
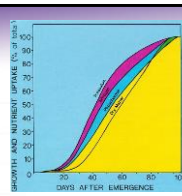

Western Kansas Corn Production Update

Lucas Haag Ph.D., Asst. Professor/Northwest Area Agronomist
K-State Northwest Research-Extension Center, Colby

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Knowledge for Life

Some topics….

- Spacing and Uniformity of Emergence
- Yield Components
- Environmental Affects on Corn Yields
- Yield Components, Plant Dynamics, and VRS
- Water Management

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Knowledge for Life

Purdue Study

- Bob Nielsen published results from an on-farm survey of corn plant uniformity in 1995
- This survey included 22 sites.
- They reported a 0.6 to 1 inch increase in SD per mph increase in planter speed. They also reported a 2.3 bu/acre yield loss when speed increased from 4 to 7 mph.
- They did not account for difference in plant population between the two speed treatments and only saw yield decreases in 5 of the 22 environments.

Nafziger and Lauer

- Nafziger (1996) reported that 10% skips reduced yields 5% to 8% and 10% doubles increased yields by 4 to 8%.
  - Was the first to suggest that the achieving the appropriate plant population with adequate spacing was the most important goal for maximizing corn yields.
- Lauer (2004) reported that plot grain yields rarely were affected by two-plant variations and yields were only affected four- and eight-plant variations (more hill like).

Pioneer

- Pioneer agronomists become interested in seed spacing uniformity in about 2000
- Early calibration demonstrations reported an average of 1.1 to 6.1 bu/acre increase for every one-inch of within-row plant spacing decrease.
- ALSO noted that you did not need a perfect stand to achieve maximum yields, on 2 to 3 inches of within row plant spacing standard deviation or less.

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Pioneer - continued

- Reported no increase in barreness with doubles. In fact these "extra" increased individual plant yields.
- Also reported plants growing next to gaps (skips) were the least productive on an individual plant basis.

The way these results are reported illustrate a fallacy in early plant spacing work, **the focus on individual plants**. We grow crops in a community. Plants can compensate across the community as a whole.

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Tollenaar 2004

- Evaluated planter speed and metering systems.
  - Reported that at low speeds (4.5 mph), finger pick-up and vacuum systems produced similar SDs. (3 vs 3.3 in ± 0.4)
  - At higher speeds (7 mph), finger pick-up SD was 3.4 in and vacuum systems SDs were 4.1 ± 0.4 in.
  - Conventionally tilled systems had lower SDs than no-till systems (4.8 vs 5.3 in ± 0.4).
  - High SDs from an air seeder treatment (7.5 in) influenced regression results resulting in results of "the highest yields were attained from treatments with the lowest SDs"

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Liu et al., 2004

- Mixed RR and conventional seed at various ratios to obtain irregular stands, planted at 70k seeds ha^{-1} (31.8k seeds ac^{-1})
- Six treatments resulting in a SD range of 6.7 to 16.2 cm (2.6 to 6.4 inches)
- Plant spacing variability had no effect on grain yield, leaf number, plant height, LAI, or HI.

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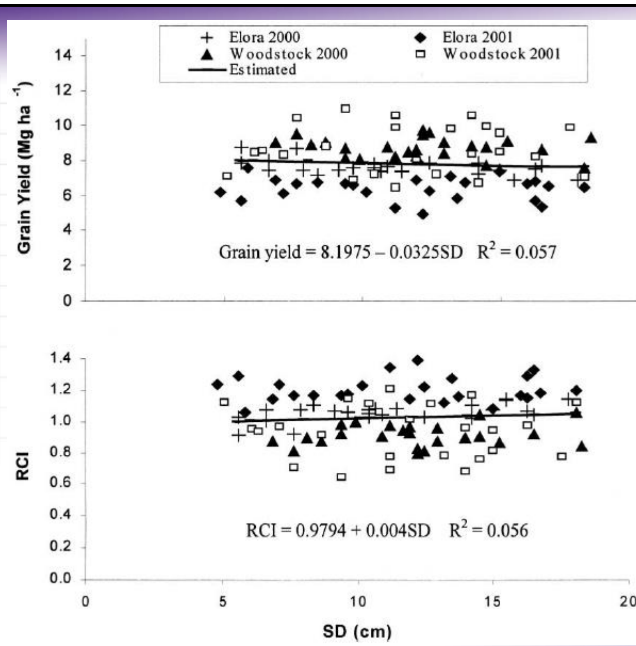
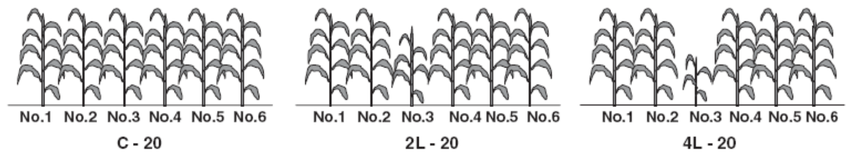
Knowledge for Life



Tollenaar 2006

- Previous research prompted a closer look at corn community response to imperfect stands.
- They looked at plant emergence delays (2 and 4 leaf delays) and a skip-double and skip-triple.
- A two leaf delay in emergence reduced yields 5 bu/acre and a 4 leaf delay reduced yields 10 bu/acre.
- Skip-double and skip-triple DID NOT reduce yields compared with a uniform stand when the whole plot yield was considered because adjacent plants compensated for the skip.

Emergence Results – Tollenaar 2006



	Plant position						
Treatment	1	2	3	4	5	6	Plot
	Grain yield or difference (bu/acre)						
Control	119.6	126.4	113.4	110.2	113.5	118.1	116.9
2-leaf delay	1.3	1.6	-44.2‡	6.4	4.8	1.0	-4.8‡
4-leaf delay	2.6	5.4	-89.3‡	10.2	9.1	2.9	-9.9‡

‡ Significantly different from control

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Plant Hierarchies in Maize

Pagano and Maddonni, 2007

- Plant variability in above ground biomass increased through the season, CV of 1.2% at at V3 to 22% at V9-V10
- Early established hierarchies differ in biomass allocation to the ear around silking
- Dominant plants exhibited greater partitioning to the ear (HI=0.41) compared to dominated plants (HI=0.36)

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Evaluating Seeder Performance

- **Seed/Plant spacing uniformity**
- Variability across the unit
- **Emergence rate**

How do we improve uniformity?

- Attachments
  - Metering
  - Seed Firmers
  - Press Wheels
- Adjustments
  - Speed
  - Down Force
- Maintenance
  - Metering System
  - Opener Disks
  - Seed Tubes

Using Seeding Depth to Overcome Spatial Variability *(Haag's opinion)*

- Spatial variability
  - soil temperature
  - soil moisture
  - bulk density
- What does the spatial variability of each of these characteristics look like as a function of depth
- Consistency of seed placement depth irrelevant if we're not deep enough

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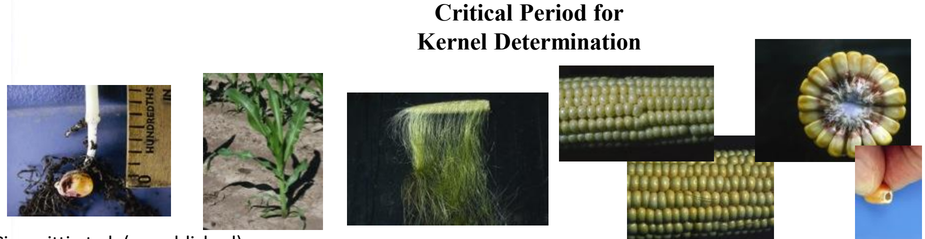
Maize Phenological Stages

Drought can be critical around the period for grain number formation around flowering (+/- 2 weeks)

Critical Period for Kernel Determination



Ciampitti et al. (unpublished)

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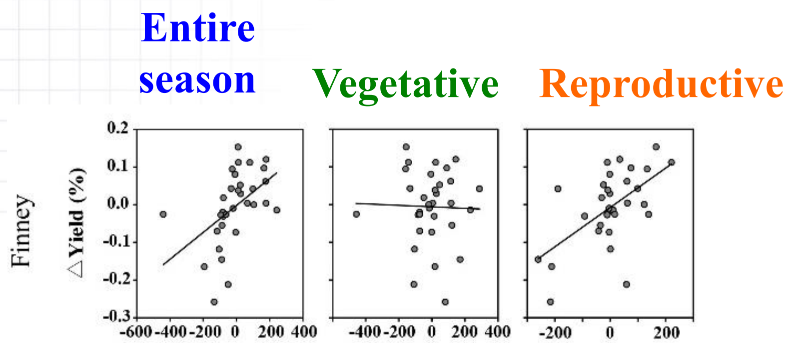
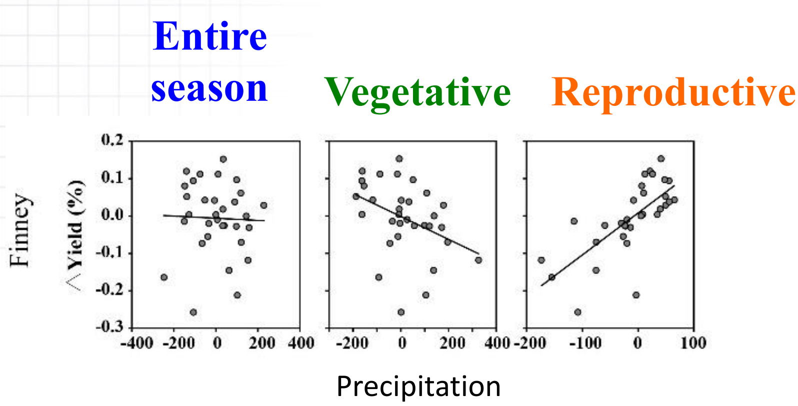
Historical Impact of Accumulated GDD on Corn in Southwest Kansas



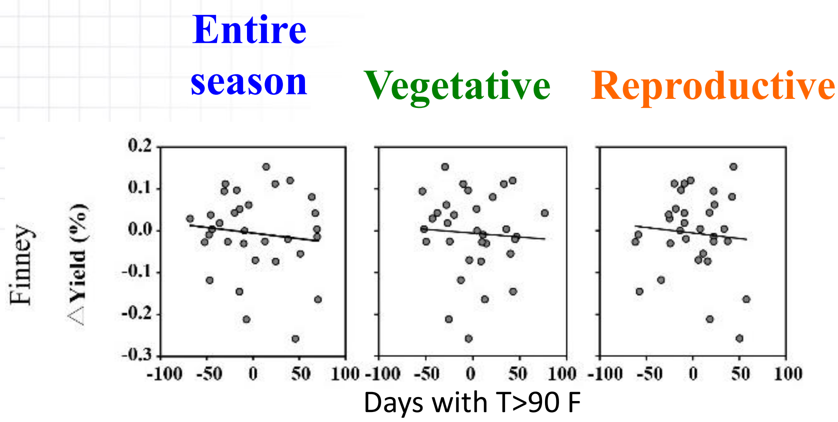
Xiaomao, Ying, Ciampitti, 2016

Historical Impact of Precipitation on Corn in Southwest Kansas



Xiaomao, Ying, Ciampitti, 2016

Historical Impact of Heat on Corn in Southwest Kansas



Xiaomao, Ying, Ciampitti, 2016

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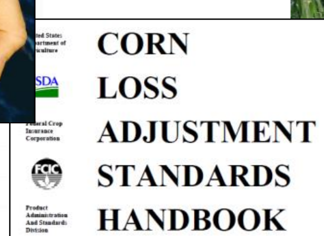
Response of Corn Grain Yield Components to Late Season Stand Reductions


CORN LOSS ADJUSTMENT STANDARDS HANDBOOK

John Holman – K-State SWREC-Garden City
Lucas Haag – K-State NWREC-Colby
Leigh Murray – K-State Dept. of Statistics
Mark Zarnstorff – NCIS
Joel Ransom – NDSU
Tom Roberts – K-State SWREC-Garden City
Scott Maxwell – K-State SWREC-Garden City

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Question

At what growth stage do the remaining plants after a stand thinning hail event loose their ability to compensate?

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Materials and Methods

- Studies were conducted at Prosper, ND and **Garden City, KS**
- Corn was planted into a strip-tilled seedbed typically the 1st week of May
- Seeded at 36,000 plants ac^{-1} then thinned back to 34,000 plants ac^{-1}
- Glyphosate, Atrazine, and BalancePro used for weed control

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Materials and Methods

- A factorial treatment structure was placed in a RCBD design
- 4 Timings of Stand Thinning
  - V5, V8, V11, V14
- 4 Rates of Stand Thinning
  - 0, 25, 50, 75% of original stand (34,000 plants ac^{-1})
- Plots were machine harvested after ear and stand counts were obtained.
- Kernel weight and protein was measured.

Garden City Results, 2008-2011

Reduction Timing and Level		Grain Yield	Harvest Moisture	Ears $Plant^{-1}$	Kernels Ear^{-1}	Kernel Weight	Protein
		bu ac^{-1}	%			g 1000^{-1}	%
Stage	V5	137.7	16.4	1.05	674.4	309.3	8.23
	V8	129.4	16.1	1.05	649.0	301.6	8.16
	V11	125.4	16.5	1.03	640.6	300.6	8.32
	V14	114.0	16.7	1.00	580.0	311.5	8.23
Reduction	0	183.0	16.2	0.97	498.2	292.3	8.09
	25	164.9	16.6	0.98	565.5	298.6	8.10
	50	137.4	16.6	1.02	665.5	308.1	8.23
	75	77.5	16.1	1.11	677.0	310.5	8.58

Garden City - Control vs. Treatments (one-way analysis)

Corn Stand Reduction Study
Garden City, KS 2008 - 2011

Stage	Reduction	Yield	Vs. Contrtol	Dunnett Adjusted P
Control		183.0		
V5	25	169.0	-14.0	0.6931
V5	50	156.2	-26.9	**0.0262**
V5	75	88.0	-95.0	**<0.0001**
V8	25	169.7	-13.3	0.7564
V8	50	137.3	-45.7	**<0.0001**
V8	75	81.0	-102.0	**<0.0001**
V11	25	174.1	-8.9	0.9780
V11	50	130.1	-52.9	**<0.0001**
V11	75	72.0	-111.0	**<0.0001**
V14	25	146.9	-36.2	**0.0007**
V14	50	126.2	-56.8	**<0.0001**
V14	75	69.1	-113.9	**<0.0001**

No difference between control and 25% removal treatments at V5, V8, and V11

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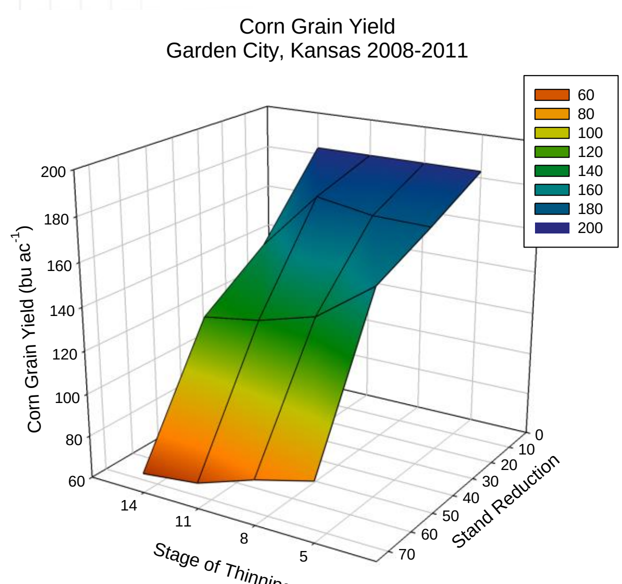
Garden City - Impact on Grain Yield



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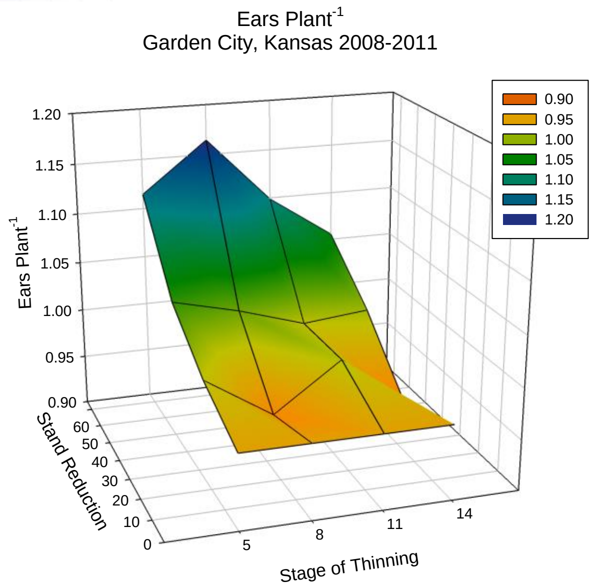
Garden City - Impact on Yield Components – Ears Plant^{-1}



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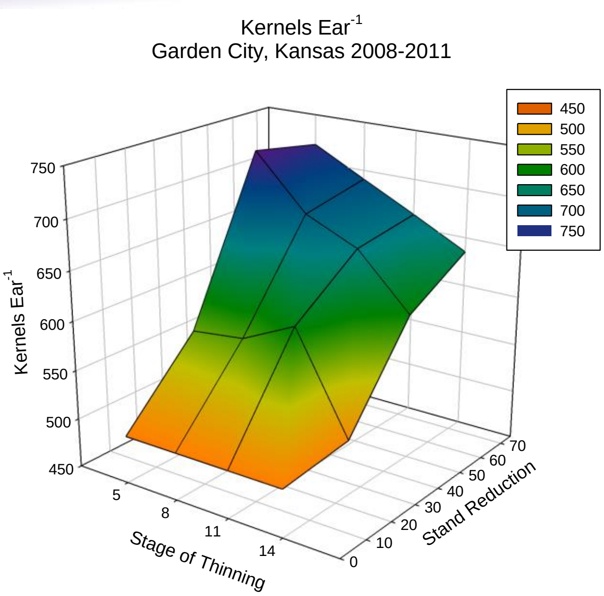
Garden City - Impact on Yield Components – Kernels Ear^{-1}



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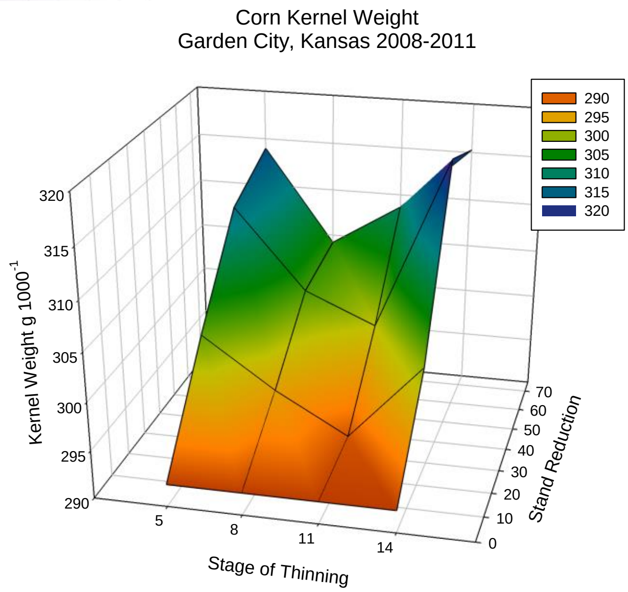
Garden City - Impact on Yield Components – Kernel Weight



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Summary of Results

- At Garden City:
  - No difference between control and 25% removal at V5, V8, and V11 stages at Garden City
  - Percentage of stand reduction effected all yield components
  - Growth stage at stand reduction effected all yield components except ears plant^{-1}
- Amount of stand reduction was more important than timing of reduction
- Yield reductions were not linearly correlated to stand reduction at either location resulting in overestimation of yield losses by current procedures
- This study, and others, would suggest that corn plants remaining after a late-season thinning have more yield plasticity than we give them credit for.

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Knowledge for Life

On-Farm Hybrid Characterization

Developing data for VRS implementation

Lucas A. Haag Ph.D.

Assistant Professor / Northwest Area Agronomist
K-State Northwest Research-Extension Center, Colby, Kansas

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Knowledge for Life

Hybrids and VRS

- Hybrid characterization is the key to effective VRS strategies
- Our ability to create VRT seeding prescriptions has exceeded our ability to characterize hybrids
  - Rapid hybrid turnover has further complicated this
- Yield components flex differently, at different rates, for different hybrids
- Fewer companies publicizing the “ear flex” scorings of products
  - Definition of ear flex, how much, what components

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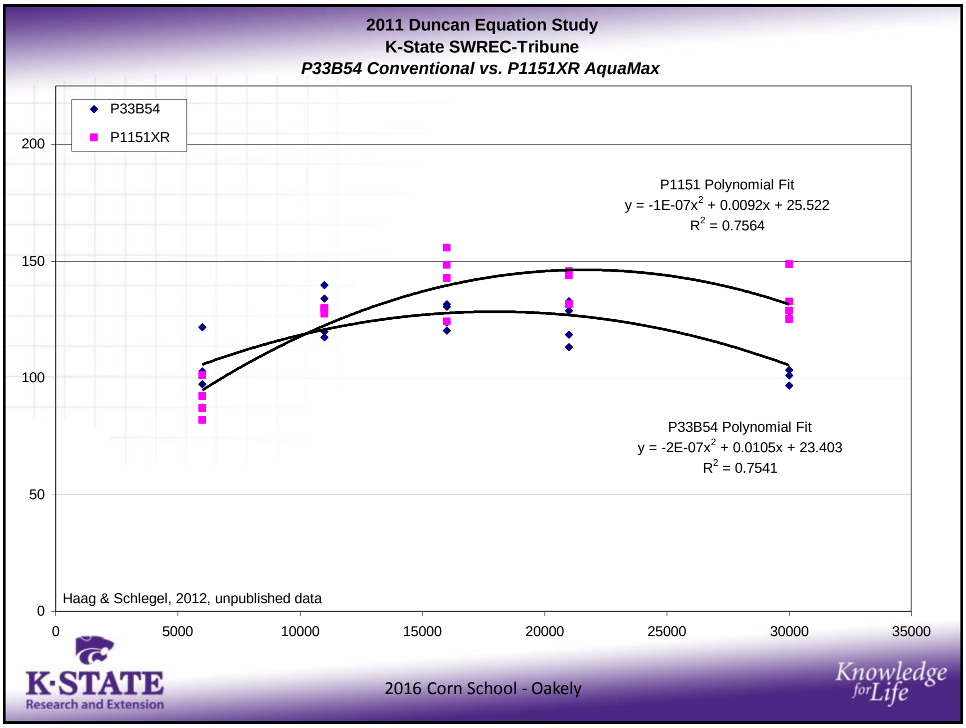
2011 Duncan Equation Study
K-State SWREC-Tribune
P33B54 Conventional vs. P1151XR AquaMax
P33B54
P1151XR
P1151 Polynomial Fit
y = -1E-07x2 + 0.0092x + 25.522
R2 = 0.7564
P33B54 Polynomial Fit
y = -2E-07x2 + 0.0105x + 23.403
R2 = 0.7541
Haag & Schlegel, 2012, unpublished data
0
50
100
150
200
0
5000
10000
15000
20000
25000
30000
35000
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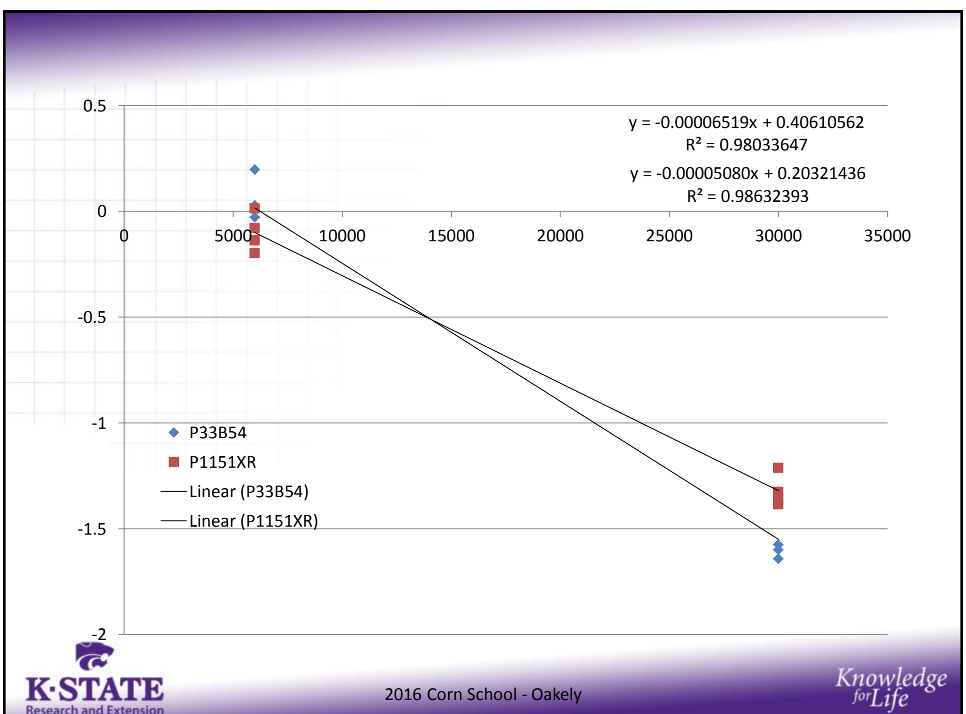
y = -0.00006519x + 0.40610562
R² = 0.98033647
y = -0.00005080x + 0.20321436
R² = 0.98632393
0.5
0
-0.5
-1
-1.5
-2
0
5000
10000
15000
20000
25000
30000
35000
P33B54
P1151XR
Linear (P33B54)
Linear (P1151XR)
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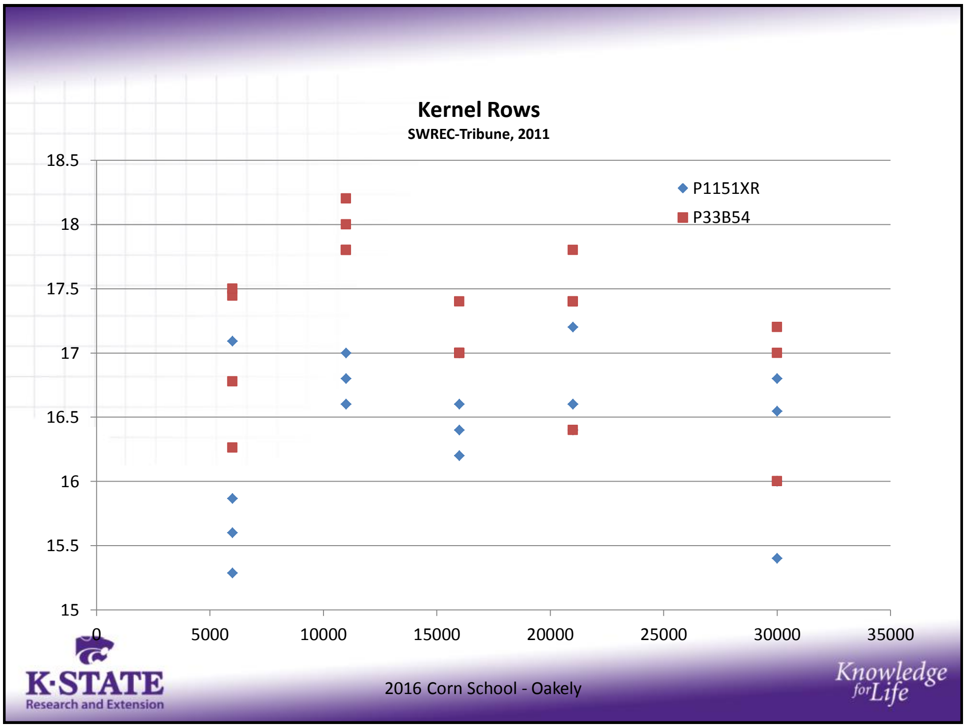
Kernel Rows
SWREC-Tribune, 2011
P1151XR
P33B54
18.5
18
17.5
17
16.5
16
15.5
15
0
5000
10000
15000
20000
25000
30000
35000
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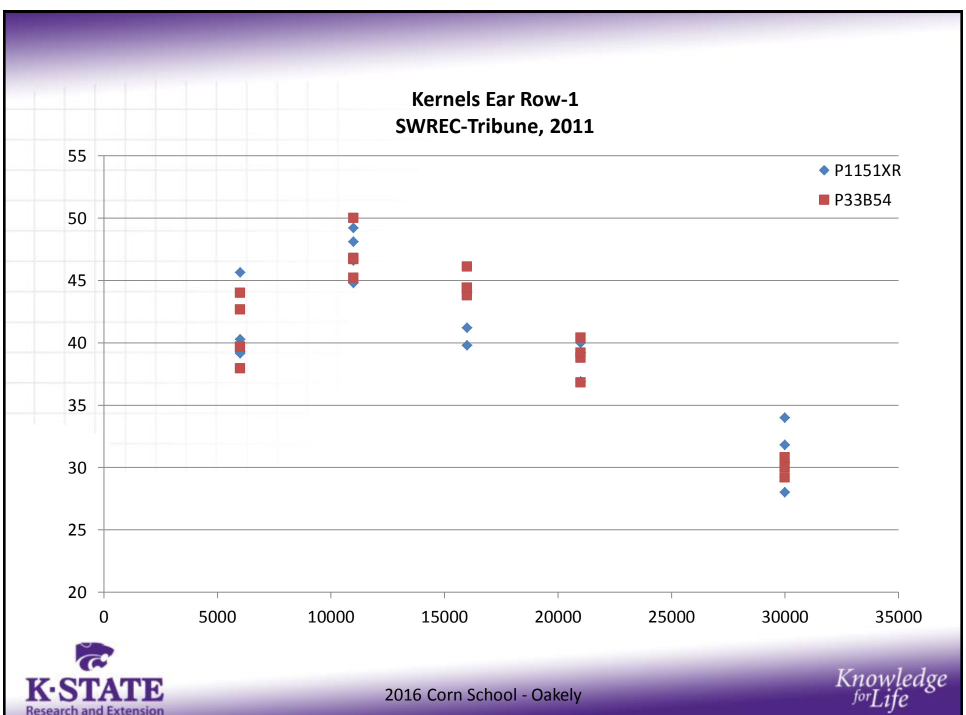
Kernels Ear Row-1
SWREC-Tribune, 2011
P1151XR
P33B54
55
50
45
40
35
30
25
20
0
5000
10000
15000
20000
25000
30000
35000
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2016 Field Trials

- Fully irrigated trial at NWREC-Colby
  - 3 Hybrids
  - 5 Seeding Rates: 13.1, 22.1, 30.8, 37.8, and 48.6k/ac
  - 4 Replications in RCBD
- Dryland trial on-farm in Decatur County
  - 38 Hybrids
  - 5 Seeding Rates: 8.1, 14.2, 17.2, 20.7, 27k/ac
  - 4 Replications in a SPD
- Yield, Kernel Rows, Kernels per Row, Kernel Wt.

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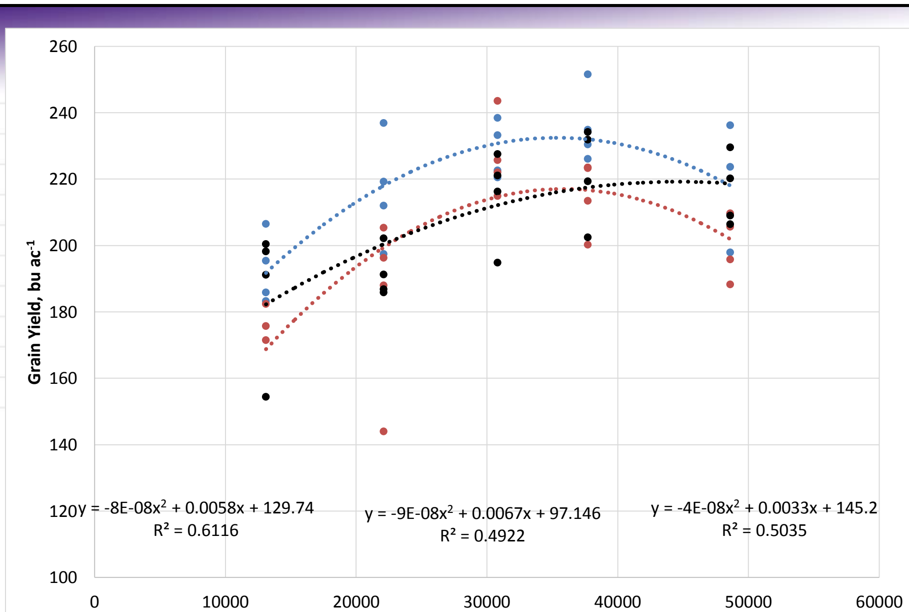

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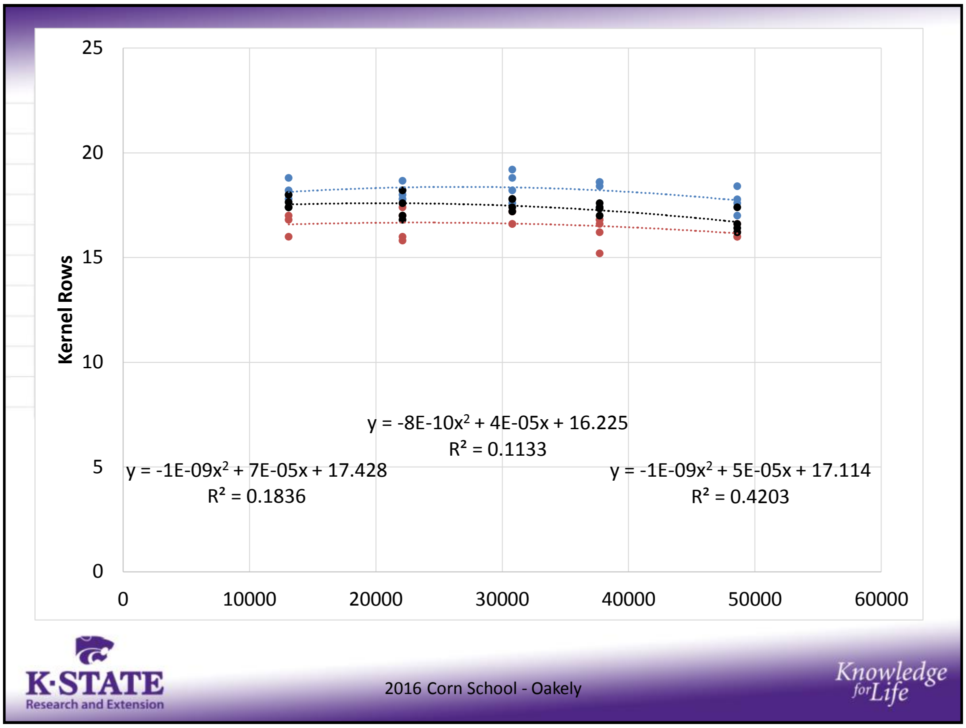
Kernel Rows
25
20
15
10
5
0
0
10000
20000
30000
40000
50000
60000
y = -8E-10x² + 4E-05x + 16.225
R² = 0.1133
y = -1E-09x² + 7E-05x + 17.428
R² = 0.1836
y = -1E-09x² + 5E-05x + 17.114
R² = 0.4203
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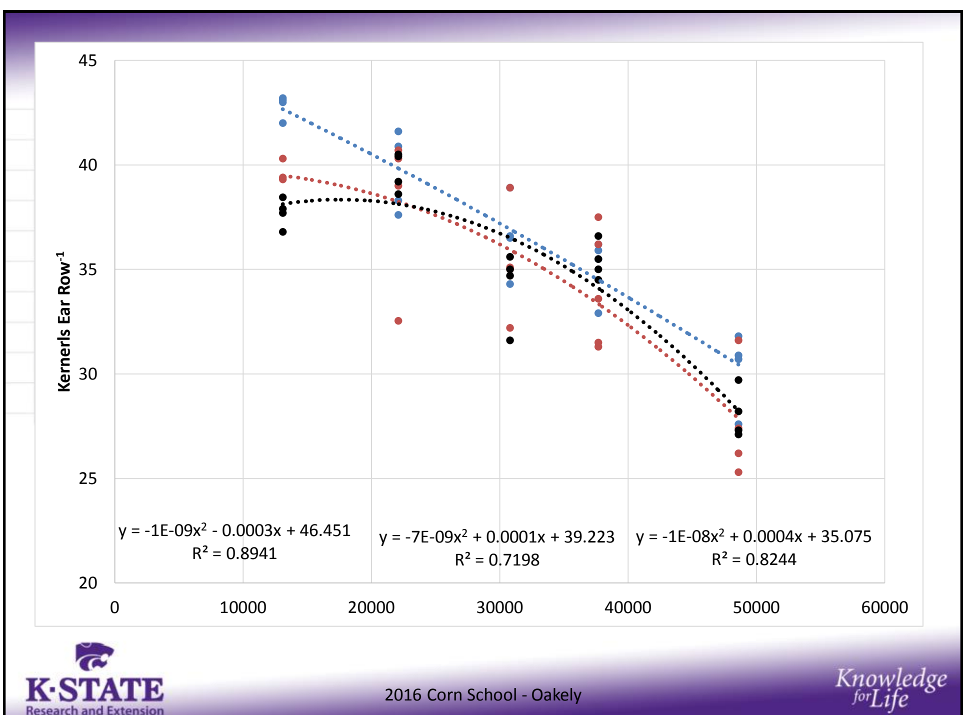
Kernerls Ear Row-1
45
40
35
30
25
20
0
10000
20000
30000
40000
50000
60000
y = -1E-09x² - 0.0003x + 46.451
R² = 0.8941
y = -7E-09x² + 0.0001x + 39.223
R² = 0.7198
y = -1E-08x² + 0.0004x + 35.075
R² = 0.8244
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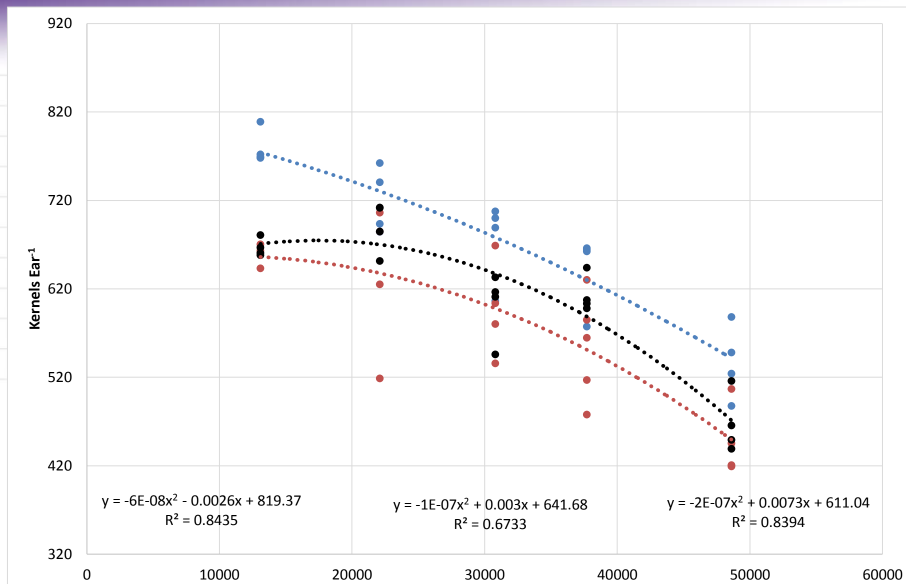

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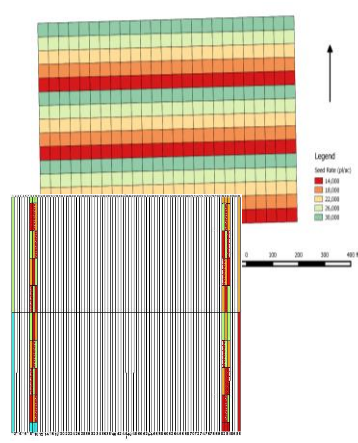
On-Farm Seeding Rate Trials

- Big enough range in seeding rates, +/- 2k isn't likely to show a response
- Treatment areas 300' long minimum, multiple field locations
- Can I use a highly variable field to generate a lot of characterization data?



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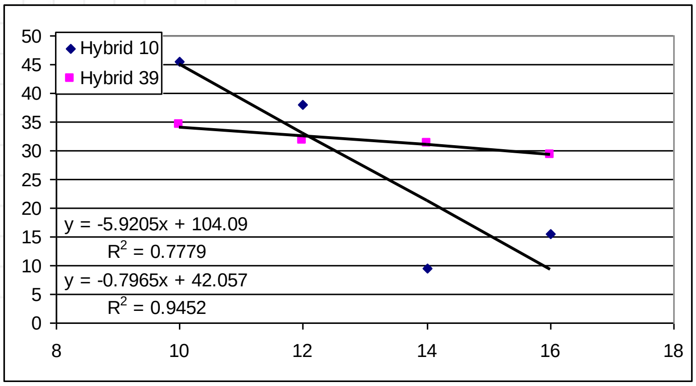
Knowledge for Life

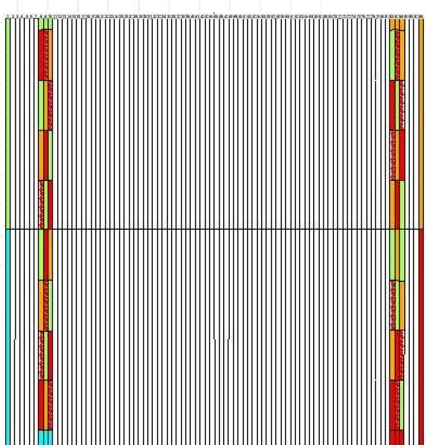
Population response of two hybrids

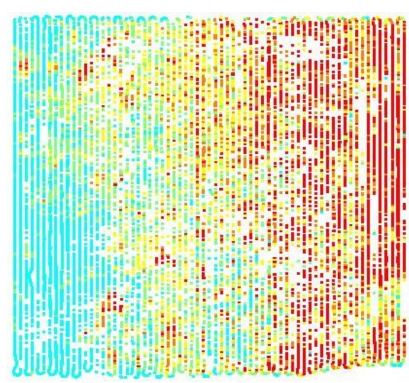


Hybrid 39 had the least response in yield across populations – population insensitive

Hybrid 10 had the most response in yield across population – sensitive to population

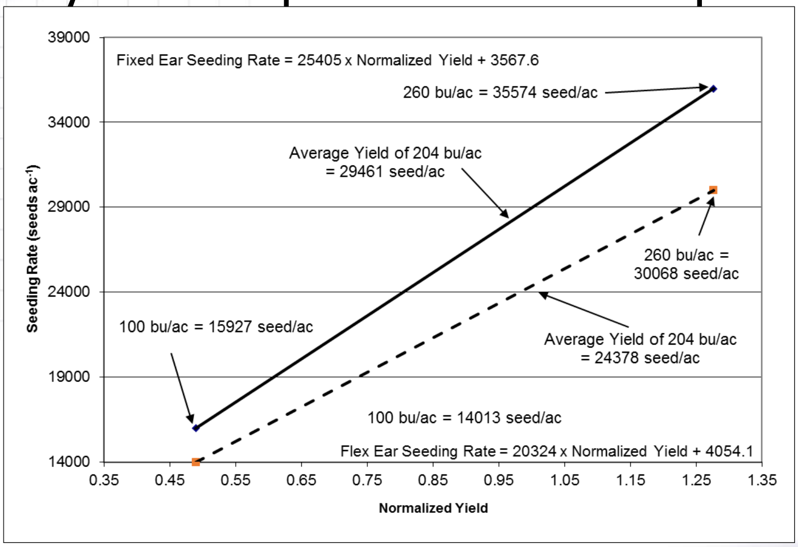
Using Field Variability to Guide Plot Placement….. Learn More





0-3’ Soil EC

Hybrid Response to VRS Scripts



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Hybrid response to population

- Effective VRT seeding requires the use of hybrids that are responsive to population.
- We need good characterization of hybrids.
- How confident are you in your prescription?
  - Are you doing something to validate/evaluate

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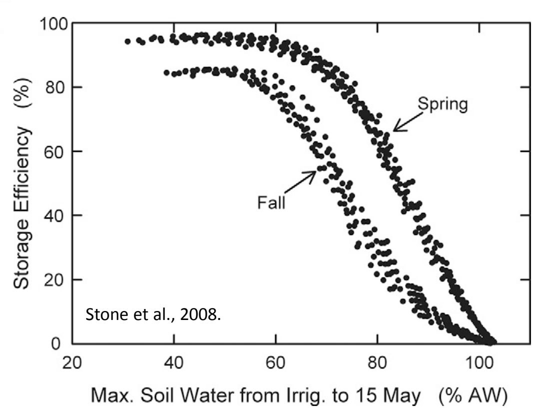
Irrigation Management

Water Loss to Drainage

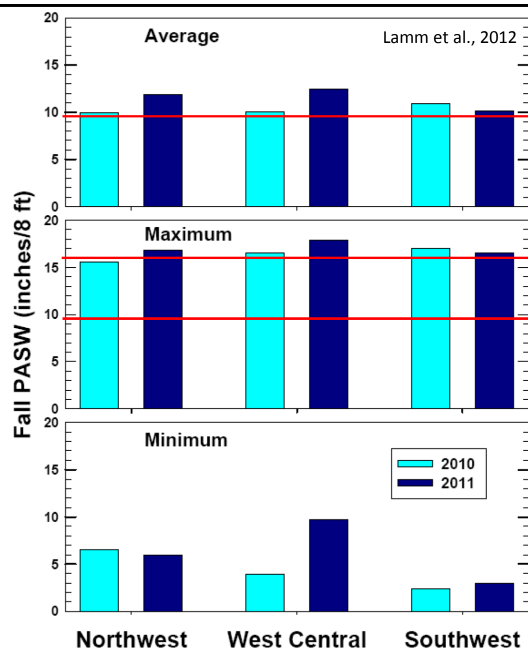
If the profile is at or above 60% full the storage efficiency of fall or spring precipitation or preseason irrigation diminishes rapidly



Potential Water Loss

In an 8' profile, 60% available soil water would be approximately 9.6" in a Western Kansas silt-loam soil

Storage efficiency of additional water approaches zero at 100% ASW, or 16" in this case



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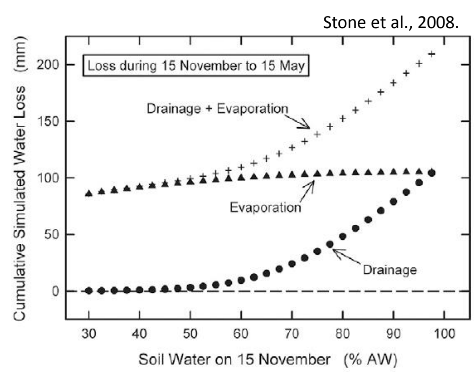
Potential Water Loss

- Proper management of irrigation at the end of the season
- Calendar not a good method (more on this later)
- Don't want to short the crop, but also don't want to reduce our storage efficiency for winter precipitation and pre-season irrigation



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Irrigation Termination

Stage of Growth	Approximate number of days to maturity	Water use to maturity (inches)
Corn		
Blister	45	10.5
Dough	34	7.5
Beginning dent	24	5
Full dent	13	2.5
Black layer	0	0
Grain Sorghum		
Mid bloom	34	9
Soft dough	23	5
Hard dough	12	2
Black layer	0	0
Soybeans		
Full pod	37	9
Beginning seed	29	6.5
Full seed	17	3.5
Full maturity	0	0

Adapted from K-State MF2174, Rogers and Sothers.

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Timing of Irrigation Termination

Year	Date of Anthesis	Date of Maturity	Irrigation Season Termination Date For		
			80% Max Yield	90% Max Yield	MaxYield
1993	20-Jul	30-Sep	5-Aug	5-Aug	15-Aug
1994	20-Jul	15-Sep	5-Aug	15-Aug	15-Aug
1995	20-Jul	29-Sep	5-Aug	13-Aug	18-Aug
1996	20-Jul	3-Oct	17-Jul	17-Jul	29-Aug
1997	23-Jul	1-Oct	23-Jul	23-Jul	27-Aug
1998	20-Jul	28-Sep	20-Jul	20-Jul	24-Aug
1999	23-Jul	6-Oct	24-Jul	13-Aug	20-Sep
2000	12-Jul	20-Sep	14-Sep	20-Sep	20-Sep
2001	16-Jul	29-Sep	30-Jul	22-Sep	22-Sep
2002	22-Jul	30-Sep	4-Aug	30-Aug	7-Sep
2003	22-Jul	23-Sep	3-Aug	3-Aug	18-Aug
2004	19-Jul	28-Sep	8-Aug	21-Aug	27-Aug
2005	20-Jul	28-Sep	2-Aug	9-Aug	29-Aug
2006	17-Jul	25-Sep	30-Jul	13-Aug	13-Aug
2007	18-Jul	19-Sep	14-Aug	21-Aug	28-Aug
2008	24-Jul	10-Oct	31-Jul	6-Aug	27-Aug
Average	**19-Jul**	**27-Sep**	**2-Aug**	**13-Aug**	**28-Aug**
Standard Dev.	**3 days**	**6 days**	**13 days**	**19 days**	**13 days**
Earliest	**12-Jul**	**14-Sep**	**17-Jul**	**17-Jul**	**12-Aug**
Latest	**24-Jul**	**10-Oct**	**14-Sep**	**21-Sep**	**21-Sep**

* *Estimated dates are based on the individual irrigation treatment dates from each of the different studies when the specified percentage of yield was exceeded.*

F. Lamm, NWREC

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This table was created to show the fallacy of using a specific date to terminate the irrigation season.

Statistics for 16 years 1993-2008	Irrigation Season Termination Date For		
	80% Max Yield	90% Max Yield	MaxYield
Mean	2-Aug	13-Aug	28-Aug
Standard Deviation	13 days	19 days	13 days
Earliest	17-Jul	17-Jul	12-Aug
Latest	14-Sep	21-Sep	21-Sep

F. Lamm, K-State NWREC

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Upcoming Opportunities

- CYA: January 17-18, Oberlin
  - www.northwest.ksu.edu/CoverYourAcres
- KARTA: January 19-20, Junction City
  - www.kartaonline.org
- Central Plains Irrig., Burlington, Feb 21-22
  - www.ksre.ksu.edu/sdi/events

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Questions?
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