Oklahoma Panhandle
Research & Extension Center

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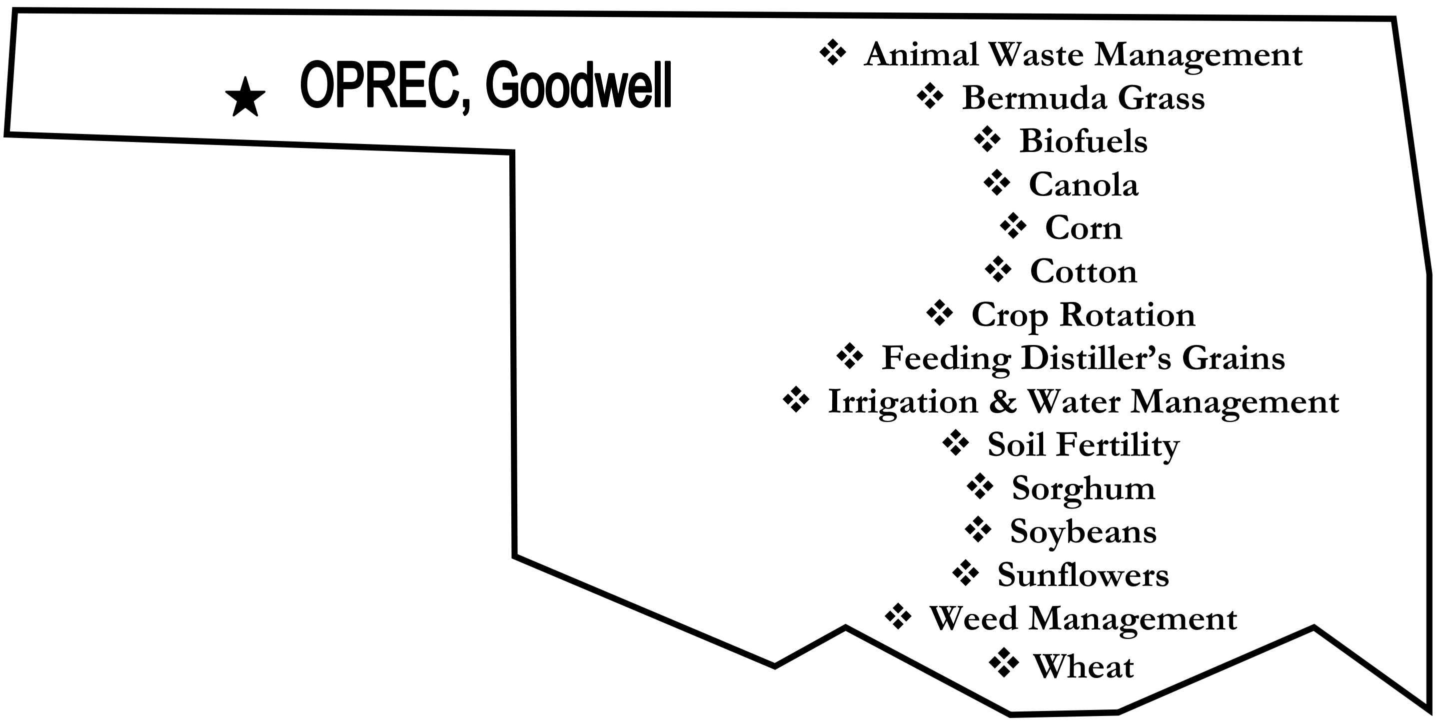
http://oaes.pss.okstate.edu/goodwell



2008 Research Highlights

Division of Agricultural Sciences and Natural Resources

Oklahoma Panhandle Research and Extension Center

Oklahoma State University

Field & Research Services Unit

Department of Animal Science

Department of Entomology and Plant Pathology

Department of Plant and Soil Sciences

Department of Biosystems and Agricultural Engineering

USDA - ARS

OKLAHOMA PANHANDLE RESEARCH AND EXTENSION CENTER

The Division of Agricultural Sciences and Natural Resources (DASNR) including the Oklahoma Agricultural Experiment Station (OAES) and the Oklahoma Cooperative Extension Service (OCES) at Oklahoma State University (OSU) have a long history of working cooperatively with Oklahoma Panhandle State University (OPSU) to meet the needs of our clientele, the farmers and ranchers of the high plains region. OAES is the research arm of DASNR and continues with the mission to conduct fundamental and applied research for the purpose of developing new knowledge that will lead to technology improvements addressing the needs of the people. The OCES continues to strive to disseminate the research information generated by OAES to the public through field days, workshops, tours, and demonstrations. This has been and will continue to be a major focus of our efforts at the Oklahoma Panhandle Research and Extension Center. Together as a team we have been able to solve many significant problems related to high plains agriculture.

The OPREC is centrally operated within the Field and Research Services Unit (FRSU) of the OAES. The FRSU serves as the back bone for well over 1,000 statewide field and lab based research trials annually. Our unit consists of 18 outlying research stations including the OPREC, the Controlled Environmental Research Lab, the Ridge Road Greenhouse Phase I and Phase II, the Noble Research Center and the Stored Product Research and Extension Center. The FRSU works to provide a central focus for station operations and management with the goal to improve overall efficiency by providing a systematic means for budget management, facility upgrades, consolidation of labor pools, maintenance and repair of equipment and buildings, and other infrastructural needs.

The Oklahoma Panhandle Research and Extension Center at Goodwell is committed to serving the people of the region. Currently our Director position is vacant but we have hopes that this position may be filled in the coming year. Many staff continue to serve our clientele and include; Rick Kochenower Area Agronomy Research and Extension Specialist, Britt Hicks Area Livestock Extension Specialist, and Lawrence Bohl Senior Station Superintendent of OPREC. Other essential OPREC personnel include Donna George Senior Secretary, Craig Chesnut Field Foreman II, Matt Lamar Field Assistant and Equipment Operator, and several wage payroll and part-time OPSU student laborers. OSU faculties from numerous Departments continue to utilize OPREC to conduct research and extension efforts in the Panhandle area. Additionally, the OPREC continues to serve as a “hub” for our commodity groups and agriculture industries by hosting several informative agriculture related meetings annually.

The DASNR, OAES, and OCES truly appreciate the support that our clientele, farmers, ranchers, commodity groups, industry, and other agricultural groups have given us over the years. Without your support many of our achievements would not have been possible. We look forward to your continued support in the future and to meeting the needs of the research, extension, and teaching programs in the high plains region.

R. Brent Westerman

R. Brent Westerman
Sr. Dir. F&RSU
Oklahoma Agricultural Experiment Station

The staff at OPREC, OAES F&RSU, Department of Plant and Soil Sciences, Department of Animal Science and Department of Biosystems and Ag Engineering at Oklahoma State University would like to thank the companies and individuals listed below, for providing resources utilized in research projects. Their valuable contributions and support allow researchers to better utilize research dollars. This research is important for producers in the high plains region, not just the Oklahoma panhandle. We would ask that the next time you see these individuals and companies that you say thank you with us.

Archer Daniels Midland Company
BASF
Bayer Crop Sciences
Dow Agro Sciences (Jodie Stockett)
DuPont (Jack Lyons and Robert Rupp)
Farm Credit of Western Oklahoma
Gustin Equipment (Sam Gustin, Kevin Allard)
Hitch Enterprises
Steve Kraich
Liquid Control Systems (Tim Nelson)
Midwest Genetics (Bart Arbuthnot)
Monsanto (Ben Mathews, T. K. Baker, Mike Lenz)
National Sorghum Producers
Rick Nelson
GM Northwest Cotton Growers Co-op
Oklahoma Grain Sorghum Commission
Oklahoma Wheat Commission
Oklahoma Wheat Growers
OPSU
Orthman Manufacturing
Pioneer Seed (Ramey Seed)
Sorghum Partners
J. B. Stewart, Jarrod Stewart
Syngenta
Texhoma Wheat Growers
Triumph Seed Company
Joe Webb

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2008 Oklahoma Panhandle Research and Extension Center

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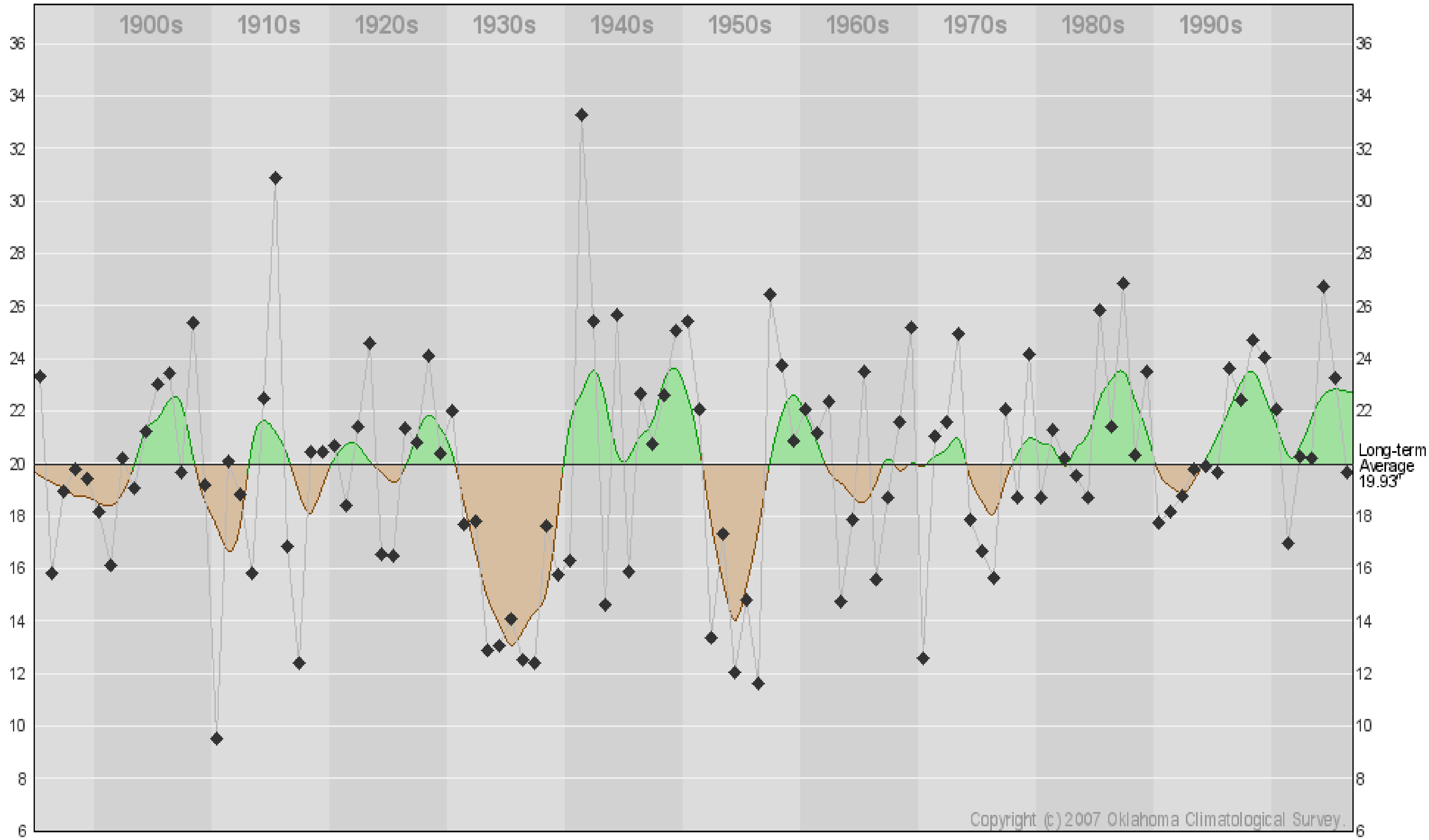


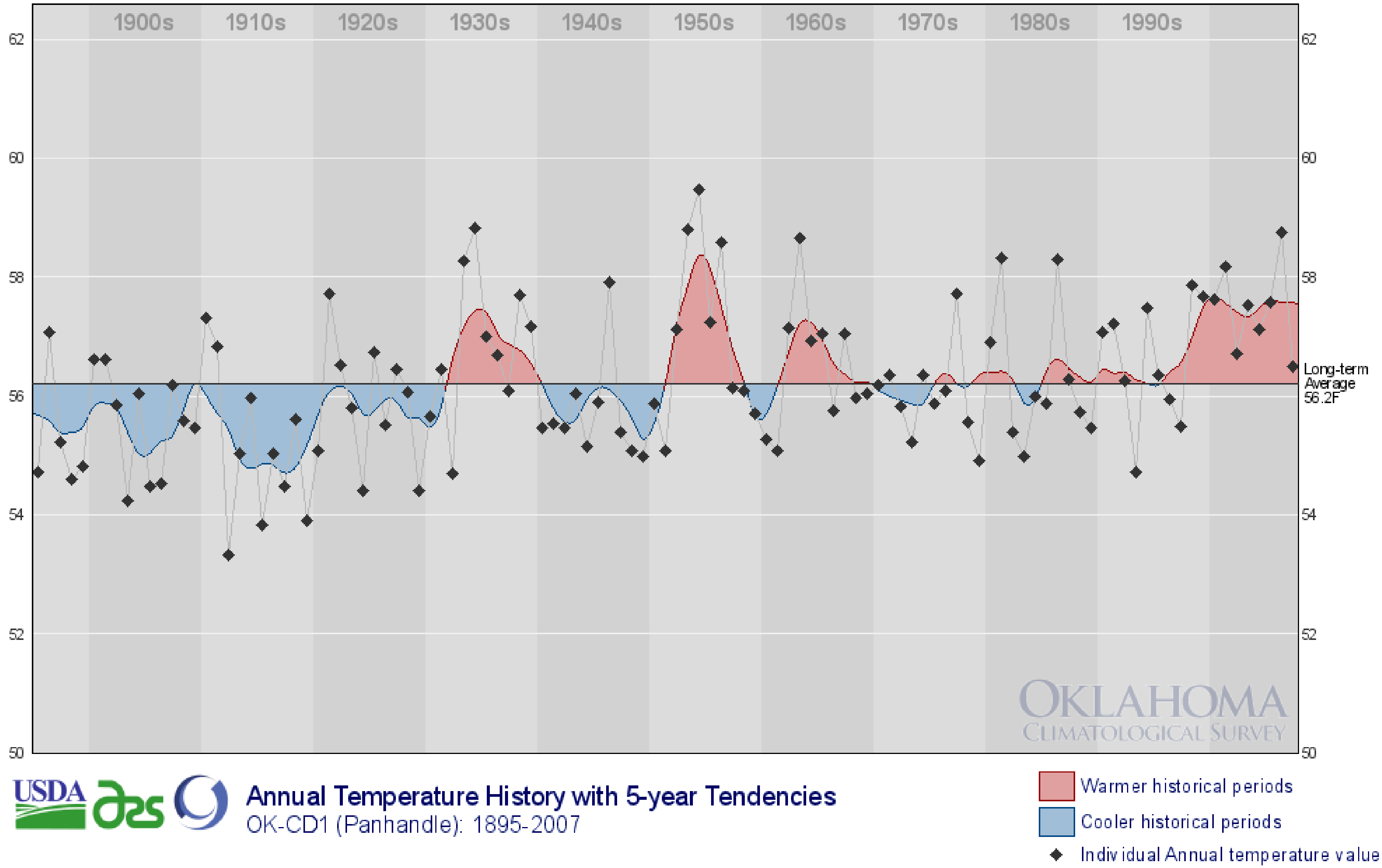
OKLAHOMA CLIMATOLOGICAL SURVEY

Annual Rainfall History with 5-yr Weighted Trends

Climate Division OK-1 (Oklahoma Panhandle): 1895-2006

Wetter historical periods

Drier historical periods

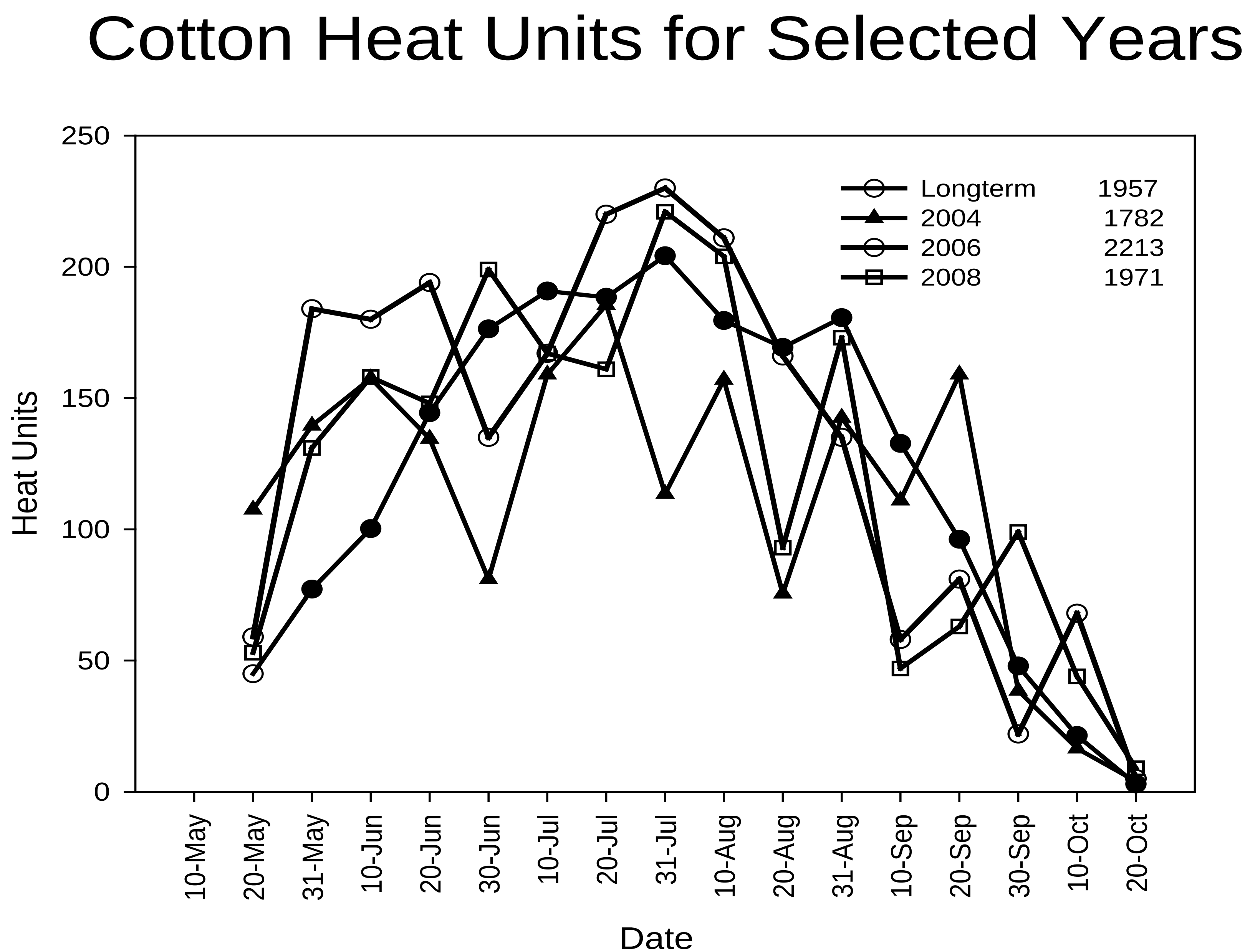


Annual Temperature History with 5-year Tendencies
OK-CD1 (Panhandle): 1895-2007

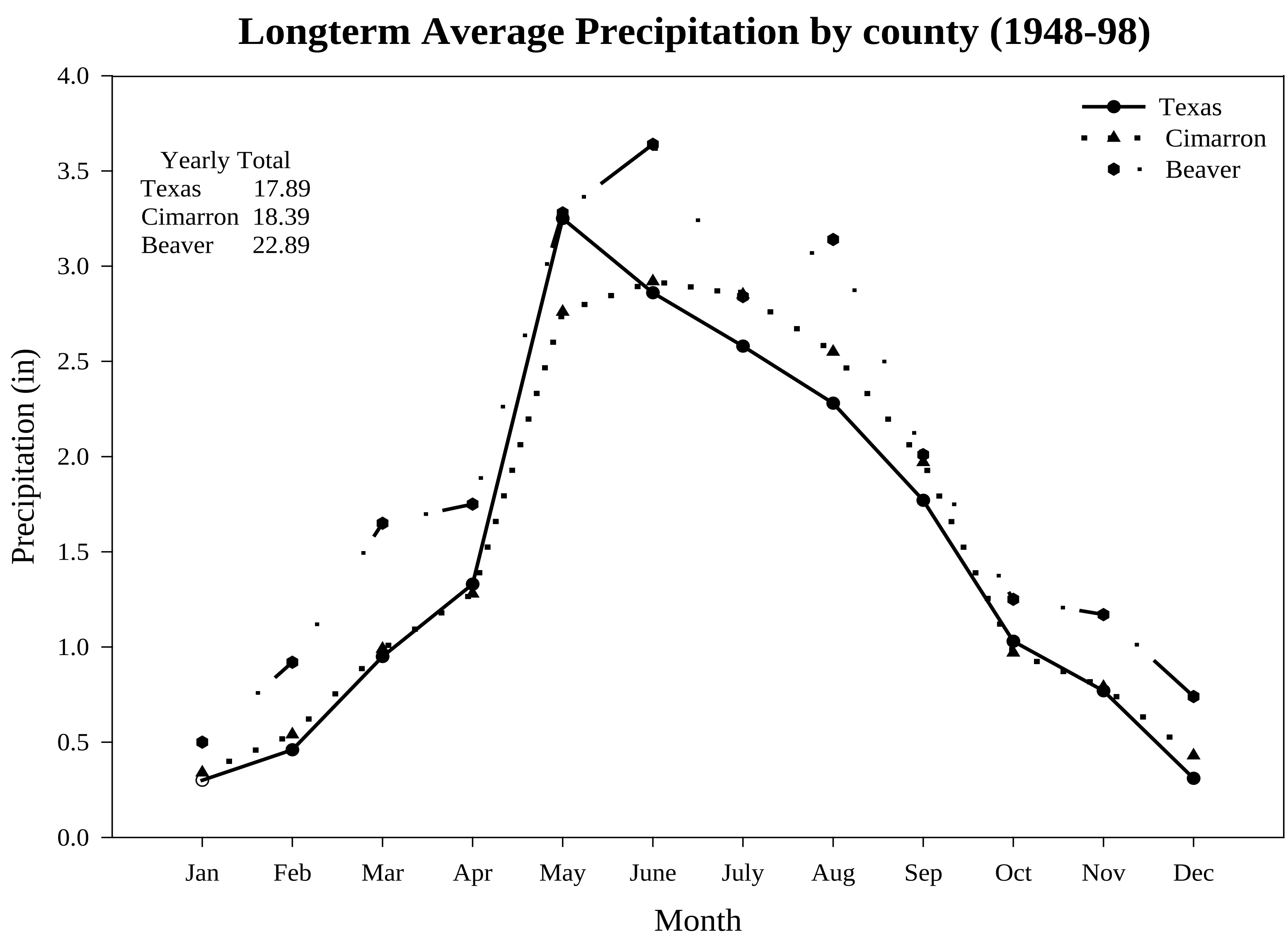
Climatological data for Oklahoma Panhandle Research and Extension Center, 2008.

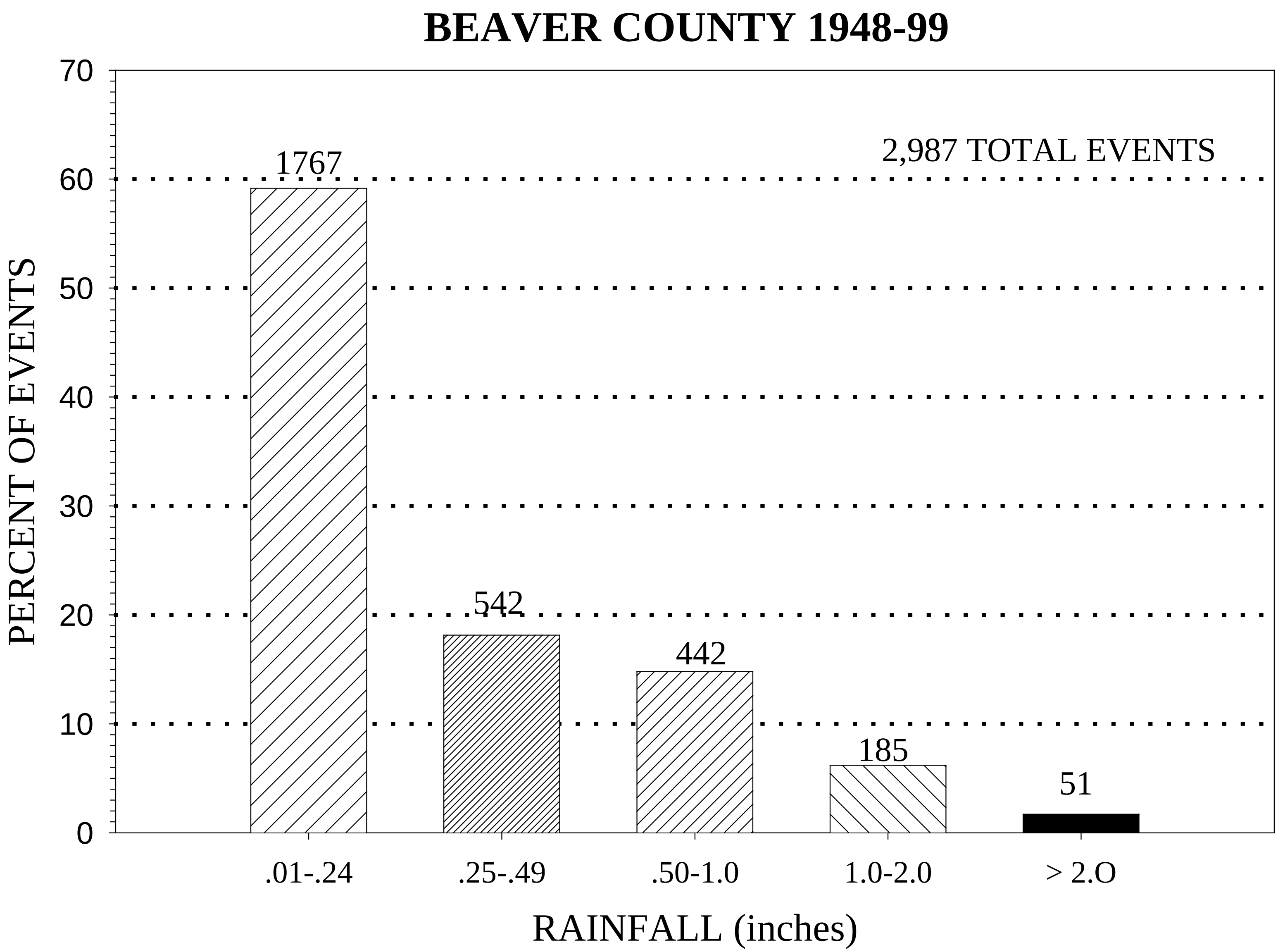
	Temperature				Precipitation			Wind	
Month	Max	Min	Max. mean	Min. mean	Inches	Long term mean	One day total	AVG mph	Max mph
Jan	74	4	51	20	0.11	0.30	0.11	13.9	56.5
Feb	69	11	54	20	0.21	0.46	0.12	11.8	50.6
March	80	14	61	29	0.09	0.95	0.06	13.3	48.1
April	92	22	71	36	0.61	1.33	0.38	15.1	57.1
May	96	31	82	49	0.93	3.25	0.50	15.9	62.8
June	106	46	93	60	1.51	2.86	1.29	15.0	67.9
July	100	60	90	65	3.77	2.58	2.50	12.6	54.5
Aug	101	57	87	63	5.64	2.28	1.68	11.2	47.9
Sept	88	41	80	53	0.36	1.77	0.24	11.3	42.8
Oct	89	25	70	42	4.74	1.03	1.63	12.7	53.4
Nov	88	18	61	32	0.19	0.77	0.14	12.5	52.2
Dec	74	4	51	20	0.11	0.31	0.11	13.9	56.5
Annual total			70.9	40.8	18.27	17.9	NA	NA	NA

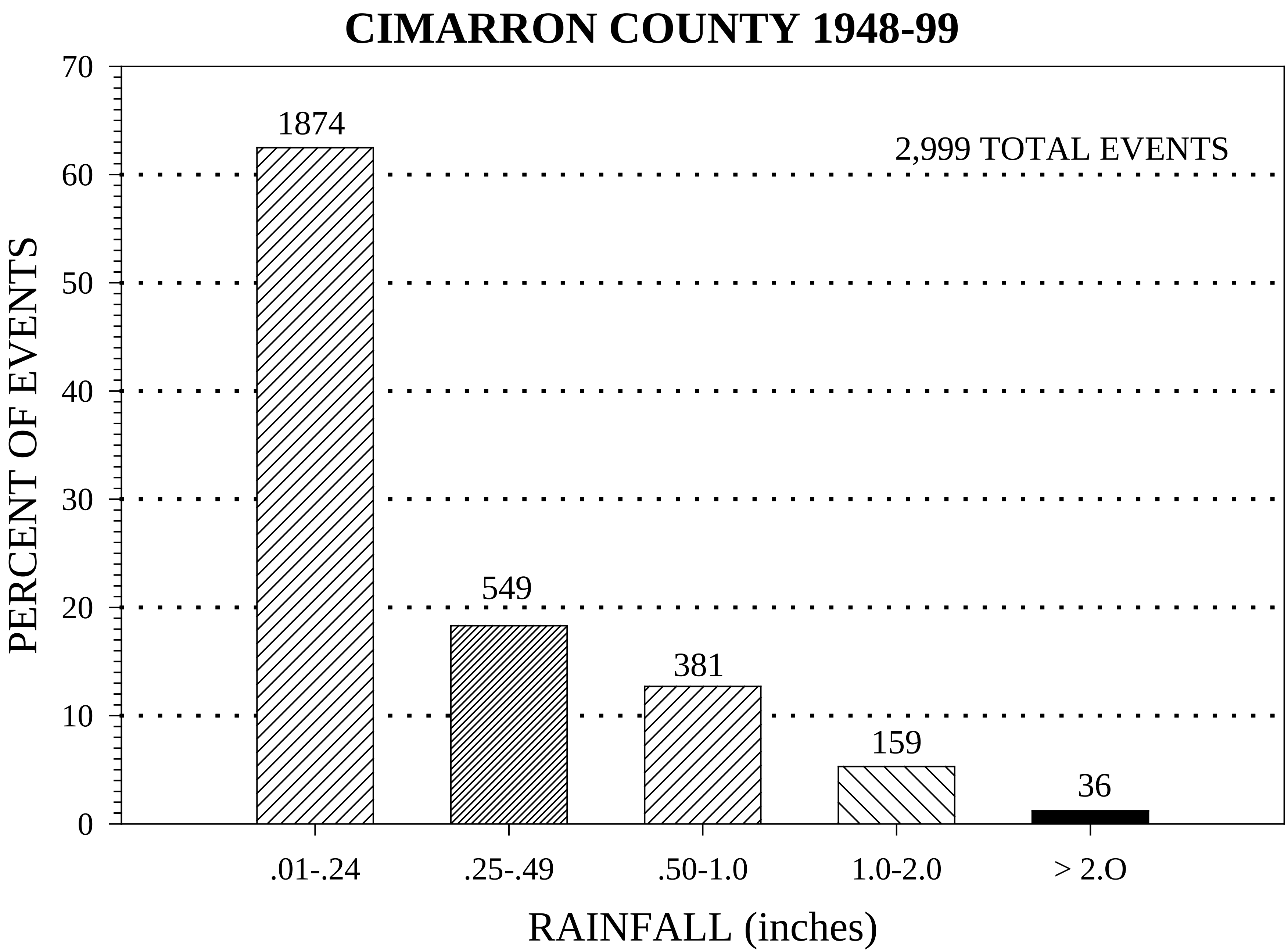
Data from Mesonet Station at OPREC

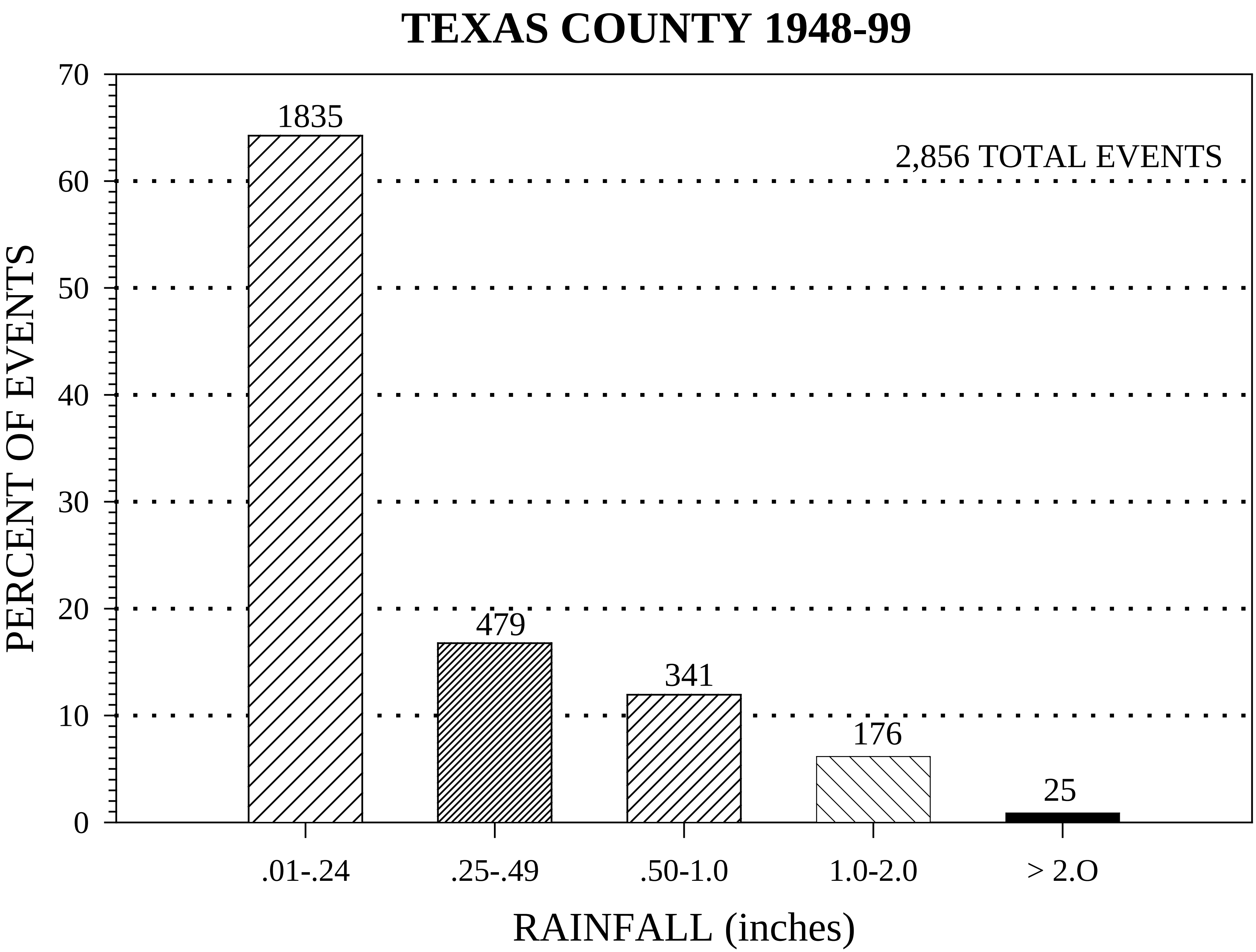


Cotton Heat Units for Selected Years
Heat Units
250
200
150
100
50
0
Longterm 1957
2004 1782
2006 2213
2008 1971
10-May
20-May
31-May
10-Jun
20-Jun
30-Jun
10-Jul
20-Jul
31-Jul
10-Aug
20-Aug
31-Aug
10-Sep
20-Sep
30-Sep
10-Oct
20-Oct
Date


Longterm Average Precipitation by county (1948-98)
Precipitation (in)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Yearly Total
Texas 17.89
Cimarron 18.39
Beaver 22.89
Texas
Cimarron
Beaver
Jan
Feb
Mar
Apr
May
June
July
Aug
Sep
Oct
Nov
Dec
Month


BEAVER COUNTY 1948-99
2,987 TOTAL EVENTS
PERCENT OF EVENTS
70
60
50
40
30
20
10
0
1767
542
442
185
51
.01-.24
.25-.49
.50-1.0
1.0-2.0
> 2.O
RAINFALL (inches)


CIMARRON COUNTY 1948-99
2,999 TOTAL EVENTS
PERCENT OF EVENTS
70
60
50
40
30
20
10
0
1874
549
381
159
36
.01-.24
.25-.49
.50-1.0
1.0-2.0
> 2.O
RAINFALL (inches)


TEXAS COUNTY 1948-99
2,856 TOTAL EVENTS
PERCENT OF EVENTS
0
10
20
30
40
50
60
70
1835
479
341
176
25
.01-.24
.25-.49
.50-1.0
1.0-2.0
> 2.O
RAINFALL (inches)

Oklahoma Panhandle Research & Extension Center
2008 Research Highlights

Crops

Animal Science

Extension Publications

Oklahoma Panhandle Research and Extension Center
Annual Report, 2009
Wheat Improvement Program
Contributed by Brett F. Carver, OSU Wheat Breeder, on behalf of the Wheat Improvement Team

Stranger comes to town, with the initials HPV

The Oklahoma Panhandle Research and Extension Center plays a prominent role in the final stages of OSU wheat variety development. Breeding lines in their first year of replicated yield trials, all the way up to those in their fifth year of replicated trials, appear at the Center in both dryland and irrigated plots. One such trial contains the most advanced (i.e., elite) breeding lines each year, called the Oklahoma Elite Trial-2 (OET2).

Typically about 10 of the 30 slots in the trial are occupied by contemporary check varieties, including the long-term check variety, Chisholm. We include varieties which represent the best available commercial genetics for Oklahoma in two market classes of wheat, HRW and HW. Thus each year the panel of checks changes slightly to reflect new improved genetics. This is also the reason we discontinued many years ago the testing of varieties such as Jagger and 2174. The 2008 trial featured 8 HRW and 2 HW check varieties, plus three candidate varieties, two of which (OK03522 and OK03305) were approved for release and licensing by the Oklahoma Agricultural Experiment Station in February 2009 (see later in this report about those two releases).

Grain yield results for the 2008 OET2 are shown in Table 1 for 30 entries tested at the OPREC (with irrigation) and at various sites across the state, including Winfield, Kansas. One obvious trend emerges from the comparison of the two sets of grain yield—that differences at Goodwell did not coincide with those observed across the entire state. For example, the variety Fuller and the experimental lines OK03305 (Pete) and OK03825-5403-6 performed very well across the state, but not at Goodwell. Furthermore, the yield level in 2008 at Goodwell was about one-half the expected level, or the level observed in the previous year. What happened in 2008 to cause this discrepancy?

Though irrigation did not fully relieve the stress of a chronic drought period in 2008, drought stress could not account for the drastic fluctuation in performance or foliar discoloration from one plot, or variety, to another (see Figure 1, resistant plot of Duster on left and susceptible plot on right). Disease pressure was most likely the reason for the unusual varietal rankings at Goodwell compared to other areas of the state, or what plant breeders call *genotype x environment interaction*. Based on DNA analysis by Dr. Bob Hunger, WIT wheat pathologist, two viruses were confirmed to be present: *High plains virus* (HPV) and *Barley yellow dwarf virus* (BYDV). Other viruses, such as *Wheat streak mosaic virus* and *Triticum mosaic virus*, were found in the High Plains region in 2008 but not confirmed in breeder nurseries at the OPREC.

We believe after comparing the grain yields of varieties with known reactions to BYDV that HPV, not BYDV, was the likely culprit for the yield reductions at Goodwell, followed by drought stress. As evidence, varieties with known susceptibility to BYDV performed relatively well at Goodwell, such as OK Bullet, OK Rising, and two reselections from OK Bullet. Conversely, experimental lines OK04315 and OK04111 have shown good tolerance to BYD in the past, yet their yield performance was relatively poor at Goodwell (Table 1). This scenario presented a unique opportunity to evaluate OSU breeding materials in the presence of a disease that has been difficult to track down. The foliar rating shown in Table 1 provides a quasi-rating for HPV foliar reaction. A score of 1 indicated a resistant reaction, while a score of 5 indicated a highly susceptible reaction. Susceptibility was defined as poor stem extension and discoloration (purpling or yellowing) of the canopy after heading.

OK Bullet, Endurance, and Duster produced some of the highest grain yields in the presence of HPV, whereas the varieties Deliver and Overley were negatively impacted by the disease. Some of the yield loss for Overley could be also attributed to shattering. A few experimental lines emerged impressively from this test, such as OK03522 (now released as Billings), but its foliar rating did not indicate the same level of HPV resistance as Endurance or Duster. Though only speculative with this amount of data, HPV tolerance did not appear to be genetically related to BYDV tolerance. Entries receiving a tolerant rating varied widely in grain yield, indicating other factors influenced yield such as tolerance to drought stress or general adaptation.

Two new OSU wheat varieties coming to the Panhandle

A proposal was presented by the Wheat Improvement Team in January 2009 to the OSU Plant Materials Release Committee for the release of two hard red winter wheat varieties, OK03522 as Billings, and OK03305 as Pete. The OAES has since granted approval for release of both varieties, and licensing proposals will be considered by an OAES committee, likely sometime in April 2009. Both varieties appear very well adapted to the Oklahoma panhandle.

Billings is highly suited for irrigated production, and will achieve far more grain production if planted in October and not grazed. This represents a significant departure from varieties released by OSU in the past, such as Endurance, Duster, and OK Bullet. Yields reported in breeding nursery plots have exceeded expectations at the OPREC, extending well above 120 bu/ac when the nursery average was approximately 95 bu/ac. It offers excellent protection against leaf rust and stripe rust, and good protection against powdery mildew. Pete is a beardless tri-purpose wheat variety that adds straw strength and yielding ability (irrigated or dryland) beyond what producers may be accustomed with Deliver. Pete’s superior test weight patterns add yet another distinction, though test weight patterns for Deliver are usually quite good. The following text is a revised summary of information provided to seed producers attending the Small Grains Subcommittee meeting at the Oklahoma Crop Improvement Association meeting in February 2009.

Experimental number and pedigree

OK03522**,** *N566/OK94P597*

N566, Institute of Plant Breeding, Odessa, Ukraine
OK94P597 = HBY359A/Fundulea 133//TAM 200 (former Pioneer HRW program)

Variety Name

‘Billings’

Target Region/Production Systems

Central and northern Oklahoma
Panhandle, with irrigation
Grain-only systems

Varietal Replacement

Cultivar	Superior attribute of Billings justifying replacement
OK Bullet	Greater yielding ability with any incidence of leaf rust
	Same test weight but larger kernel size, especially under leaf rust pressure
	Improved resistance to leaf rust
	Alternate source of adult-plant stripe rust resistance
	Improved canopy closure during fall months
Overley	Greater yielding ability in its primary adaptation area
	Improved resistance to leaf rust
	Alternate source of adult-plant stripe rust resistance
	Shattering resistant
Endurance	Greater yielding ability with any incidence of leaf rust or stripe rust
	Greater test weight with larger kernel size
	Better comprehensive foliar disease package
	Earlier maturity
	Greater straw strength

Seed Production Status

A second generation of foundation seed production is currently in progress (2008-2009 crop season) on about 30 to 40 acres each near Newkirk and McCloud, OK.

Anticipated foundation seed available in July 2009: >2500 bu

Justification

The cultivars OK Bullet (OAES) and Overley (KAES), which were released by their respective institutions in 2005 and 2003, brought significant improvement in both grain yield and end-use quality to the southern Great Plains. In the short-term, OK Bullet will continue to command acreage in central, southwest, and northwest portions of Oklahoma, whereas Overley will likely carry significant acreage in north central Oklahoma. Their long-term status, however, is already being questioned. Just as quickly as they captured the attention of wheat growers, they likewise captured the attention of *Puccinia triticina* Eriks., the causal organism of leaf rust. Races with virulence to the resistance gene featured in these cultivars, *Lr41*, soon began to multiply in the southern Great Plains. By spring 2008, susceptible reactions were found on OK Bullet and Overley throughout northern Oklahoma and southern Kansas. Resistant alternatives are constantly in demand, without sacrificing gains accrued in grain yield potential and marketing ability.

Billings can meet this demand for an alternative source of leaf rust resistance. Perhaps of greater importance is the resistance Billings offers to stripe rust, which is confirmed to be expressed in the adult plant, and potentially a different source of resistance than derived from Jagger. With additional resistance to the WSBMV/WSSMV complex and to powdery mildew, Billings offers a garrison of protection against foliar diseases that will improve upon the capabilities of OK Bullet, Overley, and other OSU releases such as Endurance and Duster. Additional traits that will be attractive to Oklahoma wheat producers is a moderate to high level of tolerance to soil acidity and a high level of shattering tolerance. The cultivar Fuller (KAES) should displace some of the

Overley acreage with its greater shattering tolerance, but Fuller does not have sufficient acid-soil tolerance to be used in many areas of north central and central Oklahoma where Billings fits well. Finally, Billings will exceed expectations of millers for its superior kernel size, and will meet or exceed expectations of bakers for its reliable dough strength at an intermediate level of protein.

Description of Adaptation and Limitations

Billings is best adapted to central and north central Oklahoma and to the panhandle with irrigation. The bulls-eye of its primary adaptation area extends from just south of Enid to Wichita, KS. Secondary areas of adaptation may extend in a southwestern direction, but Billings will be at risk in extreme southwestern portions of the state if drought stress occurs in the spring. Billings is recommended primarily for grain-only management systems. It may present added risks when adopted in early-planted grazed systems due to its susceptibility to barley yellow dwarf virus, lower propensity for tiller survival following grazing, and early winter-dormancy release with early planting. In the primary adaptation areas mentioned, Billings will be a suitable replacement for cultivars OK Bullet, Overley, and Endurance. It is expected to complement but not replace Duster in any adaptation area. Similar to Duster, Billings has shown a tendency to sprout in the head with greatly delayed harvest.

Experimental number and pedigree

OK03305**,** *N40/OK94P455*

N40, Institute of Plant Breeding, Odessa, Ukraine

OK94P455 = W0405D/KS831957//W3416/KS831957 (former Pioneer HRW program)

Variety Name

'Pete'

Target Region/Production Systems

Primary adaptation: southwestern and south central Oklahoma, and the panhandle
Secondary adaptation: northern and central Oklahoma
Dryland or irrigated
Dual-purpose, grain-only, or forage-only systems

Varietal Replacement

Cultivar	Superior attribute of Pete justifying replacement
Deliver	Higher yield potential Even higher test weight potential Earlier maturity Greater straw strength Greater low-pH tolerance in the vegetative stages

Seed Production Status

The first generation of foundation seed production is currently in progress (2008-2009 crop season) on about 12 acres each near Okeene, OK, using breeder seed harvested in 2008 at Goodwell, OK.

Anticipated foundation seed available in July 2009: >300 bu

Justification

Pete is intended to supplement if not replace the beardless cultivar, Deliver. The experimental line, OK02405, was previously considered a candidate along with Pete in 2007, but the very poor test weight patterns and later maturity of OK02405 delayed our decision to launch a replacement for Deliver that year. Pete provides bona fide improvements over Deliver, beyond its superior test weight patterns. Most notable are grain yield superiority (+4 bu/ac over 19 site–years), greatly improved straw strength, and earlier maturity. Pete appears to have better tolerance to low-pH soils than Deliver in the vegetative stages, though its tolerance level falls slightly below Duster and Endurance. Very slight or no further improvements are observed in foliar disease resistance, for which Deliver has remained effective against WSBMV/WSSMV, leaf rust, powdery mildew, and stripe rust. Pete is considered inferior to Deliver for stripe rust resistance and protein content but not necessarily for protein quality.

Description of Adaptation and Limitations

Pete is best adapted to southwest Oklahoma and the Oklahoma panhandle (dryland or irrigated). Secondary areas of adaptation may extend either south into Texas or into northern Oklahoma, though its grain yield performance in northern Oklahoma could be limited in severely acidic soils (pH<4.5). Chronic infection of stripe rust could present the greatest risk for Pete, as it appears to offer no more protection than the intermediate cultivar, Endurance.

Table 1

Oklahoma Elite Trial-2, 2008		Grain yield, bu/ac		HPV rating at Goodwell (1-5)[3]
Entry	**Pedigree**	**Goodwell[1]**	**Across all locations[2]**	
OK Bullet seln 05804	KS93U206/Jagger	53	55	3.0
OK Bullet seln 05806	KS93U206/Jagger	53	52	2.5
Endurance		**52**	**54**	**1.0**
Duster		**52**	**59**	**2.0**
OK Rising		**51**	**50**	**3.0**
OK03522 (Billings)	N566/OK94P597	50	54	3.0
OK05737W	KS93U206/Jagger	49	49	3.5
OK Bullet		**49**	**53**	**3.0**
OK02405	Tonkawa/GK50	47	53	2.5
OK04507	OK95593/Jagger //2174	45	51	4.0
OK05903C	TXGH12588-120*4/FS4//2174/3/Jagger	45	52	3.0
Fuller		**45**	**56**	**3.0**
Centerfield		**44**	**48**	**3.0**
OK05830	OK93617/Jagger	44	51	1.5
OK04525	FFR525W/Hickok//Coronado	44	54	5.0
Guymon		**44**	**44**	**3.0**
OK03305 (Pete)	N40/OK94P455	43	54	4.0
OK05905C	Deliver	40	49	2.0
OK00611W	OK00611W	40	50	3.0
OK04315	N563/OK94P597	39	52	1.5
OK05711W	G1878/OK98G508W	38	51	2.5
OK03825-5403-5	Custer*3/S. African seln	38	54	4.0
Overley		**38**	**48**	**2.5**
OK04505	OK91724/2*Jagger	37	54	2.5
Deliver		**37**	**49**	**3.5**
OK05741W	KS93U206/Jagger	36	46	4.0
OK03825-5403-6	Custer*3/S. African seln	36	54	3.5
OK03716W	Oro Blanco/OK92403	35	48	3.5
OK04111	2174*2/Jagger	35	51	4.0
Chisholm		**31**		**4.0**
Nursery mean		43	51	3.0
LSD (0.05)		6	4	1.2
C.V.		11	11	23

[1] Entries arranged in decreasing order of grain yield at Goodwell; check varieties appear in bold font.

[2] Statewide locations included (besides Goodwell) Hobart, Coyle (DP and GO), El Reno (DP), Cherokee (DP), Lahoma, and Winfield (Kansas). DP=dual-purpose; GO=grain-only management systems.

[3] Tolerant ratings are highlighted.

Fig. 1 High plains virus resistant Duster on left and susceptible variety on right at OPREC 2008

GRAIN YIELDS FROM SWINE EFFLUENT APPLICATIONS IN 2008

J. Clemn Turner and Jeff Hattey–Department of Plant and Soil Sciences
Oklahoma State University, Stillwater
Rick Kochenower–Oklahoma Panhandle Research and Extension Center, Goodwell

OBJECTIVES

1. To evaluate grain yields of continuous corn production under conventional tillage practices utilizing beef manure, swine effluent and anhydrous ammonia in the southern Great Plains region as part of an animal waste management system.
2. To evaluate the grain yields of a multi-year no-till corn–wheat–sunflower–fallow crop rotation production system in the southern Great Plains regions as part of a swine effluent management system.
3. Evaluate the effects of long-term land application of animal wastes on biological, chemical and physical properties of the soil.

INTRODUCTION

Swine and cattle production are important components to agriculture production in the Oklahoma panhandle. Therefore an effort to evaluate integration of swine and cattle production systems through the use of swine effluent and beef manure applications to crop production systems is important. Current production practices were evaluated, in addition to a crop production practice aimed at maximizing the utilization of available water resources in a no-till rotational cropping scheme.

PROCEDURE

Research plots were established in 1995 for the continuously cropped, conventionally tilled corn (*Zea mays* L.) production system (E701); with soil samples which were collected prior to establishment and each annual fertilizer application. During the 2008 growing season N was applied at rates of 50, 150, and 450 lb N ac^{-1} as swine effluent (SE), beef manure (BM) or urea (UN). In 1999 research plots were established to evaluate a no-till corn–wheat–sunflower–fallow (E703) and a no-till sorghum-wheat-sunflower-fallow (E704) crop rotation production system; with which soil samples were collected prior to establishment and each annual fertilizer application. During the 2008 growing season N was applied to both E703 and E704 at rates of 100, 200, and 400 lb N ac^{-1} as swine effluent (SE) or urea (UN); a tillage control plot was also included. Research plots consisted of a 15x30 ft (450 ft^2) area each of which had three replicates; plots had borders separating the replications to minimize effluent movement between the plots and to control for wind effects. In 2004 research plots were established to evaluate a sub-surface irrigation system (ESDI) to a Corn-Soybean-Wheat-Fallow rotation. In the ESDI experiment N is applied at rates of 0, 100 and 200 lb N ac^{-1}, while water is applied at a normal and a limited watering rate.

RESULTS

E701

Corn grain yields responded to N treatments when compared to the control in 2008 in an experiment that has been in a continuously cropped, conventional cultivation production (E701) system for thirteen years. The median yield was 151.2±7.8 bu ac^{-1}, with lower and upper (95%

confidence) levels at 49.4 and 224.7, respectfully (Table 1). Beef manure applied at all N rates increased grain yields above the control (Table 1, Figure 1); although when BM was applied at 450 lb N ac^{-1} rates there seemed to be no additional benefit above the 150 lb N rate (Figure 1). Swine effluent (SE) had a linear response to N applications; increasing yields at all N loading rates when compared to the control. However, yields of the low SE N loading rate were not significantly increased above the control (Table 1). Swine effluent at the highest N loading rate produced the greatest yields (196 bu), followed by UN at the high and medium N loading rates (196 bu) as seen in Table 1. Corn grain yields from the medium and high UN applications demonstrated no differences from each other (Table 1).

E703

In 2008 corn harvested under no-till (E703) management practices did not yield greater quantities than the conventional tillage study (E701); overall yields averaged 146.1±6.4 bu ac^{-1}, with lower and upper (95% confidence) levels at 89.1 and 252.3, respectfully (Table 2). Increased corn yields were seen for the sprinkler and surface applied SE applications as well as the UN applications (Figure 2). Yield increases responded linearly to N additions up to the high N loading rate. Table 3 shows the differences each treatment had when compared to the control (0 N rate); the control has been subtracted from the treatment means, showing the increase or decrease of each treatment from the control. The increases from N applications were approximately 55 bu greater than the control or tillage check for this harvest year (Table 3). Since inception this study (E703) has, because of conserved water in the soil profile, resulted in greater yields when compared to the conventional tillage (E701) experiment, excluding 2007 and 2006 data.

Results of wheat (*Triticum aestivum* L.) grain (E703) yields in 2008 are interesting. Following the corn harvest in 2007, wheat was planted and fertilized with UN at 100 lb N ac^{-1}. The yields indicate that N not used in corn production in 2007 was utilized in the increased growth of wheat grain for 2008; overall yields averaged 52.1±2.1 bu ac^{-1}, with lower and upper (95% confidence) levels at 32.4 and 84.9, respectfully (Table 2). Sprinkler and surface applied SE treatments had linear responses to their yields, indicating that the uniform application of UN was not the only N utilized in the production of grain (Figure 2). The linear increases to grain yields are a result of N mineralized from the applications of SE previously applied for corn production. When compared to the control (Table 3), the high N loading SE rate resulted in significant yield increases.

Sunflower (*Helianthus annuus*) yields from the no-till study (E703) again in 2008 had significant treatment effects (Table 2); overall yields averaged 2026±78 lb ac^{-1} (Figure 2), with lower and upper (95% confidence) levels at 483 and 2926, respectfully (Table 2). Treatment plots for UN and surface applied SE treatment showed linear responses to residual soil N. It should be noted that N applications are applied to the corn crop, and a flat UN rate to the wheat, and sunflower yields are obtained from any residual N from previous applications; the sunflower crop receives no N applications.

E704

Grain sorghum results for the sorghum-wheat-sunflower-fallow (E704) study did not yield any significant differences; overall yields averaged 83.1±2.9 bu ac^{-1}, with lower and upper (95% confidence) levels at 53.6 and 133.5, respectfully (Table 4). When compared to the control (Table 5) no significant differences were seen; yields were almost uniform across all N loading rates. Additionally, in 2007 no significant differences in sorghum yields were observed.

However, while no significant differences were seen in 2008 for E704 wheat grain yields, the yields followed the same pattern that was observed in E703 wheat yields. Following the sorghum harvest in 2007, wheat was planted and fertilized with UN at 100 lb N ac^{-1}. The yields indicate that N not used in sorghum production in 2007 was utilized in the increased growth of wheat grain for 2008; overall yields averaged 36.7±1.4 bu ac^{-1}, with lower and upper (95% confidence) levels at 19.7 and 59.7, respectfully (Table 4). The similarity to wheat grain yields in E703 (corn) reconfirm the residual soil N utilization concept. When compared to the control (Table 5), wheat yields were not significantly increased above the control, even though residual soil N responses were observed.

Sunflower yields from the no-till study (E704) again in 2008 had no significant treatment effects (Table 2); overall yields averaged 2016±58 lb ac^{-1} (Figure 3), with lower and upper (95% confidence) levels at 1214 and 2932, respectfully (Table 4); these yields are approximately twice those observed last year. It should be noted that N applications are applied to the sorghum crop, and a flat UN rate to the wheat, and sunflower yields are obtained from any residual N from previous applications; the sunflower crop receives no N applications.

ESDI

Corn grain yields in 2008 responded to N treatments in a no-till, sub-surface irrigated experiment (Table 6, Figure 4). The median yield was 237.1±7.3 bu ac^{-1}, with lower and upper (95% confidence) levels at 202.2 and 365.6, respectfully (Table 6). For the full water treatments, corn yields increased linearly with addition N applied (Figure 4); while corn yields remained similar for the low water treatments (Figure 4). When compared to the control (Table 6) yields were not significantly different. While there were no significant differences among the treatments it should be pointed out that yields from sub-surface irrigation resulted in yields that were 86 and 91 bu greater than E701 and E703, respectfully. These increased yields due to method of irrigation are exciting, because with a decrease in water applied and the reduction of water lost to evaporation, this experiment has for 4 years consistently out produced the continuously cropped, conventional cultivation production (E701) system and the no-till corn–wheat–sunflower–fallow (E703) studies. In the ESDI study even the lowest yielding treatments (0N) resulted in greater yields than were observed in the other two corn studies. This clearly indicates a direct benefit from sub-surface irrigation.

Soybean yields in 2008 did not respond to N treatments in a no-till, sub-surface irrigated experiment (Table 6, Figure 4). The median yield was 28.4±0.6 bu ac^{-1}, with lower and upper (95% confidence) levels at 25.6 and 36.7, respectfully (Table 6).

FUTURE WORK

Grain yield evaluation will continue on a yearly basis. In addition, soil samples will be collected to measure soil properties, biological changes in soil environment due to additions of moisture, organic C, and readily available nutrients. Other soil properties of interest are inorganic N, phosphorus loading, soil organic C, micronutrients, and salt levels. Of particular importance in these soils will be movement of salts at various depths within the soil profile. With high rates of evapotranspiration in this semiarid environment there is a potential for increased levels of salt accumulation in the upper portion of the soil profile. Long term high rates of salt accumulation in the profile will limit agronomic production and be a major concern in this agroecosystem. Physical properties examined include bulk density, soil structure, and water infiltration.

Table 1 Corn grain yields in 2008 for a continuously cropped corn system under conventional tillage (E701) using applications of Urea (UN), beef manure (BM), and swine effluent (SE) at N loading rates of 0, 50, 150, and 450 lb N ac^{-1}. Study is located at OPREC, Goodwell, OK.

Year	N Source†	N Rate‡ lb N ac^{-1}	Yield (Bu ac^{-1})	Std Err§ (Bu ac^{-1})	DF	T Value	Pr > |t|
2008	CONTROL	0	99.57	9.62	26	10.35	<.0001
	BM	50	139.41	16.65	26	8.37	<.0001
		150	182.35	16.65	26	10.95	<.0001
		450	186.60	16.65	26	11.20	<.0001
	SE	50	123.69	16.65	26	7.43	<.0001
		150	142.44	16.65	26	8.55	<.0001
		450	196.78	16.65	26	11.82	<.0001
	UN	50	151.51	16.65	26	9.10	<.0001
		150	196.52	16.65	26	11.80	<.0001
		450	196.15	16.65	26	11.78	<.0001

† Nitrogen source (BM=beef manure, SE=swine effluent, UN=urea).
‡ Annual N additions using N source.
§ Standard error = standard deviation of the samples adjusted by the number of samples.

Table 2 Grain yields in 2008 from a No-Till Corn-Wheat-Sunflower-Fallow rotation (E703) evaluating surface and sprinkler applications of SE. Study is located at OPREC, Goodwell, OK.

YEAR	TRT§	N App†	N Rate‡	Corn			Wheat			Sunflower		
				Bu ac^{-1} ±Std Err						lb ac^{-1} ±Std Err		
2008	1	SPR	0.5	129.10	12.71	***	44.47	5.93	***	2024.18	388.51	***
	2		1	160.05	12.71	***	62.32	5.93	***	1582.91	388.51	***
	3		2	194.93	12.71	***	65.92	5.93	***	2104.43	388.51	***
	4	SUR	0.5	140.58	12.71	***	49.20	5.93	***	2030.94	388.51	***
	5		1	177.24	12.71	***	61.30	5.93	***	2303.53	388.51	***
	6		2	219.48	12.71	***	63.36	5.93	***	2478.68	388.51	***
	12	UN	1	162.78	12.71	***	54.56	5.93	***	1449.45	388.51	***
	13		2	186.42	12.71	***	62.70	5.93	***	2647.96	388.51	***
	10	CHK	0	116.59	8.99	***	39.21	4.19	***	1853.39	274.72	***
	14	TCHK	0	107.19	12.71	***	47.70	5.93	***	1839.77	388.51	***

*, **, *** Significant at the 0.05, 0.01, and 0.001 probability levels, respectfully. § Treatment number. † Method of N application (SPR= sprinkler; SUR=surface; INJ=injection; UN=urea; CHK=check; TCHK=tillage check). ‡ Rate of N applied annually (0.5X, 1X, and 2X, where X=200 lb N ac^{-1}).

Table 3 The Standard Error of Differences (SED) in a corn-wheat-sunflower-fallow study (E703) in 2008. Where the control has been subtracted from the mean of each treatment, then statistically computed to determine the effect of each treatment. Yields are ± the control.

TRT‡	Corn			Wheat			Sunflower		
	Bu ac^{-1}						lb ac^{-1}		
1	12.5	15.4	NS†	5.3	7.7	NS	170.8	300.0	NS
2	43.5	15.4	NS	23.1	7.7	NS	-270.5	300.0	NS
3	78.3	15.4	***	26.7	7.7	*	251.0	300.0	NS
4	24.0	15.4	NS	10.0	7.7	NS	177.6	300.0	NS
5	60.6	15.4	**	22.1	7.7	NS	450.1	300.0	NS
6	102.9	15.4	***	24.1	7.7	*	625.3	300.0	NS
12	46.2	15.4	NS	15.3	7.7	NS	-403.9	300.0	NS
13	69.8	15.4	**	23.5	7.7	*	794.6	300.0	NS
14	-9.4	15.4	NS	8.5	7.7	NS	-13.6	300.0	NS

** Significant at the 0.01 probability level. † not significant.
‡ Treatment number, refer to Table 2 for a more complete explanation.

Table 4 Grain yields in 2008 from a No-Till Sorghum-Wheat-Sunflower-Fallow rotation (E704) evaluating surface and sprinkler applications of SE. Study is located at OPREC, Goodwell, OK.

YEAR	TRT§	N App†	N Rate‡	Sorghum			Wheat			Sunflower		
				Bu ac^{-1} ±Std Err						lb ac^{-1} ±Std Err		
2008	1	SPR	0.5	92.02	10.98	***	28.34	5.36	***	2139.3	278.4	***
	2		1	82.60	10.98	***	37.27	5.36	***	2274.5	278.4	***
	3		2	91.75	10.98	***	46.21	5.36	***	2088.2	278.4	***
	4	SUR	0.5	90.63	10.98	***	31.28	5.36	***	2158.6	278.4	***
	5		1	109.23	10.98	***	45.66	5.36	***	2141.8	278.4	***
	6		2	94.76	10.98	***	46.53	5.36	***	2314.4	278.4	***
	12	AA	1	67.09	10.98	***	30.16	5.36	***	2330.3	278.4	***
	13		2	89.60	10.98	***	40.28	5.36	***	2319.2	278.4	***
	10	CHK	0	69.77	7.77	***	35.75	3.79	***	1650.5	196.9	***
	14	TCHK	0	69.65	10.98	***	26.57	5.36	***	1823.6	278.4	***

*, **, *** Significant at the 0.05, 0.01, and 0.001 probability levels, respectfully. § Treatment number. † Method of N application (SPR= sprinkler; SUR=surface; INJ=injection; AA=anhydrous ammonia; CHK=check; TCHK=tillage check). ‡ Rate of N applied annually (0.5X, 1X, and 2X, where X=200 lb N ac^{-1}).

Table 5 The Standard Error of Differences (SED) in a sorghum-wheat-sunflower-fallow study (E704) in 2008. Where the control has been subtracted from the mean of each treatment, then statistically computed to determine the effect of each treatment. Yields are ± the control.

TRT‡	Sorghum			Wheat			Sunflower		
	Bu ac^{-1}						lb ac^{-1}		
1	22.25	12.30	NS†	-7.41	5.88	NS	488.75	234.16	NS
2	12.82	12.30	NS	1.52	5.88	NS	623.94	234.16	NS
3	21.98	12.30	NS	10.46	5.88	NS	437.70	234.16	NS
4	20.86	12.30	NS	-4.47	5.88	NS	507.91	234.16	NS
5	39.46	12.30	*	9.90	5.88	NS	491.24	234.16	NS
6	24.99	12.30	NS	10.78	5.88	NS	698.87	234.16	NS
12	-2.68	12.30	NS	-5.59	5.88	NS	679.75	234.16	NS
13	19.83	12.30	NS	4.53	5.88	NS	668.72	234.16	NS
14	-0.12	12.30	NS	-9.18	5.88	NS	173.04	234.16	NS

** Significant at the 0.01 probability level. † not significant.

‡ Treatment number, refer to Table 4 for a more complete explanation

Table 6 Grain yields in 2008 from a Sub-Surface No-Till Corn-Wheat-Soybean-Fallow rotation (ESDI) evaluating subsurface irrigation using several N rates under full and limited water applications. The standard error of differences (SED) were included where the control has been subtracted from the mean of each treatment, and then statistically computed to determine the effect of each treatment. SED yields are ± the control. Study is located at OPREC, Goodwell, OK.

YEAR	TRT§	H_2O†	N Rate‡	Corn			Wheat	Soybean		
				Bu ac^{-1} ±Std Err						
2008	1	Full	High	224.41	19.10	***		29.96	1.45	***
	2	Full	Low	227.65	19.10	***		29.80	1.45	***
	3	Full	None	238.33	19.10	***		28.64	1.45	***
	4	Limited	High	244.21	19.10	***		28.40	1.45	***
	5	Limited	Low	256.47	19.10	***		28.65	1.45	***
	6	Limited	None	231.23	19.10	***		30.77	1.45	***
				Standard Error of Differences (SED) Bu ac^{-1} ±Std Err						
	1	Full	High	3.24	27.01	NS		-0.16	2.05	NS
	2	Full	Low	13.92	27.01	NS		-1.32	2.05	NS
	3	Full	None	19.80	27.01	NS		-1.56	2.05	NS
	4	Limited	High	32.06	27.01	NS		-1.31	2.05	NS
	5	Limited	Low	6.82	27.01	NS		0.81	2.05	NS

*, **, *** Significant at the 0.05, 0.01, and 0.001 probability levels, respectfully. § Treatment number. † Water applied (Full or Limited). ‡ Rate of N applied annually (None=0, Low=100, and High=200 lb N ac^{-1}).

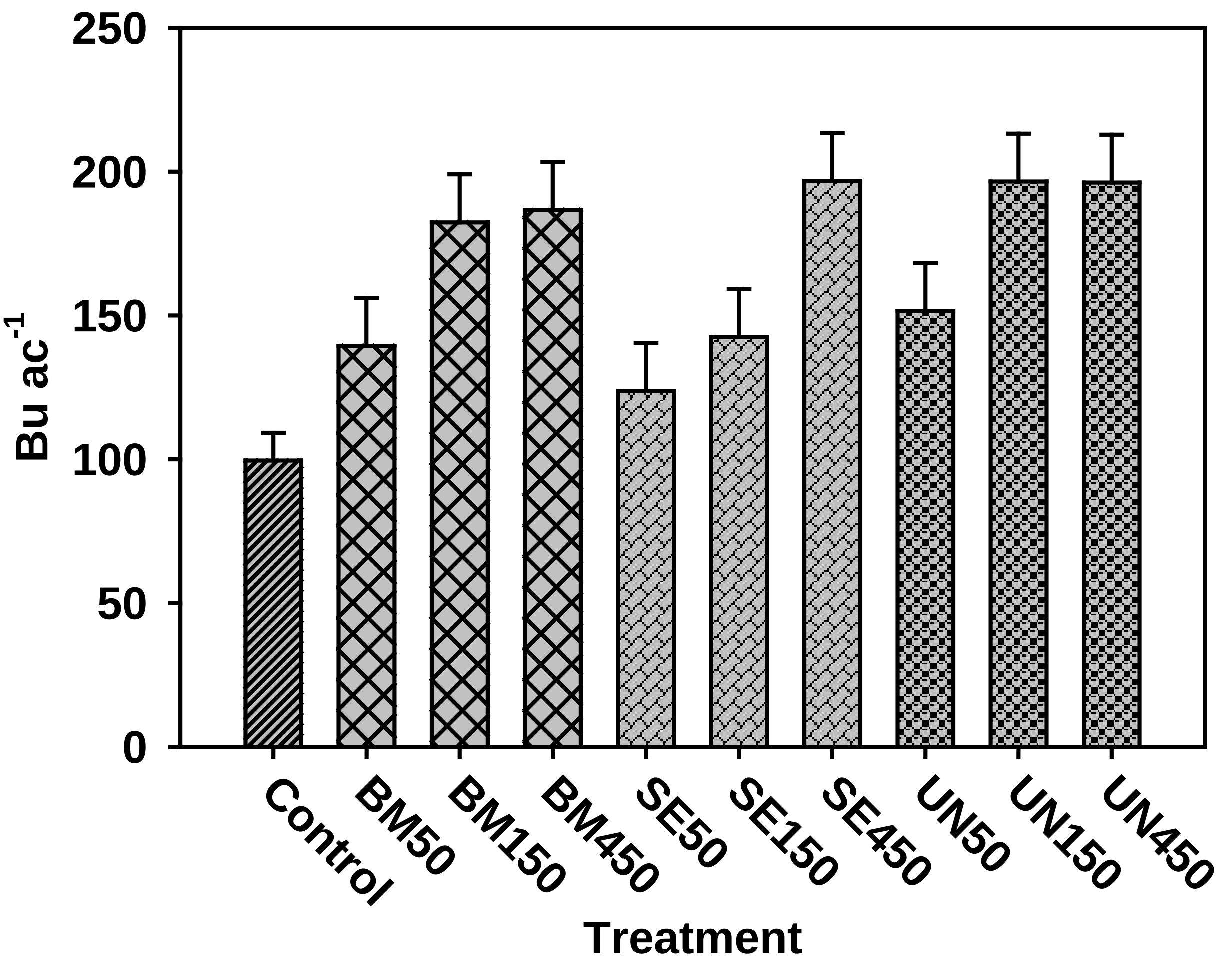


Figure 1 Corn grain yields in 2008 for a continuously cropped corn system under conventional tillage (E701) using applications of urea (UN), beef manure (BM), and swine effluent (SE) at N loading rates of 0, 50, 150, and 450 lb N ac^{-1}. Study is located at OPREC, Goodwell, OK. Control has 0 N applied.

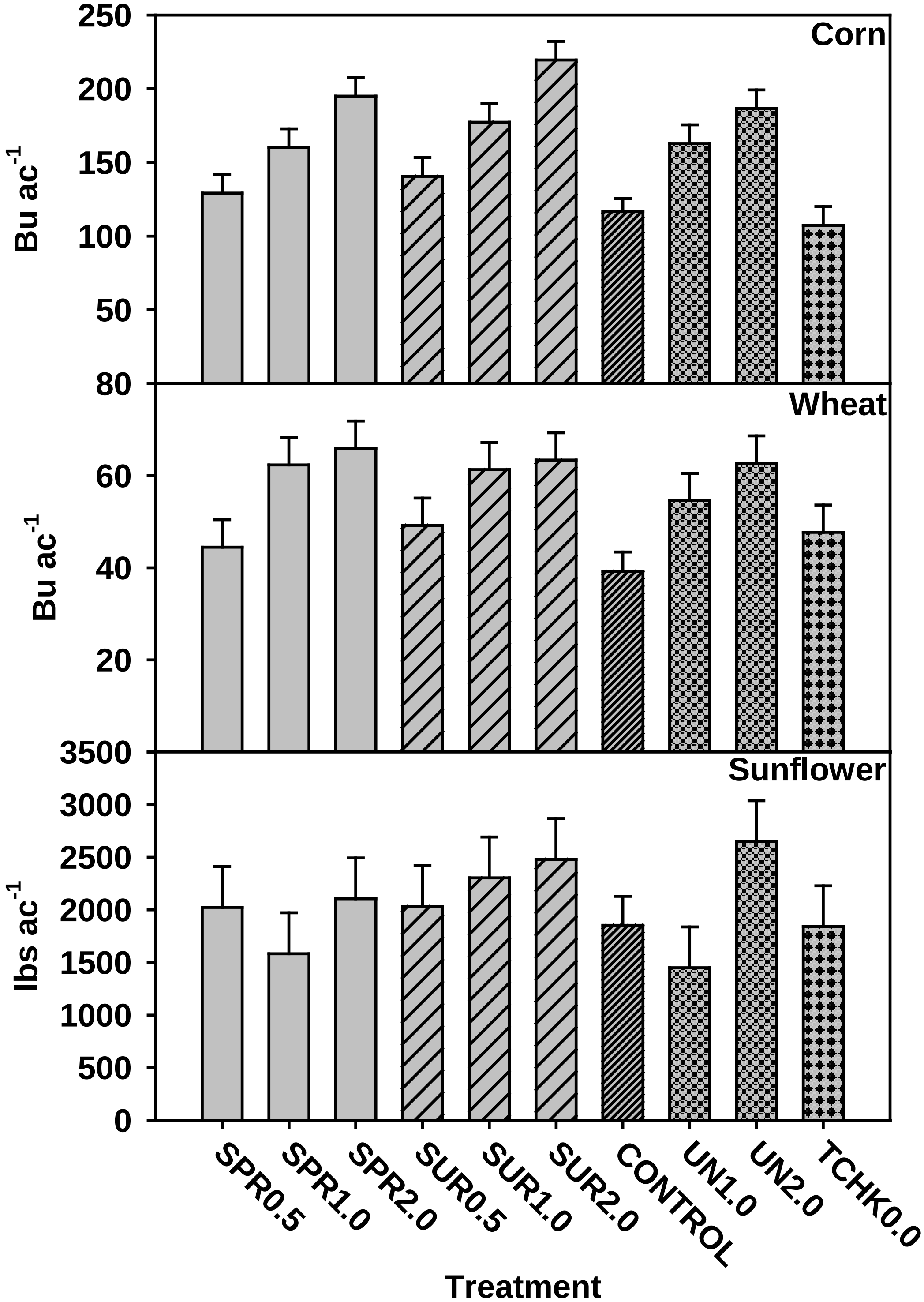


Figure 2 Grain yields in 2008 from a No-Till Corn-Wheat-Sunflower-Fallow rotation (E703) evaluating surface (SUR), sprinkler (SPR), and injection (INJ) applications of SE; these are compared to urea (UN), a control (0 N rate), and tillage control (TCHK, with 0 N applied). N rates are 0.5X, 1X, and 2X, where X=200 lb N ac^{-1}. Study is located at OPREC, Goodwell, OK.

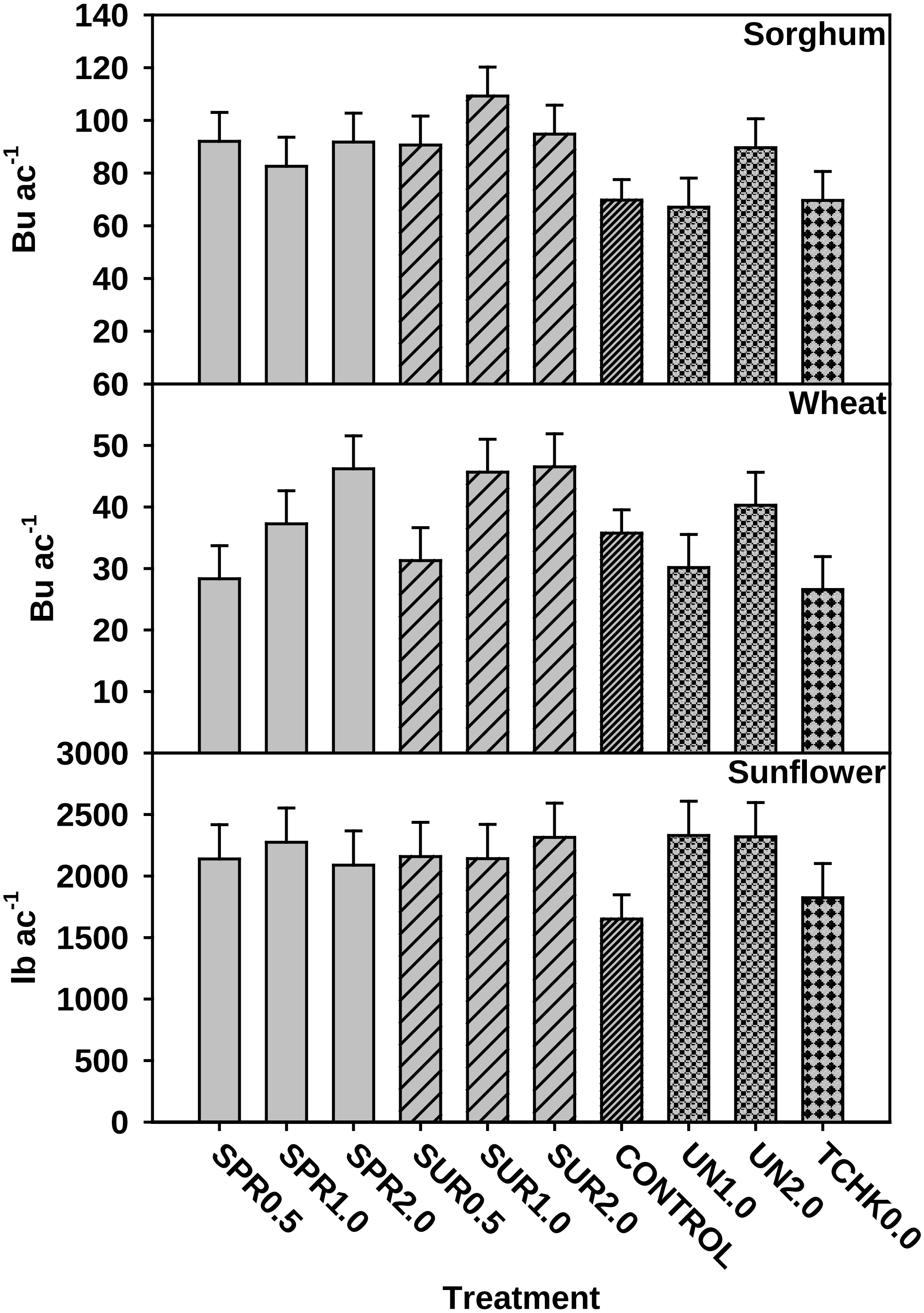


Figure 3 E704 Grain yields in 2008 from a No-Till Sorghum-Wheat-Sunflower-Fallow rotation (E704) evaluating surface (SUR), sprinkler (SPR), and injection (INJ) applications of SE; these are compared to urea (UN), a control (0 N rate), and tillage control (TCHK, with 0 N applied). N rates are 0.5X, 1X, and 2X, where X=200 lb N ac^{-1}. Study is located at OPREC, Goodwell, OK.

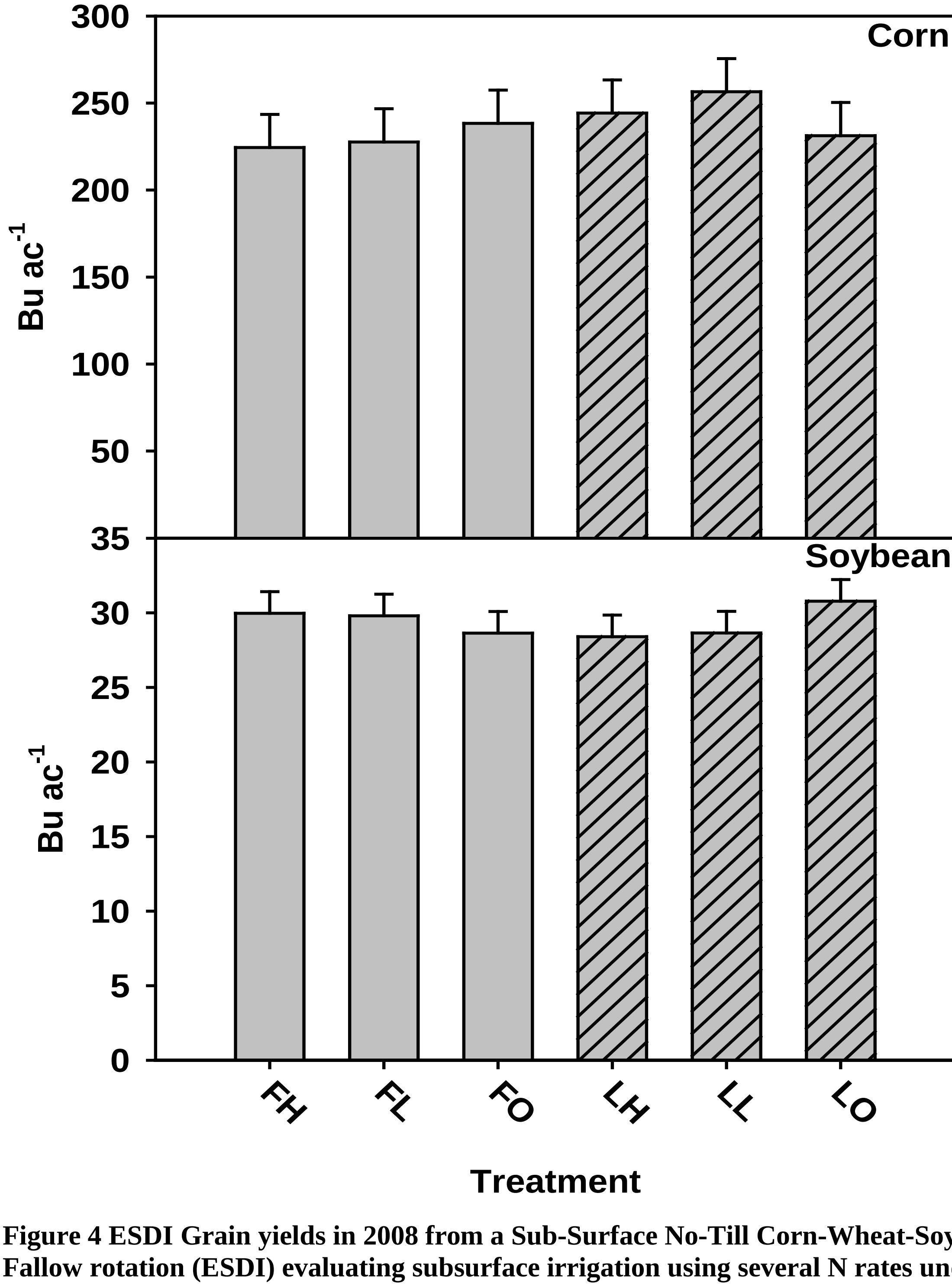


Figure 4 ESDI Grain yields in 2008 from a Sub-Surface No-Till Corn-Wheat-Soybean-Fallow rotation (ESDI) evaluating subsurface irrigation using several N rates under full and limited water applications. The standard error of differences (SED) were included where the control has been subtracted from the mean of each treatment, then statistically computed to determine the effect of each treatment. SED yields are ± the control. Study is located at OPREC, Goodwell, OK.

. **2009 Subsurface Drip Irrigation Update**

Michael Kizer, Extension Agricultural Engineer

Since 2006 no-till corn has been produced on 60 ft x 600 ft research plots equipped with subsurface drip irrigation (SDI). The SDI system is used not only to apply supplemental irrigation water, but also to apply swine effluent for crop nutrition. During this period the only fertilization applied to the plots has been swine effluent and N-phuric acid (urea sulfate and sulfuric acid blend) injected into the irrigation water for pH control.

The effluent was taken from a commercial swine farm lagoon and applied 5-6 times per season in 4500-gallon quantities (0.2 inch/application). The effluent was tested for nutrient content which varied from 2-3.5 lb of total N/1000 gallons. Normally, 75% of this nitrogen will be in the form of ammonia. Sprinkler application of this effluent in hot, dry conditions would typically result in loss of about 2/3 of the NH_4-N to volatilization. By applying the effluent through the SDI system 12-14 inches below ground, we estimate that 95+% of the NH_4-N is retained in the soil.

The N-phuric acid is injected primarily to adjust the pH of the fresh irrigation water (pH=7.5, EC=0.5 dS/m) to 6.5. This is achieved by injecting approximately 1 gallon of 15/49 N-phuric per 5400 gallons of irrigation water. This also provides 2 lb of total N fertility per 1 inch of irrigation water applied.

The SDI plots are installed with 4 different emitter arrangements: All plots have dripper lines spaced 60 inches on center, however one plot has 0.58 gph emitters spaced 24 inches apart on the dripper line, one has 0.33 gph emitters spaced at 24 inches, one has 0.24 gph emitter at 18 inches, and one has 0.16 gph emitters spaced at 18 inches. These configurations achieve water application rates of 0.085 in/hr, 0.053 in/hr, 0.045 in/hr and 0.034 in/hr, respectively. All plots are irrigated 3 hours per day, 5 days per week unless significant rainfall (greater than 0.3 in) occurs.

Table 1 below shows the results of the corn effluent irrigation study to date. The years 2006 and 2008 have nominally, the same irrigation rate of 0.255 in/day on the “high” irrigation rate and 0.135 in/day on the “low” irrigation rate plot. In 2007 the rotation placed the corn plots with 0.16 in/day on the “high” rate plot and 0.10 inch/day on the “low” rate plot. Effective rainfall was estimated based on the timing, intensity and amount of rainfall, estimated evaporation loss and available water storage capacity in the crop root zone.

Table 1. Summary of SDI corn production data at Goodwell, OK 2006-2008.

Year	Tot. Rain (in)	Eff. Rain (in)	Irrigation (in)	Effluent (in)	Total H_2O (in)	Est. Total N (lb)	Yield (Bu/A)
2006	10.9	6.0	11.2	1.0	18.2	110	145
2006	10.9	6.0	5.9	1.0	12.9	99	83
2007	7.6	5.0	10.4	1.2	16.6	111	148
2007	7.6	5.0	7.2	1.2	13.4	104	74
2008	12.4	6.5	12.0	1.0	19.5	87	187
2008	12.4	6.5	6.3	1.0	13.8	75	144

Figure 1 below shows the timing and amount of irrigation, effluent fertilization and rainfall events on the high rate irrigation corn plot for the 2008 crop season.

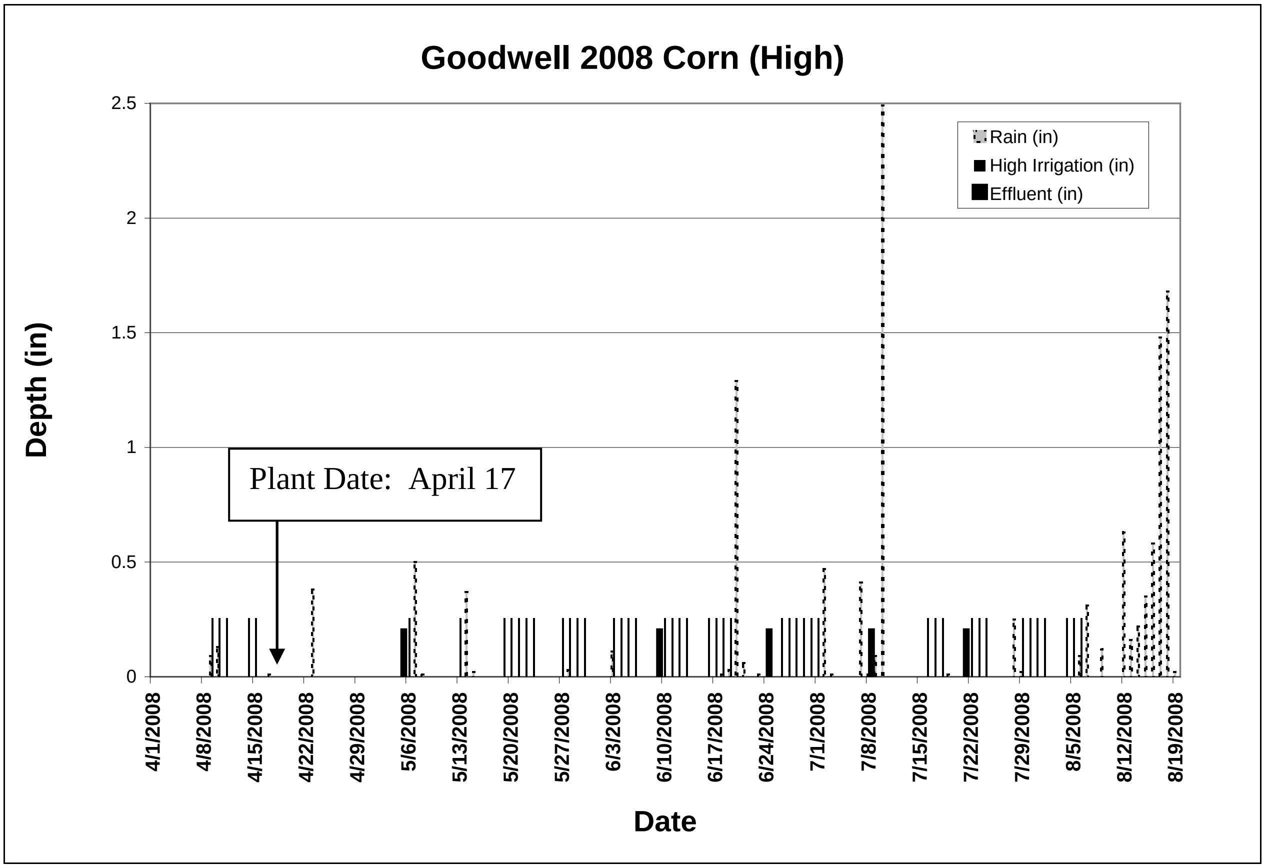


Figure 1. The timing and amounts of rainfall, irrigation and effluent application events in 2008.

Effective effluent fertilization adds another dimension to SDI which can make the capital cost of the system ($1100-1400/acre) less of a hindrance to producer adoption. Improvement of nitrogen fertility management and the added benefit of reducing nuisance odor complaints can make SDI look more attractive to producers in swine production areas. Improved water application efficiency (90-95% vs. 80-85% for center pivots with drops and low-drift nozzles) will reduce annual operating costs and reduce ground water withdrawals. The ability to irrigate with SDI during harvest of forage crops like alfalfa and Bermuda grass improves their productivity because of reduced water stress during cutting, curing and baling operations.

The management required in SDI is different than that needed for center pivot sprinkler irrigation. Water filtration, periodic treatment with acid and chlorine bleach and repair of rodent damage are issues unique to subsurface drip irrigation, but SDI has numerous benefits which pay dividends in a surprisingly short time frame.

Forage Bermudagrass for the High Plains

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No data for 2008

Interest in utilizing irrigation for production of improved grasses in the high plains has grown in the recent years. With higher fuel cost and declining capacity of irrigation wells, producers have begun to adopt high yielding and cold hardy bermudagrass for grazing in the region. With this increased interest, a bermudagrass variety trial was established in 2003. The trial includes varieties that demonstrated good performance in a previous trial established in 1997 and discontinued after data collection in 2003. The 2003 planted trial contains additional varieties not tested in the 1997 trial. Forage yield data were first collected in 2004 for all varieties except Midland and OSU Greenfield. Plots of those two varieties had to be re-established in 2004. In 2007, LCB 84X 16-66 was released as the variety “Goodwell” by the Oklahoma Agricultural Experiment Station. Forage yield data for all varieties in 2007 are given in (Table 1). Ozark, A-12245, and Goodwell are the best three forage performers in 2007. Forage yield data for varieties other than Midland and OSU Greenfield for 4-years (2004 through 2007) are given in (Table 2). Over the four years, Ozark and Goodwell bermudagrasses are significantly superior in forage production that the other tested varieties. Table 3 gives average yield data for all varieties for the years 2005 and 2006.

In May of 2004, a half circle of Goodwell bermudagrass was sprigged on the Joe Webb farm south of Guymon to evaluate its response to stocker grazing and stocker performance. The remaining half circle was sprigged to Goodwell in May 2005. Goodwell bermudagrass had demonstrated early greenup, good cold tolerance, and high yield performance in the 1997 trial at OPREC. The half a circle sprigged in 2004 was grazed in 2005 with a stocking rate of 5.1 head/ac for 109 days. The average daily gain for these cattle was 1.49 lb/day. Stocker gain on the half circle totaled 50,100 pounds. In the fall of 2005 the bermudagrass was inter-seeded with wheat. With the late first frost in 2005, not enough wheat forage was grown in the fall to allow winter grazing of the wheat. Although the interseeded wheat did provide grazing from later winter to spring. In 2006, stocker cattle grazed the complete circle with a stocking rate of 4.8

head/ac for 90 days. The average daily gain of 0.5 lb/day in 2006 was less than 2005. The reduced rate of gain was most likely due to poorer quality cattle that only gained 1.2 lbs/day on wheat pasture. The bermudagrass was again interseeded with wheat in the fall 2006. As in the fall of 2005 the first freeze was later than normal and not enough fall forage was available for grazing. Although the late winter and spring grazing was adequate (no data on stocking rate or average daily gain). In 2007, the full circle of bermudagrass was grazed for 101 days with a stocking rate of 4.9 head/ac. The average daily gain of 1.64 lbs/day is the highest obtained in the first three years. The higher rate of gain may be attributed to the 1.4 lbs/day/head of 20 % cake. Total pounds of beef remove from the circle in the summer of 2007 was 96,413 which does not include the 42,010 pounds of beef that was removed from grazing of the interseeded wheat. The results point to high biomass production and consequent high stocker carrying capacity. The differential results in individual animal gains in 2005 and 2006 indicate the need for further evaluation relative to nutritional value of the bermudagrass. Evaluation of Mr. Webb's planting will continue in 2008.

Table 1. Forage yields of bermudagrass varieties in Test 2003-1, Oklahoma Panhandle Research & Extension Center, Goodwell, OK. 2007.

Variety	**Harvest Date**				**Seasonal Total**
	6/5/07	**7/11/07**	**8/7/07**	**8/7/07**	
	----------------- Dry tons/acre ----------------------				
Ozark	4.44	6.42	4.34	5.73	20.93
A-12245	3.59	5.46	4.71	5.42	19.19
Goodwell†	4.90	4.98	3.88	5.13	18.88
Midland 99	2.65	5.69	4.71	5.37	18.43
Tifton 44	4.61	4.82	4.17	4.26	17.86
Midland	3.79	4.40	3.24	4.86	16.29
Vaughn's # 1	2.70	4.41	3.38	4.59	15.08
OSU Greenfield	3.62	4.92	2.81	3.30	14.66
World Feeder	3.99	3.97	2.52	3.61	14.09
Seay Greenfield	2.93	3.52	2.38	3.05	11.88
Shrimplin	3.55	3.55	2.07	2.69	11.87
Mean	3.71	4.74	3.47	4.37	16.29
CV (%)	33.80	21.92	37.43	27.80	21.23
5% LSD	1.70	0.93	0.85	0.96	2.17

† Goodwell was released as a cultivar in 2007. Its experimental designation was LCB84x16-66 used in previous years.

Table 2. Forage yields of bermudagrass varieties in Test 2003-1, Oklahoma Panhandle Research & Extension Center, Goodwell, OK. 2004-2007.

Variety	Year				Mean
	2004 3-harvests	2005 4-harvests	2006 3-harvests	2007 4-harvests	
	------------------ Dry tons/acre ----------------				
Ozark	10.48	12.66	13.22	20.93	14.32
Goodwell	11.56	12.28	13.75	18.88	14.12
Midland 99	10.32	10.12	12.63	18.43	12.88
A-12245	9.85	10.82	11.54	19.19	12.85
Tifton 44	10.15	10.25	11.69	17.86	12.49
Vaughn's #1	8.99	9.22	8.89	15.08	10.55
World Feeder	8.70	7.87	8.82	14.09	9.87
Seay Greenfield	8.90	7.14	7.51	11.88	8.86
Shrimplin	5.71	6.27	7.65	11.87	7.88
Mean	9.41	9.63	10.63	16.29	11.53
CV (%)	15.05	16.77	18.20	21.23	8.71
5% LSD	2.07	2.36	2.82	2.17	0.98

Table 3. Forage yields of bermudagrass varieties in Test 2003-1, Oklahoma Panhandle Research & Extension Center, Goodwell, OK. 2005-2006.

Variety	Year		Mean
	2005 4-harvests	2006 3-harvests	
	----------- Dry tons/acre ------------		
Goodwell	12.28	13.75	13.02
Ozark	12.66	13.22	12.94
Midland 99	10.12	12.63	11.38
A-12245	10.82	11.54	11.18
Tifton 44	10.25	11.69	10.97
Midland	8.73	12.31	10.52
Vaughn's #1	9.22	8.89	9.06
OSU Greenfield	8.26	9.06	8.66
World Feeder	7.87	8.82	8.34
Seay Greenfield	7.14	7.51	7.32
Shrimplin	6.27	7.65	6.96
Mean	9.42	10.64	10.03
CV (%)	16.02	17.33	16.88
5% LSD	2.18	2.66	1.69

Note: Tables 1 and 3 have Midland and OSU Greenfield included. Table 2 does not have Midland and OSU Greenfield included. Midland (Entry 1) and OSU Greenfield (Entry 9) had poor stands initially and were replanted in 2004.

Corn Planting Date

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

Previous research indicates that planting corn before the optimum date reduces yields less than planting after the optimum date (Fig. 1). Therefore, in 2000, a long-term study was initiated to determine the effect of planting date and starter fertilizer on corn ensilage, grain yield, and test weight. Six planting dates were selected April (1, 10, 20, 30) and May (10 and 20). On each selected date, corn was planted with and without a starter fertilizer (5 gal/ac 10-34-0) in the row. No yield increases were observed with starter fertilizer in 2000 - 2002. Therefore, starting in 2003 the starter fertilizer treatment was replaced with a 107-day maturity corn hybrid NC^+ 3721B. The use of a shorter season hybrid will determine if corn maturity will influence planting date. Pre-plant fertilizer applications were based on soil test N levels of 250 lb/ac (soil test + applied). P and K are applied to 100% sufficiency based on a soil test. The Dekalb hybrid DK 647BtY was planted in 2000, and in 2001 the hybrid was switched to Pioneer 33B51. Plots were planted in four 30-inch rows by 30 feet long with a target plant population of 32,000 plants per acre. Ten feet of one outside row was harvested for ensilage and the two middle rows harvested for grain.

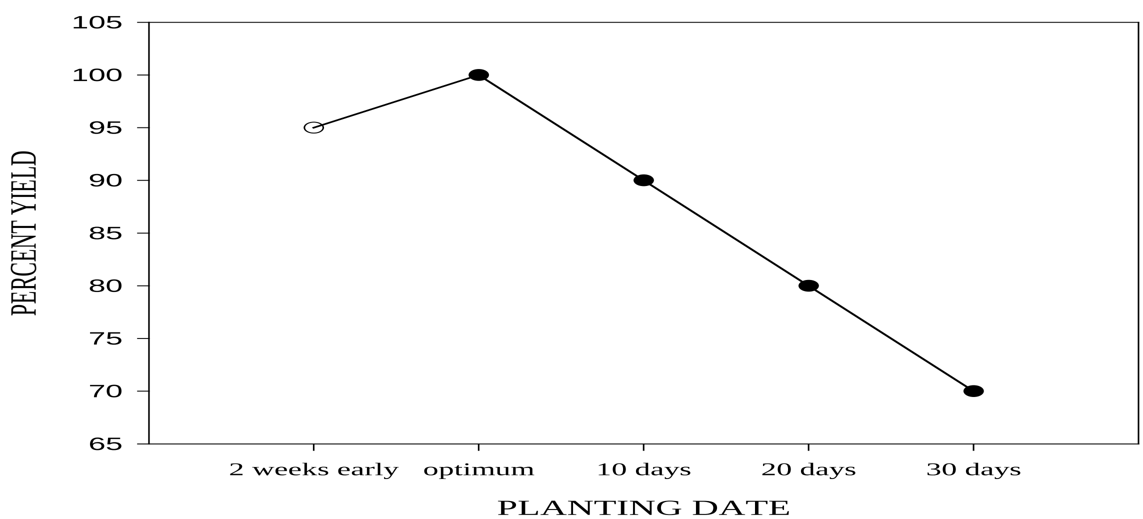

Figure 1. Ten years of grain yields at Lansing, Michigan. Source modern corn production

Aldrich, S.A., W.O. Scott, and R.G. Hoeft. Modern Corn Production. 1986, A & L Publications.

Results

Data was not collected in 2002 due to irrigation well problems or in 2006 due to windstorm.

In 2005 with the cool wet spring some dates were unable to be planted therefore, data was not collected. In 2006, two hail storms in early June severely affected the yield of the second planting date for both hybrids. The yield for the second planting date in 2006 was 42 bu/ac less than the long-term mean for the 114-day hybrid (fig. 2). This is the only time in the duration of the study that April 10 date did not have the highest grain yield for both hybrids (likely due to damage from hailstorm). Therefore data from 2006 will not be used in the long-term averages.

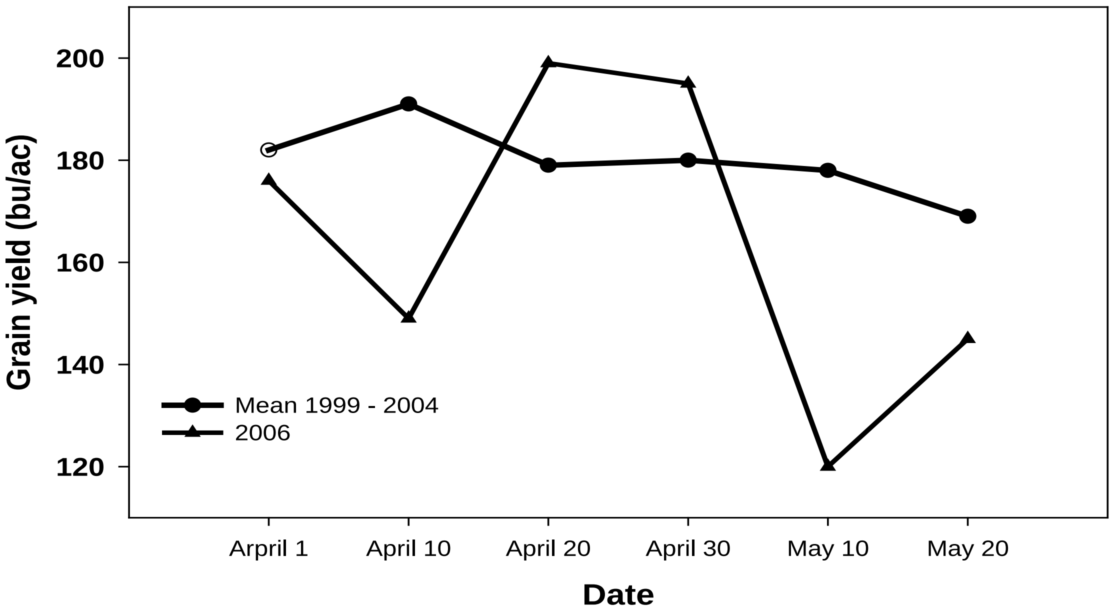

Figure 2. Mean corn grain yields bu/ac from 1999 through 2004 compared to 2006, which demonstrates the yield loss due to hail storms in early June 2006.

Climate and hybrid maturity appear to impact which date is optimum for planting corn. The full season (114 day) and short season (107 day) hybrids reacted differently in 2003 and 2004 (Table 1). No difference in grain yield was observed for any planting date in 2003 or 2004 for the full season hybrid (Table 1). Although differences were observed for the shorter season hybrid, with yield significantly reduced when planted after May 1. For the full season hybrid, when the yield environment was lower as in (2000 and 2001), the April 10 planting date had the highest yield, and yield was reduced 15 and 21% when planted May 10 or 20, respectively. With the higher yield environment of 2003 and 2004, the highest yield obtained was on April 10, which was approximately 17% higher when compared to 2000 and 2001 (Table 1). Four-year averages for the full season hybrid also show the highest yield for the April 10 planting date. With the difference in yield environments in the preceding years it is difficult to determine which date is ideal for planting corn. Therefore more years of data are required to determine what effect environment and maturity has on corn planting date.

Table 1. Mean grain yields (bu/ac) for selected years, maturities, and corn planting dates at OPREC.

Planting date	2000 – 01 114 day	2003 – 04 114 day	4-year 114 day	2003 –04 107 day
April 10	175.9 a†	205.2 a†	190.6 a†	176.0 ab†
April 1	167.6 ab	196.9 a	182.2 ab	173.1 ab
April 30	161.7 ab	198.4 a	180.1 ab	183.1 a
April 20	155.2 bc	202.6 a	178.9 bc	178.4 a
May 10	152.6 bc	202.8 a	177.7 bc	160.7 bc
May 20	145.5 cc	192.1 a	168.8 cc	150.2 c

†Yields with same letter not significantly different

Test Weight

Test weight decreased when planted after April 10 but remained above the 56 lb/bu level (data not shown) until the April 20 planting. Lower test weights can be attributed to higher grain moisture at harvest for the later planting dates.

Corn Ensilage

As with grain yield, environment has an impact on which date is optimum for planting corn utilized for ensilage (Table 1). In years when environment for grain yield is low (as in 2000 and 2001), an earlier planting date had significant impact on ensilage yield (Table 1). The April 1 planting date had ensilage yields 17% higher in 2000 – 2001, when compared too 2003 – 2004. In years with a high grain yield environment, planting date had no effect on ensilage yields. When looking at four-year means ensilage yields were significantly lower when planted May 20, and consequently corn should be planted earlier. Although hybrid maturity affected grain yield, no differences in ensilage yield were observed in 2003 and 2004 for either the short or full season hybrid.

Table 2. Mean ensilage yields (tons/ac) for selected years and maturities for corn planting date at OPREC.

Planting date	2000 – 01 114 day	2003 – 04 114 day	4-year 114 day	2003 –04 107 day
April 1	26.7 a†	22.8 a†	25.0 a†	22.0 a†
April 10	25.8 a	22.8 a	24.4 a	23.9 a
April 30	24.4 bc	23.1 a	24.4 a	21.6 a
April 20	25.0 a	24.5 a	24.2 a	22.8 a
May 10	22.3 c	25.2 a	23.5 a	22.9 a
May 20	19.6 d	20.5 a	19.9 b	24.0 a

†Yields with same letter not significantly different

IMPACT OF PLANTING DATE AND VARIETY SELECTION ON COTTON YIELDS IN THE HIGH PLAINS

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
J.C. Banks, Southwest Research and Extension Center, Altus
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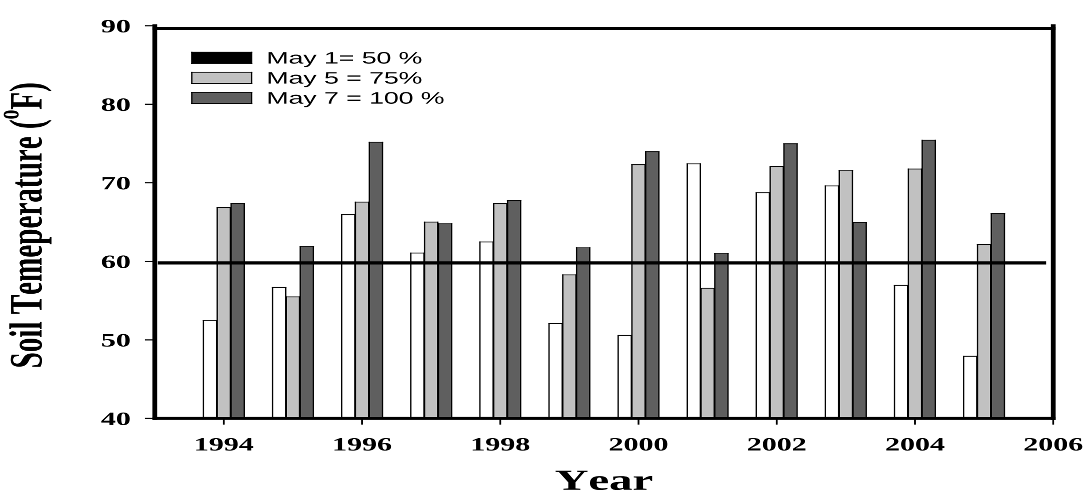
No data collected in 2008

In recent years cotton acres have increased in the high plains region. However, there was no data available for variety selection or the effect planting date would have on yields and quality of cotton. Therefore, in 2003, six cotton varieties (DP 555 B/R, PM 2280 B/R, PM 2266 RR, ST 2454 RR, PM 2145 RR, and PM 2167 RR) were planted on two dates, May 10 and May 30. These dates were selected because of the number of long-term cotton heat unit's available (1970 units) for the period from May 10 to October 20 is lower than in the traditional cotton producing areas. Therefore with limited heat units, maximizing those units is key to successfully growing cotton in this region. In 2005 the dates were changed to (May 1, 15, and 30), to determine if planting before May 10 would increase cotton yields and quality. In 2006 the dates as again changed, (May 1, 10, 20, and 30) were selected one variety PM 2140 B2RF was planted. 2140 B2RF was selected because of the ability to spray roundup for the full season. In the last 12 years the average soil temperature on May 1 is above 60º F half the time, whereas on May 7 the average soil temperature is above 60º F every year (Fig. 1).

Fig. 1 Mean soil temperatures for selected dates for years 1999-2005, at OPREC.



Many producers are growing cotton due to the lower water requirement for cotton compared to irrigated corn; therefore, maximum irrigation applied for this study was limited to 9 inches, although 6 inches has been the highest irrigation total to date. Plots were planted in 2-rows by 25 feet long, with a tractor powered two-row cone planter. In 2003 plots were hand harvested and since 2004 plots were mechanically stripped.

Results

In the summer of 2006 it was difficult to obtain reliable data from crops planted in April and May due to two hail storms in early June, therefore no data is reported. In 2007 there was no difference in yield or quality due to planting date (Table 1). This may be due to the larger than average number of heat units for the year. Also the heat units were above average from the end of July to October 20th (see cotton heat unit graph elsewhere in the report). The large number of heat units in the last half of the year would benefit later planted cotton. The yields were also the highest for any year of the experiment with an average of 2.86 bales/ac

Table 1. Cotton lint yield lb/ac and loan rate for selected dates at OPREC in 2007.

Date	Lint yield (lbs/ac)	Loan rate $/lb
May 1	1390	0.497
May 10	1450	0.500
May 20	1370	0.498
May 30	1330	0.514

It appears cotton can be successfully grown in the high plains, even with years like 2004 when the total heat units were 188 less than the long-term mean (heat unit graph is in climate section of highlights). With these decreased heat units in 2004, planting date severely affected cotton lint yield (Table 2). In 2005, the May 1 planting date (actually planted May 7) had higher yields than did May 15 and 30 (Table 3) although variety didn't have the same affect as in years past. The picker cotton DP 555 B/R will not work in this region because of short growing season, it was the only variety that was significantly different in yield in 2005 at all dates. It appears that cotton needs to be planted as soon as soil temperature will allow, to obtain the highest yields.

Table 2. Cotton lint yields (lbs/ac) for year, variety, and planting date at OPREC.

Variety	Planting Date	2003	2004	Two-year
PM 2145 R	5/10	1,087 a[†]	1,153 a[†]	1,120 a[†]
PM 2266 RR	5/10	1,029 a	1,049 a	1,039 a
PM 2167 RR	5/10	1,033 a	1,024 a	1,029 a
PM 2280 B/R	5/10	746 bc	1,025 a	885 ab
DP 555 B/R	5/10	664 bc	1,102 a	883 ab
ST 2454 R	5/10	859 b	813 ab	836 abc
PM 2167 RR	5/30	998 a	403 b	701 bc
PM 2266 RR	5/30	885 b	434 b	659 bc
ST 2454 R	5/30	795 b	468 b	632 bc
PM 2145 R	5/30	923 a	281 b	602 bc
DP 555 B/R	5/30	613 bc	502 b	558 c
PM 2280 B/R	5/30	747 bc	310 b	529 c

[†]Yields with same letter not significantly different

Table 3. Cotton lint yields (lbs/ac) for 2005 by planting date and highest yielding variety at OPREC.

Planting date	Yield	PM 2145 R
May 7	845	1,064
May 15	682	786
May 30	509	646
L.S.D.	73	NA

Table 4. Lint yields and loan rates for cotton variety trial planted at OPREC, in 2007

Variety	Lint yield lbs/ac	Loan rate $/lb
FM 9058 F	1,431	0.524
PM 2140 B2F	1,292	0.515
PM 2141 B2F	1,219	0.518
NG 3550 F	1,212	0.517
PM 3225 B2F	1,200	0.493
AFD 5064 F	1,178	0.504
NB 3273 B2F	1,166	0.512
AFD 5065 B2F	1,156	0.538
PM 2150 B2F	1,104	0.520
NG 1572 F	1,077	0.520
Mean	1,203	0.516
CV%	14.3	4.9
L.S.D.	NS	NS

NO-TILL VS MINIMUM-TILL DRY-LAND CROP ROTATIONS

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

A study was initiated in 1999 to evaluate four different dry-land cropping rotations and two tillage systems for their long-term productivity in the panhandle region. Rotations evaluated include Wheat-Sorghum-Fallow (WSF), Wheat-Corn-Fallow (WCF), Wheat-Soybean-Fallow (WBF), and Continuous Sorghum (CS). Soybean and corn were not successful in the first five years of the study; therefore in 2004 cotton replaced soybean and sunflower replaced corn in the rotation, also continuous sorghum was replaced with a grain sorghum-sunflower (SF) rotation. Tillage systems include no-till and minimum tillage. Two maturity classifications were used with all summer crops in the rotations until 2001, at which time all summer crops were planted with single maturity hybrids or varieties. Most dry-land producers in the panhandle region utilize the WSF rotation. Other rotations would allow producers flexibility in planting, weed management, insect management, and marketing.

Results

Climate

Precipitation since 1999 has been erratic for the panhandle region with yearly totals ranging from a low of 12.0 inches in 2007 to a high of 20.31 in 2004. Even in 2008 the yearly total of 18.27 inches was above the long-term mean of 17.89 inches, although most of the rainfall 14.81 inches was received after July 1. The mean rainfall for the last nine summer growing seasons (June, July, and August) of 6.28 is 1.5 inches below the long term mean (Table 1). Four of the nine years have been 3 inches or more below the long term mean therefore summer crops yields have been affected. In 2008 there was not enough soil moisture for conventional till cotton to emerge after planting, while the no-till emerged but with reduced stands and therefore reduced yields. Between drought and hail storms three wheat crops have failed in the duration of the study. In 2002 rainfall was not received in time to activate the preemergent herbicide and no sorghum was harvested the only time that has happened.

Table 1. Summer growing season precipitation at OPREC

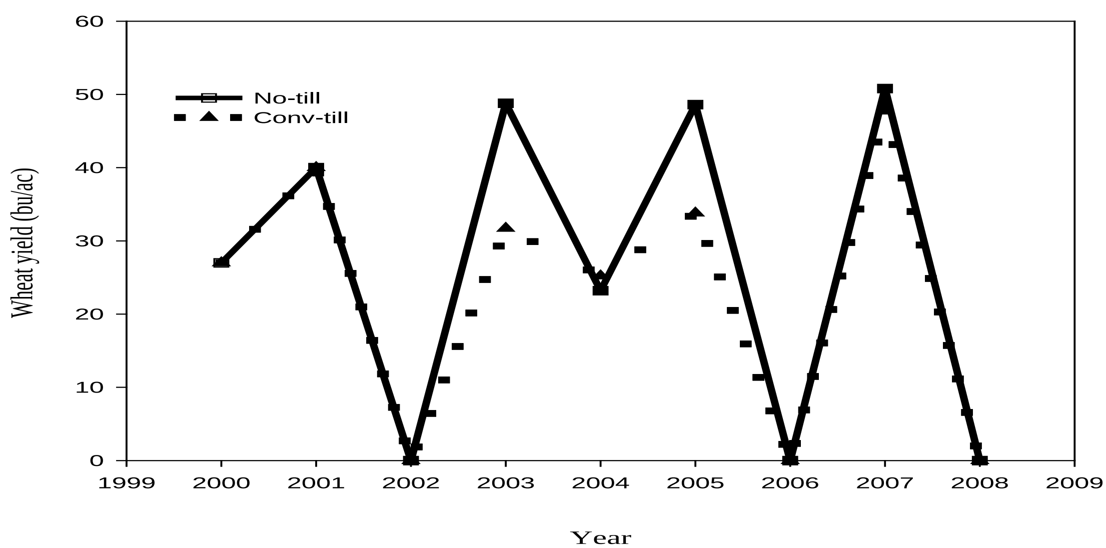
Month	2000	2001	2002	2003	2004	2005	2006	2007	2008	Long-term mean
June	2.29	0.61	1.32	5.26	3.82	2.01	2.34	1.62	1.51	2.86
July	0.76	0.00	2.52	1.87	2.43	1.40	2.05	2.00	3.77	2.58
August	1.09	0.66	0.27	1.19	2.87	3.21	4.06	0.26	5.64	2.28
Total	4.14	1.27	4.11	8.32	9.12	6.62	8.45	3.88	10.64	7.72

Wheat

No wheat was harvested in 2002 and 2008 due to drought, and 2006 due to a hail storm.

This report will focus on wheat yields following grain sorghum, because in some years other crops never emerged or were lost to other factors. Wheat yields following other crops used in this experiment were essentially the same as wheat-fallow-wheat because preceding crops didn't emerge or were lost due to other factors. Data from the wheat-cotton-fallow (WCOTF) rotation is reported for 2007, which was the first time wheat was harvested following cotton (Table 2).

Fig. 1. Wheat grain yields (bu/ac) from WSF in dryland tillage and crop rotation study at OPREC.



Neither tillage system produced, or will produce grain when drought occurs and no crops are harvested as in 2002 and 2008 (Figure 1). In two years 2003 and 2005 no-till wheat grain yields were significantly higher than conventional till by an average of 15.9 bu/ac. No difference in test weights was observed between tillage systems. In 2007 wheat grain yields following cotton were less than when following grain sorghum regardless of tillage system, although differences were not statistically significant.

Table 2. Wheat grain yields (bu/ac) from W-Cot-F in dryland tillage and crop rotation study at OPREC.

Rotation	No-till	Conventional till
W-GS-F	50.8	47.9
W-Cot-F	30.1	41.6

Grain Sorghum

As with wheat when no precipitation is received one tillage system makes no difference as in 2002 when no sorghum was harvested. From 1999 – 2003 grain sorghum was the only summer crop successfully harvested each year. Since 2004, grain sorghum yields have been significantly higher for no-till than conventional tillage (Table 3). This increase in sorghum grain yields was in year 6 or the third time through the rotation. This yield difference was also observed and reported by researchers at Kansas State University at the Tribune location. In 2004, 2006, and 2007 no-till grain yields were double of those for minimum tillage. Part of the higher grain yield in 2006 can be attributed to higher test weights for no-till (Table 4). The delayed maturity of minimum till grain sorghum adversely affected the test weights. In 2008 with delayed planting, maturity selection was too long for the year with the cooler conditions that existed. The mean high temperatures in 2008 for July and August were 3 and 9 F^{o} cooler than in 2007 at 90 and 87 F^{o} respectively. These cooler temperatures didn't allow for maturity of the grain sorghum and reduced yields. In hybrid performance trial near this study the highest yields 75bu/ac were obtained with shorter season hybrids than was planted in this study. In all other years no difference in test weight was observed between tillage treatments, although yields for no-till were higher than minimum till. Planting was delayed in 2004 due to a lack of soil moisture; therefore, an early maturity sorghum was utilized instead of the normal medium maturity.

Figure 2. Grain yields of grain sorghum (bu/ac) for dry-land tillage and crop rotation study at OPREC.

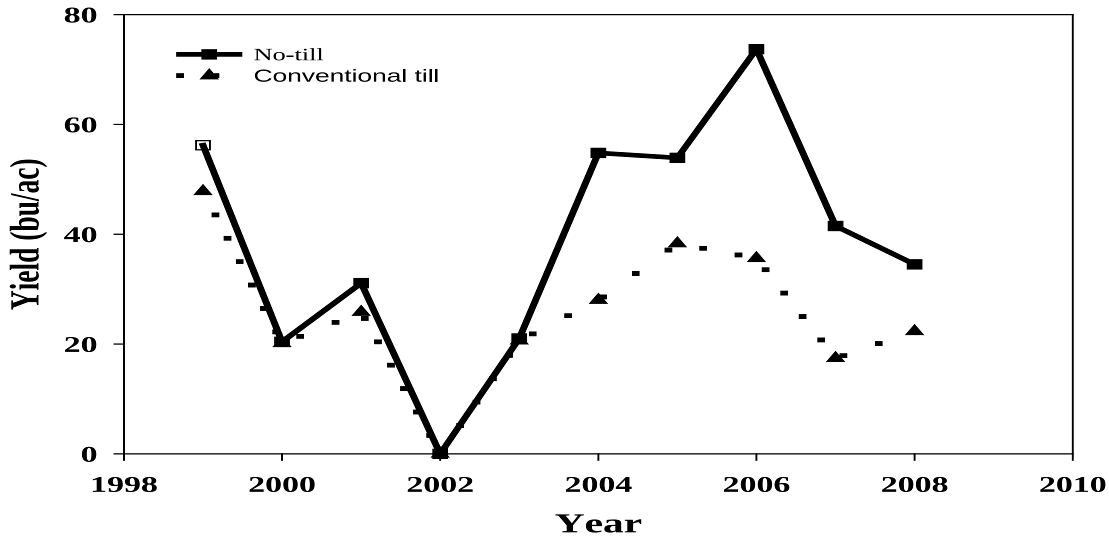


Table 3. Yields of grain sorghum (bu/ac) for dry-land tillage and crop rotation study at OPREC.

Tillage	2004	2005	2006	2007	2008	Five-year
No-till	54.8	53.9	73.7	41.5	34.5	51.7
Minimum till	28.0	38.3	35.6	17.4	22.3	30.0
Mean	42.3	46.2	53.5	29.5	28.4	40.8
CV %	6.4	13.6	19.0	8.0	55.3	26.4
L.S.D.	6.1	NS	24.2	8.3	NS	8.4

Table 4. Test weight of grain sorghum (lb/bu) for dry-land tillage and crop rotation study at OPREC.

Tillage	2004	2005	2006	2007	2008	Five-year
No-till	56.5	57.8	56.8	57.9	50.9	56.0
Minimum till	55.8	56.9	49.6	57.9	49.5	53.9
Mean	56.3	57.2	53.1	57.9	50.2	55.0
CV %	0.8	1.6	4.2	0.4	2.3	4.1
L.S.D.	NS	NS	5.0	NS	NS	1.8

Cotton

Cotton was planted for the first time in 2004. In 2008 just like 2004 seeds were planted into marginal soil moisture conditions, and the resulting stands were less than ideal. In 2008 the minimum till cotton never emerged although it did in 2004 with reduced stands and yields. Yields in both years may have been higher with adequate stand, but were not adjusted for reduced population or fruit set. There have no differences in yields between tillage treatments until 2008 (Table 5). Although yields were substantially higher in 2005 and 2007 than 2004, no difference was observed in yield or quality between tillage treatments. In 2006 the hail storms in June affected yields and are not reported. Although adequate yields have been observed quality could be a concern for dryland cotton production. The 2007 loan rate for no-till and conventional till was $0.408/lb and $0.429/lb respectively. Quality for limited irrigation trials located at OPREC in 2007 was significantly higher at $0.516/b and $0.547/lb.

Table 5. Lint yields of cotton (lbs/ac) for dry-land tillage and crop rotation study at OPREC.

Tillage	2004	2005	2007	2008	Three-year
Minimum till	196.3	594.2	429.1	150	326.0
Strip-till	193.9	505.8	405.1	0	305.0
Mean	185.2	561.7	417.1	NA	316.5
CV %	17.4	13.7	15.5	NA	NA
L.S.D.	NS	NS	NS	NA	NA

Sunflower

In 2008 sunflowers were harvested for the first time and no difference was observed between tillage systems with grain yields of 1183 and 1104 lb/ac for no-till and minimum tillage respectively. Due to planter and herbicide problems, no sunflower was harvested in 2004. In 2005, 2006, and 2007 there were good to excellent stands, but due to jackrabbits removing all or most of the plots they were lost. Due to lack of soil moisture replanting could not be accomplished.

EFFECT OF PLANTING DATE ON YIELD AND TEST WEIGHT OF DRY-LAND WHEAT IN THE OKLAHOMA PANHANDLE

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Jeff Edwards, Dept. of Plant and Soil Sciences, Oklahoma State University, Stillwater

Dryland wheat producers in the panhandle region often plant wheat when soil moisture is adequate regardless of calendar date. In the fall of 2004 a study was initiated at OPREC to determine the effect of planting date and variety on dryland wheat grain yield and test weight. Hard red winter wheat (HRW) and hard white winter wheat (HWW) were sown the first and fifteenth of September, October, and November 2004. Seeding rates were consistent with standard practice of most producers in the high plains and were 45 lb/ac for September dates, 60 lbs/ac for October 1, and 90 lb/ac for the last three dates. A HRW and a HWW variety were chosen because they consistently have high yields and test weights in the panhandle wheat variety trials. Plot size was 5 feet wide by 35 feet long planted with a Great Plain no-till plot drill.

Results

No data collected in 2006 due to a hail storm. In 2008 due to drought no results.

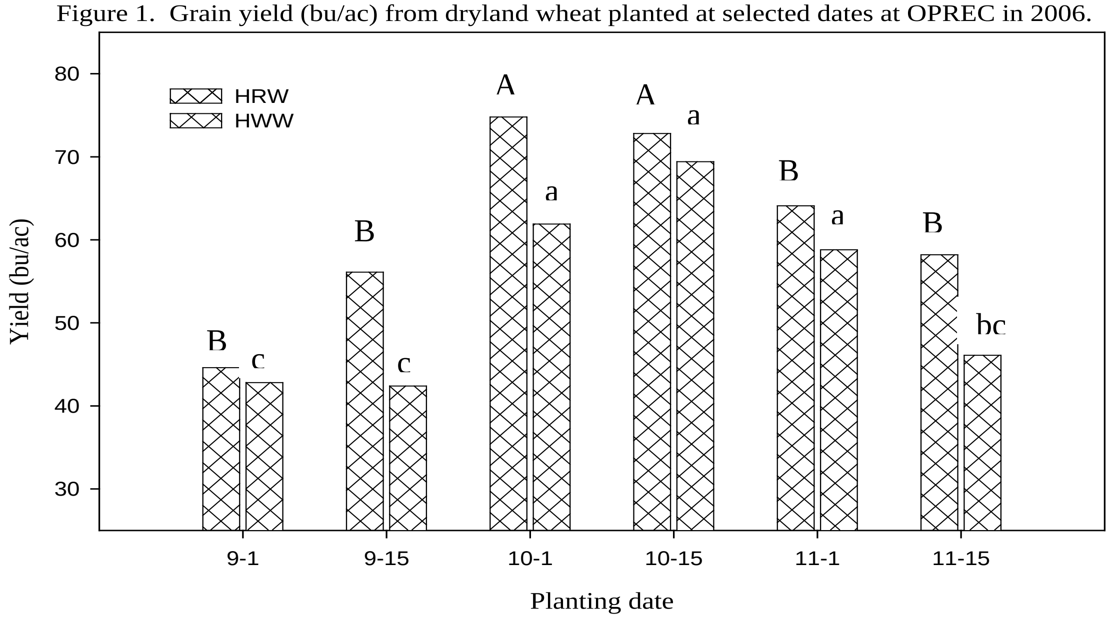
Grain yields for this and other studies in 2007 were some of the highest obtained at OPREC in the last 10 years. As in 2005 the September dates yielded less than October planting dates. This was true in two very different grain production years. The 2005 harvest year was marked by heavy stripe rust pressure and reduced yields. As mention earlier the 2007 harvest year say abnormally high dryland yields. In both of these environments, though, October-sown wheat out yielded September-sown wheat. While not as large as planting date differences reported by Texas A&M for the region, but this can be explained by the amount of rainfall received during planting season and early winter (Table 1). In 2007 the HRW was overall the higher yielding variety across all dates by 8.2 bu/ac. The highest yields were observed for both varieties in October with the HRW on October 1 and the HWW on the October 15 planting date (Figure 1). The two-year data suggest (Figure 2) that

Table 1. Long-term (51 years) mean and 2004 and 2006 rainfall (inches/month) for September through December at OPREC.

Year	Sept	Oct	Nov	Dec	Total
Mean	1.77	1.03	0.77	0.31	3.88
2004	2.56	0.64	3.51	0.16	6.87
2006	1.19	2.02	0.00	3.70	6.91

October 1 is the optimum planting date. While no grain yield data was collected in 2006 due to a hailstorm, visual estimation indicated a 15 to 20 bu/ac yield difference was realistic for the October 1 planting date when compared to later plantings. The reason for the October 1 planting date yielding that much greater is that was dusted in and emerged after rainfall on October 9th. Those few days more of moisture allowed the plants to develop a crown root system that later plantings did not develop until spring when rainfall was received.

Figure 1. Grain yield (bu/ac) from dryland wheat planted at selected dates at OPREC in 2006.



Yields with same letter are not significantly different not between variety just date

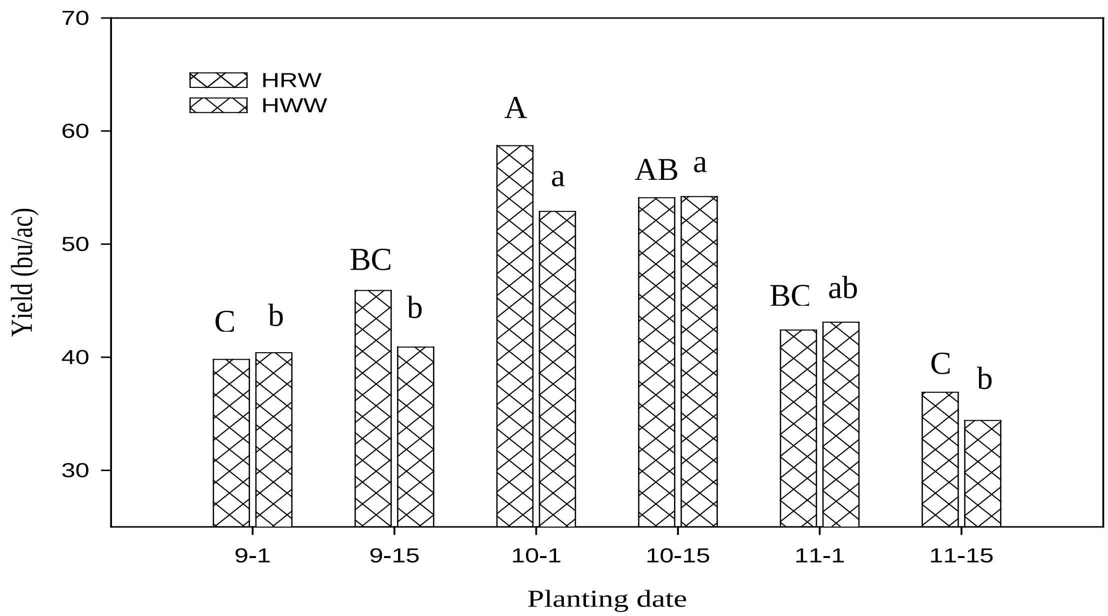
Planting date has an effect on test weight with a 3.0 lb/bu difference observed between the September 1 planting date and the November 1 date in 2007. Planting in September negatively affects test weights of both varieties. Looking at the two-year data it is apparent that later planting tends to produce higher test weights (Table 2.) Also variety selection plays an important role in test weight and as has been observed and reported in other sections of this report. More years of data are needed before final conclusions can be reached, but it appears that October 1 is the optimum planting date for dry-land wheat in this region. A good suggestion may be to start dusting in wheat on September 20th if precipitation is not received. As observed in the fall of 2005 when the October 1 planting date developed a crown root system that fall the later plantings did not.

Table 2. Test weight for HWW and HRW hard red winter wheat planted at different dates at OPREC in 2004 and 2006.

Planting date	HRW	Planting date	HRW
September 1	57.3 b	September 1	56.2 b
September 15	57.5 b	September 15	57.1 ab
October 1	59.2 a	October 15	57.1 ab
October 15	59.4 a	November 15	57.3 a
November 1	60.4 a	November 1	58.3 a
November 15	59.5 a	October 1	58.1 a

Yields with same letter are not significantly different

Figure 2. Grain yield (bu/ac) for dryland wheat planted at six different dates at OPREC in 2004 and 2006.



EFFECT OF SEEDING RATE ON YIELD OF DRY-LAND WHEAT IN THE OKLAHOMA PANHANDLE

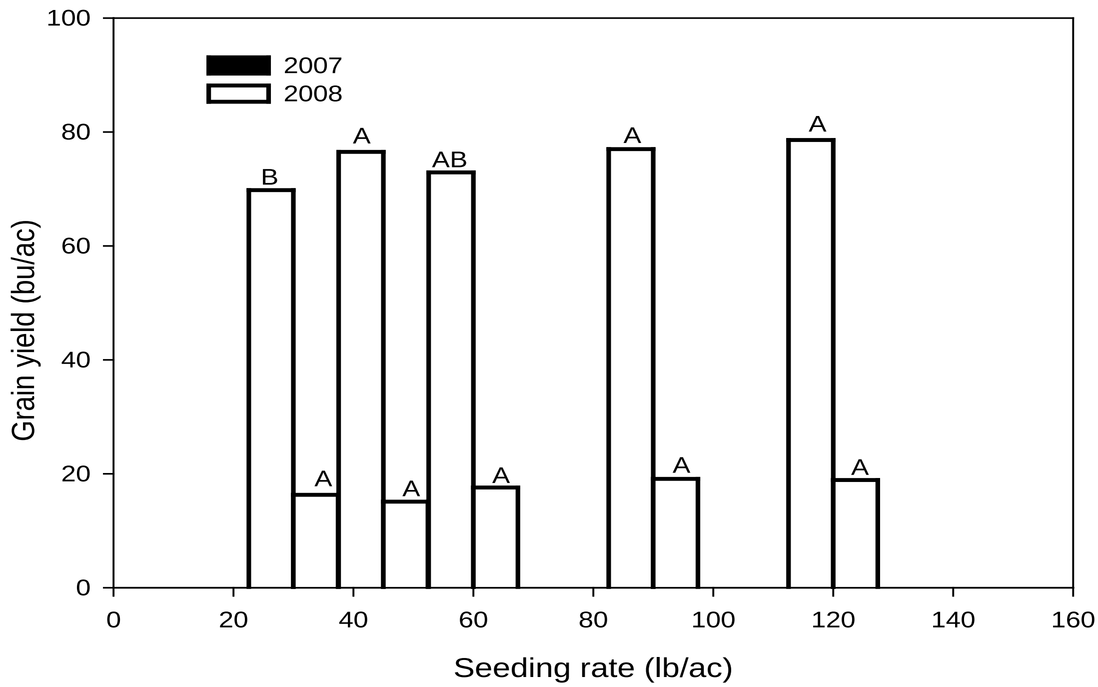
Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell
Jeff Edwards, Dept. of Plant and Soil Sciences, Oklahoma State University, Stillwater

When adequate fall moisture is present, dry-land wheat producers in the southern high plains region utilize wheat for both cattle grazing and grain production (dual-purpose). In the fall of 2001 a dry-land seeding rate study was established near Keyes, to determine the effect of seeding rate on dual-purpose wheat grain yield. The most widely grown dry-land wheat variety in the area (TAM 110) was planted at rates of 30, 45, 60, 90, of 120 pounds per acre. The 30 and 45 pounds per acre rates represent standard practices for the region. The 60, 90, and 120 pounds per acre rates were used to determine if higher forage production associated with increased seeding rates in irrigated systems, would also be exhibited in a dry-land system. Due to differences in fall precipitation collecting reliable, accurate dryland fall forage data has been difficult in this and other studies in the panhandle region; therefore, due to differences in fall precipitation and in adequate forage growth data are not reported. Since forage data collection was not feasible the focus of the study was changed in 2004 to determine if increased seeding rates were required for higher grain yields when October planting dates were used. With the change in emphasis varieties were changed and a hard white winter wheat (HWW) and a hard red winter wheat (HRW) were planted. Plot size was 5 feet wide by 35 feet long and all plots planted with a Great Plain no-till plot drill.

Results

The last two years were as good as possible to obtain data from seeding rate studies for dry-land wheat grain yield. Growing condition for the 2007 crop season were almost ideal with grain yields the highest in the last 11 years of research in the panhandle. Then growing conditions for the 2008 crop year were as severe as possible with only 2.03 inches of moisture received between planting and harvest at the study site in Cimarron county. In both years when planting in early October there is a trend for increased yield with increased seeding rate (Figure 1). In 2007 the 30 lb/ac seeding rate significantly reduced yields when compared to higher seeding rates. Although in 2008 no differences were observed again there was a trend for higher yields with higher seeding rates. No observed difference in yields with increased seeding rates in lower yielding environments is consistent with previous years (data not reported). Therefore it appears that producers that are utilizing the 30 lb/ac seeding rate will cost themselves yield in years with higher yielding environments as in 2007. No difference has been observed between the hard white wheat and hard red winter wheat varieties.

Figure 1. Grain yields across varieties for selected seeding rates in Cimarron county Oklahoma planted in the fall of 2006 and 2007.



Yields with same letter are not significantly different

Increasing seeding rate had no effect on test weight of dry-land wheat. In both 2007 and 2008 the only difference observed was between varieties. The white wheat is generally near the top in test weight in variety trials in the panhandle year in and year out. In the seeding rate study it was 2.3 lb/bu and 1.7 lb/bu higher than red wheat in 2007 and 2008 respectively. In no year of data collection has seeding rate affected test weight.

TIMING OF DRY-LAND STRIP-TILLAGE FOR GRAIN SORHUM PRODUCTION IN THE HIGH PLAINS

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

With the growing interest in strip-till throughout the high plains, a study was initiated in the fall of 2003 to determine if timing of strip-till would affect yield of dry-land grain sorghum. After three years it appeared that strip-till reduced grain yields when compared to no-till. But one question was not answered in the previous study was would strip-tilling just before planting reduced yields. Therefore in the summer of 2007 a new study with four dates of strip-tilling was initiated. The dates were immediately after wheat harvest, fall, spring, and on the same day as planting. The immediately after harvest date was selected for two reasons, generally a good time when producer have time do tillage and the chance to receive rainfall and replenish the tilled strips with moisture. The fall date was selected due data from the previous study, in 2005 yield for fall strip-till was same as no-till (Table 1). This can be explained by the strip-tillage having been done before a significant rainfall event in November of 2004. With the amount of rainfall received 3.51 inches the tillage strips were replenished with moisture before planting, therefore no reduction in grain yields was observed. The spring date was selected because again it is time when producers can do tillage work. One of the concerns many producers have with no-till is that nitrogen (N) is tied-up in the crop residue when surface applied or volatilized. Nitrogen tie-up and volatilization is greatly reduced with strip-till due to the N being placed below (generally 3 – 8 inches) seeding depth. Many irrigated producers in the region are doing strip-till from late fall to early spring. This original study was designed to determine what the affect of strip-till (no fertilizer applied) at different dates would have on grain sorghum yield. In the new study all fertilizer in the strip-till treatments is applies with the strip-till unit, and only the no-till fertilizer is applied on the surface. Grain sorghum was selected as the crop to be grown, because it is the most widely grown summer row crop in the region. Plots were four rows wide by 50 foot long and strip-tilled with an Orthman four-row one-tripper at a depth of 7 inches.

Table 1. Grain sorghum yield (bu/ac) for selected years from a timing of dry-land strip-till experiment at OPREC.

Timing	2004	2005	2006	Two-year
No-till	62.5 a[†]	81.7 a	80.1 a	74.8 a
March (spring)	47.6 b	77.6 a	54.1 b	59.1 b
September (fall)	45.5 b	66.9 a	56.6 b	57.9 b
January	42.1 b			
November	37.9 b			

[†]Yields with same letter not significantly different

Results

Due to climate condition 2008 was not a great year to start a new study looking at strip-till. The planting date was delayed due to dry conditions until 1.29 inches of rainfall was received on June 20th. With the delay in planting grain sorghum yields were affected. Due to variation no statistical difference between any of the treatments was observed although the spring yield was lower numerically (Table 2). It appears that possibly doing strip-till immediately after harvest or at planting will have yields as high as no-till. More years of data need to be collected to determine if strip-till will be a good option for dry-land sorghum production.

Table 2. Grain sorghum yield (bu/ac) for 2008 timing of dry-land strip-till experiment at OPREC.

Strip-till Timing	2008
At planting	50.7
After harvest	48.1
Fall	45.4
No-till	44.2
Spring	31.8

UTILIZING STRIP-TILL FOR DOUBLE CROP SUNFLOWERS

Rick Kochenower, Oklahoma Panhandle Research and Extension Center, Goodwell

Many producers are utilizing sunflowers as a double crop option in irrigated crop rotations. When planting sunflowers not-till following wheat getting good plant emergence and stand can sometimes be difficult. Therefore in 2008 a study was initiated to determine if utilizing strip-till in a double crop situation exhibits an advantage. Strip-till was compared to no-till, for plant stand, lodging, and yield. Both treatments were pre-irrigated, then when soil moisture allowed strip-tilled and planted on same day. Plots were 50 ft long by four rows wide

Results

No difference was observed in plant stand, lodging or grain yield in 2008. With a mean population of 22,500 plants/ac, with no lodging observed, and an average grain yield of 1,950 lb/ac.

Effect of Inclusion of Wet Distiller's Grains in Corn Based Diets on Feeding Logistics in a Commercial Feedyard

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Introduction

Due to the low dry matter content (~35%) and high density (~58 lb/cu ft) of wet distiller's grains plus solubles (WDGS), feeding WDGS could substantially affect the feeding logistics in a feedyard (number of truck loads required to feed a given number of cattle). The two factors affecting the amount of feed that a feed truck can haul are the weight and density of the feed. Since WDGS contains only about 35% DM, the as fed intake of cattle will increase necessitating more feed being delivered to a pen of cattle. In contrast, since WDGS is denser than steam flaked corn (58 vs. 22.5 lb/cu ft), feeding WDGS may allow one to haul more feed in a given volume. However, I am aware of only one research trial attempting to address this issue. Dr. Mike Brown with West Texas A&M University recently touched on this issue at the High Plains Biofuels Co-Product Nutrition Conference held in Garden City, KS on February 20, 2008 (Brown and Cole, 2008). Brown suggested that feeding an equal volume of feed per truck load would increase the number of loads required to feed cattle by about 10% when a steam flaked corn (SFC) based diet containing 15% sorghum WDGS is fed. Feeding an equal weight of feed per truck load would increase the number of loads required to feed cattle by about 23% (Figure 1).

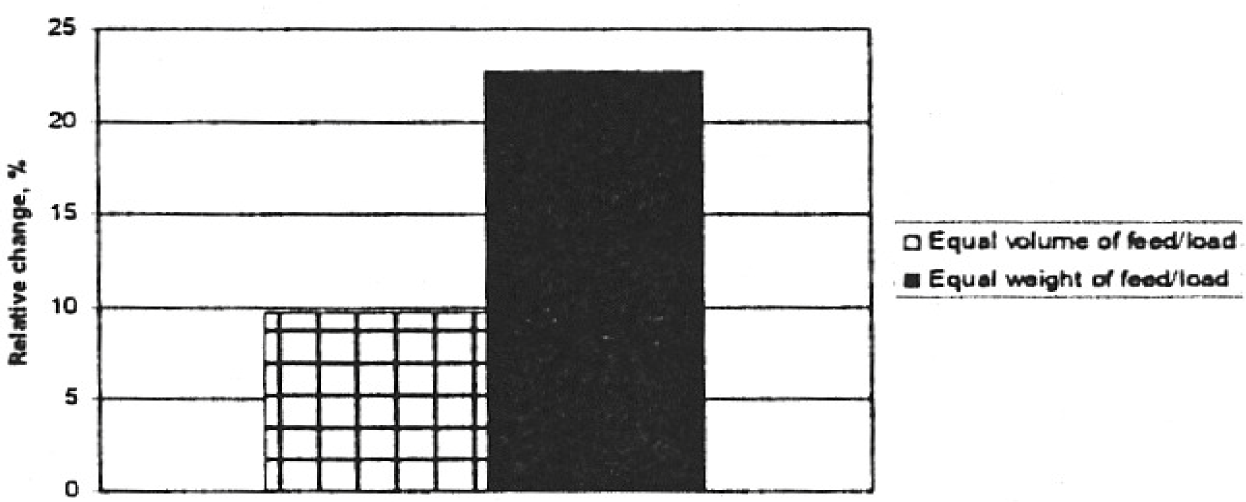

Figure 1. Increase in number of loads (900 cu ft each) required for wet sorghum distiller's grains plus solubles. Assume DMI, ration density, and ration DM of 20 lb, 14.2 lb/cu ft, and 83.37%, respectively, for 0% WDGS and 21 lb, 16.6 lb/cu ft, and 67.63% for 15% WDGS. **Source: Brown and Cole, 2008**

Procedures

In an attempt to better evaluate the effect of feeding WDGS on feeding logistics in a commercial feedyard, I looked at the density of corn based rations containing increasing levels of

WDGS (0, 10, 20 and 30% of DM). All diets contained 8.0% ground alfalfa. 7.5% of a pelleted supplement, and WDGS inclusions replaced corn. These diets are based on experimental rations that were fed in recent research (Hicks et al., 2007) conducted at the Oklahoma Panhandle Research and Extension Center (OPREC). Three types of processed corn were evaluated in my calculations, SFC, dry rolled corn (DRC), and high moisture corn (HMC). I have calculated ration densities assuming that density is proportional to the density and inclusion rate of each ingredient in the diet. The composition of the rations and DM and densities of the ingredients that were used in my calculations are shown in Tables 1 and 2, respectively. The density of 22.5 lb/cu ft used for SFC is equivalent to 28 lb/bu. The density of 56 lb/cu ft for HMC was obtained from data collected by Dr. Bob Lake with Hitch Enterprises (personal communication). The density of WDGS of 58 lb/cu ft was based on measurements on product that was fed in our OPREC research trial (Hicks et al., 2007). This density value closely agrees with recently published data suggesting a density of 57.7 lb/cu ft (Rosentrater and Lehman, 2008).

In my calculations, I assumed that 10,000 head of cattle with an average daily DM intake (DMI) of 21 lb were fed using a feed truck with a capacity of 620 cu ft. This capacity truck is typical of that used in commercial feedyards (Rod Schemm, Henry C Hitch Feedyard, personal communication). I have assumed that this truck has a capacity of 18,600 lb or 30 lb/cu ft. The assumed capacity of 30 lb/cu ft is based on data obtained from Kuhn-Knight's web site on their reel TMR mixers (Kuhn-USA).

Table 1. Composition of diets (DM basis).

Ingredient	Control	10% WDGS	20 % WDGS	30% WDGS
Corn	84.50	74.50	74.00	64.50
Ground Alfalfa	8.00	8.00	8.00	8.00
WDGS	---	---	10.00	20.00
Pelleted supplement	7.50	7.50	7.50	7.50

Table 2. Assumed DM contents and densities used in calculations.

Ingredient	DM Content, %	Density, lb/cu ft
Steam Flaked Corn	82	22.5
Dry Rolled Corn	88	35.0
High Moisture Corn	72	56.0
Ground Alfalfa	88	12.0
WDGS	35	58.0
Pelleted supplement	92	40.0

Results and Discussions

The effects of replacing SFC with increasing levels of WDSG are presented in Table 3. These data suggest that feeding up to 20% WDGS actually decreases the number of loads required to feed 10,000 head of cattle. This occurs because the density of the control diet is only about 23 lb/cu ft. Thus, feeding WDGS increases the density of the diet making more efficient utilization of the truck capacity of 30 lb/cu ft. Feeding 10% WDGS would reduce the number of loads required to feed the cattle by 13.3%.

The effects of replacing DRC with increasing levels of WDGS are presented in Table 4. These data suggest that feeding increasing levels of WDGS increases the number of loads required to feed 10,000 head of cattle. This occurs because the density of the control diet (33.5

lb/cu ft) is already greater than the truck capacity. Feeding 10, 20, or 30% WDGS increased the number of loads required to feed the cattle by 15.2, 30.4, and 45.6%, respectively.

Table 3. Effect of feeding WDGS in SFC based diets.

Ingredient	Control	10% WDGS	20 % WDGS	30% WDGS
Ration DM, %	83.13	73.17	65.34	59.02
DM Intake, lb	21.0	21.0	21.0	21.0
As Fed Intake, lb	25.26	28.70	32.14	35.58
Density, lb/cu ft	22.89	30.27	36.06	40.74
Number of Loads	17.80	15.43	17.28	19.13
Difference, # Loads	----	-2.37	-0.52	1.33
Difference, %	----	-13.3	-2.9	7.5

Table 4. Effect of feeding WDGS in DRC based diets.

Ingredient	Control	10% WDGS	20 % WDGS	30% WDGS
Ration DM, %	88.29	76.64	67.71	60.65
DM Intake, lb	21.0	21.0	21.0	21.0
As Fed Intake, lb	23.79	27.40	31.01	34.63
Density, lb/cu ft	33.51	38.75	42.76	45.94
Number of Loads	12.79	14.73	16.67	18.62
Difference, # Loads	----	1.94	3.89	5.83
Difference, %	----	15.2	30.4	45.6

The effects of replacing HMC/SFC (70:30 ratio, DM basis) with increasing levels of WDGS are presented in Table 5. This ratio of HMC to SFC is equivalent to that fed by the Hitch Feedyards (Bob Lake, Hitch Enterprises, personal communication). These data suggest that feeding increasing levels of WDGS increases the number of loads required to feed 10,000 head of cattle. Feeding 10, 20, or 30% WDGS increased the number of loads required to feed the cattle by 11.7, 23.3, and 35.0%, respectively.

Table 5. Effect of feeding WDGS in HMC/SFC (70:30 ratio) based diets.

Ingredient	Control	10% WDGS	20 % WDGS	30% WDGS
Ration DM, %	76.74	68.73	62.23	56.86
DM Intake, lb	21.0	21.0	21.0	21.0
As Fed Intake, lb	27.37	30.56	33.75	36.94
Density, lb/cu ft	43.98	46.47	48.49	50.16
Number of Loads	14.71	16.43	18.14	19.86
Difference, # Loads	----	1.72	3.43	5.15
Difference, %	----	11.7	23.3	35.0

The effect of WDGS on feeding logistics is complicated by the inconsistent moisture content of WDGS which results in inconsistent densities in WDGS. Recent University of Nebraska research (Buckner et al., 2008) looked at the variation in DM content of WDGS samples collected from six ethanol plants in Nebraska in two periods (late summer 2006 and winter 2007). In this study, samples representing a semi-truck load of WDGS that a cattle producer would receive were collected. Samples were taken from four to five locations in the

WDGS pile to be loaded on the truck or directly from the loader that filled the truck. These samples were then combined, mixed thoroughly, and 0.5 to 1.0 lb samples were saved for DM analysis. Ten samples were taken per day for five consecutive days, with 50 samples total during the week over the two sampling periods (100 samples total per plant). These researchers reported that the coefficients of variation for DM within plants ranged from 0.9 to 7.1%, indicating more variation in some plants than others. In addition, the variation was not necessarily the same across the two sampling periods for a plant. Loads varied within a day, within a plant, as well as across days. This variation in DM content in turn affects the density of WDGS which alters the feeding logistics of the product.

In addition to the effect that replacing corn with WDGS has on the transportation and labor costs of delivering feed to cattle, the effect of WDGS on cattle performance must also be evaluated when determining if feeding WDGS is economical. Nebraska research has shown that the response to WDGS is greater with less intensely processed corn. Data from Vander Pol et al. (2006) evaluated feeding yearling steers (773 lb initial weight) 0, 10, 20, 30, 40, or 50% (DM basis) of corn WDGS in DRC/HMC (1:1 ratio) based diets. WDGS improved performance at all inclusion levels with the optimum response occurring with 30 to 40% WDGS which improved feed efficiency 11 to 13%. Additional Nebraska research (Corrigan et al., 2007) fed feedlot steers (692 lb initial weight) corn WDGS at 0, 15, 27.5, or 40% of the diet (DM basis) in DRC, HMC and SFC based diets. Optimal feedlot performance was observed with 40%, 27.5%, and 15% WDGS in DRC, HMC, and SFC based diets, respectively. Data from Vander Pol, et al. (2006) suggested the energy value of corn WDGS relative to HMC/DRC (1:1 ratio) was 121 to 178% when fed at levels of 0, 10, 20, 30, 40, or 50% (DM basis). In this research, the energy value of WDGS decreased as dietary inclusion rate increased from 10 to 50%. A meta-analysis of nine Nebraska feedlot trials replacing DRC or HMC with WDGS indicated WDGS fed between 15 to 40% of diet DM was 130% the feeding value of corn (Bremer et al., 2008). These data suggest that the increased transportation and labor cost associated with delivering WDGS in DRC or HMC based diets will be offset by improved performance.

In contrast, research evaluating the inclusion of WDGS in SFC based diets has shown that feeding WDGS may actually decrease feedlot performance (May et al., 2007; Vasconcelos et al., 2007). OPREC research suggest that the NEg content of WDGS (approximately 70% corn and 30% sorghum) is approximately 86% that of SFC (Hicks et al., 2007). This value is similar to that observed by Texas researchers. Texas AgriLife Research data from Bushland (MacDonald, 2008) suggest the NEg content of WDGS is 99.8% of SFC when 20% WDGS is fed in SFC based diets. Data from West Texas A&M University (Brown and Cole, 2008) suggest the NEg content of WDGS is 81% of SFC when 15% sorghum WDGS is fed in SFC based diets. Thus, even though feeding up to 20% WDGS decreases the cost of feed delivery; the reduction in performance might offset this benefit.

As previously cited, Nebraska research suggest that feeding corn WDGS in HMC or HMC/DRC (1:1 ratio) based diets improves feedlot performance (Vander Pol, et al., 2006; Corrigan et al., 2007; Bremer et al., 2008). However, the processing form of the HMC (rolled vs. ground) effects performance. This Nebraska research does not mention the processing form of the HMC. A review by Owens et al. (1997) suggests that performance is about 7% greater with ground HMC as compared to rolled HMC. This same review suggests that the energy content of SFC is about 9% greater than that of HMC. Most feedlots use roller mills to process high moisture corn because it is easier to manage rolled than hammer milled high moisture corn (ground) at the feed bunk (Hicks and Lake). In contrast, the Hitch feedyards which have more than 40 years experience in handling and feeding HMC feed ground HMC (Hicks and Lake). Dr. Bob Lake with Hitch Enterprises feels that the performance that they observe with HMC is comparable to that observed with SFC (personal communication). In the past, some rolled HMC was fed at Hitch Feeders II in Garden City, KS and it was observed that feed conversions "really suffered" compared with ground HMC (Hicks and Lake).

In summary, the effect of WDGS on feeding logistics must be considered when evaluating the feeding of WDGS. Due to the low dry matter content (~35%) and high density (~58 lb/cu ft) of WDGS, feeding WDGS could substantially affect the feeding logistics in a feedyard (number of truck loads required to feed a given number of cattle). These data suggest that the logistics of feeding WDGS is affected by the processing form of the corn grain (SFC, DRC, or HMC; Figure 2). Feeding WDGS in DRC or HMC based diets may substantially increase the number of truck loads required to feed cattle. The high variability in the moisture content of WDGS further complicates the logistics of feeding WDGS. The effect of WDGS on feed delivery cost (fuel, labor, etc.) must be considered along with the effect of WDGS on performance when making financial decisions. Roto-Mix has seen an increase in mixer maintenance at their two retail locations when WDGS is fed with both their own mixers and competitor s mixers (Mark Cooksey, Roto-Mix LLC, personal communication). An example of this increased maintenance would be a decreased mean time between bearing failures.

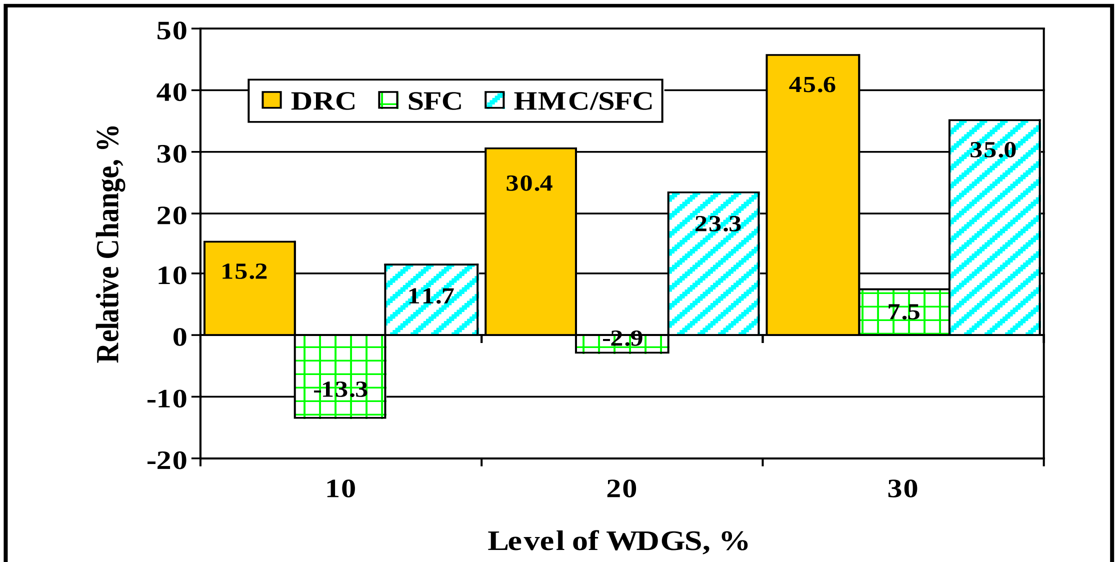

Figure 2. Relative increase in number of loads by corn processing method.

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