-5403-6 (1, 7+9, 5+10, d, d, d) had a similar pattern to Custer (Null, 7+9, 5+10, d, d, d) except for *Glu-A1* expressing allele 1 in the former and absent (null) in Custer. The LMW-GS composition of *Glu-A3d*, *Glu-B3d* and *Glu-D3d* is not very common in the available literature. From the information learned this year with this set of samples, Custer, OK03825-5403-6 and OK03825-5403-5 were the only samples containing a triplicate set of LMW-GS d alleles. The presence of these alleles in OK03825-5403-6, OK03825-5403-5 and Custer are not surprising considering the two experimental lines are sister lines, each having Custer as a predominant parent.

Candidate variety OK05526 contained the HMW-GS *Glu-A3* allele 2+12, which is generally thought to confer less desirable dough characteristics compared to allele 5+10, the more predominant subunit among OSU advanced lines. Its LMW-GS allelic composition was *Glu-A3a*, *Glu-B3d* and *Glu-D3b*. What makes this sample unique is the presence of the *Glu-B3d* allele, a rare allele in this set of genotypes except for the above mentioned OK03825-5403-6 and its sister line OK03825-5403-5. Contrary to its glutenin subunit composition, OK05526 produced high sedimentation volume, a desirable characteristic related to the amount of protein that forms a hydrated gel and is related to good baking performance.

Candidates OK05511 and OK05212 also attracted special interest. Their HMW-GS allelic composition appeared to be quite favorable (2* and 1, 7+8, 5+10) with two possible exceptions. The mobility of their 5+10 HMW subunint appeared to be of lighter molecular weight, i.e., they traveled slower in the electrophoresis analysis. This suggests that these alleles may be slightly different than the commonly observed 5+10 alleles. It is not known how this would impact end-use performance. OK05511 and OK05212 had the LMW-GS *Glu-A3c* allele, which is the most common allele in the reported literature and in our set of samples. The LMW subunits c, g and c (*Glu-A3*, *-B3* and *-D3*, respectively) present in OK05212 were also present in the variety Danby, which is considered a good reference in terms of end-use properties.

QTL Discovery and Genomic Technology

Liuling Yan
Plant and Soil Sciences

Wheat genomic research in 2008-2009 focused on the development and application of a PCR-based marker for resistance to leaf rust, molecular explanation for allelic variation in powdery mildew resistance, and the application of three reproductive developmental genes.

The most striking breakthrough was the development of a PCR marker for alleles of the *Lr34* gene that confers resistance to leaf rust and other diseases. Leaf rust is one of the most persistent deterrents to wheat production in the southern Great Plains. The WIT found segregation for leaf rust resistance in a Jagger x 2174 population of recombinant inbred lines (RILs) field-tested for three years. The *Lr34* locus on the short arm of chromosome 7D explained 18 percent to 35 percent of the total variation in disease severity of adult plants in any given year. The *Lr34* gene was recently cloned, and three polymorphisms were reported responsible for allelic variation in *Lr34* between the resistant form 'Chinese Spring' and the susceptible form in 'Renan' (*Science,* 2009, Krattinger et al.). However, none of these polymorphic sites accounted for any difference between Jagger and 2174. Thus, up to 16,000 base pairs of the *Lr34* gene were sequenced for the susceptible Jagger allele and for the resistant 2174 allele and found that a point mutation in Jagger resulted in a nonfunctional (leaf rust susceptible) *Lr34* allele. Dozens of locally adapted varieties have been genotyped for *Lr34* using the team's own constructed gene (or perfect) marker. This marker is being used to more accurately develop OSU's next generation of wheat varieties.

Powdery mildew is another major disease and significantly affects grain yield and end-use quality of winter wheat in the southern Great Plains. In a previous funding year, a major QTL was found on chromosome 1A responsible for segregation of powdery mildew resistance in the Jagger x 2174 population. This year, the WIT learned further that 2174 has a resistant *Pm3a* allele, whereas Jagger has a susceptible *Pm3a* allele. Among 31 locally adapted varieties, four possessed the resistant *Pm3a* allele (2174, Okfield, Centerfield and Ok102). Severe susceptibility in Jagger was caused by the absence of the resistant *Pm3a* allele. In addition, four minor QTLs were mapped in the Jagger x 2174 population. Development of molecular markers for resistant alleles characterized for the major gene and minor genes will facilitate marker-assisted selection for powdery mildew resistance in OSU's wheat breeding program. Near-complete resistance in a wheat variety is expected to be obtained by pyramiding the major gene and minor resistance genes. This research work has been published in *Molecular Breeding*.

Maturity of wheat is usually characterized using a single trait such as heading date or flowering time. Although in the southern Great Plains, maturity may additionally be described as the date of first-hollow-stem stage. We dissected the life cycle of winter wheat into three developmental phases by characterizing three developmental stages: stem elongation, heading date and physiological maturity. A developmental phase is the duration between two successive stages in development. Variation in duration of a developmental phase has important implications for yield formation. The WIT found that reproductive development in winter wheat grown in the southern Great Plains is primarily controlled by three major QTLs, each tightly associated with a known flowering gene. These are *VRN-A1* on chromosome 5A, *PPD-D1* on chromosome 2D, and *VRN-D3* on chromosome 7D. It was concluded that integration of different QTLs, their alleles, and duration of their effects altogether determined variation in the timing of each developmental stage and, thus, various developmental phases. These gene markers will be useful to fine-tune the developmental process and optimize yield component formation in winter wheat. This research work produced new names of QTLs featuring OSU in their syntax and awaits publication.

Wheat Breeding and Variety Development

Brett Carver
Plant and Soil Sciences

A look back on the 2008-2009 crop year challenges one not to focus on the negative. If one phenomenon could account for the majority of selection pressure applied in any stage of the OSU wheat improvement program, it would be the early spring freeze in April 2009. While other biotic and abiotic factors figured heavily in our selection decisions, it was this one weather event (spanning two days) that trumped them all. On first reaction within three weeks of the freeze, it was readily apparent that breeding nurseries at the Wheat Pasture Research Unit near Marshall, the North Central Agronomy Research Station at Lahoma, and the Agronomy Research Station at Stillwater were hardest hit. Further, no one genotype or lineage appeared to escape unscathed. The freeze event of early April acted like a cluster bomb to the entire breeding program. These three locations together contained the core of the 10- to 12-year cycle of breeding materials and therefore placed the program in serious jeopardy.

Yet, as reproductive development continued, it became obvious that while damage was omnipotent, the degree of freeze recovery was highly genotype-dependent, i.e., genetic patterns could easily be detected among sister lines or populations sharing a common parentage. Most notably, breeding populations or breeding lines that contained Duster, Santa Fe or TAM 203 in their lineage fared visibly better than others. It was these three varieties that also performed relatively well for grain yield in the 2009 OSU wheat variety trials conducted by Jeff Edwards. None of these varieties would be considered late maturing, or certainly not late to first-hollow-stem stage, making it difficult to reach the conclusion that later-maturing varieties provided the best escape route from the early-spring freeze in April—as one might conclude for the variety Endurance.

To the contrary, where data could be collected on winter dormancy release of breeding materials almost one month before the April freeze, breeding lines or populations that appeared to recover best from the freeze showed a wide range of dormancy release patterns. As an example of this disconnect between the timing of winter dormancy release (akin to first-hollow-stem arrival) and degree of freeze damage incurred, data for each of those traits were collected in a large set (*n*=317) of early-generation breeding populations at Stillwater. This material was chosen because it featured some of the widest maturity range in the OSU wheat improvement program, and the material was grown under conditions where freeze damage was most severe.

As evident in Figure 3, populations that reached first-hollow-stem stage similar to Duster (intermediate time frame) varied from severe freeze damage to minimal damage. Populations that reached first-hollow-stem stage similar to Billings (moderately early time frame) varied just as widely in freeze damage. Even early dormancy release was not a guarantee for failure, though these populations tended to recover the least. What is the take-home message, and what are the implications to OSU wheat improvement? While the team cannot be certain why varieties such as Billings and Pete, which have very similar reproductive development patterns, responded quite differently to this freeze event, priority was given to materials that released winter dormancy in a timeframe of Billings to Duster, yet showed acceptable, but perhaps not stellar, freeze recovery. This approach allowed sufficient but not excessive selection pressure for response to environmental conditions that might be considered highly infrequent.

Other types of selection pressure came from continued testing in low pH soils near Enid, where the WIT

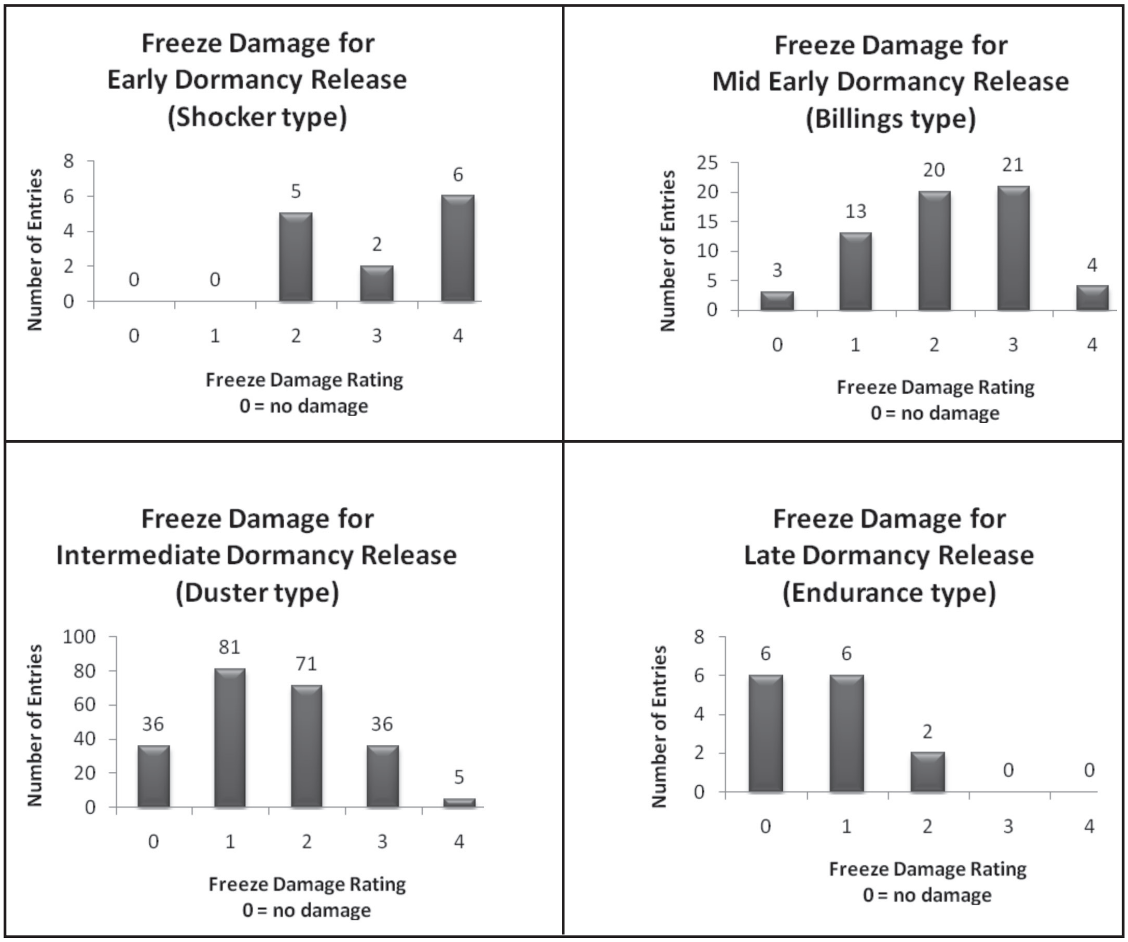

Figure 3. Relationship between winter dormancy release and subsequent freeze damage in April 2009, as recorded for 318 winter wheat breeding populations in Stillwater. Dormancy release ratings varied from very early to late, whereas freeze damage ratings varied from minimal (0) to severe (4).

collected some of the most reliable and consistent readings in 2009 since this work began two decades ago. These readings figured heavily into selection decisions in 2010. For example, of the 35 advanced lines that will be further evaluated in the OET2 and OET3 in 2010, 22 have highly effective levels of acid-soil tolerance and therefore may not show measurable grain yield loss in acidic soils typically found in Oklahoma. The WIT is well positioned to provide varieties in the future that carry forward the acid-soil tolerance of those before such as Endurance, Duster and Billings. The most notable candidate currently under watch is OK05212 (OK95616/Hickok//Betty).

Other pressure points came from moderate to heavy infections of WSBMV/WSSMV, barley yellow dwarf virus, leaf rust and other nonconfirmed foliar diseases that added up in the annual assessment of green-leaf retention, which is much like a human stress test to see which genotypes can maintain healthy green leaves the longest. Often it is not known for certain why some experimental lines show poor green-leaf retention (or stay-green), but it is customary that these genotypes are on a cataclysmic course for poor yield performance, or at the least, small kernel size. The recent release Billings, and the candidate variety OK05212, represent desirable levels of green-leaf retention at contrasting maturity levels.

Recent strides in Hessian fly resistance should not go without mentioning. Unlike any other year, the proportion of advanced lines scheduled for testing in the 2010 OET3, which feature effective levels of resistance, is nearly 50 percent (Table 3). This turnaround is comparable to that achieved by the WIT 10 years ago in releasing experimental lines with resistance to WSBMV / WSSMV.

Reasons for this recent success are three-fold. First, two of the WIT members devote a large part of their research programs to understanding the natural diversity that exists in Hessian fly populations in Oklahoma and evaluating field reactions of OSU advanced experimental lines to native populations of the fly (see report above by Kris Giles and Tom Royer). Second, Ming Chen, a USDA-ARS entomologist in Manhattan, Kan., has collaborated with the team and other breeding programs in the southern Great Plains to meticulously survey seedling resistance in breeding materials. This information is used in selection decisions every year, but the WIT also retains Hessian-fly

Table 3. Advanced lines scheduled for testing in the 2010 OET3 (highly advanced experimental lines) and their reaction to Hessian fly based on greenhouse seedling tests and field tolerance measured in the field.

Experimental	*Pedigree*	*Complete*	*Partial*
OK03825-5403-6	Custer*3/94M81		
OK05526	KS94U275/OK94P549		✓
OK05312	TX93V5919/WGRC40//OK94P549/WGRC34		
OK05511	TAM 110/2174		✓
OK05204	SWM866442/OK95548		✓
OK05212	OK95616-1/Hickok//Betty		
OK05711W	G1878/OK98G508W		
OK06029C	TXGH12588-120*4/FS4//2*2174		
OK06617	FAWWON 06/2137//OK95G703-98-61421		
OK06618	SWM866442/OK94P549//2174	✓	
OK06127	KS91W049-1-5-1/CMBW90M294//X920618-C-4-1/3/X85W663-7-4-2/HBF0435//....		
OK06332	SWM866442/OK95548//2174	✓	
OK06336	Magvars/2174//Enhancer		
OK06609	SWM866442-7H/2174//OK95548-26C	✓	
OK06528	Vilma/Hickok//Heyne		
OK06822W	OK97G611/Trego	✓	
OK07209	Duster progenitor/OK99621		
OK07214	Duster progenitor/OK99711	✓	
OK07231	OK92P577-(RMH 3099)/Duster progenitor	✓	
OK07919C	OK98G508W/(IMITX105/2174 F3 seln)		

Table 4. Summary of unique strengths and weaknesses of four candidate cultivars currently under examination for potential release.

Experimental number	*Yield Rank (n=30–40)*						
Pedigree	*2005*	*2006*	*2007*	*2008*	*2009*	*Unique strengths*	*Weaknesses*
OK05526 *KS94U275/Endurance*	1	7	28	1	3	Yielding ability with early maturity Baking quality Test weight + kernel size	Stripe rust reaction no better than Endurance.
OK05212 *OK95616/Hickok//Betty*	1	16	4	4	1	Very broad adaptation; resilient Highly tolerant to acid soils Drought tolerant Flood tolerant! Avoided two spring freezes - '07, '09	Small kernel size Test weight.
OK05511 *TAM 110/2174*	3	4	15	4	4	Greenbug and Hf resistance (partial) Highly drought tolerant Resistant to stripe rust, powdery mildew Opposite to Billings for adaptation Similar to Billings for quality	Leaf rust and WSBMV reactions.
OK03825-5403-6 *Custer*3/94M81*	--	--	1	10	29	Stacked RWA resistance Broader adaptation than Custer	Sensitive to early spring freeze. WSSMV reaction

single-plant selections from otherwise segregating lines for further selection, purification and field testing. Plant selections of two of the candidate varieties discussed below (OK05526 and OK05511), are currently on this track. Finally, while 2174 no longer commands the wheat acreage it once held, its legacy lives on as a source of Hessian fly resistance as evident in the pedigrees of the advanced lines listed in Table 3. Note also the emergence of Duster—another potential source of Hessian fly resistance—as a parent for some lines, a pattern that will continue for several more years.

Taking into account agronomic and end-use quality data collected in the 2008-2009 crop season, the WIT will focus on four experimental lines as candidates for possible release in early 2010 (Table 4). Further investigation of historical data on each candidate is needed to take any further action on any of these lines. Each line has been placed under foundation seed increase by Oklahoma Foundation Seed Stocks, Inc. The experimental line, OK05526, received 50 percent of its genetic makeup from Endurance. It possibly has the highest yielding ability, though that ability is not always realized given the frequency of early spring freeze events of the last three years, coupled with its early maturity (similar to Jagger and Overley). This line also provides the best overall milling quality and dough strength of all candidates. OK05526 represents a significant improvement over Endurance in yield potential, test weight, kernel size, dough strength, consistency in plant height and adaptation range, but it provides no improvement in stripe rust resistance and has less acid-soil tolerance.

Two other experimental lines, OK05212 and OK05511, are considered more resilient types, with a slight edge to OK05212 in adaptation range and yield potential. OK05212 extends very well both geographically and edaphically. It has consistently performed well above average in dry soils, acidic soils and water-logged soils. Its grazing tolerance is on par with Duster and Endurance. On the other hand, OK05511 provides much needed insect resistance currently not offered in OSU releases—specifically greenbug and Hessian fly—though the frequency of resistance is not 100 percent for either trait. Oddly, the adaptation range of OK05511 is an exact mirror image of that of Billings. It performs relatively best in southwestern Oklahoma and in the panhandle in dryland-production systems. Lastly, the team is giving final consideration to the experimental line OK03825-5403-6, which could be touted as an improved version of Custer, fortified with two genes for resistance to the two major biotypes of Russian wheat aphid.

Genetic Improvement of Winter Wheat through Genomic Applications and the USDA CAP Project

Liuling Yan and Brett Carver

2008 to 2009 progress made possible through OWRF/OWC support

- **More than 5% of the 50,000 lines tested annually in the OSU wheat breeding head-row nursery now originate from marker-assisted selection applied in earlier inbreeding generations.**
- **Forty SSR (simple sequence repeat) markers and 10 gene markers have now been constructed for deployment in various variety development schemes.**
- **Genetic mapping of several traits with economic importance to Oklahoma was completed, including the timing of reproductive development (*VRN-A1*, *VRN-D3*, *PPD-D1*) and reaction to powdery mildew (*Pm3a*), stripe rust (*QYr.osu.2A*), and leaf rust (*Lr34*).**

The USDA Cooperative State Research, Education, and Extension Service (CSREES), through the National Research Initiative (NRI) and within the framework of the Coordinated Agricultural Projects (CAP), funded a four-year project to four regional genotyping laboratories and 17 public wheat breeding programs across the United States. The overall objective of this project was to incorporate modern molecular technologies such as marker assisted selection (MAS) to increase the competitiveness of these public wheat breeding programs. With a supplemental grant provided by the Oklahoma Wheat Commission to the ongoing CAP, the WIT has made in areas relevant to Oklahoma wheat producers.

Objective 1: Selection of advanced breeding lines.

The team continues to adopt pedigree-selection methods to advance breeding lines in the OSU wheat improvement program that specifically originated in the CAP-MAS project. Populations were initially enriched for genes conferring race-specific resistance to leaf rust, enhanced aluminum tolerance and/or resistance to additional biotypes of Hessian fly (other than GP) using MAS in the F_2 generation. Typically 10 to 13 elite populations resident to the program were targeted. The MAS component was designed to supplement or augment desirable expression of the traits mentioned above in the enriched populations.

Derived progenies now infiltrate

every aspect of the experimental line-testing phase of our 10- to 12-year breeding cycle. A set of 99 $F_{4:6}$ lines, which trace to the first cycle of CAP-MAS in 2006, will be evaluated in preliminary yield and quality trials in 2009-2010. Additionally, six $F_{3:6}$ lines were entered in statewide advanced trials in 2009-2010, any one of which could be designated for candidate-cultivar status in 2011.

From the second cycle of CAP-MAS initiated in 2007, nearly 900 $F_{4:5}$ lines will be evaluated in a head-row nursery in 2009-2010. Additionally, from a pool of 140 $F_{2:4}$ lines tested in preliminary yield and quality trials in 2009, the team has advanced 18 of those as $F_{2:5}$ lines for testing in statewide advanced line trials. Progenies from the third and fourth cycles of CAP-MAS are undergoing generation advance and limited field observation, as those materials are prepared for further yield and quality testing. The OSU wheat improvement program annually evaluates more than 55,000 head-row lines. In 2009-2010, approximately 7 percent of this nursery originated in the CAP-MAS project.

Objective 2: Completion of a genetic linkage map.

With the completion of the CAP project in 2009, the WIT has added 40 SSR (simple sequence repeats) markers and 10 gene markers to linkage groups in 96 recombinant inbred lines of Jagger x 2174 population. The gene markers will be used to characterize, from this point forward, elite lines in the wheat breeding program which are being considered for their candidacy as varieties. The molecular information derived from gene markers greatly increase the level of precision in making key selection decisions relative to disease resistance and reproductive development patterns.

Objective 3: Mapping of agronomically important traits.

- The team mapped a major locus for stem elongation to the region where *VRN-A1* resides on chromosome 5A. In the southern Great Plains, 17 of 19 locally adapted cultivars contained the 2174 *VRN-A1* allele. The results from this study have been published in *Theoretical and Applied Genetics* (Chen et al. 2009, 118: 881-889).
- The three major QTLs for the developmental process were located, and each was tightly associated with a known flowering gene: *VRN-A1* on chromosome 5A, *PPD-D1* on chromosome 2D, and *VRN-D3* on chromosome 7D. Our findings suggest these gene loci, their alleles, and the duration of their effect should be combined to regulate various developmental phases in winter wheat. The results from this study will be published in *Molecular Breeding* (Chen et al. 2009).
- The WIT discovered segregation for powdery mildew resistance in a population of Jagger (susceptible) x 2174 (resistant) was controlled by a major QTL associated with the *Pm3* gene on the short arm of chromosome 1A and modified by four minor QTLs on chromosomes 1B, 3B, 4A and 6D. The resistant *Pm3a* allele was present among four of 31 cultivars currently being produced in the southern Great Plains. The results from this study were published in *Molecular Breeding* (Chen et al. 2009, 24:141-152).
- The *Lr34* gene for leaf rust reaction was characterized in the Jagger x

2174 population. *Lr34* was located in the center of a QTL. A survey of 33 local hard winter wheat cultivars indicated that seven cultivars carry the Jagger susceptible allele, and 26 cultivars carry the 2174 resistant allele. The results from this study will be published in *Theoretical and Applied Genetics* (Cao et al. 2009).

- A novel gene locus was discovered on the short arm of chromosome 2A for stripe rust resistance (*QYr.osu.2A*) in the Jagger x 2174 population, in collaboration with scientists at Washington State University and China Agricultural University. The results from this study are in preparation for publication.

2009 Small Grains Variety Performance Tests

Jeff Edwards, Rick Kochenower, Richard Austin, Jay Ladd, Brett Carver, Bob Hunger, Dillon Butchee and Casey Andrews

2008 to 2009 progress made possible through OWRF/OWC support

- **Commercially-available cultivars and advanced breeding lines were tested in 25 environments from Afton to Keyes.**
- **Variety trial information was delivered directly to more than 8,000 stakeholders via the *High Plains Journal*.**
- **Newer varieties outperformed Jagger and Jagalene at most locations.**

The 2008-2009 Oklahoma wheat crop will go down as one of the smallest crops on record. Oklahoma weather can be tough, and it is not uncommon for Oklahoma wheat producers to face drought, flood, disease, hail, cool weather, heat and late spring freezes. It is uncommon, however, for them to face all of these events during the same wheat production season. This perfect storm of adverse weather conditions devastated the 2008-2009 wheat crop.

A few timely rainfalls in September and October meant conditions for sowing were generally favorable in areas north of Highway 51. South of Highway 51 the rainfall events were less frequent, so good timing and a lot of luck were required to obtain adequate stands of wheat. Once wheat emerged, growth was slowed by dry soil conditions, inadequate rainfall and limited soil nitrogen. Combined, these made for a lackluster fall forage production season in most of the state. Rainfall data are presented in Figure 1, and more information on fall forage production by winter wheat varieties in 2008 can be found in Extension Current Report CR-2141.

Nitrogen fertilizer prices were still relatively high during sowing in 2008, and many producers opted to forgo preplant nitrogen fertilizer. This choice resulted in nitrogen-hungry wheat fields and was compounded by poor root growth and inadequate soil moisture, limiting availability of soil nitrogen. Nitrogen prices moderated somewhat by topdress time, and most producers chose to apply some topdress nitrogen during winter. However, reports from sensor-based nitrogen trials in growers' fields around the state indicate the nitrogen requirement for wheat this year was greater than normal, and most producers under fertilized.

Several insect pests were present during the 2008-2009 production year. Moderate to severe drought prevented wheat from outgrowing damage caused by winter grain mites and brown wheat mites in some areas of the state. Aphids were present across most of the state, and fields infected with barley yellow dwarf virus were easy to find after greenup in the spring of 2009. While wheat streak mosaic virus, high plains virus and triticum mosaic virus were present in the panhandle, some fields infected with barley yellow dwarf virus were misdiagnosed as having one of the other three viruses. Tissue samples revealed that other fields were affected by a complex of two or more of these viral diseases.

Hessian fly was barely a blip on the radar screen of Oklahoma wheat producers five years ago. Increased adoption of conservation and no-tillage production practices, however, has made Hessian fly a force to be reckoned in Oklahoma. In fact, there were several reports of fields being "zeroed out" in southwest Oklahoma due to Hessian fly damage. Growers impacted by Hessian fly in 2009 are now strongly encouraged to plant a variety with some level of resistance to Hessian fly, such as Duster, Centerfield or Shocker.

It was a relatively quiet year for foliar diseases of wheat, with a few reports of powdery mildew and leaf rust. Fungal disease of wheat came back with a vengeance at flowering, however. Fusarium head blight (head scab) was a major factor in north-central and eastern Oklahoma. Corn and/or wheat residue provided the inoculant, and Mother Nature provided the persistent cool, damp conditions during flowering that are required for infection. Properly timed foliar fungicides likely reduced the level of infection in some fields but did not eliminate the problem. The end result was low test weight wheat with marketing loss issues due to vomitoxin.

Weather was the biggest story of the 2008-2009 wheat crop. While the freeze events in March and April 2009 received the most attention, drought had already severely limited the potential of much of the Oklahoma wheat crop before the freeze events. It was common to see wheat heading at a total plant height of only 8 inches to 10 inches, and in areas south of I-40 the freeze finished off what the drought had started.

The first 2009 spring freeze injury to wheat occurred over the four-day period from March 26 to March 30. Temperatures dipped below freezing across most of the state, and the cold snap resulted in various levels of injury, from cosmetic damage in northern Oklahoma to total sterility in some fields in southern Oklahoma. Most years Oklahoma wheat would not be far enough along by the end of March for such an event to be of great concern. However, the warm temperatures during February and the extreme drought stress sped the wheat crop along in 2009. As a result, much of the crop in southwest Oklahoma was starting to head when the freeze occurred.

The entire state of Oklahoma endured freeze events again on the nights of April 6 and April 7. In fact, many areas fell into the lower 20s or upper teens for several hours. These types of temperatures placed the entire wheat crop in jeopardy. Stops were made at several of the variety trial locations to split stems of the earliest wheat varieties. If significant freeze injury was present, random tiller samples (primary and secondary) were collected from Overley, OK Bullet, Jagger, Duster, Doans and Endurance. From each variety, 25 random tillers were split and checked for injury.

Moderate freeze injury was found at the Cherokee location, but only minor damage was found at Alva, Kildare and Afton. Rick Kochenower reported similar findings in the panhandle, with early-sown fields showing injury and later-sown fields showing little to no injury. Outside of this northern tier of counties, the freeze injury increased dramatically. There were 40 percent to

88 percent non-viable (i.e. dead) tillers in our Lahoma samples. Marshall plots had 52 to 92 percent nonviable heads, and it appears that grazing had little effect on survival. The Kingfisher plots were severely injured, and the plots at Apache were a complete loss.

Most agronomists agree that cool, moist conditions are beneficial after freeze events, as they promote survival of secondary tillers. The problem in 2009, was that the cool, wet conditions persisted for a 14- to 20-day period, and many fields remained waterlogged. Waterlogged conditions were not restricted to terrace channels and low-lying areas. As a result, large areas of fields turned white, and yield potential was reduced or eliminated.

Harvest began just before Memorial Day, but proceeded at a crawl due to rain and green "sucker" heads low in the canopy. By mid June the rains subsided and 100 F temperatures quickly ripened the green heads that remained. Harvest then proceeded rapidly and was nearly complete by July 1. Harvested acreage was 3.6 million acres or 80 percent of the 2008 harvested acreage. This reduction in harvested acres was in spite of a 5 percent increase in planted acres. Statewide average yield was not finalized at the time of this report, but it is a certainty that total production will be only a fraction of that produced in 2008.

Methods

Cultural Practices

Conventional plots were eight rows wide with 6-inch row spacing. No-till plots were seven rows wide with 7.5-inch row spacing. Plots were 20 feet long. Conventional till plots received 50 lbs/A of 18-46-0 in-furrow at planting. No-till plots received 5 gals/A of 10-34-0 at planting. The El Reno and Marshall dual-purpose (DP) were sown at 120 lbs/A. All other locations were sown at 60 lbs/A. Grazing pressure, nitrogen fertilization, and insect and weed control decisions were made on a location-by-location basis and reflect standard management practices for the area.

Additional Information on the Web

A copy of this publication as well as additional variety information and more information on wheat management can be found at: www.wheat.okstate.edu. Complete variety trial information for all crops can be found at http://croptrials.okstate.edu/

Marketing Rights

Breeding programs responsible for varietal release are indicated as the "source" in the results tables. In many cases, a separate entity has the marketing rights for these varieties. For this reason, a list of wheat seed companies and the varieties they market is provided below.

AgriPro
Doans
Fannin
Jackpot
Jagalene
TAM 111
TAM 203
OK Rising (W)

Kansas Wheat Alliance
Fuller
Jagger
Overley

Oklahoma Genetics, Inc.
Billings
Centerfield
Duster
Guymon (W)
OK Bullet
Pete

OK Foundation Seed
Deliver
Endurance

Scott Seed
TAM 304

WestBred
Armour
Aspen (W)
Keota
Santa Fe
Shocker
Winterhawk

Whatley Seed
TAM 112

Husker Genetics
Mace

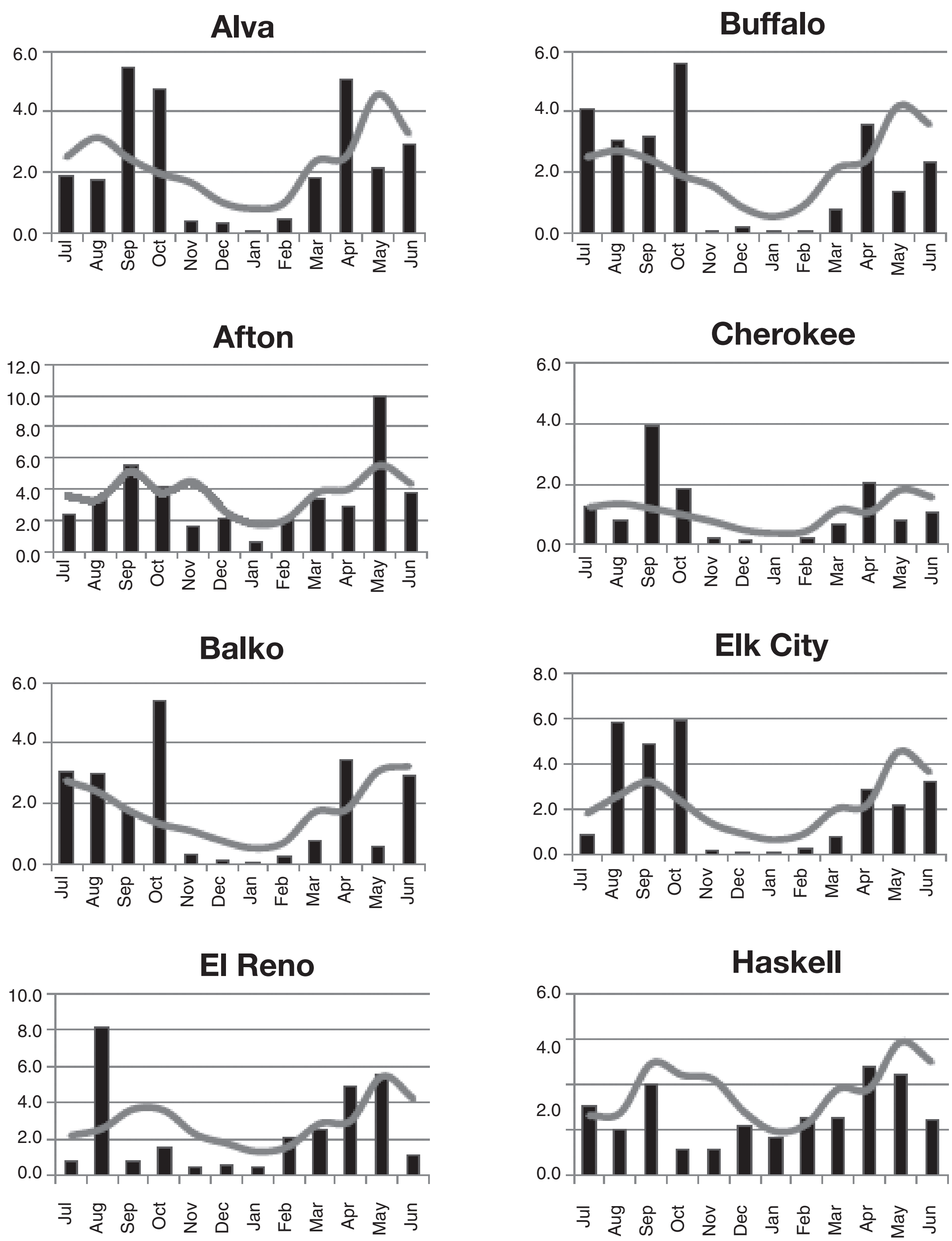

Figure 1. Rainfall (inches) during the 2008-09 wheat production season (bars) and 30-year average rainfall (smoothed lines) for wheat variety test sites.

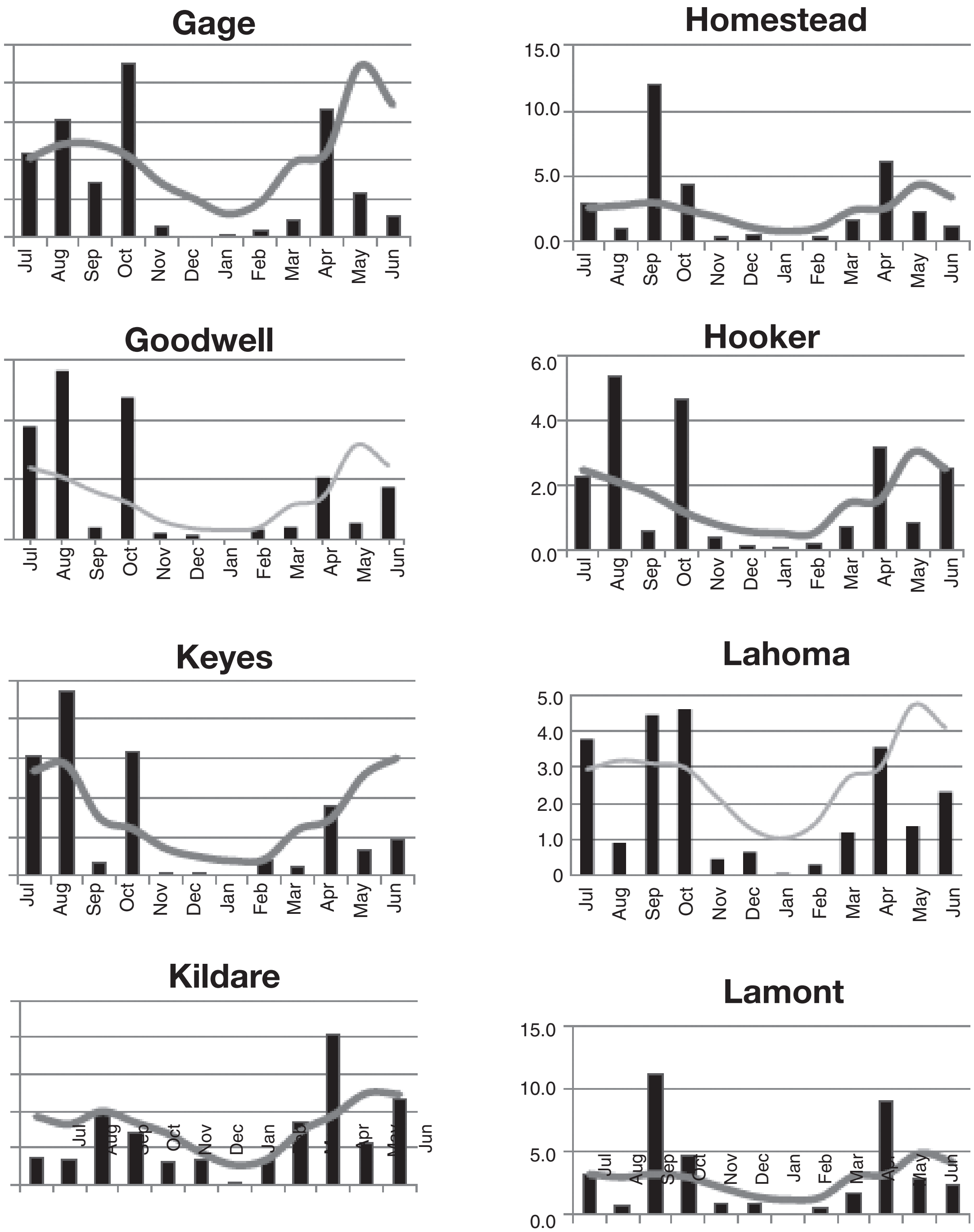

Figure 1. Rainfall (inches) during the 2008-09 wheat production season (bars) and 30-year average rainfall (smoothed lines) for wheat variety test sites. (continued)

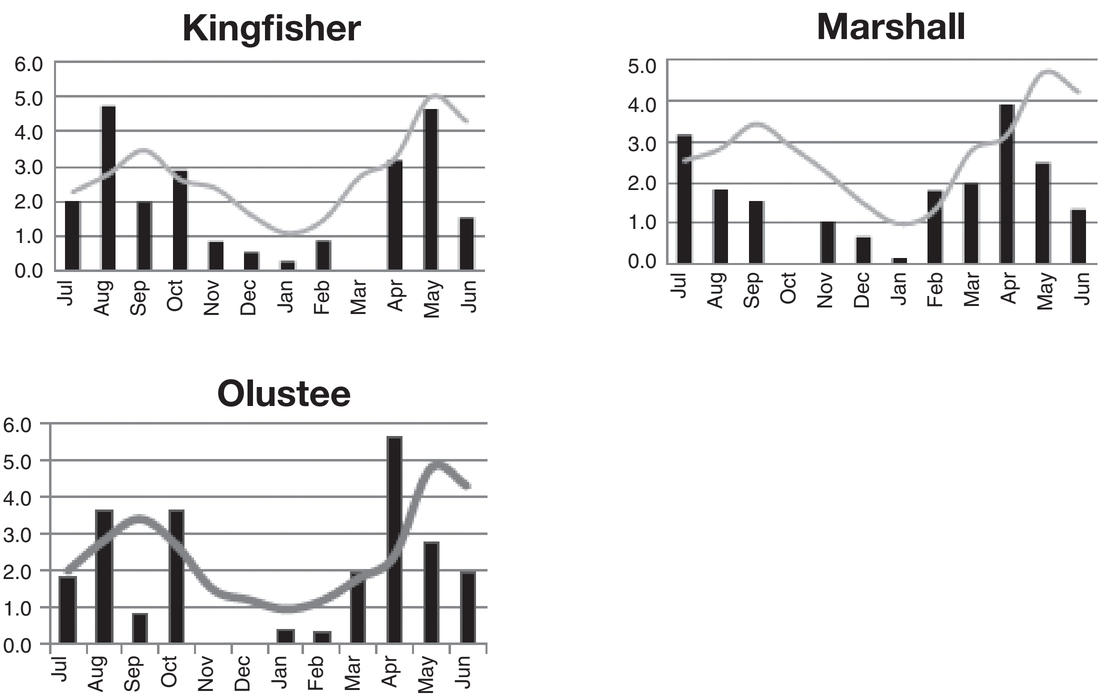

Figure 1. Rainfall (inches) during the 2008-09 wheat production season (bars) and 30-year average rainfall (smoothed lines) for wheat variety test sites. (continued)

2009 Oklahoma Wheat Variety Trial Summary

Variety	Afton	Alva	Balko	Buffalo	Cherokee	Elk City	El Reno Conv Till DP	El Reno Conv Till GO	El Reno No Till DP	El Reno No Till GO	Gage	Goodwell NI
	-----	-----	-----	-----	-----	bu/A	-----	-----	-----	-----	-----	-----
Armour	36	41	53	57	40	24	35	24	27	28	20	39
Aspen (W)	-	-	59	-	-	-	-	-	-	-	-	36
Billings	20	45	-	-	-	-	23	-	-	-	-	
Centerfield	22	44	46	61	38	24	30	36	25	28	26	33
Deliver	24	46	46	64	37	21	35	31	23	24	23	34
Doans	24	42	51	61	41	25	37	26	34	32	25	30
Duster	23	47	49	70	44	22	36	44	26	31	27	41
Endurance	31	51	59	74	48	26	43	36	31	31	29	44
Fannin	-	-	-	-	-	-	22	16	21	22	-	
Fuller	28	42	46	55	39	24	26	28	29	25	24	29
Guymon (W)	-	-	56	-	-	-	-	-	-	-	-	36
Jackpot	17	47	47	58	34	17	27	23	18	21	26	25
Jagalene	19	46	59	69	48	22	21	26	21	17	27	41
Jagger	24	45	54	54	36	22	19	15	20	16	27	29
Keota												
-	41	49	69	41	21	-	-	-	-	29	41	
Mace	-	-	55	-	-	-	-	-	-	-	-	29
OK Bullet	18	40	49	59	41	26	26	24	23	21	23	27
OK Rising (W)	16	40	47	53	33	21	22	26	19	19	19	24
Overley	14	44	52	61	36	21	22	19	19	14	25	39
Pete	12	45	50	-	37	16	15	-	-	-	23	33
Santa Fe	26	47	51	55	40	27	35	36	33	29	25	32
Shocker	23	42	49	49	31	22	26	13	28	25	21	25
TAM 111	-	41	55	65	39	27	-	-	-	-	26	38
TAM 112	-	45	58	63	40	27	-	-	-	-	30	44
TAM 203	29	48	54	63	44	27	33	38	27	29	26	34
TAM 304	16	-	-	-	-	-	-	-	-	-	-	40
Winterhawk	-	45	50	66	47	25	-	-	-	-	25	35
OK04315	-	-	-	-	-	26	29	-	-	-	-	
OK05312	-	-	60	-	-	-	-	-	-	-	-	38
OK05526	25	51	50	-	45	24	35	-	-	-	-	
OK05742W	-	-	-	-	-	24	-	-	-	-	-	
OK06114	-	-	-	-	-	-	-	-	-	-	-	
OK06729	-	-	-	-	-	-	-	-	-	-	-	
OK04525	-	49	-	-	-	25	-	-	-	-	-	
STARS 0601W	-	51	50	-	-	-	-	-	-	-	-	35
Mean	22	45	52	61	40	23	28	27	25	24	25	34
LSD $_{(0.05)}$	6	5	8	6	5	4	7	9	9	9	3	6

(W) = Hard white wheat variety

2009 Oklahoma Wheat Variety Trial Summary

Variety	Haskell	Homestead Conv Till	Homestead No Till	Hooker	Keyes	Kildare	Kingfisher	Lamont	Lahoma	Lahoma fungicide	Marshall Dual Purpose	Marshall Grain Only	Olustee
	bu/A												
Armour	24	35	35	10	36	31	34	37	62	69	6	25	24
Aspen (W)	-	-	-	16	48	-	-	-	-	-	-	-	-
Billings	15	-	-	-	-	31	29	36	49	52	4	16	-
Centerfield	19	36	38	17	38	30	36	46	54	58	7	22	23
Deliver	14	33	39	14	36	33	37	43	51	58	5	20	20
Doans	10	35	37	14	35	22	40	43	53	58	13	27	23
Duster	18	38	43	11	43	44	50	37	59	68	13	30	28
Endurance	20	39	40	18	50	32	44	46	62	67	8	31	23
Fannin	-	-	-	-	-	-	-	-	-	-	-	-	17
Fuller	18	35	37	10	36	34	32	38	50	56	10	21	25
Guymon (W)	-	-	-	16	37	-	-	-	-	-	-	-	-
Jackpot	12	34	32	11	32	32	34	37	50	51	7	17	23
Jagalene	17	32	36	11	44	30	41	43	51	65	5	13	27
Jagger	15	29	32	14	35	30	29	43	51	55	4	11	25
Keota	-	-	-	12	38	-	-	-	47	57	-	-	-
Mace	-	-	-	27	47	-	-	-	-	-	-	-	-
OK Bullet	18	36	33	14	33	30	40	38	48	57	10	17	29
OK Rising (W)	17	31	25	8	35	34	37	35	49	55	4	13	24
Overley	7	35	32	14	39	27	30	42	47	53	4	12	26
Pete	14	-	-	-	-	-	27	-	43	50	3	13	23
Santa Fe	18	38	37	9	34	39	40	48	67	61	10	25	27
Shocker	12	37	33	7	34	32	23	49	48	53	14	20	24
TAM 111	-	-	-	16	48	-	-	-	49	60	-	-	-
TAM 112	-	-	-	22	45	-	-	-	47	63	-	-	-
TAM 203	19	37	38	12	39	35	41	46	56	63	12	29	27
TAM 304	17	-	-	-	-	36	28	40	53	60	-	-	-
Winterhawk	-	-	-	19	37	-	-	-	59	57	-	-	-
OK04315	-	-	-	15	-	-	-	-	-	-	12	29	-
OK05312	-	-	-	-	43	-	-	-	-	-	-	-	-
OK05526	-	-	-	12	-	43	27	39	56	61	12	23	-
OK05742W	-	-	-	-	-	-	36	-	-	-	-	-	27
OK06114	-	-	-	-	-	32	-	42	53	61	-	-	-
OK06729	-	-	-	-	-	-	-	-	-	-	-	-	24
OK04525	-	-	-	-	-	36	-	-	-	-	-	-	23
STARS 0601W	-	-	-	-	-	-	-	-	-	-	-	-	17
Mean	16	35	35	14	39	33	35	41	53	59	8	21	24
LSD (0.05)	5	5	5	4	9	7	6	8	4	6	4	5	3

(W) = Hard white wheat variety

Afton Variety Trial

Cooperator: Greg Leonard
Soil type: Parsons silt loam
Planting date: 10-14-08
Harvest date: 6-26-09

Tillage: Conventional till
Management: Grain only
Previous crop: Corn
Soil test information: pH = 6.9 , P = 104, K = 236

Source	*Variety*	*Grain Yield 2008-09*	*Test Weight 2008-09*
		-----bu/A----	*-----lb/bu-----*
WestBred	Armour	36	-
OSU	Endurance	31	-
TAMU	TAM 203	29	-
KSU	Fuller	28	-
WestBred	Santa Fe	26	-
OSU	Deliver	24	-
AgriPro	Doans	24	-
KSU	Jagger	24	-
WestBred	Shocker	23	-
OSU	Duster	23	-
OSU	Centerfield	22	-
OSU	Billings	20	-
AgriPro	Jagalene	19	-
OSU	OK Bullet	18	-
AgriPro	Jackpot	17	-
TAMU	TAM 304	16	-
OSU	OK Rising (W)	16	-
KSU	Overley	14	-
OSU	Pete	12	
Experimentals			
	OK05526	25	-
	Mean	22	-
	LSD $_{(0.05)}$	6	

(W) = Hard white wheat variety

Notes: Grain yield of all varieties was greatly reduced by waterlogged soil conditions and Fusarium head blight (scab). Grain yield was not sufficient to measure test weight.

Alva Variety Trial

Cooperator: Wes Mallory
Soil type: Grant silt loam
Planting date: 10-29-08
Harvest date: 6-23-09

Tillage: Conventional till
Management: Grain only
Previous crop: Wheat
Soil test information: pH = 6.4, P = 71, K = 680

Source	*Variety*	*Grain Yield 2008-09*	*Grain Yield 2-Year*	*Grain Yield 3-Year*	*Test Weight 2008-09*
		------------bu/ac-----------			*---lb/bu---*
OSU	Endurance	51	56	48	53
TAMU	TAM 203	48	-	-	52
WestBred	Santa Fe	47	54	47	51
OSU	Duster	47	56	49	52
AgriPro	Jackpot	47	56	-	53
AgriPro	Jagalene	46	52	41	53
OSU	Deliver	46	53	47	55
OSU	Billings	45	53	-	52
KSU	Jagger	45	52	42	51
TAMU	TAM 112	45	-	-	53
OSU	Pete	45	52	-	56
WestBred	Winterhawk	45	-	-	53
KSU	Overley	44	50	45	53
OSU	Centerfield	44	52	46	53
WestBred	Shocker	42	50	44	52
KSU	Fuller	42	55	48	52
AgriPro	Doans	42	52	46	56
WestBred	Keota	41	-	-	52
WestBred	Armour	41	-	-	50
TAMU	TAM 111	41	51	43	53
OSU	OK Bullet	40	50	45	54
OSU	OK Rising (W)	40	51	45	53
Experimentals					
	STARS 0601W	51	-	-	56
	OK05526	51	-	-	54
	OK04525	49	-	-	55
	Mean	45	53	45	53
	LSD $_{(0.05)}$	5	4	3	1

(W) = Hard white wheat variety

Balko Variety Trial

Cooperator: Kenton Patzkowsky
Soil type: Ulysses-Richfield complex
Planting date: 9-24-08
Harvest date: 6-25-09
Tillage: No-till
Management: Grain only
Previous crop: Wheat/fallow

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Grain Yield 3-Year	Test Weight 2008-09
		------------bu/ac-----------			---lb/bu---
OSU	Endurance	59	76	55	59
AgriPro	Jagalene	59	73	55	61
WestBred	Aspen (W)	59	-	-	61
TAMU	TAM 112	58	77	-	62
OSU	Guymon (W)	56	72	54	62
TAMU	TAM 111	55	76	57	60
UNL	Mace	55	-	-	60
TAMU	TAM 203	54	-	-	58
KSU	Jagger	54	69	51	59
WestBred	Armour	53	-	-	57
KSU	Overley	52	72	53	59
WestBred	Santa Fe	51	72	53	58
AgriPro	Doans	51	67	-	62
OSU	Pete	50	-	-	61
WestBred	Winterhawk	50	-	-	60
OSU	OK Bullet	49	70	54	61
WestBred	Shocker	49	65	-	58
WestBred	Keota	49	-	-	61
OSU	Duster	49	71	53	60
OSU	OK Rising (W)	47	-	-	60
AgriPro	Jackpot	47	-	-	60
KSU	Fuller	46	67	-	59
OSU	Centerfield	46	67	-	61
OSU	Deliver	46	65	47	61
Experimentals					
	OK05312	60	-	-	62
	OK05526	50	-	-	61
	STARS 0601W	50	-	-	62
	Mean	52	71	25	60
	LSD (0.05)	8	6	4	1

(W) = Hard white wheat variety

Buffalo Variety Trial

Cooperator: NRCS
Soil type: St. Paul silt loam
Planting date: 9-29-08
Harvest date: 6-22-09
Tillage: Conventional till
Management: Grain only
Previous crop: Wheat
Soil test information: pH = 7.3, P = 61, K = 592

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Grain Yield 3-Year	Test Weight 2008-09
		------------bu/ac-----------			---lb/bu---
OSU	Endurance	74	69	58	57
OSU	Duster	70	67	57	57
WestBred	Keota	69	-	-	59
AgriPro	Jagalene	69	59	51	59
WestBred	Winterhawk	66	-	-	59
TAMU	TAM 111	65	62	52	56
OSU	Deliver	64	64	54	58
TAMU	TAM 112	63	-	-	57
TAMU	TAM 203	63	-	-	55
OSU	Centerfield	61	58	-	56
KSU	Overley	61	61	53	57
AgriPro	Doans	61	62	-	59
OSU	OK Bullet	59	61	52	58
AgriPro	Jackpot	58	-	-	56
WestBred	Armour	57	-	-	54
KSU	Fuller	55	60	-	56
WestBred	Santa Fe	55	60	-	54
KSU	Jagger	54	52	43	55
OSU	OK Rising (W)	53	58	-	57
WestBred	Shocker	49	54	-	54
	Mean	61	61	52	57
	LSD (0.05)	6	3	3	1

(W) = Hard white wheat variety.
Notes: Location not harvested in 2008 so 2 and 3-year averages use 2007 and 2006 data.

Cherokee Variety Trial

Cooperator: Kenneth Failes
Soil type: Dale silt loam
Planting date: 10-1-08
Harvest date: 6-23-09

Tillage: Conventional till
Management: Grain Only
Previous crop: Wheat
Soil test information: pH = 6.2, P = 66, K = 643

		Grain Yield			Test Weight
Source	*Variety*	*2008-09*	*2-Year*	*3-Year*	*2008-09*
		------------bu/ac-----------			---lb/bu---
OSU	Endurance	48	51	47	55
AgriPro	Jagalene	48	50	38	57
WestBred	Winterhawk	47	-	-	56
OSU	Duster	44	50	42	55
TAMU	TAM 203	44	-	-	54
WestBred	Keota	41	-	-	55
AgriPro	Doans	41	46	40	57
OSU	OK Bullet	41	45	40	57
WestBred	Armour	40	-	-	53
WestBred	Santa Fe	40	45	41	55
TAMU	TAM 112	40	-	-	56
TAMU	TAM 111	39	-	-	55
KSU	Fuller	39	43	40	55
OSU	Centerfield	38	43	40	55
OSU	Pete	37	-	-	56
OSU	Deliver	37	42	40	55
KSU	Overley	36	38	36	55
KSU	Jagger	36	43	36	55
AgriPro	Jackpot	34	41	-	54
OSU	OK Rising (W)	33	-	-	54
WestBred	Shocker	31	40	38	54
Experimentals					
	OK05526	45	-	-	56
	Mean	40	44	40	55
	LSD $_{(0.05)}$	5	5	4	1

(W) = Hard white wheat variety

Notes: Moderate freeze injury. Management was dual purpose in 2007-2008

Elk City Variety Trial

Cooperator: Carl Simon
Soil type: Grandfield sandy loam
Planting date: 9-30-08
Harvest date: 6-15-09

Tillage: Conventional till
Management: Grain Only
Previous crop: Wheat
Soil test information: pH = 5.9, P = 38, K = 289

		Grain Yield			Test Weight
Source	*Variety*	*2008-09*	*2-Year*	*3-Year*	*2008-09*
		------------bu/ac-----------			---lb/bu---
TAMU	TAM 112	27	-	-	58
TAMU	TAM 203	27	-	-	56
TAMU	TAM 111	27	27	32	58
WestBred	Santa Fe	27	26	34	57
OSU	OK Bullet	26	28	38	59
OSU	Endurance	26	28	36	57
AgriPro	Doans	25	26	37	60
WestBred	Winterhawk	25	-	-	58
KSU	Fuller	24	27	36	58
OSU	Centerfield	24	25	32	57
WestBred	Armour	24	-	-	55
OSU	Duster	22	25	30	57
AgriPro	Jagalene	22	23	27	59
KSU	Jagger	22	23	29	57
WestBred	Shocker	22	21	33	56
KSU	Overley	21	20	29	58
OSU	Deliver	21	21	35	58
WestBred	Keota	21	-	-	58
OSU	OK Rising (W)	21	22	36	57
AgriPro	Jackpot	17	21	-	56
OSU	Pete	16	21	33	57
Experimentals					
	OK04315	26	-	-	58
	OK04525	25	-	-	59
	OK05526	24	-	-	57
	OK05742W (W)	24	-	-	58
	Mean	23	24	33	58
	LSD $_{(0.05)}$	4	2	1	1

(W) = Hard white wheat variety

Notes: Grain yield impacted by drought, freeze injury, and two hail storms after heading

El Reno Conventional Till Variety Trial

Cooperator: Bornemann Farms
Planting date: 9-25-08
Harvest date: 6-16-09

Soil type: Pond creek silt loam
Management: Dual Purpose
Soil test information: pH = 5.6, P = 108, K = 362

Tillage:Conventional till
Previous crop: Canola

		Grain Yield									Test Weight		
		2008-09			2-year			3-year					
Source	Variety	Grazed	Non-grazed	Diff.	Grazed	Non-grazed	Diff.	Grazed	Non-grazed	Diff.	Grazed	Non-grazed	Diff.
		bu/ac									lb/bu		
OSU	Endurance	43	36	-7	58	55	-3	45	45	0	54	53	-2
AgriPro	Doans	37	26	-11	51	39	-12	41	33	-8	58	57	-2
OSU	Duster	36	44	8	62	64	3	47	52	5	53	55	2
WestBred	Santa Fe	35	36	0	50	52	2	38	42	4	54	57	3
OSU	Deliver	35	31	-4	51	42	-9	40	35	-5	55	57	1
WestBred	Armour	35	24	-10	-	-	-	-	-	-	52	53	2
TAMU	TAM 203	33	38	4	-	-	-	-	-	-	50	53	3
OSU	Centerfield	30	36	5	43	44	0	34	33	-1	52	56	4
AgriPro	Jackpot	27	23	-4	45	39	-6	-	-	-	51	54	3
WestBred	Shocker	26	13	-13	42	34	-8	33	30	-3	51	53	1
KSU	Fuller	26	28	2	48	49	1	37	41	4	53	58	5
OSU	OK Bullet	26	24	-1	42	45	2	34	37	3	53	53	0
OSU	Billings	23	-	-	-	-	-	-	-	-	51	-	-
KSU	Overley	22	19	-3	36	32	-4	29	32	3	51	56	5
AgriPro	Fannin	22	16	-6	34	36	3	25	31	6	53	56	3
OSU	OK Rising (W)	22	26	4	-	-	-	-	-	-	49	52	3
AgriPro	Jagalene	21	26	5	39	42	3	29	34	5	51	56	5
KSU	Jagger	19	15	-4	40	37	-3	29	31	2	49	52	3
OSU	Pete	15	-	-	-	-	-	-	-	-	50	-	-
	OK05526	35	-	-	-	-	-	-	-	-	55	-	-
	OK04315	29	-	-	-	-	-	-	-	-	53	-	-
	Mean	28	27	-1	46	43	-3	35	37	2	52	55	3
	LSD $_{(0.05)}$	7	9	7	7	5	5	2	4				

(W) = Hard white wheat variety

Notes: Non-grazed plots were sown earlier than recommended for grain-only production and do not represent full yield potential of varieties in a true grain-only system. Dual-purpose plots were grazed for 69 days. Stocking rate was 0.28 head per acre and average daily gain was 2.5 lb/hd/day.

El Reno No-Till Variety Trial

Cooperator: Bornemann Farms
Planting date: 9-25-08
Harvest date: 6-16-09

Soil type: Pond creek silt loam
Management: Dual Purpose
Soil test information: pH = 5.1, P = 102, K = 279

Tillage: No-till
Previous crop: Canola

		Grain Yield									Test Weight		
		2008-09			2-year			3-year					
Source	Variety	Grazed	Non-grazed	Diff.	Grazed	Non-grazed	Diff.	Grazed	Non-grazed	Diff.	Grazed	Non-grazed	Diff.
		bu/ac									lb/bu		
AgriPro	Doans	34	32	-2	52	49	-4	45	42	-3	56	57	2
WestBred	Santa Fe	33	29	-4	59	56	-3	44	47	3	53	55	2
OSU	Endurance	31	31	0	56	54	-2	44	45	1	51	54	3
KSU	Fuller	29	25	-4	62	51	-11	48	44	-4	53	56	4
WestBred	Shocker	28	25	-3	53	47	-6	40	39	-1	51	55	3
TAMU	TAM 203	27	29	2	-	-	-	-	-	-	49	51	3
WestBred	Armour	27	28	1	-	-	-	-	-	-	49	51	2
OSU	Duster	26	31	5	60	59	-1	46	48	2	50	53	3
OSU	Centerfield	25	28	4	53	47	-6	39	35	-4	51	54	3
OSU	Deliver	23	24	1	53	48	-5	41	39	-2	51	55	4
OSU	OK Bullet	23	21	-2	52	50	-2	41	42	1	52	53	1
AgriPro	Fannin	21	22	1	40	40	1	29	34	5	53	55	2
AgriPro	Jagalene	21	17	-4	50	44	-6	37	36	-1	51	51	0
KSU	Jagger	20	16	-4	52	41	-11	38	34	-4	48	51	3
OSU	OK Rising (W)	19	19	-1	-	-	-	-	-	-	50	50	-1
KSU	Overley	19	14	-5	37	34	-4	31	33	2	50	52	2
AgriPro	Jackpot	18	21	3	52	46	-7	-	-	-	48	51	3
	Mean	25	24	-1	52	47	-5	40	40	0	51	53	2
	$LSD_{(0.05)}$	9	9	6	6	4	4	3	1				

(W) = Hard white wheat varietyed for 69 days. Stocking rate was 0.28 head per acre and average daily gain was 2.5 lb/hd/day.

Gage Variety Trial

Cooperator: Curtis Torrance
Soil type: St. Paul silt loam
Planting date: 9-23-08
Harvest date: 6-24-09
Tillage: Conventional till
Management: Dual Purpose
Previous crop: Wheat
Soil test information: pH = 7.8, P = 12, K = 464

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Grain Yield 3-Year	Test Weight 2008-09
		------------bu/ac-----------			---lb/bu---
TAMU	TAM 112	30	-	-	59
OSU	Endurance	29	35	41	57
WestBred	Keota	29	-	-	59
AgriPro	Jagalene	27	34	36	59
KSU	Jagger	27	31	33	56
OSU	Duster	27	34	39	57
AgriPro	Jackpot	26	34	-	58
TAMU	TAM 111	26	33	38	58
OSU	Centerfield	26	31	34	57
TAMU	TAM 203	26	-	-	56
WestBred	Santa Fe	25	31	35	56
AgriPro	Doans	25	31	35	60
KSU	Overley	25	30	34	57
WestBred	Winterhawk	25	-	-	58
KSU	Fuller	24	32	40	56
OSU	OK Bullet	23	31	37	58
OSU	Pete	23	-	-	58
OSU	Deliver	23	28	35	57
WestBred	Shocker	21	27	31	56
WestBred	Armour	20	-	-	55
OSU	OK Rising (W)	19	28	34	56
	Mean	25	31	36	57
	LSD $_{(0.05)}$	3	2	2	1

(W) = Hard white wheat variety
Notes: Grain yield impacted by drought during fall and winter months. Plots were not grazed in 2006-07.

Goodwell Nonirrigated Variety Trial

Cooperator: OK Panhandle Research and Extension Center
Soil type: Richfield clay Loam
Planting date: 10-3-08
Harvest date: 6-19-09
Tillage: No-till
Management: Grain only
Previous crop: Wheat

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Test Weight 2008-09
		------------bu/ac----------		---lb/bu---
OSU	Endurance	44	61	60
TAMU	TAM 112	44	-	58
OSU	Duster	41	62	59
WestBred	Keota	41	-	59
AgriPro	Jagalene	41	58	59
TAMU	TAM 304	40	-	57
KSU	Overley	39	58	58
WestBred	Armour	39	-	58
TAMU	TAM 111	38	56	60
WestBred	Aspen (W)	36	-	59
OSU	Guymon (W)	36	52	61
WestBred	Winterhawk	35	-	60
TAMU	TAM 203	34	-	58
OSU	Deliver	34	53	59
OSU	Centerfield	33	46	60
OSU	Pete	33	-	60
WestBred	Santa Fe	32	52	59
AgriPro	Doans	30	47	60
KSU	Jagger	29	48	58
UNL	Mace	29	-	59
KSU	Fuller	29	54	58
OSU	OK Bullet	27	52	59
WestBred	Shocker	25	46	58
AgriPro	Jackpot	25	-	59
OSU	OK Rising (W)	24	49	59
Experimentals				
	OK05312	38	-	61
	STARS 0601W	35	-	59
	Mean	34	53	59
	LSD $_{(0.05)}$	6	8	1

(W) = Hard white wheat variety
Notes: Plots were not harvested in 2007-2008, so 2-year average includes 2006-2007 harvest year

Haskell Variety Trial

Cooperator: Eastern Research Station
Soil type: Taloka silt loam
Planting date: 10-13-08
Harvest date: 6-26-09

Tillage: Conventional till
Management: Grain only
Previous crop: Wheat
Soil test information:
pH = 6.4, P = 45, K = 209

		Grain Yield			Test Weight
Source	*Variety*	*2008-09*	*2-Year*	*3-Year*	*2008-09*
		---------------bu/ac-----------			---lb/bu---
WestBred	Armour	24	-	-	-
OSU	Endurance	20	43	45	-
TAMU	TAM 203	19	-	-	-
OSU	Centerfield	19	35	38	-
KSU	Fuller	18	39	-	-
OSU	OK Bullet	18	34	38	-
OSU	Duster	18	40	43	-
WestBred	Santa Fe	18	35	38	-
OSU	OK Rising (W)	17	-	-	-
AgriPro	Jagalene	17	30	35	-
TAMU	TAM 304	17	37	-	-
OSU	Billings	15	-	-	-
KSU	Jagger	15	31	35	-
OSU	Deliver	14	35	35	-
OSU	Pete	14	-	-	-
AgriPro	Jackpot	12	32	-	-
WestBred	Shocker	12	29	-	-
AgriPro	Doans	10	31	-	-
KSU	Overley	7	26	32	-
	Mean	16	34	38	-
	LSD $_{(0.05)}$	5	4	2	

(W) = Hard white wheat variety

Notes: All plots had some bird damage and Overley was worst hit with > 60% injury. Grain yield of all varieties was greatly reduced by waterlogged soil conditions and Fusarium head blight (scab). Grain yield was not sufficient to measure test weight.

Homestead Variety Trial

Cooperator: Brook Strader
Soil type: Canadian fine sandy loam
Planting date: 11-3-08
Harvest date: 6-17-09

Management: Grain only
Tillage: Conventional till and No-till
Previous crop: Grain sorghum
Soil test information: pH = 6.0, P = 44, K = 451

		Grain Yield						*Test Weight*		
		2008-09			*2-year*					
Source	*Variety*	*Grazed*	*Non-grazed*	*Diff.*	*Grazed*	*Non-grazed*	*Diff.*	*Grazed*	*Non-grazed*	*Diff.*
OSU	Duster	38	43	4	35	44	9	59	58	-1
OSU	Endurance	39	40	1	37	41	4	60	58	-2
OSU	Deliver	33	39	6	32	39	7	60	59	-1
TAMU	TAM 203	37	38	1	-	-	-	59	58	-1
OSU	Centerfield	36	38	2	35	39	5	59	58	-1
WestBred	Santa Fe	38	37	-1	38	39	1	60	59	-2
KSU	Fuller	35	37	2	36	43	7	58	57	-1
AgriPro	Doans	35	37	2	34	38	5	61	61	0
AgriPro	Jagalene	32	36	5	30	35	5	60	59	-1
WestBred	Armour	35	35	0	-	-	-	57	57	0
OSU	OK Bullet	36	33	-3	35	36	1	60	57	-3
WestBred	Shocker	37	33	-4	34	35	2	59	57	-1
KSU	Jagger	29	32	3	32	35	4	58	57	-1
AgriPro	Jackpot	34	32	-2	38	39	1	59	57	-2
KSU	Overley	35	32	-3	31	33	2	60	58	-1
OSU	OK Rising (W)	31	25	-6	-	-	-	58	55	-4
	Mean	35	35	0	34	38	4	59	58	-1
	LSD (0.005)	5	4		5	5		1	2	

(W) = Hard white wheat variety

Hooker Variety Trial

Cooperator: Dan Herald
Soil type: Dalhart fine sandy loam
Planting date: 9-24-08
Harvest date:6-25-09

Tillage: No-till
Management: Grain only
Previous crop: Grain sorghum

		Grain Yield				*Test Weight*
Source	*Variety*	*2008-09*	*WSM rating*	*2-Year*	*3-Year*	*2008-09*
			---*lb/bu*---			
UNL	Mace	27	1.0	25	-	58
TAMU	TAM 112	22	1.3	25	-	58
WestBred	Winterhawk	19	1.8	-	-	56
OSU	Endurance	18	3.3	23	40	55
OSU	Centerfield	17	3.0	-	-	57
TAMU	TAM 111	16	1.5	22	38	55
WestBred	Aspen (W)	16	4.0	-	-	55
OSU	Guymon (W)	16	2.8	21	-	58
KSU	Overley	14	2.3	-	-	55
AgriPro	Doans	14	3.5	-	-	58
OSU	Deliver	14	3.8	20	-	57
OSU	OK Bullet	14	1.5	21	38	56
KSU	Jagger	14	2.3	20	35	54
WestBred	Keota	12	2.0	-	-	55
TAMU	TAM 203	12	2.5	-	-	53
AgriPro	Jackpot	11	1.8	-	-	54
AgriPro	Jagalene	11	2.0	21	34	55
OSU	Duster	11	4.0	18	-	-
KSU	Fuller	10	2.5	20	-	51
WestBred	Armour	10	4.0	-	-	53
WestBred	Santa Fe	9	3.3	-	-	-
OSU	OK Rising (W)	8	2.3	-	-	-
WestBred	Shocker	7	3.8	-	-	-
Experiementals						
	OK04315	15	2.00	-	-	57
	OK05526	12	2.75	-	-	55
	Mean	14	21	37	55	
	LSD $_{(0.05)}$	4	3	2	2	

(W) = Hard white wheat variety

Wheat Streak Mosaic Virus ratings recorded by Dr. Bob Hunger on 05-14-2009. A 0-5 scale was used where:

- 0=no symptoms/healthy
- 1=Very slight yellowing
- 2=Mild yellow and/or mosaic; some stunting
- 3=Moderate yellow and/or mosaic; some stunting
- 4=Severe yellowiing and/or mosaic; moderate stunting
- 5=Severe yellowing and/or mosaic; stunted; dead or nearly dead

Keyes Variety Trial

Cooperator: J.B. Stewart
Soil type: Richfield clay loam
Planting date: 9-29-08
Harvest date: 6-26-09

Tillage: Minimum-till
Management: Grain only
Previous crop: Grain sorghum

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Grain Yield 3-Year	Test Weight 2008-09
		------------bu/ac----------			---lb/bu---
OSU	Endurance	50	38	48	59
TAMU	TAM 111	48	39	49	61
WestBred	Aspen (W)	48	-	-	60
UNL	Mace	47	35	-	60
TAMU	TAM 112	45	37	-	60
AgriPro	Jagalene	44	34	44	60
OSU	Duster	43	34	-	59
TAMU	TAM 203	39	-	-	58
KSU	Overley	39	-	-	58
OSU	Centerfield	38	-	-	60
WestBred	Keota	38	-	-	59
WestBred	Winterhawk	37	-	-	60
OSU	Guymon (W)	37	32	-	62
WestBred	Armour	36	-	-	58
OSU	Deliver	36	30	-	59
KSU	Fuller	36	27	-	59
OSU	OK Rising (W)	35	-	-	59
KSU	Jagger	35	24	37	58
AgriPro	Doans	35	-	-	60
WestBred	Shocker	34	-	-	58
WestBred	Santa Fe	34	-	-	58
OSU	OK Bullet	33	28	43	59
AgriPro	Jackpot	32	-	-	59
Experimentals					
	OK05312	43	-	-	60
	Mean	39	33	44	59
	LSD (0.05)	9	5	3	2

(W) = Hard white wheat variety

Kildare Variety Trial

Cooperator: Don Schieber
Soil type: Tabler Silt Loam
Planting date: 10-2-08
Harvest date: 6-25-09

Tillage: No-till
Management: Grain only
Previous crop: Soybean
Soil test information: pH = 5.8, P = 122, K = 414

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Test Weight 2008-09
		-----------bu/ac----------		---lb/bu---
OSU	Duster	44	48	54
WestBred	Santa Fe	39	50	55
TAMU	TAM 304	36	46	52
TAMU	TAM 203	35	-	52
OSU	OK Rising (W)	34	36	55
KSU	Fuller	34	47	55
OSU	Deliver	33	41	56
WestBred	Shocker	32	44	55
AgriPro	Jackpot	32	41	53
OSU	Endurance	32	43	54
OSU	Billings	31	38	54
WestBred	Armour	31	-	53
AgriPro	Jagalene	30	38	55
OSU	Centerfield	30	38	55
KSU	Jagger	30	37	57
OSU	OK Bullet	30	35	55
KSU	Overley	27	35	55
AgriPro	Doans	22	35	55
Experimentals				
	OK05526	43	-	57
	OK04525	36	-	57
	OK06114	32	-	55
	Mean	33	41	55
	LSD (0.05)	7	5	2

(W) = Hard white wheat variety

Kingfisher Variety Trial

Cooperator: Rodney Mueggenborg
Soil type: Tillman silt loam
Planting date:10-9-08
Harvest date: 6-15-09

Tillage: Conventional till
Management: Grain only
Previous crop: Wheat
Soil test information: pH = 6.7, P = 29, K = 400

		Grain Yield			Test Weight
Source	*Variety*	*2008-09*	*2-Year*	*3-Year*	*2008-09*
		------------bu/ac-----------			---lb/bu---
OSU	Duster	50	57	56	59
OSU	Endurance	44	53	50	59
TAMU	TAM 203	41	48	-	57
AgriPro	Jagalene	41	51	46	61
WestBred	Santa Fe	40	48	48	59
AgriPro	Doans	40	49	45	60
OSU	OK Bullet	40	47	49	61
OSU	Deliver	37	43	42	60
OSU	OK Rising (W)	37	46	48	59
OSU	Centerfield	36	47	42	59
WestBred	Armour	34	-	-	57
AgriPro	Jackpot	34	47	-	59
KSU	Fuller	32	49	50	60
KSU	Overley	30	42	45	60
KSU	Jagger	29	42	42	59
OSU	Billings	29	43	45	59
TAMU	TAM 304	28	-	-	57
OSU	Pete	27	42	-	59
WestBred	Shocker	23	38	41	58
Experimentals					
	OK05742W	36	-	-	59
	OK05526	27	-	-	60
	Mean	35	47	46	59
	LSD $_{(0.05)}$	6	4	3	1

(W) = Hard white wheat variety

Lahoma Variety Trial

Cooperator: North Central Research Station
Soil type: Pond Creek Silt Loam
Planting date: 10-10-08
Harvest date: 6-18-09

Management: Grain only
Soil test information: pH = 6.4 , P = 32, K = 378
Previous crop: Wheat
Fungicide = 10 oz/A Stratego on 15 April 2009

		Grain Yield						*Test Weight*		
		2008-09			*2-year*					
Source	*Variety*	*Grazed*	*Non-grazed*	*Diff.*	*Grazed*	*Non-grazed*	*Diff.*	*Grazed*	*Non-grazed*	*Diff.*
WestBred	Santa Fe	67	61	-6	70	69	-1	59	58	-1
OSU	Endurance	62	67	5	64	71	7	58	58	0
WestBred	Armour	62	69	8	-	-	-	58	58	0
WestBred	Winterhawk	59	57	-2	-	-	-	58	58	0
OSU	Duster	59	68	9	62	73	11	58	59	1
TAMU	TAM 203	56	63	7	67	73	6	56	57	0
OSU	Centerfield	54	58	4	57	63	6	57	58	0
TAMU	TAM 304	53	60	7	-	-	-	55	56	1
AgriPro	Doans	53	58	5	63	66	3	60	61	1
AgriPro	Jagalene	51	65	14	47	68	21	58	59	1
OSU	Deliver	51	58	7	59	67	8	59	59	0
KSU	Jagger	51	55	5	49	64	15	57	58	0
KSU	Fuller	50	56	6	62	68	7	58	59	1
AgriPro	Jackpot	50	51	1	65	73	8	58	58	0
OSU	Billings	49	52	3	63	65	2	57	56	-1
TAMU	TAM 111	49	60	11	-	-	-	57	59	2
OSU	OK Rising (W)	49	55	7	54	66	12	57	57	0
OSU	OK Bullet	48	57	10	50	65	15	59	60	1
WestBred	Shocker	48	53	5	64	68	4	57	58	0
WestBred	Keota	47	57	10	-	-	-	59	59	0
KSU	Overley	47	53	6	56	64	8	58	58	1
TAMU	TAM 112	47	63	16	-	-	-	58	60	2
OSU	Pete	43	50	7	-	-	-	59	59	1
Experimentals										
	OK05526	56	61	5	-	-	-	59	59	0
	OK06114	53	61	8	-	-	-	58	59	1
	Mean	53	59	6	60	68	8	58		
	LSD $_{(0.05)}$	58	0	4	6	25	4	1	1	NS

(W) = Hard white wheat variety

Lamont Variety Trial

Cooperator: Kirby Farms
Soil type: Pond creek silt loam
Planting date: 11-4-08
Harvest date: 6-25-09

Tillage: Conventional till
Management: Grain only
Previous crop: Wheat
Soil test information: pH = 6.3, P = 40, K = 459

		Grain Yield			*Test Weight*
Source	*Variety*	*2008-09*	*2-Year*	*3-Year*	*2008-09*
		------------*bu/ac*-----------			---*lb/bu*---
WestBred	Shocker	49	52	-	54
WestBred	Santa Fe	48	55	53	55
TAMU	TAM 203	46	-	-	53
OSU	Centerfield	46	46	44	56
OSU	Endurance	46	48	45	54
AgriPro	Doans	43	54	-	56
AgriPro	Jagalene	43	44	46	54
OSU	Deliver	43	45	42	55
KSU	Jagger	43	44	47	54
KSU	Overley	42	50	48	55
TAMU	TAM 304	40	52	-	52
KSU	Fuller	38	54	-	54
OSU	OK Bullet	38	43	45	56
AgriPro	Jackpot	37	54	-	55
WestBred	Armour	37	-	-	52
OSU	Duster	37	52	52	53
OSU	Billings	36	50	-	54
OSU	OK Rising (W)	35	42	43	55
Experimental					
	OK06114	42	-	-	55
	OK05526	39	-	-	56
	Mean	41	49	46	55
	LSD $_{(0.05)}$	8	5	3	2

(W) = Hard white wheat variety

Marshall Variety Trial

Cooperator: Henry Fuxa
Soil type: Kirkland silt loam
Soil test information: pH = 5.3, P = 50, K = 386
Planting date: Dual purpose = 9-17-08; Grain only = 10-20-08

Tillage: Conventional till
Previous crop: Wheat
Harvest date: 6-16-09

		Grain Yield						*Test Weight*		
		2007-08			*2-year*					
Source	*Variety*	*Grazed*	*Non-grazed*	*Diff.*	*Grazed*	*Non-grazed*	*Diff.*	*Grazed*	*Non-grazed*	*Diff.*
WestBred	Shocker	20	14	-6	39	34	-5	35	30	-5
AgriPro	Doans	27	13	-13	43	32	-10	40	28	-12
OSU	Duster	30	13	-18	48	36	-11	42	31	-10
TAMU	TAM 203	29	12	-17	47	37	-10	-	-	-
KSU	Fuller	21	10	-11	44	35	-9	42	29	-13
OSU	OK Bullet	17	10	-7	36	33	-3	36	29	-8
WestBred	Santa Fe	25	10	-15	41	32	-9	38	28	-10
OSU	Endurance	31	8	-23	46	34	-13	40	29	-11
OSU	Centerfield	22	7	-15	40	29	-11	34	23	-12
AgriPro	Jackpot	17	7	-10	42	34	-8	-	-	-
WestBred	Armour	25	6	-19	-	-	-	-	-	-
OSU	Deliver	20	5	-15	38	26	-12	36	24	-12
AgriPro	Jagalene	13	5	-8	25	26	1	24	21	-3
KSU	Overley	12	4	-7	36	32	-5	33	27	-7
KSU	Jagger	11	4	-6	27	31	3	25	24	-2
OSU	Billings	16	4	-13	38	30	-8	-	-	-
OSU	OK Rising (W)	13	4	-9	34	26	-8	41	24	-17
OSU	Pete	13	3	-10	-	-	-	-	-	-
Experimentals										
	OK04315	29	12	-17	-	-	-	-	-	-
	OK05526	23	12	-10	-	-	-	-	-	-
	Mean	21	8	-13	39	32	-7	36	27	-9
	LSD $_{(0.05)}$	5	4		2	5		3	3	

Notes: Recovery from grazing impacted by drought. Grain yields were insufficient to obtain test weight measurements. Dual purpose plots were grazed from 4 December 2008 to 6 March 2009 (92 days). Average initial cattle weight was 534 lb and cattle were stocked at 0.446 head per acre. ADG was 2.52 lb/head/day.

Olustee Variety Trial

Cooperator: David Bush
Soil type: Tillman silt loam
Planting date: 10-23-08
Harvest date: 6-8-09

Tillage: Conventional till
Management: Grain only
Previous crop: Wheat
Soil test: pH = 8.0, P = 21, K = 1040

Source	Variety	Grain Yield 2008-09	Grain Yield 2-Year	Grain Yield 3-Year	Test Weight 2008-09
		------------bu/ac-----------			---lb/bu---
OSU	OK Bullet	29	42	50	62
OSU	Duster	28	39	44	61
AgriPro	Jagalene	27	42	47	62
WestBred	Santa Fe	27	42	50	61
TAMU	TAM 203	27	43	-	59
KSU	Overley	26	41	50	61
KSU	Fuller	25	42	51	60
KSU	Jagger	25	41	48	60
WestBred	Armour	24	-	-	59
OSU	OK Rising (W)	24	-	-	60
WestBred	Shocker	24	39	46	59
OSU	Centerfield	23	37	43	60
AgriPro	Doans	23	37	44	61
OSU	Endurance	23	38	45	60
AgriPro	Jackpot	23	40	-	61
OSU	Pete	23	38	47	61
OSU	Deliver	20	39	45	58
AgriPro	Fannin	17	33	41	60
Experimentals					
	OK05742W	27	-	-	60
	OK06729	24	-	-	63
	OK04525	23	-	-	61
	STARS 0601W	17	-	-	60
	Mean	24	40	47	60
	LSD $_{(0.05)}$	3	3	2	1

Hulless Barley Trials

Newkirk Cooperator: Don Merz
Buffalo Cooperator: NRCS
Marshall Cooperator: Henry Fuxa

Variety	Buffalo	Marshall Dual-Purpose	Marshall Grain Only	Newkirk
VA 125	33	14	34	25
EVE	29	23	38	24
VA03H-61	-	-	-	40
TAMBAR 501 check	-	-	-	18
Jagger Check	54	5	14	-
Duster Check	70	16	35	-
Mean	47	15	30	27
LSD $_{(0.05)}$	7	5	2	10

Notes: All yields, including barley, calculated using a 60 lb bushel weight.

Plant height, lodging score, and heading date for selected variety trials in Oklahoma in 2009.

	Plant Height											Lodging		Heading date	
	Balko	Buffalo	Keyes	El Reno Conv Till DP	El Reno Conv Till GO	El Reno No Till DP	El Reno No-till GO	Kingfisher	Lahoma	Lamont	Olustee	Alva	Buffalo	Lahoma	Stillwater early-sown
Variety				----------	----------	----------	----------	*inches*	----------	----------	----------			*0 - 10 scale†*	
Armour	24	24	24	24	24	23	22	22	28	24	19	3	1	21-Apr	15-Apr
Aspen (W)	26	-	25	-	-	-	-	-	-	-	-	-	-	-	15-Apr
Billings	-	-	-	23	-	-	-	23	26	27	-	2	-	20-Apr	16-Apr
Centerfield	28	24	26	22	23	24	22	26	27	28	20	2	1	22-Apr	18-Apr
Deliver	28	26	28	24	28	26	22	24	31	30	20	3	2	25-Apr	17-Apr
Doans	28	28	36	24	26	25	23	25	30	29	20	2	2	21-Apr	19-Mar
Duster	29	25	28	24	27	24	23	25	29	28	23	4	3	23-Apr	18-Apr
Endurance	28	28	28	25	26	25	24	26	32	30	23	2	2	24-Apr	18-Apr
Fannin	-	-	-	22	24	22	22	-	-	-	20	-	-	-	14-Apr
Fuller	26	22	26	24	26	24	24	25	29	29	21	3	1	19-Apr	16-Apr
Guymon (W)	29	-	26	-	-	-	-	-	-	-	-	-	-	-	19-Apr
Jackpot	27	26	26	25	26	24	22	24	28	28	21	2	2	19-Apr	17-Apr
Jagalene	28	27	29	24	26	25	24	25	30	27	23	2	1	23-Apr	19-Mar
Jagger	26	24	26	22	25	23	21	24	27	28	21	5	3	20-Apr	17-Apr
Keota	31	29	30	-	-	-	-	-	32	-	-	2	2	25-Apr	18-Apr
Mace	30	-	28	-	-	-	-	-	-	-	-	-	-	-	21-Apr
OK Bullet	30	28	29	25	28	25	27	26	29	30	23	1	1	24-Apr	18-Apr
OK Rising (W)	28	27	28	24	26	25	24	26	29	30	22	1	1	23-Apr	17-Apr
Overley	30	24	29	23	24	24	23	24	30	30	22	2	1	22-Apr	15-Apr
Pete	26	-	-	24	-	-	-	21	28	-	19	2	-	16-Apr	14-Apr
Santa Fe	26	24	26	24	24	23	23	26	29	30	21	4	2	22-Apr	16-Apr
Shocker	28	23	27	23	24	23	22	23	29	32	21	3	2	21-Apr	15-Apr
TAM 111	30	26	29	-	-	-	-	-	30	-	-	1	2	24-Apr	20-Apr
TAM 112	26	26	28	-	-	-	-	-	29	-	-	5	4	17-Apr	17-Apr
TAM 203	28	25	26	25	26	25	22	24	29	30	22	2	2	25-Apr	18-Apr
TAM 304	-	-	-	-	-	-	-	23	27	24	-	-	-	19-Apr	15-Apr
Winterhawk	28	26	26	-	-	-	-	-	28	-	-	2	2	21-Apr	16-Apr
OK04315	-	-	-	24	-	-	-	-	-	-	-	-	-	-	-
OK05312	30	-	28	-	-	-	-	-	-	-	-	-	-	-	18-Apr
OK05526	30	-	-	25	-	-	-	27	31	29	-	2	-	19-Apr	15-Apr
OK05742W	-	-	-	-	-	-	-	25	-	-	23	-	-	-	16-Apr
OK06114	-	-	-	-	-	-	-	-	27	28	-	-	-	20-Apr	14-Apr
OK06729	-	-	-	-	-	-	25	-	-	-	20	-	-	-	16-Apr
STARS 0601W	31	-	-	-	-	-	-	-	-	-	21	1	-	-	17-Apr

† Scale of 0 - 10 with 0 representing no lodging and 10 representing severe lodging

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OKLAHOMA STATE UNIVERSITY

RESEARCH