4th Annual TAWC

Water College

January 24, 2018

Lubbock Civic Center

Lubbock, TX

The TAWC project was made possible through a grant from the
Texas Water Development Board

4th Annual Water College

January 24, 2018
Lubbock Memorial Civic Center
Lubbock, TX

Morning Sessions:

8:30 am **Registration and exhibits**

8:50 am **Welcome & Introductions** — ***Cameron Turner**, Manager, Agricultural Water Conservation Program, Texas Water Development Board*

9:00 am **Utilizing Variable Rate Irrigation Technology in West Texas Cotton**
***Lloyd Arthur**, TAWC Producer*
***Jeff Miller**, Forefront Agronomy*

10:00 am **When Less is More: Soil Management for Ideal Water Infiltration**
***RN Hopper**, TAWC Producer*

10:45 am **Break with exhibits**

11:00 am **From Field to Fabric – Wrangler's commitment to Healthy Soils**
***Roian Atwood,** Director of Sustainability, Wrangler*

11:30 am **Improving Corn Water Use with Hybrid Selection: trait evaluation for both dryland and limited irrigated systems**
Dr. *Jourdan Bell, Assistant Professor, Agronomist Texas A&M AgriLife Extension*

12:00 pm **Lunch** — ***Wyman Meinzer**, Texas Nature Photographer*

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Afternoon Sessions:

1:00 pm **Upcoming Weather Patterns** — ***Brian Bledsoe**, Chief Meteorologist & Climatologist, Colorado Springs*

1:30 pm **Overview of Texas Water Law** — ***Tiffany Dowell Lashmet**, Extension Specialist, Agricultural Law with Texas A&M AgriLife Extension*

2:15 pm **Update from Texas Water Development Board**

***Kathleen Jackson**, Texas Water Development Board*

2:45 pm **Break with exhibits**

3:00 pm **Profit Potential Using Split Pivot Irrigation Strategies in Cotton Production**

***Bob Glodt**, AgriSearch Consulting*
***Layton Schur**, TAWC Producer*

4:00 pm **Grower Perspective of Various Irrigation Systems**

***Glenn Schur**, TAWC Producer*

4:20 pm **West Texas Mesonet – Useful Tools to Aid Producers**

***Wesley Burgett**, Operations Manager, West Texas Mesonet, Texas Tech University*

5:00 pm **Close**

Texas Alliance For Water Conservation
TAWC
"Water is Our Future"

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Texas Water Development Board

Moderator and Presenters for

2018 TAWC Water College

Mr. Cameron Turner

Cameron Turner is the Team Lead for the Agricultural Water Conservation Program at the Texas Water Development Board. His duties include managing grant projects, developing statewide irrigation estimates, and providing outreach and education to the public.

He was raised on a family farm with operations in parts of Deaf Smith, Parmer, Bailey, and Lamb counties. His rural upbringing fuels his passion for conservation as a means to preserve rural economies, livelihoods, and the prosperity of agriculture in rural Texas.

Cameron attended Texas A&M University where he received a degree in Agricultural Economics with a focus on Farm and Ranch Management. He now lives in Cedar Park with his wife and two children.

Mr. Lloyd Arthur

Lloyd Arthur graduated from Ralls High School in 1980 attending Western Texas College and graduating from Texas Tech University in 1986.

He is a fifth-generation farmer living in Ralls, Texas with his wife Angela. They have four children, and together the family has created a farming operation that has received awards and recognition such as Texas Farm Bureau District II Outstanding Young Farmer and Rancher in 1995, Crosby County Agriculturist of the Year in 2002, and the Ralls Chamber of Commerce “Mr. & Mrs. Cotton Boll” in 2015.

Lloyd has served in numerous leadership roles and Agricultural Organizations including the boards of Rio Blanco Soil and Water Conservation District, Cotton Incorporated, and Texas Farm Bureau (just to name a few). He recently served as President of the Crosby County Farm Bureau from 2016-2017 and has been a board officer and member since 1991. Lloyd has been a cooperating producer in the Texas Alliance for Water Conservation since 2012.

Mr. Jeff Miller

Jeff Miller was born and raised in Plainview, TX and has been involved in agriculture his whole life. Jeff holds a BS in Integrated Pest Management from Texas Tech and an MS in Crop Physiology from Texas Tech.

Jeff is married to Kate and has 4 beautiful children. Jeff worked for 10 years with Deltapine/Monsanto in product development and worked 8 years with Pioneer in drought research, sales, and agronomy.

He founded Forefront Agronomy in 2017 to provide leading edge individualized agronomy insight and support to the growers of West Texas. There are many challenges in agriculture and by utilizing our partnerships with DuPont Pioneer, CropMetrics, and 360 Yield Center we have the best support behind us to tackle these challenges and strive for profitability.

Mr. RN Hopper

R. N. is a continuous no-till farmer from Petersburg, TX. He and his wife Lyndi live on the farm with their three children. They grow corn, cotton, wheat, and sunflowers. R. N. is one of the founders and current President of the No-Till Texas organization whose focus is to increase awareness of soil health issues and to establish a network of producers helping each other implement soil conservation practices.

He and his father were recognized by The Cotton Foundation and the Farm Press for their conservation efforts with the 2015 High Cotton Award and also by the Water Conservation Advisory Council with the 2017 Blue Legacy Award. Mr. Hopper is a graduate of Texas Tech University (BS Agronomy 2000) and a cooperator on our TAWC project.

Mr. Roian Atwood

Roian Atwood is the Director of Sustainability for Wrangler, Lee jeans, and several other brands and geographic regions. Atwood leads brand sustainability strategy, engages suppliers globally to drive greater social and environmental performance, and works cross functionally with product development and marketing to create more sustainable products and share brand relevant stories.

With fifteen years' experience in footwear & apparel sustainability, his diverse project management experience includes implementing renewables and discovering energy efficiency measures to project managing materials innovation pilots and leading teams into an action-oriented, results driven approach to corporate sustainability.

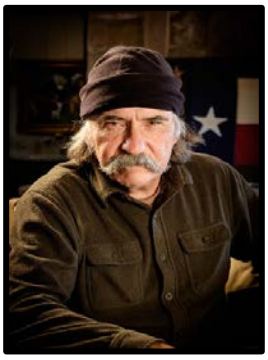
Atwood's undergraduate work was in Complex Systems with Naropa University, and he holds a Master's of Environmental Management from the Nicholas School of the Environment at Duke University.

Dr. Jourdan Bell

Jourdan Bell is the regional Agronomist for Texas A&M AgriLife Research and Extension at Amarillo. She received her PhD in Soil Science from Texas A&M University. Her B.S. and M.S. degrees were received from WTAMU in Canyon in Agriculture and Plant, Soil, and Environmental Science.

Prior to joining Texas A&M AgriLife in 2014, Dr. Bell worked as a Research Technician for the USDA-ARS at Bushland for 14 years in the Soil and Water Management Unit. With USDA-ARS, she assisted in research focusing on manure management, soil water dynamics in dryland cropping systems, and irrigation scheduling.

Her current Research and Extension programs evaluate and promote agronomic practices to enhance crop production and profitability under limited irrigation and dryland systems of the Texas High Plains. She is a current member of the American Society of Agronomy, Crop Science Society and Soil Science Society of America. She previously served as the Vice Leader (2014) and Leader (2015) of the American Society of Agronomy Crop Irrigation Strategies and Management Community.



Mr. Wyman Meinzer, Special Guest Speaker

Wyman Meinzer is the only official State Photographer of Texas, named so in 1997 by the Texas State Legislature and then Gov. George W. Bush, an honor he still holds today. He was raised on the League Ranch, a 27,000-acre ranch in the rolling plains of Texas. Since then, he has traveled to every corner of this great state and all points in between in search of the first and last rays of sunlight in its magnificent sweep across the Texas landscape.
Meinzer graduated from Texas Tech in 1974 with a Bachelor of Science degree in Wildlife Management and was voted Outstanding Alumnus in 1987 by the department of Range and Wildlife Management at Texas Tech University. He also received the Distinguished Alumnus award in 1995 from the School of Agricultural Sciences and Natural Resources. In august of 1999, Meinzer was honored to give the graduation commencement address at his alma matter Texas Tech University. During his 12 years as adjunct instructor in communications at Texas Tech University, Wyman was selected as Agriculture Communications Teacher of the Year in 2005. In 2009 he received the Distinguished Alumnus award from Texas Tech University in recognition of outstanding achievement and dedicated service.

Post-graduation Wyman spent five years as a professional predator hunter on the big ranches of the rolling plains. During this period, he worked to perfect his photographic skills and now, after 33 years as a professional photographer, Wyman has photographed and /or written 24 large format books, and his images have appeared on more than 250 magazine covers throughout America. His images have appeared in Smithsonian, National Geographic Books, Natural History, Ebony, Time, Newsweek, U.S. News and World Report, Audubon, Sports Afield, Field and Stream, Outdoor life, Texas Parks and Wildlife, Texas Highways, Korea GEO, German GEO, Das Tier, Airone, Horzu, BBC Wildlife, and a host of others.

Honors include: Official State Photographer of Texas by the 75th Texas State Legislature, the John Ben Sheppard Jr. Award from the Texas State Historical Foundation for contributing to the preservation of Texas History through writing and photography, 1997 National Literary Award for the book, "Texas Lost: Vanishing Heritage" (with author Andrew Sansom), the San Antonio Conservation Award for the natural history book, "Roadrunner", the 2003"Star of Texas Award", from the Gillespie County Historical Society with author John Graves for their collaborative work, "Texas Hill Country", and in 2011 the dual awards of "Texas Heroes Hall of Honor", from the Frontier Times Museum in Bandera, Texas, and The A.C. Green Literary Award, presented to a distinguished Texas author for lifetime achievement.
Meinzer is a self-taught historian who lives in Benjamin with his wife, Sylinda. Along with his photography, Meinzer loves hunting with rifles, pistols and bow, flying and wood work. David Baxter, former editor of Texas Parks & Wildlife Magazine, described Meinzer best when he called him "a man with the eye of a nineteenth-century impressionist painter and the soul of a buffalo hunter".

Mr. Brian Bledsoe

Brian Bledsoe grew up on a farm/ranch in eastern Colorado. He has been interested in weather since he was a child. Brian's true passion is helping farmers and ranchers with seasonal weather forecasting. He speaks all over the state of Colorado and elsewhere. Brian's work has been featured in the High Plains Journal, Southern Livestock Standard, Ag Journal, and the Greeley Tribune. He also writes for the Colorado Association of Wheat Growers. He deems it his mission to show how he can make the weather can work for you.

Brian is currently Chief Meteorologist at KKTV 11 News in Colorado Springs, Colorado Area. Brian graduated from the University of Northern Colorado and maintains his own weather forecasting website: BrianBledsoeWX.com.

Tiffany Dowell Lashmet, Esq.

Tiffany Dowell Lashmet is an Assistant Professor and Extension Specialist in Agricultural Law with Texas A&M Agrilife Extension. Tiffany grew up on a family farm and ranch in Eastern New Mexico, received her Bachelor of Science in Agribusiness (Farm and Ranch Management) *summa cum laude* at Oklahoma State University, and her law degree *summa cum laude* at the University of New Mexico.

Prior to joining Texas A&M Agrilife Extension, Tiffany worked for 4 years at a law firm in Albuquerque practicing civil litigation. She is licensed to practice law in New Mexico and Texas. She lives in the Texas Panhandle with her husband, son, and daughter.

In 2016, Tiffany was named the State Specialist of the Year for Texas Agriculture by the Texas County Agricultural Agents Association.

Ms. Kathleen Jackson

Kathleen Jackson was reappointed to the Texas Water Development Board by Governor Greg Abbott on March 9, 2017. She was appointed to the Board by Governor Rick Perry on March 18, 2014.

Jackson has a diverse background representing agricultural, environmental, industrial, and wholesale-supply interests, which includes developing and implementing water management strategies for Southeast Texas. As a registered professional engineer, Jackson served as public affairs manager for one of the world's largest petroleum and petrochemical producers.

Additionally, she was involved in production agriculture with her late husband, who ran a cattle operation and farmed rice. She served as a past member of the Lower Neches Valley Authority Board of Directors, the Texas Water Conservation Association, and participated on the Sabine and Neches Rivers Bay and Estuary Environmental Flows Assessment Program Stakeholders Committee.

She is also a board member and past president of the Lamar Institute of Technology Foundation, a sustaining member of the Junior League of Beaumont, a member of the Texas Farm Bureau, past president of the American Cancer Society of North Jefferson County, and a past board member of Junior Achievement of the Golden Triangle.

Jackson received a bachelor's degree in chemical engineering from North Carolina State University. Jackson has three children, sixth-generation Texans who all reside and work in Texas, and one granddaughter. She is a long-time resident of Beaumont.

Mr. Bob Glodt

Bob is the president and founder of Agri-Search, Inc.- an independent research and consulting firm in Plainview, Texas. Agri-Search was founded in 1980 and is the oldest continuously operating independent agricultural research firm on the Texas High Plains. In addition to independent research trials, Bob serves as agricultural consultant and advises growers in Hale, Lamb, and Castro Counties on irrigation management, weed, insect, and disease control.

He has received numerous awards including Cotton Farming Magazine's "Cotton Consultant of the Year Award" and Texas Association of Agricultural Consultants – "Consultant of the Year Award." Bob served as an IPM Specialist with the Texas Agricultural Extension Service in Georgetown, Texas. He Bob also served in the United States Army and received a bachelor's of science degree in entomology from Texas A&M University. He and his wife Barbara have raised two sons and live in Plainview, Texas.

Mr. Layton Schur

Layton Schur is the son of Glenn Schur raised on the family farm near Plainview, Texas. Layton graduated from Texas Tech University in 2017 in Agricultural and Applied Economics with the full intention of returning to production agriculture following graduation. Layton is now one of our young up and coming agricultural producers and part of the Texas Alliance for Water Conservation Project.

Layton is licensed by the State of Texas as an Auctioneer.

Mr. Glenn Schur

Glenn Schur of Plainview, Texas, is the owner/operator of Glenn Schur Farms producing a variety of crops including cotton, grain sorghum, wheat, seed crops and sunflowers. In addition, his farm operations include Schur Limousin, a 100-plus registered cow/calf operation.

Glenn received his bachelor's degree in agricultural economics from Texas Tech in 1980. He is a member of The CASNR Advisory Board and is chairman of the Texas Alliance for Water Conservation. Schur received the Blue Legacy Award in 2011, CASNR Distinguished Alumni Award in 2008 and the Texas Agricultural Lifetime Leadership Award for 1990-92.

Mr. Wesley (Wes) Burgett

Wesley Burgett received his Bachelor of Science degree (B.S.) in Meteorology from Millersville University, Pennsylvania in 1993 and his Master of Science (M.S.) in Atmospheric Science from Texas Tech University in 1996. Mr. Burgett was a Meteorologist with Aeromet, Inc. on Kwajalein Atoll in the Marshall Islands, Pacific Ocean from 1997-1999 with duties including radar focal point for DWSR-93S radar, operational weather forecasting, and ICBM mission forecasting for USAKA (United States Army Kwajalein Atoll).

Since 1999, he has been the Research Associate and Operations Manager of the West Texas Mesonet with Texas Tech University National Wind Institute located at Reese Technology Center, Lubbock, Texas. His main duties include maintaining data flow, instrument repair, communications, station construction, computer support, and maintenance for 111 mesonet stations, 6 SCINTEC SODAR units, one boundary-layer radar profiler, and one atmospheric sounding system.

Mr. Burgett received a Top Techsan award in 2017 from the Texas Tech Alumni Association.

Texas Alliance For Water Conservation

TAWC

"Water is Our Future"

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Special Thanks to:

Texas Department of Agriculture
Texas Water Development Board

*** Please see their display booth in exhibit hall.**

Texas Alliance For Water Conservation

TAWC

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CropMetrics™
Yield Optimization Technology

Precision Irrigation Technology in West TX Cotton

Jeff W. Miller
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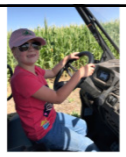
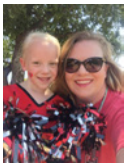
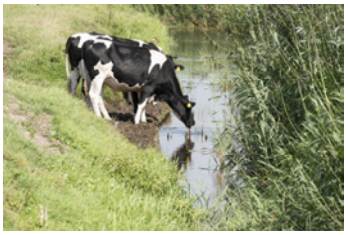
@jeffmillerttu

Lloyd Arthur
Texas Alliance for
Water Conservation
Producer/Cooperator
Ralls, Texas



QUANTITY

QUALITY

What is Precision Agriculture?

Define Precision

Quality of being precise, definite, exact, very accurate, and distinguished from every other.

Expected Result of Precision Ag?

Profit

Sustainable Precision Ag

Repeatable Solutions

Expected Results

ROI – Return on Input

True Precision Ag Foundation

Systems Approach for Precision Ag Success



Measureable Success Program IF…

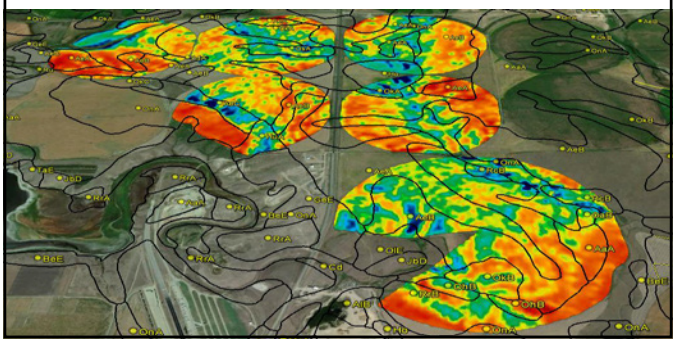
Baseline is Established

2 Types of Variability

Non-Changing	Changing
Soil Texture Topography	Weather Yield Results Genetics Prices
Foundational	Measurable

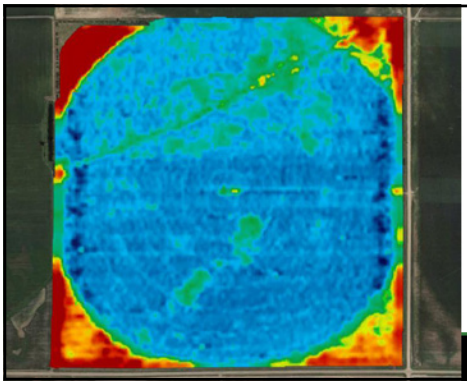
CropMetrics YIELD OPTIMIZATION TECHNOLOGY

Purpose of Identifying FIXED Data



Permeability & Available Water Storage Capacity by Soil Type

Soil Name	Depth of Layers (inches)	Permeability (in/hr)	Available Water Capacity (In water/in of soil)
Acuff	0-12 12-38 38-40	0.6-2.0 0.6-2.0 0.6-2.0	0.12-0.18 0.14-0.19 0.10-0.16
Amarillo	0-14 14-46 46-80	2.0-6.0 0.6-2.0 0.6-2.0	0.6-0.10 0.14-0.18 0.10-0.15
Brownfield	0-24 24-64 64-80	0.6-2.0 0.6-2.0 6.3-20.0	0.15-0.17 0.10-0.12 0.05-0.07
Olton	0-10 10-42 42-80	0.6-2.0 0.2-0.6 0.2-0.6	0.15-0.20 0.14-0.19 0.10-0.16
Pullman	0-12 12-46 46-80	0.2-0.6 <0.06 0.06-0.2	0.14-0.19 0.12-0.17 0.10-0.16



Identify Soil Variability
(fixed variable)

Build the Solution
(optimize variables)

Analyze the Results
(profit in variables)

CropMetrics YIELD OPTIMIZATION TECHNOLOGY

Water Optimization for Utilization Efficiency

CropMetrics YIELD OPTIMIZATION TECHNOLOGY

Precision Irrigation Management

–Plant available water
–Active root zone of crop
–Water needs of the crop
–Oxygen needs of the crop
–Weather

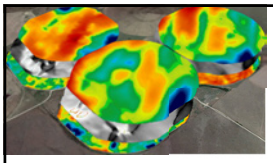
CropMetrics YIELD OPTIMIZATION TECHNOLOGY

Precision Irrigation Management

INTEGRATED Systems Approach

- Apply water
  - At the right time
  - In the right amount
  - On every part of the field
    - **increase profitability**
    - **maximize irrigation efficiency**
    - **conserve natural resources**

CropMetrics YIELD OPTIMIZATION TECHNOLOGY



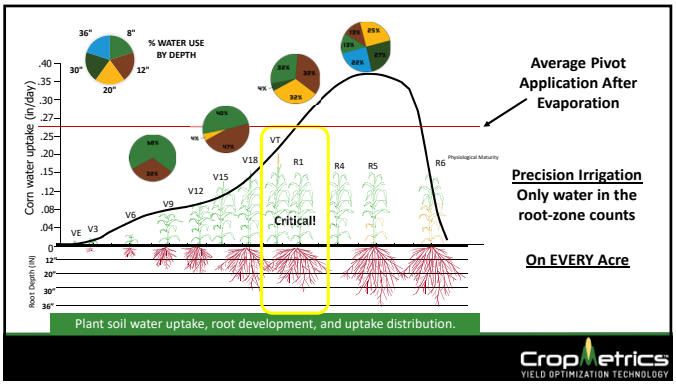
Precision Technology

??

How much do I irrigate?

When do I irrigate?

CropMetrics YIELD OPTIMIZATION TECHNOLOGY



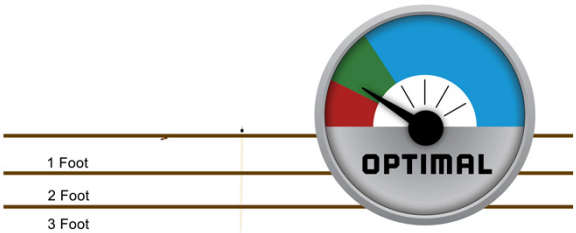
Plant soil water uptake, root development, and uptake distribution.

Average Pivot Application After Evaporation

Precision Irrigation
Only water in the root-zone counts

On EVERY Acre

CropMetrics YIELD OPTIMIZATION TECHNOLOGY



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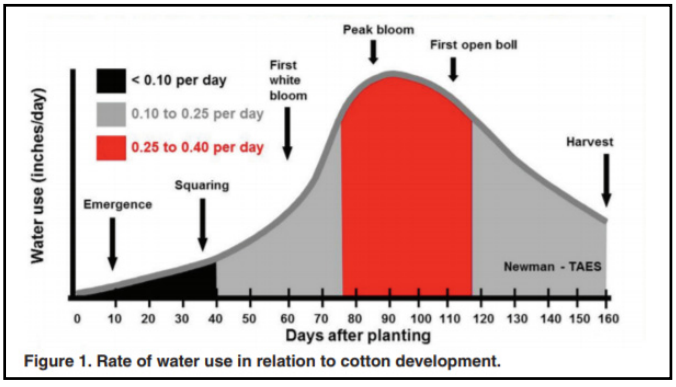
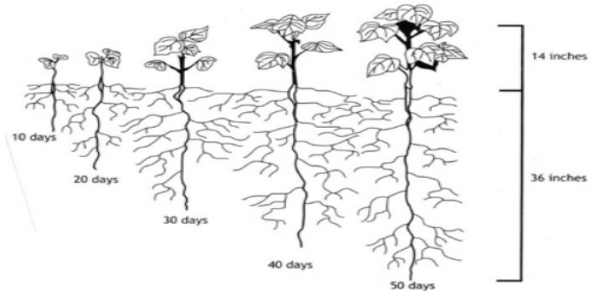


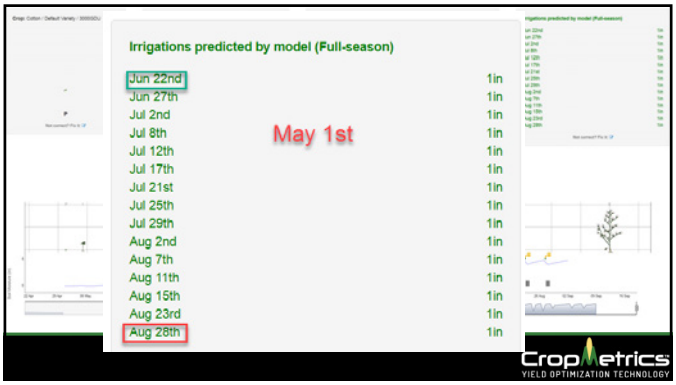
Figure 1. Rate of water use in relation to cotton development.

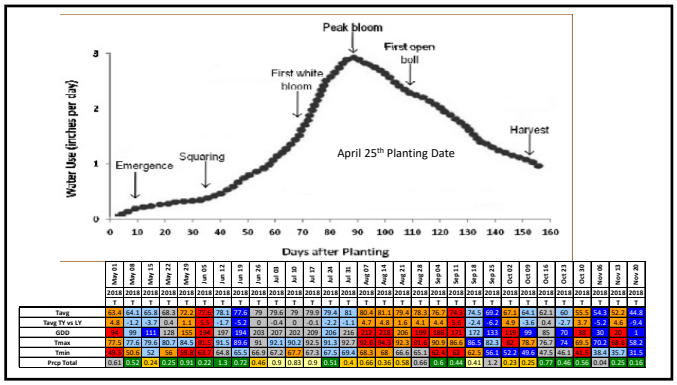
Rooting Depth in the 1st 50 Days

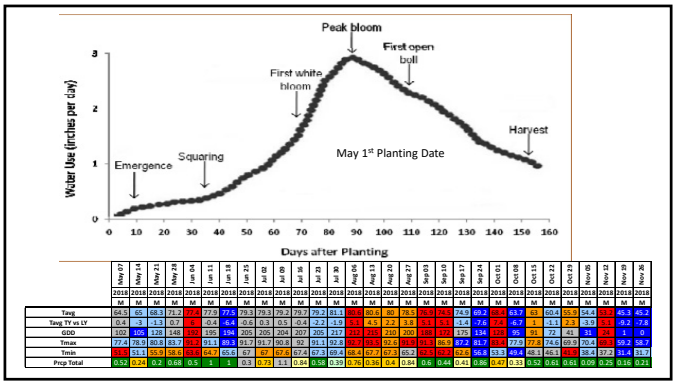


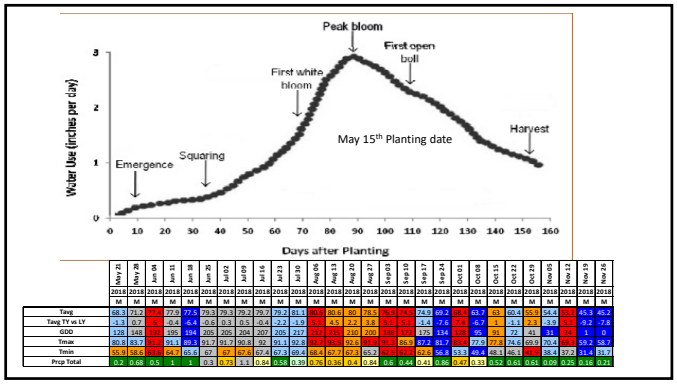
Irrigation Recommendations for Cotton

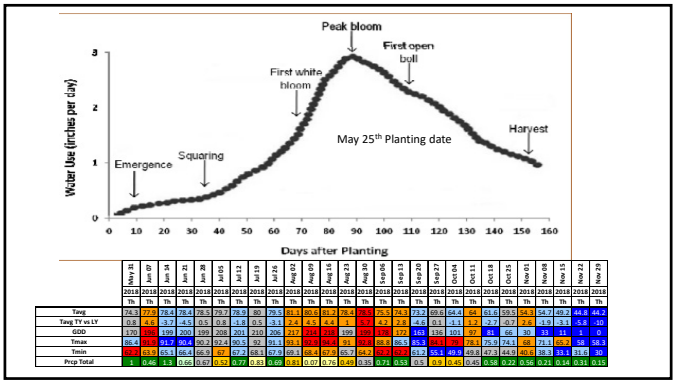
- Germination to 1st Square – Irrigate only to maintain growth and/or as a carrier of nutrients
- 1st Square – replace 30-35% of PET – add 5% per week for 4 weeks
- 1st Flower – 50-55% PET – add 10% for 4 weeks
- Peak Bloom – 90-95% PET –
- Continue till cotton is 25-50% open boll. Can cut back 10% for 3 weeks to finish the cotton.











Planting Date Effects on Cotton Water Use

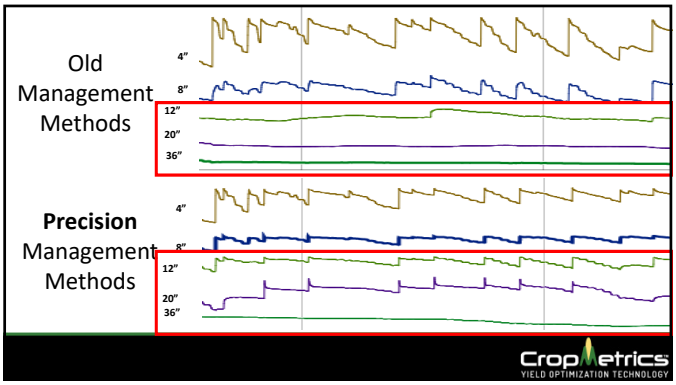
What's happening below the ground?

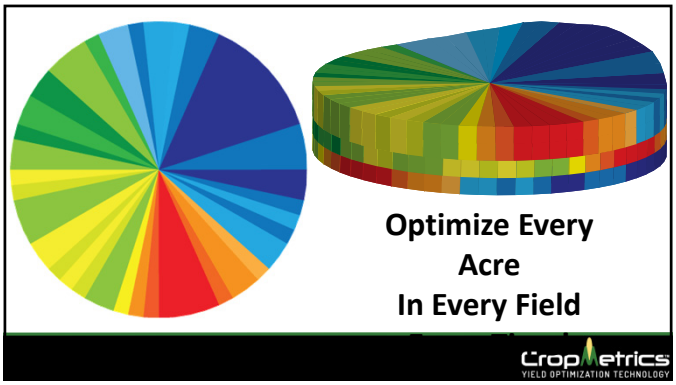
What's the cost of estimating?

The #1 way to **SAVE** money?
ELIMINATE WASTE

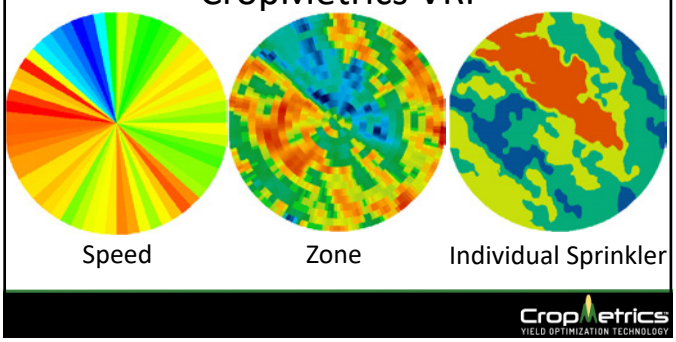
The #1 way to **MAKE** money?
MAXIMIZE ROI

Return on INPUT!





CropMetrics VRI



Precision Irrigation
What Determines Success?

- Increased Yields
- Decreased Inputs

Profit

CropMetrics
YIELD OPTIMIZATION TECHNOLOGY

CropMetrics™
Yield Optimization Technology

A Purposed and Adoptable Systems Approach to Increase Profitability

Lloyd Arthur Pivot 12 Field Information

- NG 3517 B2XF – 56,557ppa
- Planted – May 12th
- Fertility – 32-0-0 99.35lb/A
- Herbicide – Trifluralin (1qt), 2x-Roundup PowerMax(32oz), 2x-Engenia(12oz), Outlook(12.8oz)
- Growth Regulator – MepStar (12oz)
- Harvested - Nov. 2-4

#	Start	Stop	Area (ac)	Application Depth	Speed (%)	Soil AWC (in/profile)	Field Capacity	Wilting Point	Yield Goal	% Runoff
31	100	106	2.00	1.05	9.5	6.83	18.14	9.53	0	0
32	106	112	2.00	1.05	9.5	6.83	12.09	6.35	0	0
33	112	118	1.99	0.99	10.1	7.24	9.08	4.75	0	0
34	118	124	1.99	0.85	11.8	8.44	7.3	3.76	0	0
35	124	130	1.94	0.9	11.1	7.97	9.12	4.7	0	0
36	130	136	1.95	0.99	10.1	7.24	9.12	4.72	0	0
37	136	142	1.97	0.9	11.1	7.97	7.33	3.75	0	0
38	142	148	1.98	0.85	11.8	8.44	7.36	3.69	0	0
39	148	154	1.98	0.85	11.8	8.44	9.2	4.62	0	0
40	154	160	2.00	0.85	11.8	8.44	9.21	4.62	0	0
41	160	166	2.01	0.9	11.1	7.97	9.21	4.62	0	0
42	166	172	1.98	0.9	11.1	7.97	9.21	4.61	0	0
43	172	178	1.98	0.95	10.5	7.55	7.35	3.71	0	0

Irrigation Scheme	Application/Pass	Total inches applied inseason
NW VRI	1.00073	4.00
SE VRI	0.93426	3.74
NE Flat Rate	1.00015	4.00
SW Flat Rate	1.00028	4.00

4.93" applied **20.58" rainfall**

In-season irrigation events – May12, July 10th, July 17, July 26, Aug 8, Aug 20

Plant Differences September 9th

Flat Rate

VRI

TAWC VRI Project 2017 – Ralls, TX

Flat Rate

VRI

TAWC VRI Project 2017 – Ralls, TX

Flat Rate

VRI

TAWC VRI Project 2017 – Ralls, TX

Flat Rate

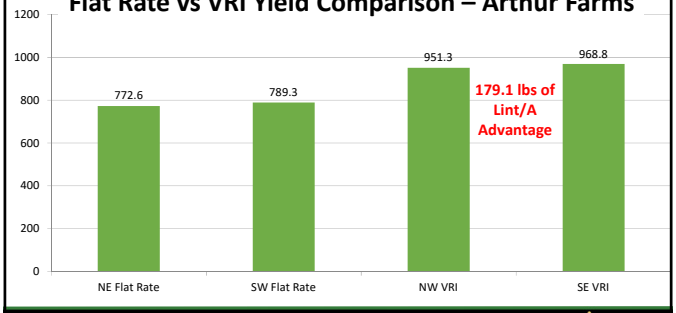
VRI

TAWC VRI Project 2017 – Ralls, TX

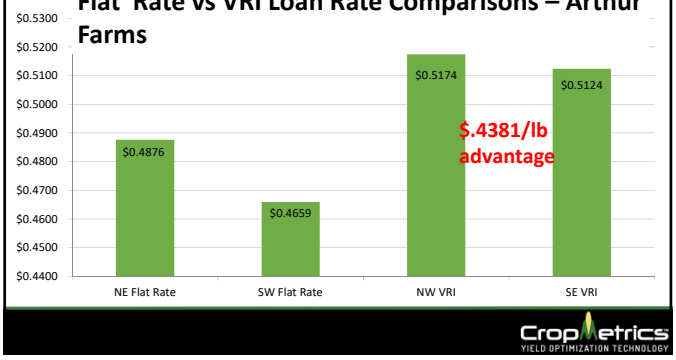
Flat Rate

VRI

Flat Rate vs VRI Yield Comparison – Arthur Farms



Flat Rate vs VRI Loan Rate Comparisons – Arthur Farms



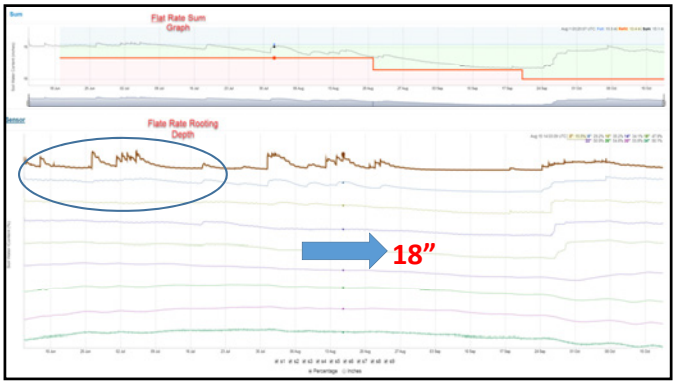
Flat Rate vs VRI Grade Comparisons – Arthur Farms

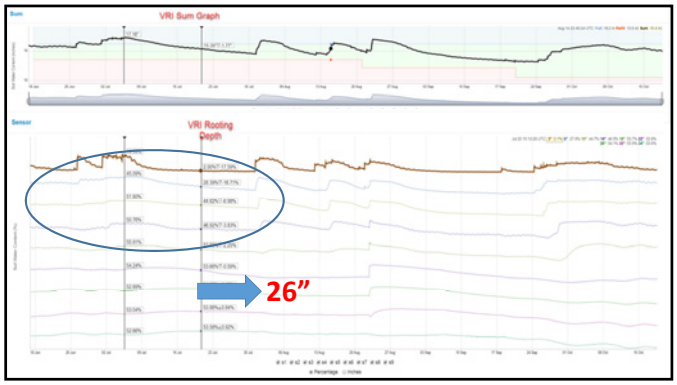
	Color	Leaf	Staple	Mic	Strength	Length	Uniformity	Loan
NE Flate Rate	41	3	36.0	32.6	30.8	112.1	79.7	$.4876
SW Flat Rate	42	3.3	35.7	32.6	30.8	111.2	79.2	$.4659
NW VRI	41	2.9	36.4	35.5	31.0	113.4	80.2	$.5174
SE VRI	31	2.7	36.2	34.2	31.3	112.4	79.5	$.5124

FOREFRONT AGRONOMY, LLC

Sector	Yield	Lint	Total
NE Flat Rate	772.6	.4876	$376.72
SW Flat Rate	789.3	.4659	$367.73
NW VRI	951.3	.5174	$492.20
SE VRI	968.8	.5124	$496.41
VRI Advantage	179.1	$.4381	$78.46
Probe Cost			-$22.08/A ($11.67)
VRI Cost			-$5/A
Controller Cost			-$16.66/A
			$34.72
Water savings of 0.25" @$8/inch		$2.00	**$36.72**

CropMetrics YIELD OPTIMIZATION TECHNOLOGY

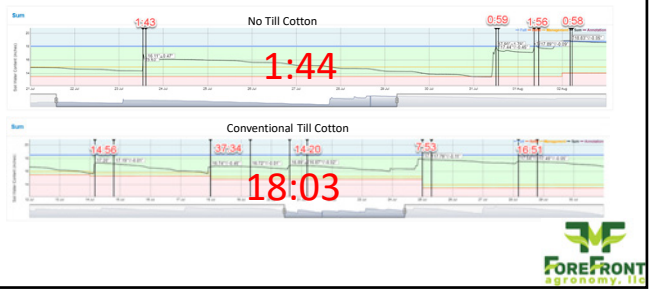




No-Till vs Conventional Till Infiltration Observations from 2017

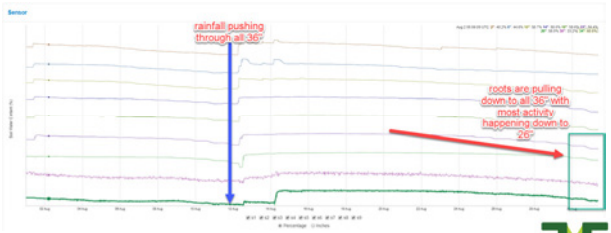
FOREFRONT agronomy, llc

Infiltration Rate Comparison



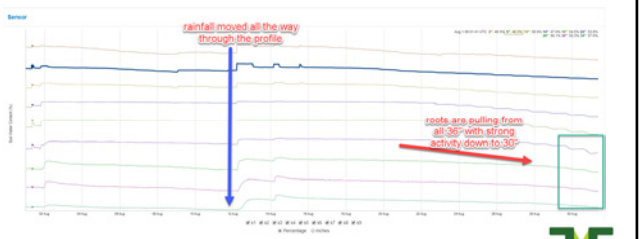
FOREFRONT agronomy, llc

Conventional Till Cotton Rooting Activity

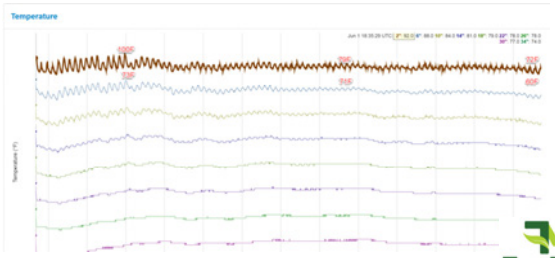


FOREFRONT agronomy, llc

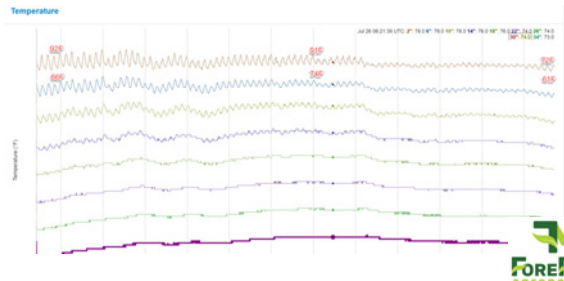
No Till Cotton Rooting Activity



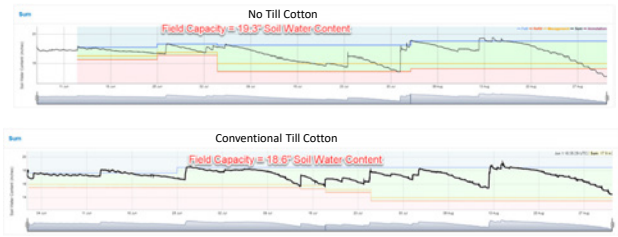
Conventional Till Cotton 2" Temperature



No Till Cotton 2" Temperature



Water Holding Capacity Comparison



Technology is <u>NOT</u> the Solution

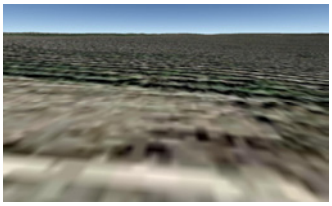
The <u>ADOPTION</u> of Technology is the Solution

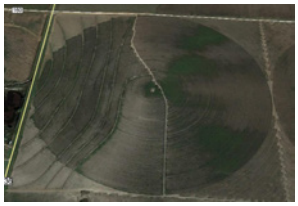
CropMetrics
YIELD OPTIMIZATION TECHNOLOGY

Lloyd's Thoughts on Precision Irrigation Technology

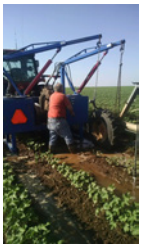
Pivot Access Roads

Slope & Elevation





Lloyds Thoughts on Precision Irrigation



Systemized Solutions for Irrigation

CropMetrics
Yield Optimization Technology

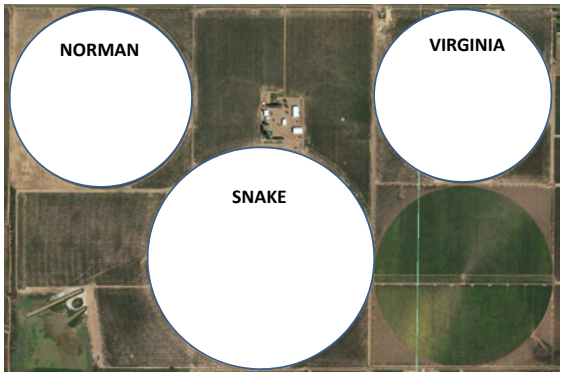
TAWC

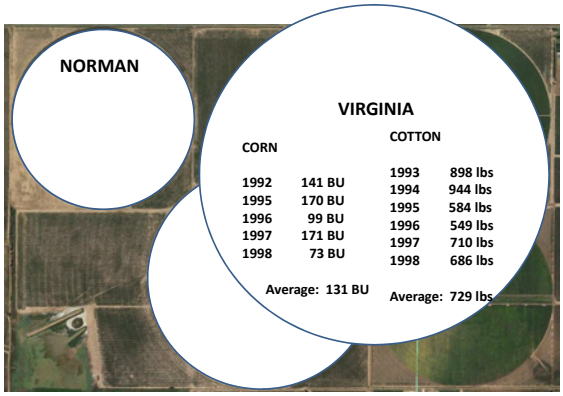
Jeff W. Miller
ForeFront Agronomy LLC
(806) 787-6954
forefrontagronomy@gmail.com
@jeffmillerttu

FIELDNET BY LINDSAY

When Less is More

RN Hopper
Texas Alliance for
Water Conservation
Producer





"Paradigm"

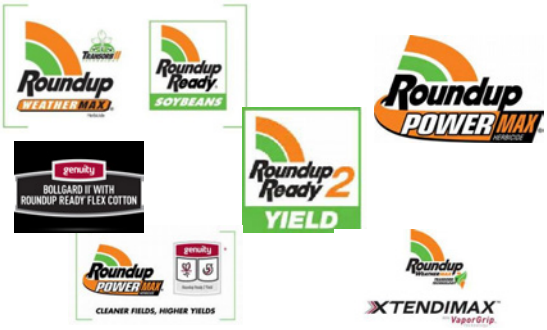
- : a philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalizations and the experiments performed in support of them are formulated; *broadly* : a philosophical or theoretical framework of any kind

  -Merriam-Webster

The "Row Water" Paradigm

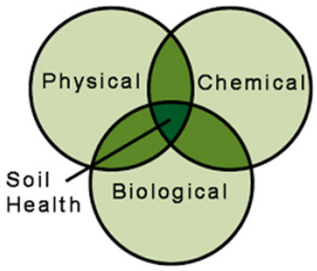

The "Pivot" Paradigm

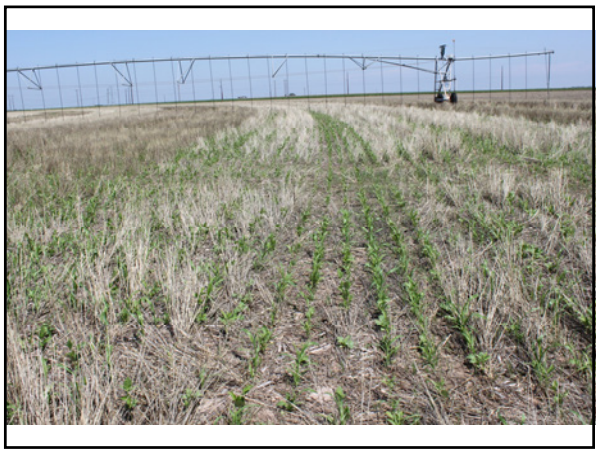
The "Roundup Ready" Paradigm



The “No-Till” Paradigm

The “Biological” Paradigm

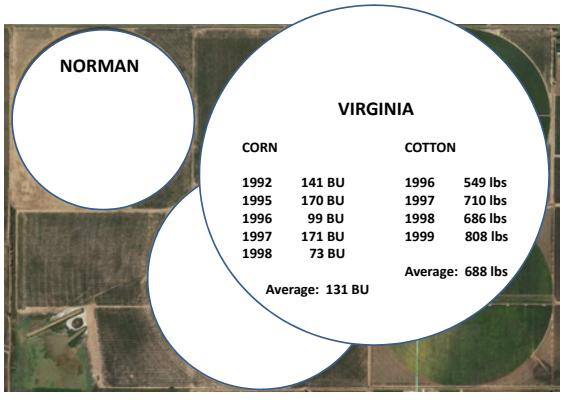


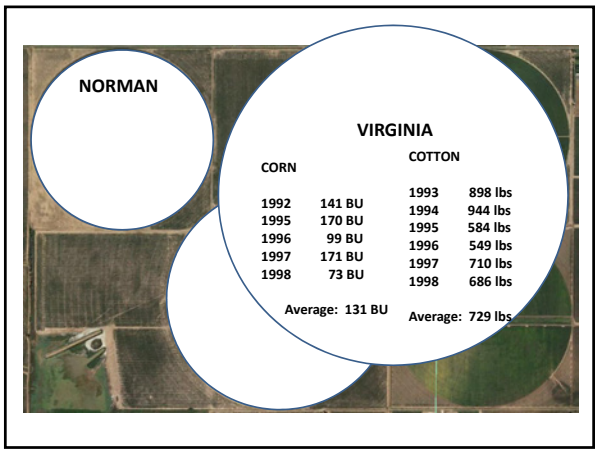


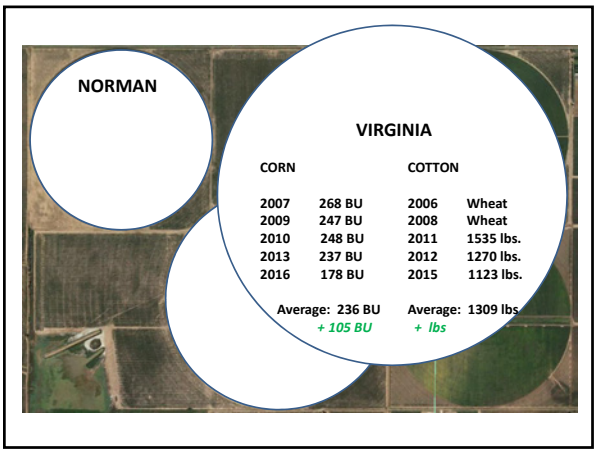
When Less is More

Less tillage equates to more. . .

- ❖ Fungal domination in your soil
- ❖ Increases in organic matter
- ❖ Greater aggregate stability
- ❖ Improved structure
- ❖ Increased water infiltration
- ❖ Increased water holding capacity

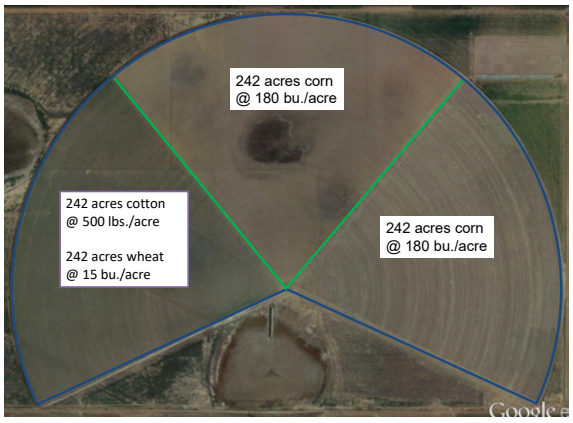


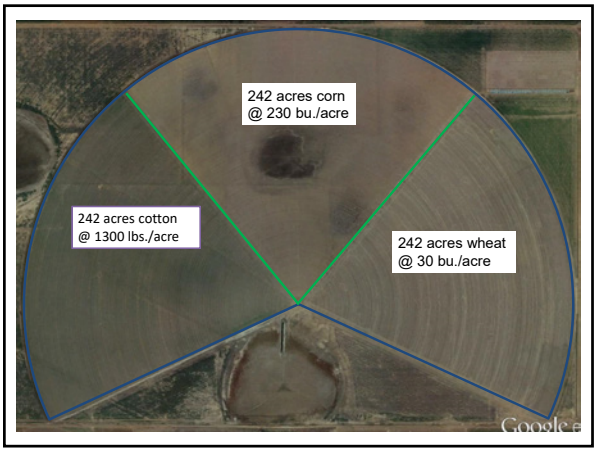




Shifting Paradigms

The "Staying in Business" Paradigm





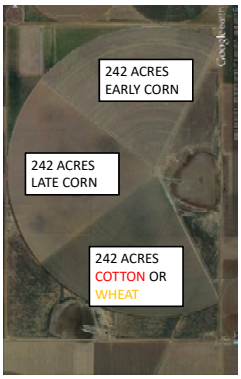
OUTPUTS:

CORN
180 BUSHELS on 484 ACRES @ $5.00/BU.
- $435,600

COTTON
500 LBS ON 242 ACRES @ $0.70/LB.
- $84,700

WHEAT
15 BUSHELS ON 242 ACRES @ $4.50/BU
- $16,335

TOTAL: $ 536,635



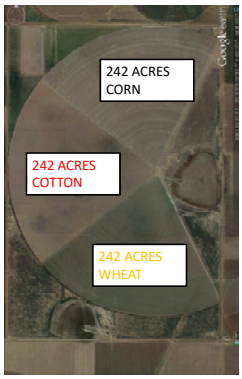
OUTPUTS:

CORN
230 BUSHELS ON 242 ACRES @ $5.00/BU.
- $278,300

COTTON
1300 LBS ON 242 ACRES @ $0.70/LB.
- $220,220

WHEAT
30 BUSHELS ON 242 ACRES @ $4.50/BU
- $32,670

TOTAL: $ 531,190



CORN/CORN/COTTON-WHEAT

180 BUSHELS ON 484 ACRES @ $5.00/BU.
- $435,600

500 LBS ON 242 ACRES @ $0.70/LB.
- $84,700

15 BUSHELS ON 242 ACRES @ $4.50/BU
- $16,335

TOTAL: $ 536,635

CORN/COTTON/WHEAT

230 BUSHELS ON 242 ACRES @ $5.00/BU.
- $278,300

1300 LBS ON 242 ACRES @ $0.70/LB.
- $220,220

30 BUSHELS ON 242 ACRES @ $4.50/BU
- $32,670

TOTAL: $ 531,190

WOULD YOU TRADE

- 31,460 BU CORN ($5)
  $157,300
- 387.2 BALES COTTON ($0.70)
  $135,520
- 3,630 BU WHEAT ($4.50)
  $16,335
- $48,400 REDUCED PRODUCTION COST

$200,255
+ $42,955

WOULD YOU TRADE

- 31,460 BU CORN ($7)
  $220,220
- 387.2 BALES COTTON ($0.74)
  $143,264
- 3,630 BU WHEAT ($6.50)
  $23,595
- $60,600 REDUCED PRODUCTION COST

$227,459
+ 7,239

WOULD YOU TRADE

- 31,460 BU CORN ($8)
  $251,680
- 484 BALES COTTON 1500 lbs. ($0.70)
  $169,400
- 6,050 BU WHEAT 40 BU ($7.50)
  $45,375
- $48,400 REDUCED PRODUCTION COST
  $263,175

+ $11,495

WHAT IF WATER IS NOT LIMITING?

COTTON/CORN

- 240 ACRES CORN AT 220 BU $5.00/BU
- 240 ACRES COTTON AT 1300 LBS $0.70/LB

COTTON /CORN/WHEAT

- 160 ACRES CORN AT 245 BU $5.00/BU
- 160 ACRES OF COTTON AT 1600 LBS $0.70/LB
- 160 ACRES OF WHEAT AT 50 BU $4.50/BU
- $64,000 REDUCED PRODUCTION COST

WOULD YOU RATHER

- 13,600 BU CORN ($5) $68,000
- 112 BALES COT ($0.70) $39,200

$107,200

- 9,600 BU WHEAT ($4.50) $43,200
- $64,000 REDUCED PRODUCTION COST

$107,200

WOULD YOU RATHER

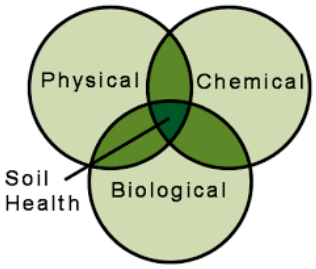
- 13,600 BU CORN ($7) $95,200
- 112 BALES COT ($0.70) $39,200

$134,400

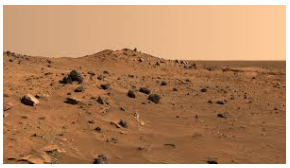
- 9,600 BU WHEAT ($6.50) $62,400
- $72,000 REDUCED PRODUCTION COST

$134,400

Healthy Soil is Comprised of 3 *Equal* Components?



Biology Reigns Supreme



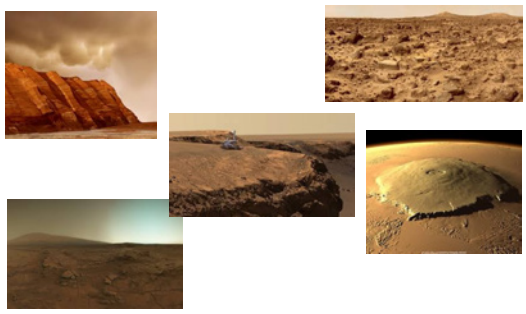

Biology is the most powerful geological force in existence.






Plants and microbes modify the soil in a way that our chisels and equipment never could.

"Because soil without biology is just geology"
- Ray Archuleta



Genesis 2:7
The Bridge

And the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul.

Genesis 3:19

In the sweat of thy face shalt thou eat bread, till thou return unto the ground; for out of it wast thou taken: for dust thou art, and unto dust shalt thou return.

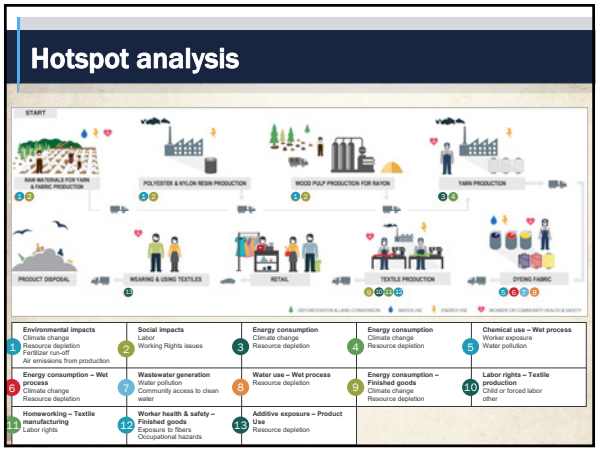
When Less is More

SOIL HEALTH SYMPOSIUM
FEB 13-14
BAYER MUSEUM

TAMARA DANIEL
(254) 778-8741

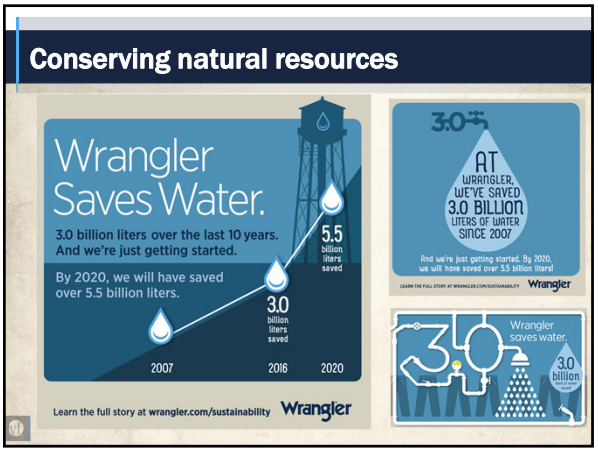

Wrangler
Accelerating our global citizenship
Roian Atwood, Director of Sustainability


Wrangler since 1947
Historical brand:
Current brand representation:
Wrangler
Wrangler RED
Wrangler JEANS CO
Wrangler
RUSTLER
HARD WORKING JEANS...GUARANTEED
Wrangler FIVE STAR
CASEY JONES
WRANGLER BLUE BELL
Wrangler PRCA OFFICIAL DEALER
2


Hotspot analysis
START
RAW MATERIALS FOR YARN & FABRIC PRODUCTION
POLYESTER & NYLON RESIN PRODUCTION
WOOD PULP PRODUCTION FOR RAYON
YARN PRODUCTION
PRODUCT DISPOSAL
WEARING & USING TEXTILES
RETAIL
TEXTILE PRODUCTION
DYEING FABRIC
1 Environmental impacts Climate change Resource depletion Fertilizer run-off Air emissions from production
2 Social impacts Labor Working Rights issues
3 Energy consumption Climate change Resource depletion
4 Energy consumption Climate change Resource depletion
5 Chemical use – Wet process Worker exposure Water pollution
6 Energy consumption – Wet process Climate change Resource depletion
7 Wastewater generation Water pollution Community access to clean water
8 Water use – Wet process Resource depletion
9 Energy consumption – Finished goods Climate change Resource depletion
10 Labor rights – Textile production Child or forced labor other
11 Homeworking – Textile manufacturing Labor rights
12 Worker health & safety – Finished goods Exposure to fibers Occupational hazards
13 Additive exposure – Product Use Resource depletion

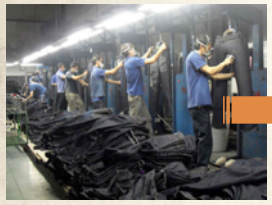

Modern supply chain issues
RECENT HEADLINES:
SOURCING JOURNAL
Mumbai Factory Shut Down After Untreated Wastewater Turns Dogs Blue
ECOTEXTI
The environmental magazine for the global textile supply chain
Most Bangladesh mills ignore effluent treatment


A Wrangler approach...
WE TAKE CARE OF:
THE LAND
OUR PEOPLE
THE INDUSTRY
THE FUTURE


Conserving natural resources
Wrangler Saves Water.
3.0 billion liters over the last 10 years. And we're just getting started.
By 2020, we will have saved over 5.5 billion liters.
5.5 billion liters saved
3.0 billion liters saved
2007
2016
2020
Learn the full story at wrangler.com/sustainability
Wrangler
3.0
AT WRANGLER, WE'VE SAVED 3.0 BILLION LITERS OF WATER SINCE 2007
And we're just getting started. By 2020, we will have saved over 5.5 billion liters!
Wrangler saves water.
3.0 billion

Embracing innovative practices

Hand sanding



Laser finished

Past

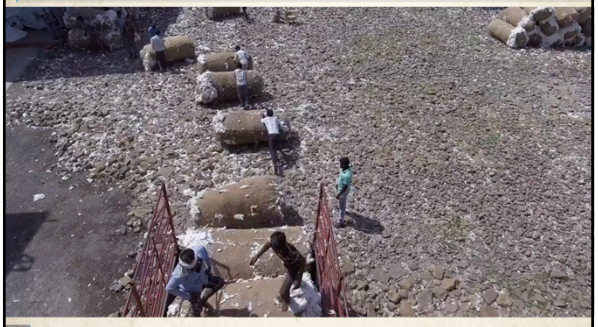
Today

More modern supply chain issues:

Sign the petition

To: Wrangler, Calvin Klein, Tommy Hilfiger, Guess, Express, American Eagle and Lee: Commit to the Paris Climate Agreement and take responsibility for your product's emissions.

More modern supply chain issues:



Even more modern supply chain issues:

The land feeds us...

Wrangler wants to return the favor.

Training our future leaders

Soil Health Conference with FFA

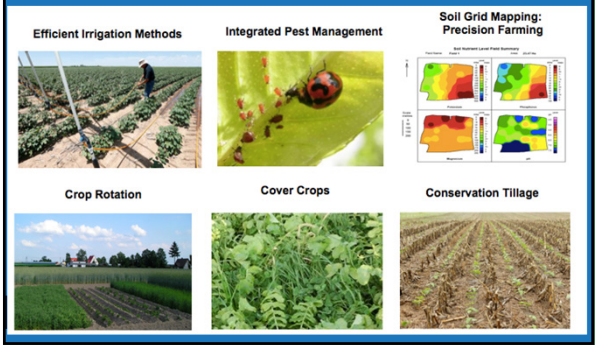
for aspiring young farmers and agroecologists

at Wrangler headquarters
April 2017

NRCS Natural Resources Conservation Service

Wrangler

Advocating for specific practices…



Tracking + measuring = credit for good practice

Wrangler's healthy soils journey…

In their own words…

Closing remarks

Improving Corn Water Use With Hybrid Selection: Trait evaluation for both dryland and limited irrigated systems

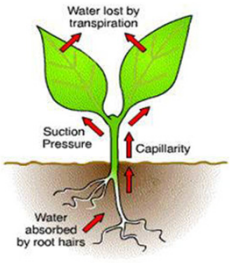
2018 TAWC Water College, Lubbock Texas
Jourdan M. Bell
Texas A&M AgriLife Extension and Research - Amarillo

TEXAS A&M AGRILIFE EXTENSION TEXAS A&M AGRILIFE RESEARCH

Crop Water Use

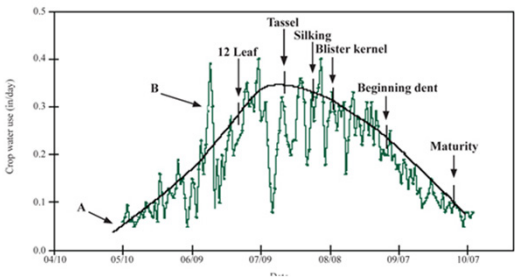
Water use is driven by environmental demands

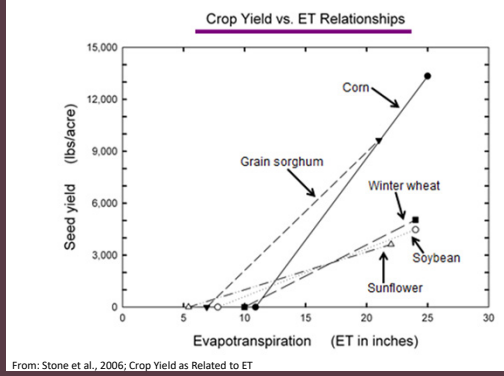
1. Maintain turgor
2. Transport nutrients
3. Transpiration and Photosynthesis



WATER USE = YIELD

Corn Water Use





From: Stone et al., 2006; Crop Yield as Related to ET

Irrigated or Dryland

Maximum corn water use ~ 0.35 in./day at tassel

Water use ≥ 0.3 in./day from 12-leaf through blister ~ 2 months

How does this impact your water plan and hybrid selection?

Corn Hybrid Traits that Enhance Water Use

- Maturity – Total water use changes with maturity class NOT daily water use
- Drought Tolerance – does not always mean plants use less water
- Ear Flex
- Leaf Orientation
- Aggressive Silking
- Staygreen

Corn Maturity Classes

- Longer season hybrids do not always out yield earlier maturing hybrids
  - Longer season may have a greater yield potential, but final yield a function of specific agronomic traits and management
- Corn Belt: Greater concern about RM as related to GDDs
- Texas High Plains not a GDD limited region for corn
  - Corn heat units calculated on a 50°F base not 60°F like cotton
- Texas High Plains challenges: water and heat
  - greater RM class = greater seasonal crop water demand
  - early maturing hybrids often have kernel integrity issues

GDD and Maturity Classification

Maturity	Days	GDD
Early	85-100	2100-2400
Mid	101-130	2400-2800
Full	131-145	2900-3200

Average hybrid requirement is 2700 GDDs

- 1400 GDD planting to mid-silk
- 1925 GDD planting to soft-dough
- 2450 GDD planting to dent
- 2700 GDD planting to physiological maturity

Drought Tolerance ≠ Heat Tolerance

- At increased temperatures less assimilate is produced per growth stage
- High temperatures damage pollen
  - Pollen shed occurs early to mid-morning
  - As we move east across the Panhandle we often see a yield reduction due to increased night-time temperatures
- In susceptible hybrids, high temperatures during grain-fill can result in poor kernel integrity
- Manage maturity class and/or planting date to offset heat stress

Kernel Integrity

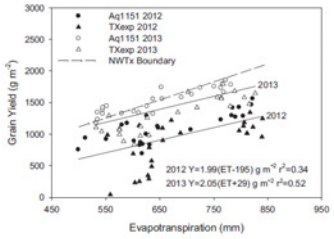
- Early planted, early maturing hybrids planted early can be prone to kernel splitting/silk cut
  1. Rapid drying of kernel surface
     - Premature hardening of the kernel surface
  2. Followed by rehydration at nights results in splitting
- This often not considered a problem but…
  - 2018 increased fumonisin levels correlated to poor kernel integrity

Drought Tolerant Hybrids

- AQUAmax (Pioneer)
- Droughtgard (Monsanto)
- Artesian (Syngenta)

Drought Tolerant Hybrids and WUE

- Traditional Hybrids: As water use decreases, yield decreases and WUE decreases
- Drought tolerant hybrids maintain WUE because they seem to partition water into biomass more efficiently (Tolk, 2016)



Drought Tolerant Hybrids

AQUAmax (Pioneer)

- Native Traits
- Enhanced stay green for deeper kernel set
- Aggressive silking
- Stomatal regulation

Drought Tolerant Hybrids

Droughtgard (Monsanto)

- Combination of native traits and transgenic
- Cold shock protein – "RNA chaperone"
- Temporal pattern of water use varies not necessarily seasonal water use – ensures plant reaches flowering under favorable soil moisture

Drought Tolerant Hybrids

Artesian (Syngenta)

- Native Traits
- Enhanced stay green for deeper kernel set
- Aggressive silking
- Robust root system

Ear Flex: Provides flexibility to match the population to the available water

1. **Fixed Ear (Determinate)**
   - Ear size not easily changed
   - Plant at higher populations to optimize yield
2. **Semi-flex Ear**
   - Less flex than true flex
   - Maintain size at higher population
   - Flexes to preserve yield at lower populations
3. **Flex Ear**
   - Ear size increases with optimum inputs
   - Maximizes yields at LOWER populations
   - Hybrids flex down under high populations and poor fertility

Leaf Orientation

1. Upright Leaf Hybrids
   - Ideal for high populations, narrower rows
   - Leaves grows straight up
   - Allows light to penetrate canopy to maximize photosynthesis
2. Pendulum Leaf Hybrids
   - Ideal for low populations or in a situation with low crop residue
   - Leaves "flop-out" to enhance canopy closure
   - Minimize soil evaporation
   - Intercept light
3. Semi-upright hybrids
   - Best of both worlds
   - Lower leaves are pendulum to shade soil and capture sunlight
   - Upper leaves are very upright to allow sunlight to penetrate the canopy

Aggressive Silking

- Water stress delays silking
- Hybrids marketed to ensure that pollination and silking coincide
- Objective to increases kernel number

Images from Pioneer.com

Do not confuse aggressive silks with unusually Long Silks

- Cool temperatures
- Cloudy weather
- Sufficient soil moisture
- Silking prior to pollen shed- asynchrony in pollination

Increased Staygreen Expression in Corn

- Plant Continues photosynthesis under drought - Leaves staygreen rather than senesce
- Increased dry matter production during grain development
- Increases duration of grain filling-- deeper kernel set, greater test weight
- Assimilate stored in the stem enhances filling rate after assimilate used from leaves…but you need to keep the plant standing

In order to get the most out of your staygreen trait…you have to manage in-season Nitrogen

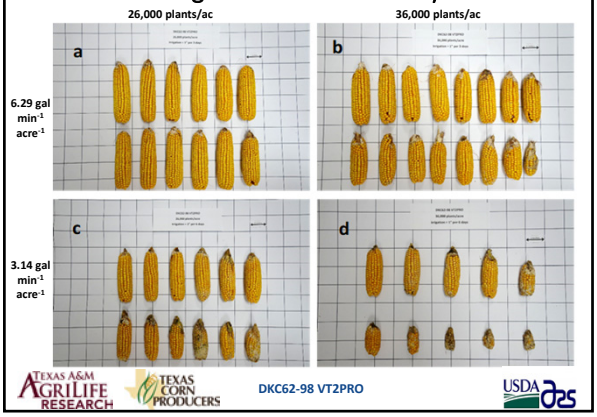
- Green leaves need N
- N deficient plants have reduced hydraulic conductivity through root cells
- Optimum fertility improves production per unit of water

- Nitrogen management is a seasonal program
- How will you split your fertilizer applications? **2,3 or even 4 splits?**

Position Corn Hybrids and Population to Available Water:

- Racehorse hybrid environment
  - Highly productive environment (fertility and water)
  - Upright leaves and determinate ear to push population
- Drought environment
  - Pendulum leaf
  - Lower populations and a flex ear to maximize yield
- Variable soils
  - Semi-upright leaf and semi-flex ear

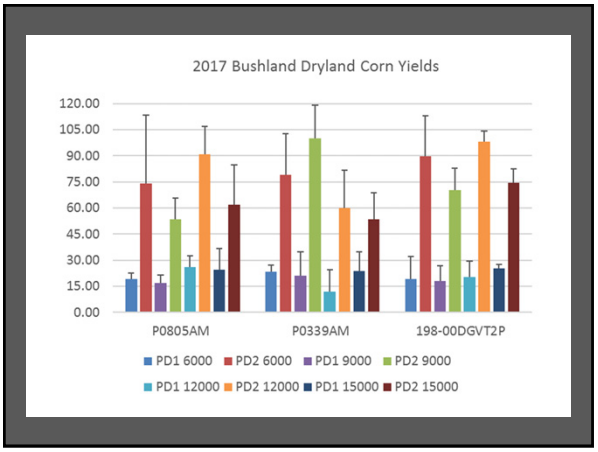
Management must Match Hybrid

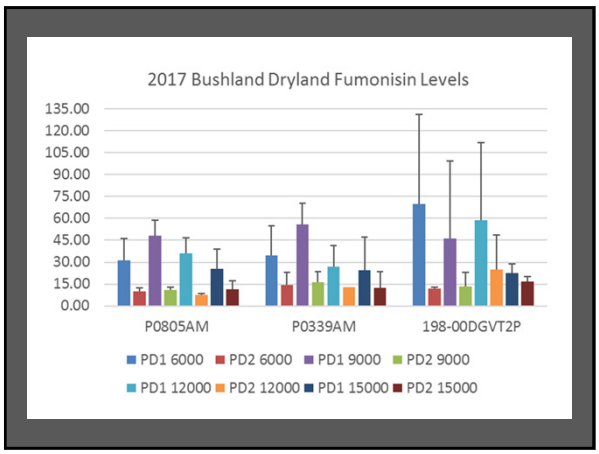


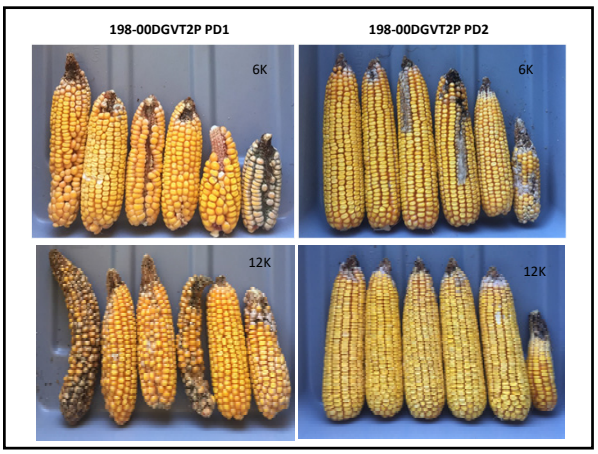

2017 Bushland
Dryland Corn Trial
Calvin Trostle, Jourdan Bell, Qingwu Xue,
Ronnie Schnell and Diana Jones
TEXAS CORN PRODUCERS


Bushland Dryland Corn
Planted May 5
Photo Taken August 17


Bushland Dryland Corn
Planted June 20
Photo Taken August 17


2017 Bushland Dryland Corn Yields
120.00
105.00
90.00
75.00
60.00
45.00
30.00
15.00
0.00
P0805AM
P0339AM
198-00DGVT2P
PD1 6000 PD2 6000 PD1 9000 PD2 9000
PD1 12000 PD2 12000 PD1 15000 PD2 15000


2017 Bushland Dryland Fumonisin Levels
135.00
120.00
105.00
90.00
75.00
60.00
45.00
30.00
15.00
0.00
P0805AM
P0339AM
198-00DGVT2P
PD1 6000 PD2 6000 PD1 9000 PD2 9000
PD1 12000 PD2 12000 PD1 15000 PD2 15000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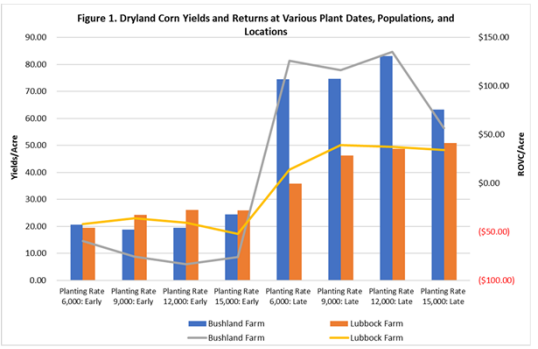
198-00DGVT2P PD2
6K
6K
12K
12K



Economic Analyses Completed by D. Jones

Table 1. Projected 2018 Dryland Corn Profitabilty at Various Seeding Rates, Locations and Planting Dates - Small Plot Results

Bushland Farm	Average Yield/Ac	Projected Price/Bu	Total Revenue Per Acre	Total Variable Costs Per Acre	Return Over Variable Costs	Total Costs Per Acre	Return Over Total Costs
Planting Rate 6,000: Early	20.60	$3.85	$79.27	$138.76	($59.49)	$189.17	($109.90)
Planting Rate 9,000: Early	18.80	$3.85	$72.30	$148.05	($75.75)	$198.46	($126.16)
Planting Rate 12,000: Early	19.50	$3.85	$75.00	$158.37	($83.37)	$208.78	($133.78)
Planting Rate 15,000: Early	24.50	$3.85	$94.33	$170.45	($76.13)	$220.86	($126.54)
Planting Rate 6,000: Late	74.40	$3.85	$286.59	$160.84	$125.75	$211.25	$75.34
Planting Rate 9,000: Late	74.60	$3.85	$287.17	$170.93	$116.24	$221.34	$65.83
Planting Rate 12,000: Late	83.00	$3.85	$319.55	$184.41	$135.14	$234.82	$84.73
Planting Rate 15,000: Late	63.20	$3.85	$243.13	$186.30	$56.83	$236.71	$6.42
Lubbock Farm							
Planting Rate 6,000: Early	19.47	$3.85	$74.96	$117.17	($42.21)	$167.58	($92.62)
Planting Rate 9,000: Early	24.30	$3.85	$93.56	$129.76	($36.20)	$180.17	($86.61)
Planting Rate 12,000: Early	26.10	$3.85	$100.49	$141.10	($40.62)	$191.51	($91.03)
Planting Rate 15,000: Early	25.87	$3.85	$99.60	$151.62	($52.02)	$202.03	($102.43)
Planting Rate 6,000: Late	35.80	$3.85	$137.83	$123.86	$13.97	$174.27	($36.44)
Planting Rate 9,000: Late	46.23	$3.85	$177.99	$138.75	$39.24	$189.16	($11.17)
Planting Rate 12,000: Late	48.73	$3.85	$187.61	$150.38	$37.23	$200.79	($13.18)
Planting Rate 15,000: Late	50.93	$3.85	$196.08	$161.89	$34.19	$212.30	($16.22)
Small Plot Averages	**41.00**	**$3.85**	**$157.84**	**$152.04**	**$5.80**	**$202.45**	**($44.61)**

Bushland plots were planted 5-5-2017 and 6-28-17; Lubbock plots were planted 5-2-17 and 6-30-17

Bushland Farm	Average Yield/Acre	Total Variable Costs Per Acre	Break Even Price to Cover VC	Total Costs Per Acre	Break Even Price to Cover TC
Planting Rate 6,000: Early Planting	20.60	$138.76	$6.74	$189.17	$9.19
Planting Rate 9,000: Early Planting	18.80	$148.05	$7.88	$198.46	$10.57
Planting Rate 12,000: Early Planting	19.50	$158.37	$8.13	$208.78	$10.72
Planting Rate 15,000: Early Planting	24.50	$170.45	$6.96	$220.86	$9.01
Planting Rate 6,000: Late Planting	74.40	$160.84	$2.16	$211.25	$2.84
Planting Rate 9,000: Late Planting	74.60	$170.93	$2.29	$221.34	$2.97
Planting Rate 12,000: Late Planting	83.00	$184.41	$2.22	$234.82	$2.83
Planting Rate 15,000: Late Planting	63.20	$186.30	$2.95	$236.71	$3.75
Lubbock Farm					
Planting Rate 6,000: Early Planting	19.47	$117.17	$6.02	$167.58	$8.61
Planting Rate 9,000: Early Planting	24.30	$129.76	$5.34	$180.17	$7.41
Planting Rate 12,000: Early Planting	26.10	$141.10	$5.41	$191.51	$7.34
Planting Rate 15,000: Early Planting	25.87	$151.62	$5.86	$202.03	$7.81
Planting Rate 6,000: Late Planting	35.80	$123.86	$3.46	$174.27	$4.87
Planting Rate 9,000: Late Planting	46.23	$138.75	$3.00	$189.16	$4.09
Planting Rate 12,000: Late Planting	48.73	$150.38	$3.09	$200.79	$4.12
Planting Rate 15,000: Late Planting	50.93	$161.89	$3.18	$212.30	$4.17
Small Plot Averages	**41.00**	**$152.04**	**$4.67**	**$202.45**	**$6.27**

Bushland plots were planted 5-5-2017 and 6-28-17; Lubbock plots were planted 5-2-17 and 6-30-17

Bushland Farm	Average Price/Bu	Total Variable Costs Per Acre	Break Even Yield to Cover VC	Total Costs Per Acre	Break Even Yield to Cover TC
Planting Rate 6,000: Early Planting	$3.85	$138.76	36.05	$189.17	49.10
Planting Rate 9,000: Early Planting	$3.85	$148.05	38.50	$198.46	51.50
Planting Rate 12,000: Early Planting	$3.85	$158.37	41.15	$208.78	54.20
Planting Rate 15,000: Early Planting	$3.85	$170.45	44.30	$220.86	57.40
Planting Rate 6,000: Late Planting	$3.85	$160.84	41.70	$211.25	54.90
Planting Rate 9,000: Late Planting	$3.85	$170.93	44.40	$221.34	57.50
Planting Rate 12,000: Late Planting	$3.85	$184.41	47.90	$234.82	61.00
Planting Rate 15,000: Late Planting	$3.85	$186.30	48.40	$236.71	61.50
Lubbock Farm					
Planting Rate 6,000: Early Planting	$3.85	$117.17	30.43	$167.58	43.53
Planting Rate 9,000: Early Planting	$3.85	$129.76	33.70	$180.17	46.80
Planting Rate 12,000: Early Planting	$3.85	$141.10	36.65	$191.51	49.74
Planting Rate 15,000: Early Planting	$3.85	$151.62	39.38	$202.03	52.48
Planting Rate 6,000: Late Planting	$3.85	$123.86	32.17	$174.27	45.26
Planting Rate 9,000: Late Planting	$3.85	$138.75	36.04	$189.16	49.13
Planting Rate 12,000: Late Planting	$3.85	$150.38	39.06	$200.79	52.15
Planting Rate 15,000: Late Planting	$3.85	$161.89	42.05	$212.30	55.14
Small Plot Averages	**$3.85**	**$152.04**	**39.49**	**$202.45**	**52.58**

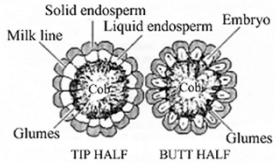
Bushland plots were planted 5-5-2017 and 6-28-17; Lubbock plots were planted 5-2-17 and 6-30-17

Dryland Data Summary

- No Significant yield difference between hybrids
- Significant difference between planting dates
- Greatest economic return for second planting date at 12,000 seed/acre population
- One year data set -- multiple years needed to evaluate production stability

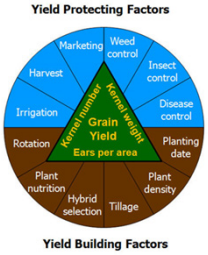
Last thought…..

- Does the last inch of water matter…depends on the hybrid
- ROT…shut off irrigation at milk line…depends on the hybrid
- We can control irrigation, agronomics, but we cannot control the environment



Conclusions

- Don't expect irrigation to compensate for poor agronomics
- Don't expect agronomics to compensate for poor irrigation
- Agronomic plan must complement available water



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General Notes

Wyman Meinzer

The TAWC project was made possible through a grant from the
Texas Water Development Board

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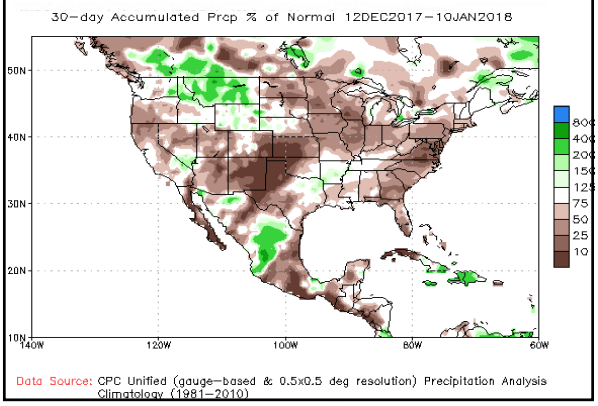
Long Range Forecast 2018: Drought, Deluge, or "Normal"?

Weather 5280

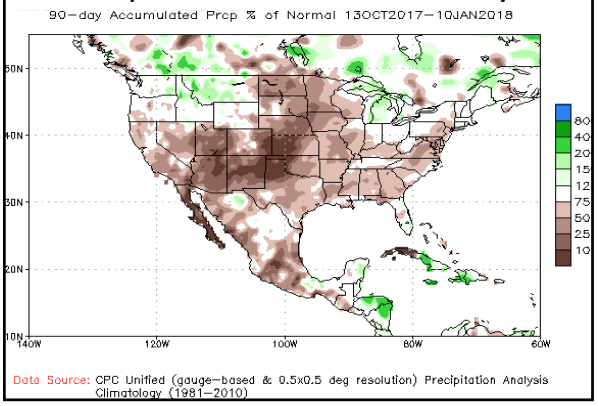
Current Status

Weather 5280

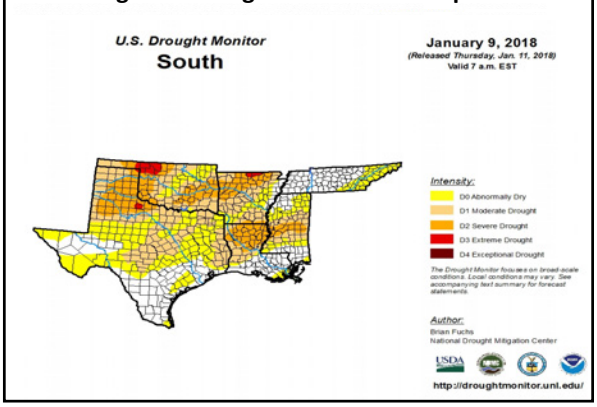
Precipitation % of "Normal" Past 30 Days



Precipitation % of "Normal" Past 90 Days



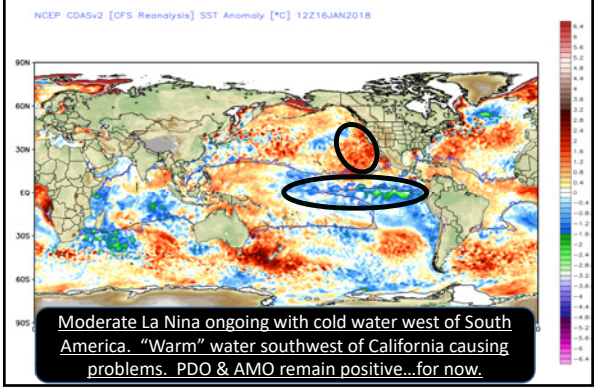
Regional Drought Continues to Expand



A Look at The Oceans

Weather 5280

Sea Surface Temperature Anomalies 1/16/18

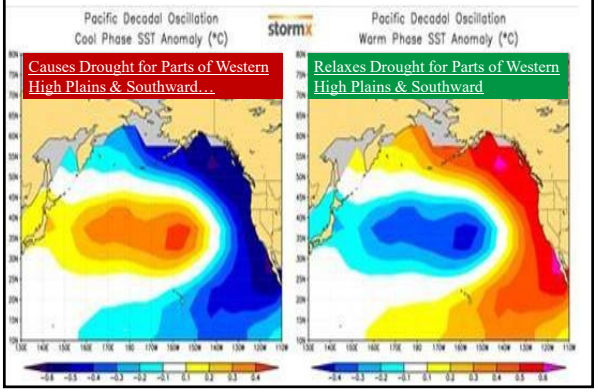


Moderate La Nina ongoing with cold water west of South America. "Warm" water southwest of California causing problems. PDO & AMO remain positive…for now.

Pacific Decadal Oscillation
Negative = Cold Positive = Warm

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC
2005	0.44	0.81	1.36	1.03	1.86	1.17	0.66	0.25	-0.46	-1.32	-1.50	0.20
2006	1.03	0.66	0.05	0.40	0.48	1.04	0.35	-0.65	-0.94	-0.05	-0.22	0.14
2007	0.01	0.04	-0.36	0.16	-0.10	0.09	0.78	0.50	-0.36	-1.45	-1.08	-0.58
2008	-1.00	-0.77	-0.71	-1.52	-1.37	-1.34	-1.67	-1.70	-1.55	-1.76	-1.25	-0.87
2009	-1.40	-1.55	-1.59	-1.65	-0.88	-0.31	-0.53	0.09	0.52	0.27	-0.40	0.08
2010	0.83	0.82	0.44	0.78	0.62	-0.22	-1.05	-1.27	-1.61	-1.06	-0.82	-1.21
2011	-0.92	-0.83	-0.69	-0.42	-0.37	-0.69	-1.86	-1.74	-1.79	-1.34	-2.33	-1.79
2012	-1.38	-0.85	-1.05	-0.27	-1.26	-0.87	-1.52	-1.93	-2.21	-0.79	-0.59	-0.48
2013	-0.13	-0.43	-0.63	-0.16	0.08	-0.78	-1.25	-1.04	-0.48	-0.87	-0.11	-0.41
2014	0.30	0.33	0.97	1.13	1.81	0.82	0.70	0.67	1.08	1.49	1.72	2.51
2015	2.45	2.35	2.00	1.44	1.22	1.54	1.84	1.56	1.94	1.47	0.86	1.01
2016	1.53	1.75	2.40	2.62	2.35	2.03	1.25	0.52	0.45	0.56	1.88	1.17
2017	0.77	0.70	0.74	1.12	0.88	0.79	0.10	0.09	0.32	0.05	0.15	0.50

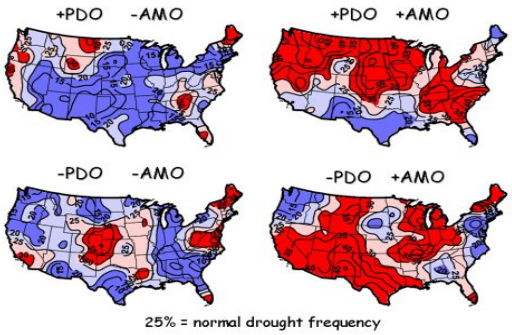
Pacific Decadal Oscillation Phases



Atlantic Multi-decadal Oscillation
Negative = Cold Positive = Warm

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC
2005	-0.04	0.06	1.37	0.51	0.88	1.65	0.71	1.05	0.77	0.99	0.34	1.00
2006	0.72	0.77	1.01	0.43	0.71	0.02	0.34	1.21	1.80	1.97	1.14	0.05
2007	0.32	0.95	-0.14	0.65	-0.14	0.82	1.56	0.81	1.07	1.21	1.11	0.65
2008	0.08	-0.09	-0.30	0.20	1.22	1.07	0.69	1.43	0.34	-0.16	-0.15	0.06
2009	0.15	0.13	-0.02	-0.58	-1.31	0.17	0.58	0.06	-0.81	0.96	0.19	0.59
2010	0.53	1.69	0.65	1.08	1.34	1.30	1.17	1.70	2.61	1.97	1.81	2.33
2011	1.76	1.02	0.23	-0.25	-0.81	-0.59	-0.39	0.54	0.20	0.20	0.28	-1.04
2012	-0.81	-0.59	-0.65	-0.26	-0.07	1.50	1.96	1.67	0.99	1.69	0.58	0.67
2013	0.44	0.21	1.30	0.10	-1.09	-1.10	-0.26	0.28	0.44	1.55	0.30	-0.19
2014	-0.30	-0.55	-1.12	-0.94	-1.08	0.08	-0.26	1.15	0.67	0.56	-0.10	-1.20
2015	-1.56	-1.47	-1.88	-1.81	-2.24	-2.37	-0.76	-0.87	-0.26	-0.22	-0.57	-1.39
2016	-0.86	-1.72	-1.74	-1.64	-1.43	-0.32	-0.07	0.50	-0.16	0.25	0.17	-0.18
2017	-0.58	0.08	-0.61	-0.81	0.22	0.06	-.089	0.00	0.31	0.16	0.39	0.33

Pertaining to Drought Frequency (McCabe 2004)
Blue = Lower Frequency Red = Higher Frequency

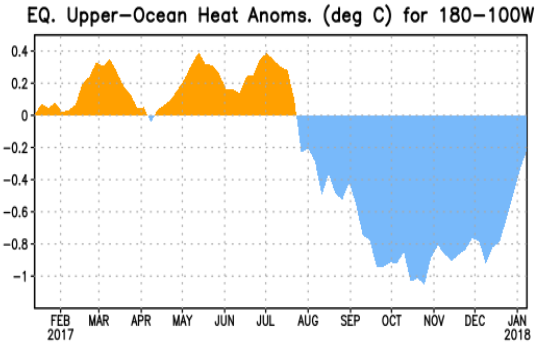


25% = normal drought frequency

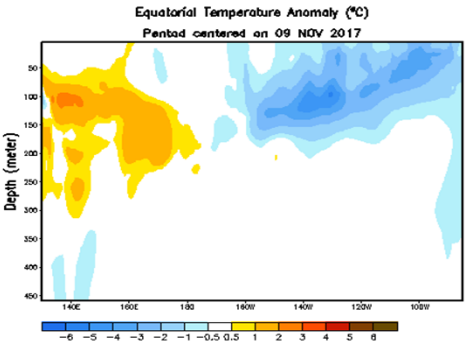
ENSO Forecast Update!

Weather 5280

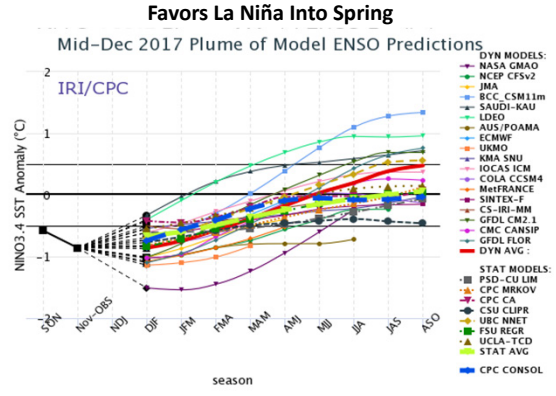
Colder than average water most prevalent since October, with "warming" taking place now…



Something to watch…
Warmer than average water beneath the surface…



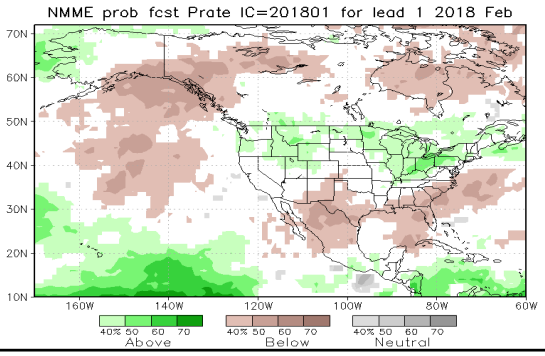
ENSO Plumes Ensemble
Favors La Niña Into Spring



Long Range Forecast:
NMME Computer Model Forecast

Weather
5280

NMME Model Precipitation Forecast
Green = Wetter Brown = Drier White = "Average"



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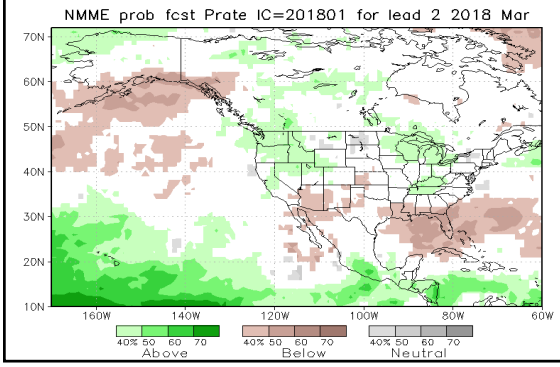

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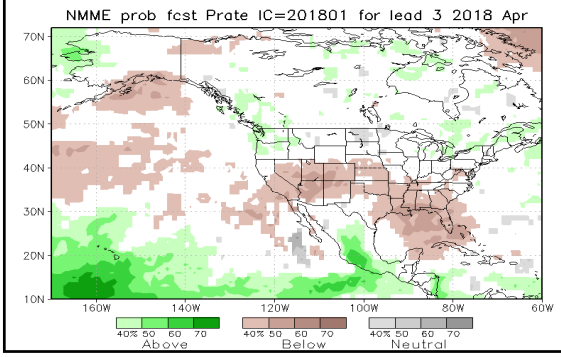

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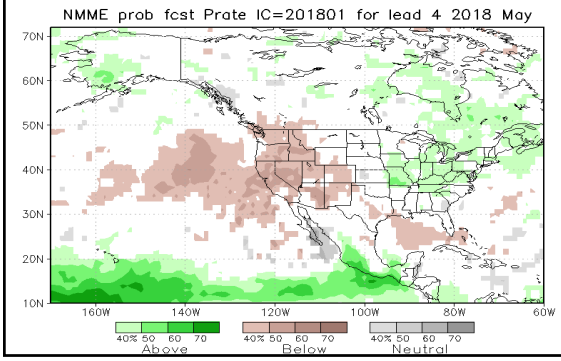

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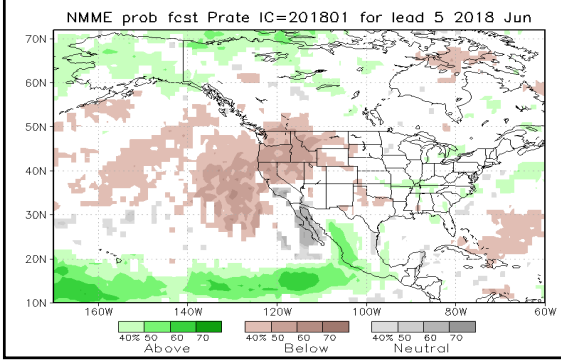

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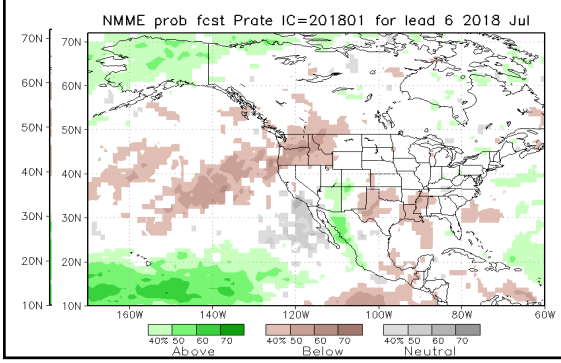

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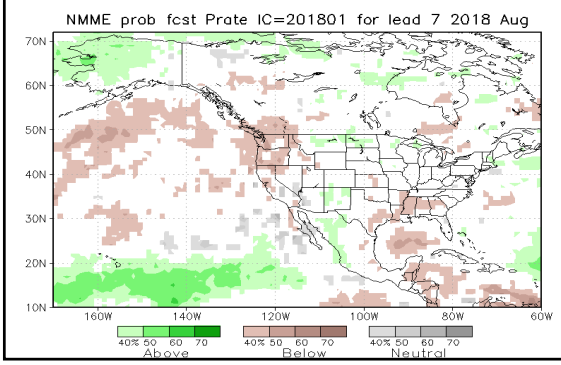
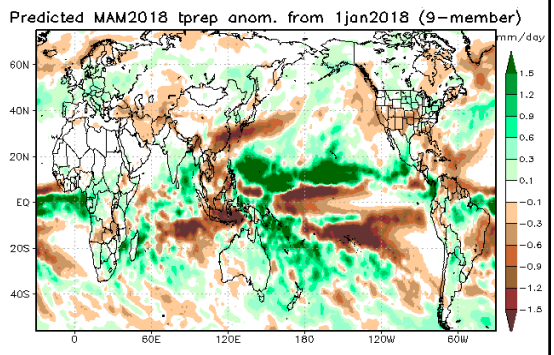


Long Range Forecast:
JAMSTEC Computer Model Forecast

Weather
5280

JAMSTEC Model Precipitation Forecast
Green = Wetter Brown = Drier White = "Average"



JAMSTEC Model Precipitation Forecast
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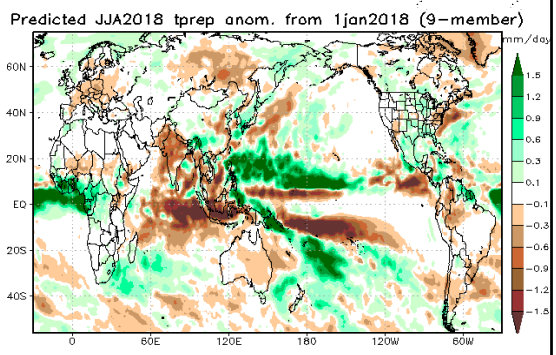

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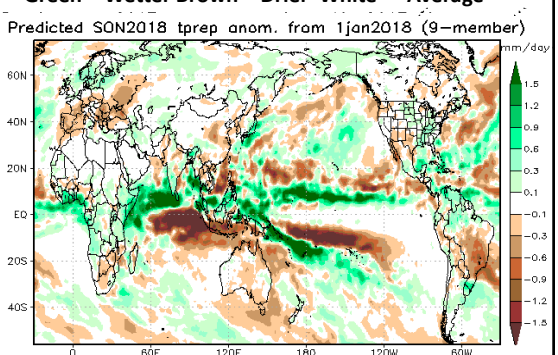

Long Range Forecast:
CFSv2 Computer Model Forecast

Weather
5280

CFSv2 Model Precipitation Forecast
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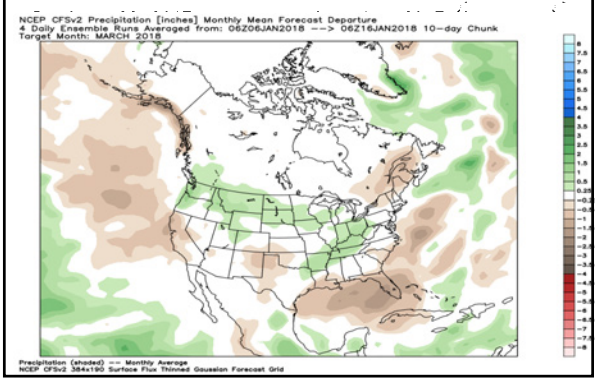

CFSv2 Model Precipitation Forecast
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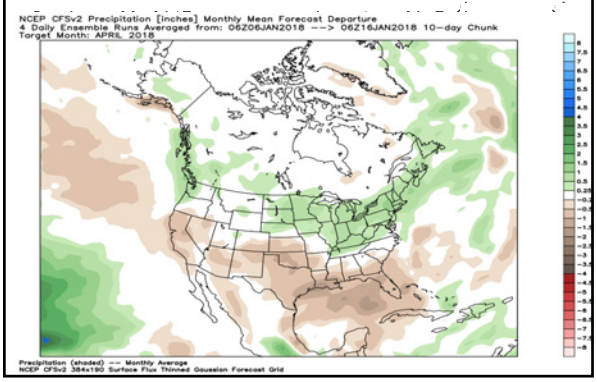

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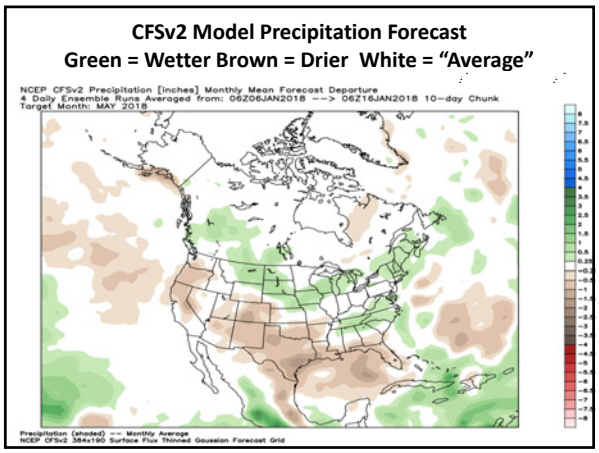

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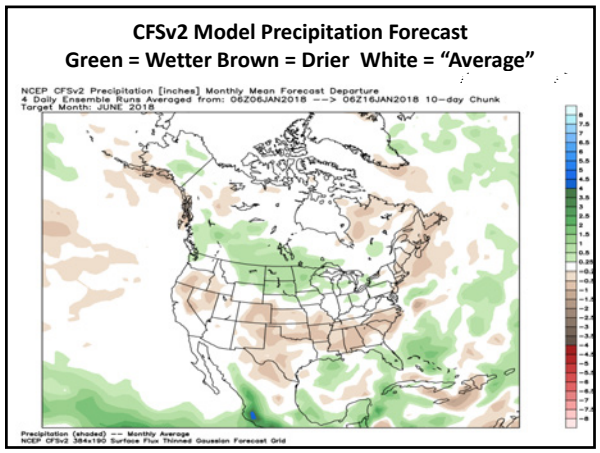

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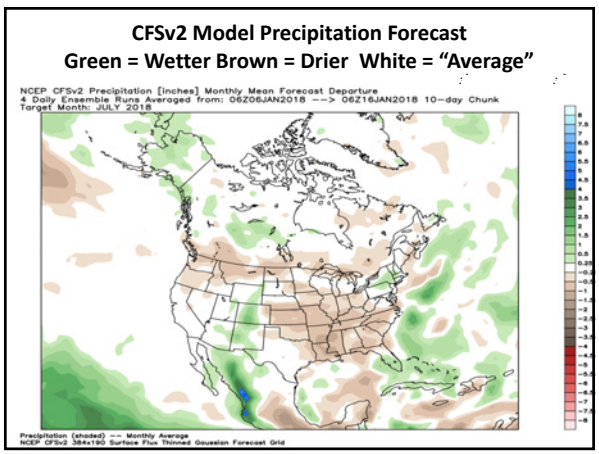

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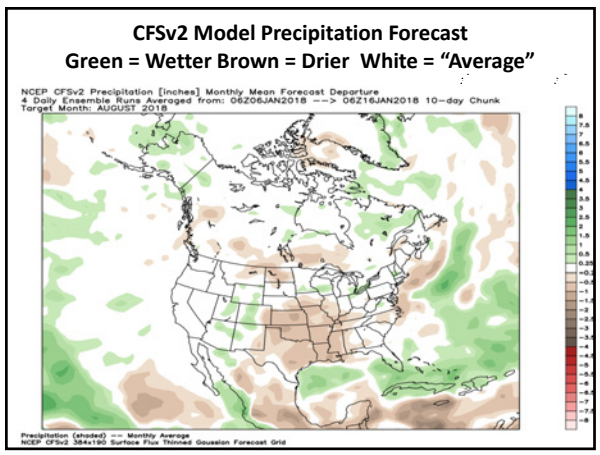

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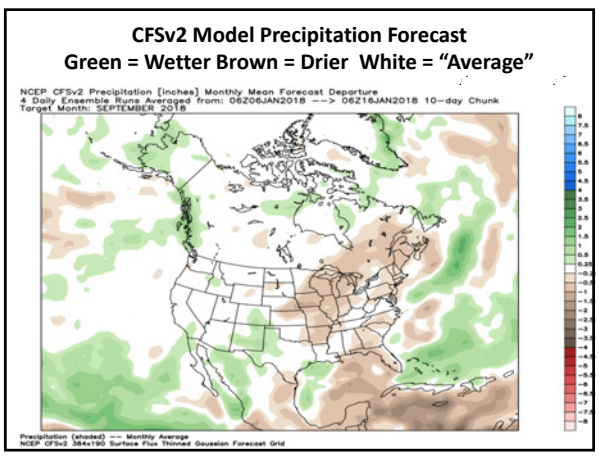

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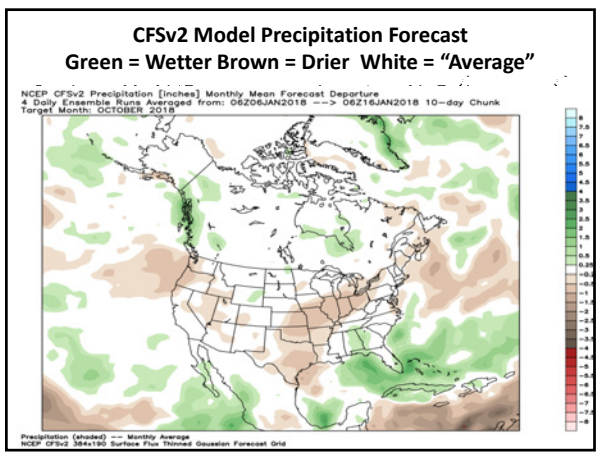

Weather 5280

- ***My Thoughts…***
- La Niña continues through spring, but likely has peaked. Models VERY unsure of future ENSO state.
- Neutral or any El Niño development doesn't guarantee immediate drought relief.
- Regional drought development will likely get worse before it gets better…especially WEST.
- Pacific is not in a cold state (+PDO) & favors drought relaxation at some point. When?

Weather 5280

- brianbledsoewx@gmail.com
- E-Mail Anytime
- Twitter @BrianBledsoe

- Need weather for your biz? Just ask for a quote…
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Texas Alliance for Water Conservation
Water College
January 24, 2018

OVERVIEW OF TEXAS WATER LAW

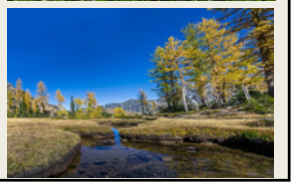
Tiffany Dowell Lashmet
Texas A&M Agrilife Extension

Disclaimer

This presentation is for educational purposes only as well as to give general information and a general understanding of the law, not to provide specific legal advice. This presentation does not create an attorney/client relationship and should not be used as a substitute for the advice of a licensed attorney.

SURFACE AND GROUNDWATER IN TEXAS

Categories of Water



- Water law depends on category.
- **Groundwater** (2 categories)
  - *Percolating (aquifers)*
  - *Subterranean rivers (none in TX)*
- **Surface water** (2 categories)
  - *Surface water in a defined water course*
  - *Diffused surface water*

Groundwater Law Basics

- Who owns groundwater in Texas?
  - *Landowners own water beneath their property.*
- Governed by the Rule of Capture.
  - *Landowner has the right to pump as much water as he wants, even if it drains his neighbor's well (subject to limitations on next slide).*
  - *East and Day cases*
  - *"Law of the biggest pump"*

Limits on Rule of Capture

- There are two categories of exceptions to the Rule of Capture:
- Common Law Exceptions
  - *Maliciously take for sole purpose of injuring neighbor*
  - *Wanton and willful waste*
  - *Negligently drilling/pumping that causes subsidence*
  - *Pumping from contaminated well*
  - *Trespassing in order to drill.*
- Groundwater Conservation Districts
  - *"Preferred method of groundwater management"*
  - *Enact rules/regulations related to groundwater*

Groundwater Conservation Districts

- **Must** require a permit for the drilling and operating of any well or altering the size of a well or pump.
  - *Impact on existing users,*
  - *Beneficial use,*
  - *Waste/conservation plan, and*
  - *Consistent with GCD plan*
- **Must** require drillers logs be kept and filed.
- **May** require records and reports of drilling and production.
- **May** regulate spacing of wells and production of groundwater.
- **May** impose export fees for groundwater to be taken out of the district.

Groundwater Conservation Districts (cont.)

- Currently 98 GCDs, 4 pending confirmation.
- Cover all (or portions of) 174 counties.
- 85% of Texas groundwater.

Exempt Wells

- No permit necessary for certain types of wells:
  - *Domestic use or providing water for livestock or poultry if:*
    - Located on 10 acres or more; and
    - Not capable of producing more than 25,000 gallons/day
  - *Used to supply water for a rig actively engaged in drilling or exploration operations for oil & gas if located on the same lease*
  - *Water used for some mining activities.*
- These exemptions are a baseline—a local GCD can allow more exemptions.

Bragg v. Edwards Aquifer Authority

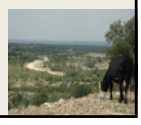
- Pecan farmer in Medina County seeks permits to irrigate long-standing pecan orchards.
- EAA denies permits.
- Farmer files suit for regulatory taking.
  - *Penn Central factors:*
    - Nature of the right infringed upon
    - Investment backed expectations
    - State's interest in regulating

Bragg v. Edwards Aquifer Authority (cont'd)

- Trial court & San Antonio Court of Appeals side with farmer.
- TX Supreme Court refuses to hear the case.
- On remand, jury awards $2.5 million, EAA pays.
- Left with first takings verdict in TX for groundwater.

Lubbock v. Coyote Lake Ranch

- Ranch sells groundwater rights to Lubbock in 1953.
- In 2012, Lubbock shows up ready to start drilling wells.
- Current ranch owner argues accommodation doctrine.
- Mineral owner has right to use as much of the surface as is reasonably necessary to produce oil and gas, but must accommodate existing surface uses if landowner proves:
  - *Substantially impact on existing surface use*
  - *Mineral can be produced another way*
  - *Surface use cannot be conducted in another way.*

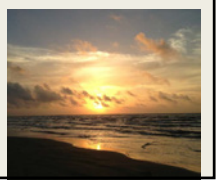


Lubbock v. Coyote Lake Ranch (cont'd)

- Trial court issued injunction; Amarillo Court of Appeals reversed—said no A.D. for groundwater.
- Texas Supreme Court issued huge water law ruling.
  - *Groundwater estate is dominant when severed.*
  - *Accommodation doctrine applies to groundwater owners.*
- Impact on other surface owners—groundwater owner now has the right to use as much of the surface as reasonably necessary to produce groundwater.
- Case back at trial court. Will the landowners meet burden of proof so accommodation doctrine applies?
  - *Substantially impact on existing surface use*
  - *Mineral can be produced another way*
  - *Surface use cannot be conducted in another way.*

Surface Water Basics

- Who owns surface water?
  - *Surface water in a "defined watercourse"*
  - Defined bed and banks
  - Current of water
  - Permanent source and supply
  - Owned by the state of TX
  - *Diffused surface water*
  - Runoff from rain/snow before it gets into a watercourse
  - May be captured by landowner while on his property.



Surface Water Law Basics (cont'd)

- Must obtain a permit from TCEQ to use state-owned water.
- Governed by prior appropriation
  - *First in time, first in right.*
  - *Senior rights superior to junior rights.*
- Emergency exceptions do exist if necessary to protect public health, safety and welfare.

Exempt Diversions

- No permit necessary for certain types of diversions on non-navigable streams:
  - ***Domestic or livestock purposes:*** *Can build a tank or reservoir if less than 200 acre-feet capacity and for a non-commerical purpose.*
  - ***Commercial or non-commercial wildlife management, including fishing, but not fish farming:*** *Can build a tank or reservoir if less than 200 acre-feet capacity.*
  - ***Surface coal mining operations:*** *May maintain a reservoir if used solely for sediment control or compliance with laws regarding fire/dust suppression.*
  - ***Drilling and producing petroleum:*** *May divert from the Gulf, bays and arms, so long as not more than 1 acre foot/day.*

"Navigable Streams"

- Classification matters for two reasons.
  - *Exempt diversions allowed only on non-navigable streams.*
  - *Beds of navigable streams are owned by the state, meaning public can use the stream even if flowing across private land and the landowner may not fence or dam.*
- Navigability tests
  - *Navigable in fact: Can serve as "common highway for trade and travel."*
  - *Navigable in law: Does streambed maintain average width of 30 feet from the mouth up?*

Texas Farm Bureau v. TCEQ

- Facts
  - *Dow Chemical is 1942 water holder on Brazos River.*
  - *Makes priority call in 2012.*
  - *TCEQ grants call, but exceptions for municipalities and power generators.*
  - *Suspended rights: 841 rights; 117,227 AF/yr*
  - *Exempted rights: 19; 1.8 million AF/yr*

Texas Farm Bureau v. TCEQ

- Farmers argue this violates prior appropriation, not following "first in time, first in right."
- TCEQ argues they have power under emergency exception.
- Appellate Court sides with farmers—TCEQ can suspend, but they have to comply with prior appropriation.

> • Texas Water Code Section 11.053:
> • "During a period of drought or other emergency shortage of water, as defined by commission rule, the executive director by order may in accordance with the priority of water rights "as between appropriators, first in time is the first in right.":
> • (1) temporarily suspend the right of any person who holds a water right to use the water; and
> • (2) temporarily adjust the diversions of water by water rights holders."

http://agrilife.org/texasaglaw

aglaw.libsyn.com

Thank you!

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Twitter: @TiffDowell

WATER for TEXAS

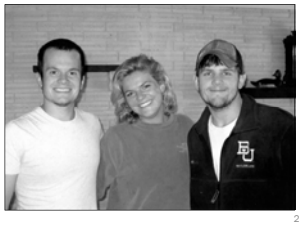
Water for the Future

Kathleen Jackson, Director

Texas Water Development Board

OUR MISSION

To provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas.



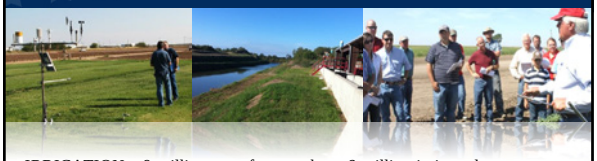
2

AGRICULTURAL WATER CONSERVATION

TWDB provides funding for projects that research, educate, demonstrate, and implement proven **best management practices** to conserve water and increase irrigation water use efficiency.

3

AGRICULTURAL WATER CONSERVATION



IRRIGATION: 9 million acre-feet on about 6 million irrigated acres

EFFICIENCY: Individual Ag producers can achieve up to 98 percent irrigation efficiency with their irrigation systems

EDUCATION: Technical assistance, public speaking, and outreach to Ag communities

FUNDING: TWDB has provided over $100 million in Ag Grants and Ag Loans since 1985

TEXAS ALLIANCE FOR WATER CONSERVATION

Texas Tech University, Texas A&M AgriLife, High Plains Water District, Irrigation Equipment Dealers, Crop Consultants & Agricultural Producers in the Southern High Plains

→ Mission: *To conserve water with practices and technologies that reduce depletion of groundwater while enhancing economic opportunities*

Texas Water Development Board

NORTH PLAINS GROUNDWATER CONSERVATION DISTRICT

3-4-5 Gallon Production Maximization

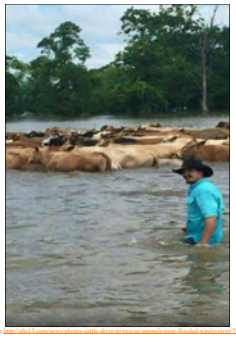
→ Participants apply variable rate irrigation to simulate 3, 4, and 5 gallons-per-minute (GPM) per-acre conditions in side-by-side, production-scale demonstrations.

→ $197,313 in grant assistance provided by TWDB

Texas Water Development Board

IMPACT OF HURRICANE HARVEY FLOODING – SOUTHEAST TEXAS

TWDB TNRIS ASSISTANCE DURING EXTREME FLOODING



Source: http://www.chron.com/news/houston-texas/houston/article/Hundreds-of-cattle-stranded-in-flood-drives-12082251.php#photo-8074682

Source: http://abc13.com/news/photos-cattle-drive-to-rescue-animals-near-flooded-trinity-river/1948283/#gallery-2

Texas Natural Resource Information System (TNRIS) helped plot the route using Geographic Information System (GIS) data to analyze the surrounding terrain, enabling a rancher to move cattle to higher ground.

Dayton, Texas

8

REGIONAL WATER PLANNING GROUPS

Region O

Region A

- Local Political Subdivision serves as administrator
- Public, consensus-driven
- Local/regional decision making process

Region F

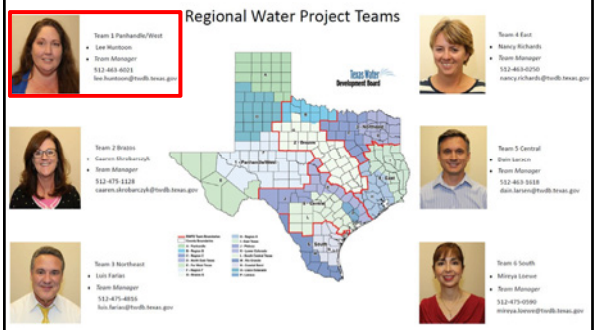
REGIONAL WATER PLANNING GROUPS AGRICULTURAL VOTING MEMBERS (A-H)

Voting Region	First Name	Last Name	Entity	Interest County
A	Ben	Weinheimer	Texas Cattle Feeders Association	All counties
A	Joe	Baumgardner	Farmer	Collingsworth
A	Janet	Tregellas		Lipscomb
B	Wilson	Scaling	Clay County Commissioners Court	Clay
B	Dale	Hughes	W.T. Waggoner Estate	Wilbarger
C	Tom	Woodward	Broseco Ranches	Wise
D	Dennis	Hilliard		Van Zandt
D	David	Nabors	RWPG	Lamar
D	Johnny Mack	Bradley		Marion
D	Bob	Staton		Smith
E	Rick	Tate	Presidio County Rancher/Agriculture	Presidio
E	Tom	Beard		Brewster
F	Kenneth	Dierschke	Texas Farm Bureau	Tom Green
F	Don	Daniel		Mason
G	Wayne	Wilson	Wilson Cattle Company	Brazos
G	Dale	Spurgin	Jones County	Jones
H	Robert	Bruner	Bruner Cattle	Walker
H	Pudge	Willcox		Chambers

REGIONAL WATER PLANNING GROUPS AGRICULTURAL VOTING MEMBERS (CONT'D I-P)

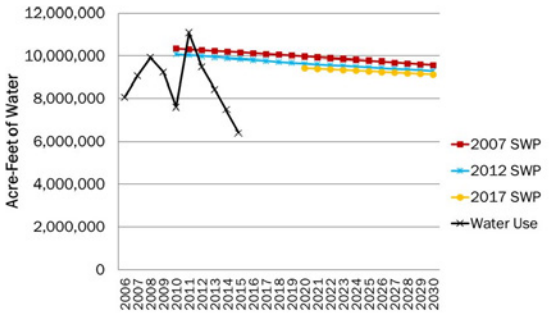
Voting Region	First Name	Last Name	Entity	Interest County
I	Josh Wilson	David	Rancher	Tyler
I	David	Alders	Carrizo Creek Corporation	Nacogdoches
J	Wes	Robinson	Rancher	Kinney
K	Paul	Sliva		Matagorda
K	W.A. (Billy)	Roeder	Gillespie County Commissioners Court, Pct. 2	Gillespie
L	Weldon	Riggs	South Texas Cattleman's Association	
L	Adam	Yablonski	Medina County Farm Bureau	Medina
L	Blair	Fitzsimons	Tx Agricultural Land Trust	
M	Neal	Wilkins	East Wildlife Foundation	Jim Hogg
M	Dale	Murden	Texas Citrus Mutual	Cameron
N	Chuck	Burns	Willacy Co.	Willacy
N	Charles	Ring	San Patricio Co.	San Patricio
O	Jimmy	Wedel	Wedel Farms	
O	Mark	Kirkpatrick	Farming and Ranching	
O	Delmon	Ellison, Jr.	Agricultural Producer	
O	Ben	Weinheimer	Texas Cattle Feeders Association	
O	Chris	Grotegut, DMV		
O	Harry	DeWit	Blue Sky Farms	
P	Robert	Martin		Jackson
P	L.G.	Raun	El Campo Farmer	Wharton
P	Lester	Little	Lavaca County Farmer	Lavaca

TWDB REGIONAL TEAMS



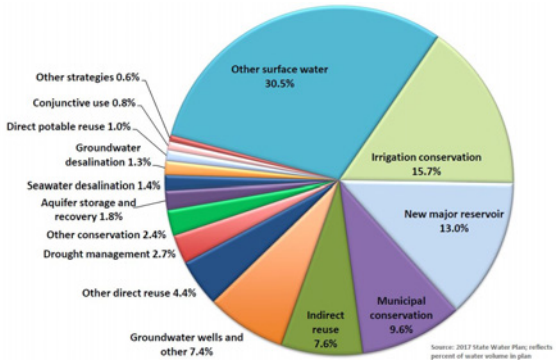
12

IRRIGATION WATER USE AND DEMAND PROJECTIONS



13

SHARE OF WATER MANAGEMENT STRATEGIES IN 2070



BRACKISH RESOURCES AQUIFER CHARACTERIZATION SYSTEM

BRACS PROGRAM: Brackish = 1,000 to 10,000 ppm TDS

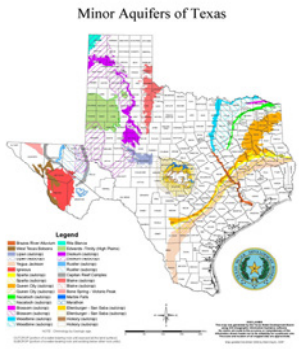
- Program began in 2009
- Objective is to map in sufficient detail the brackish groundwater resources of each major/minor aquifer
- We collect and load data into a relational database (BRACS) and GIS datasets
- We maintain a collection of well reports and geophysical well logs
- All data is available from our website: www.twdb.texas.gov

15

NINE MAJOR AQUIFERS

16

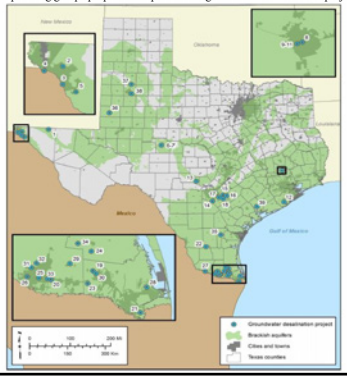
TWENTY-ONE MINOR AQUIFERS



17

BRACKISH GROUNDWATER DESAL PLANTS 2017 STATE WATER PLAN

Regional water planning groups propose to implement 39 groundwater desalination projects



18

AGRICULTURAL WATER CONSERVATION GRANTS

$600,000

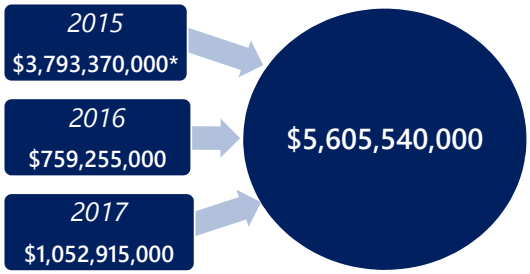
RFA Open until February 14, 2018

1. **Equipment cost share and technology transfer**
2. Demonstrations of innovative & alternative production systems
3. Planning and design for irrigation system improvements
4. Feasibility study of irrigating with produced water

To submit an application, please visit: http://www.twdb.texas.gov/
Eligible applicants are political subdivisions and state agencies

19

TOTAL SWIFT COMMITMENTS



* Reflects subsequent adjustment based on actual closings.

20

TWDB SWIFT AG FUNDED PROJECTS

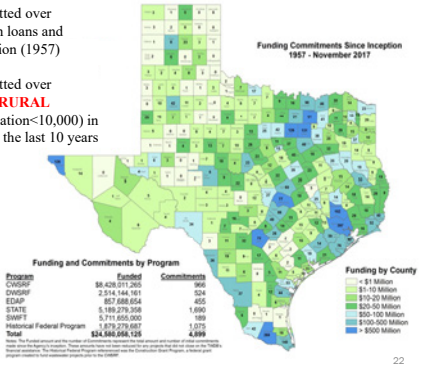
Hidalgo County Irrigation District #1
SWIFT - $7,100,000
Ag Irrigation Conveyance System Improvements

United Irrigation District
SWIFT - $8,100,000
Off Channel Storage Facility

21

COMMUNITIES FUNDED

- TWDB has committed over **$24.5 BILLION** in loans and grants since inception (1957)
- TWDB has committed over **$1 BILLION TO RURAL ENTITIES** (population<10,000) in loans and grants in the last 10 years



22

TWDB REGIONAL FINANCIAL ASSISTANCE WORKSHOPS

Location *	Date	Building Name/Room	Address
Beaumont	December 13, 2017 – 9 a.m. *Disaster Recovery Topics Only*	South East Texas Regional Planning Commission-Mayor Homer E. Nagel Conference Room	2210 Eastex Frwy Beaumont, TX
Glen Rose	January 9, 2018 – 1 p.m.	Somervell County Water District Administrative Office-Board Room	2099 County Road 301 Glen Rose, TX
Denton	February 6, 2018 – 9 a.m.	Public Safety Training Facility-Conference Room C	719 Hickory Denton, TX
Big Spring	March 15, 2018 – 2:00 p.m.	Colorado River Municipal Water District-Perry Board Room	400 E. 24th Street Big Spring, TX
Sugar Land	April 10, 2018 – 9 a.m.	Sugar Land Public Works-Training Room	111 Gillingham Lane Sugar Land, TX
Pleasanton	May 8, 2018 – 9 a.m.	Pleasanton Civic Center-Main Exhibit Hall	115 N. Main St Pleasanton TX
Beeville	June 5, 2018 – 1 p.m.	Beeville Community Center	111 E. Corpus Christi Street Beeville, TX

23

AGRICULTURE SUPPORTS A STRONG TEXAS!

Joe Reinart
Stratford
Sherman County

24

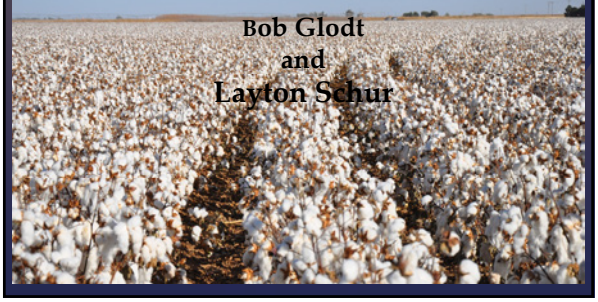
HOW TO CONTACT ME

Kathleen Jackson, P.E.
@twdb_kathleen
512.463.7847
Kathleen.Jackson@twdb.texas.gov

www.twdb.texas.gov

25

PROFIT POTENTIAL USING SPLIT PIVOT IRRIGATION STRATEGIES IN COTTON PRODUCTION



Bob Glodt
and
Layton Schur

Discussion Topics

- Split pivot irrigation strategies with 200 gallon per minute irrigation potential.
- Parameters and production guidelines for using split pivot irrigation strategies.
- Variable cost breakdown and profit potential when irrigating using a split pivot production strategy.
- 2017 grower examples of using split pivot irrigation strategies.

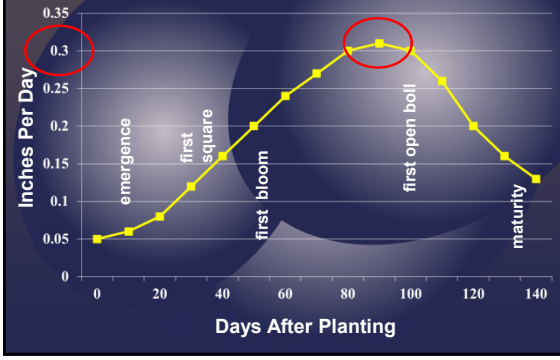
COTTON MANAGEMENT GUIDELINES FOR SPLIT PIVOT IRRIGATION STRATEGIES

DEFINING THE PARAMETERS

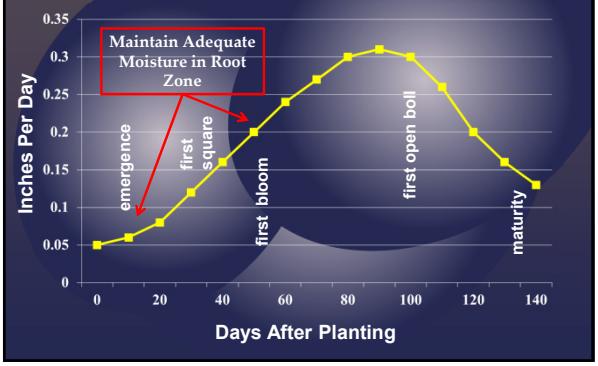
- WATER DELIVERY MUST BE APPLIED IN ACCORDANCE TO CROP DEMAND.
- IRRIGATION MUST BE APPLIED STRATEGICALLY.
- WE MUST UNDERSTAND THE RELATIONSHIP BETWEEN YIELD POTENTIAL AND WATER.

PRE-WATER AS CLOSE TO PLANTING AS POSSIBLE TO A DEPTH OF 18-24″

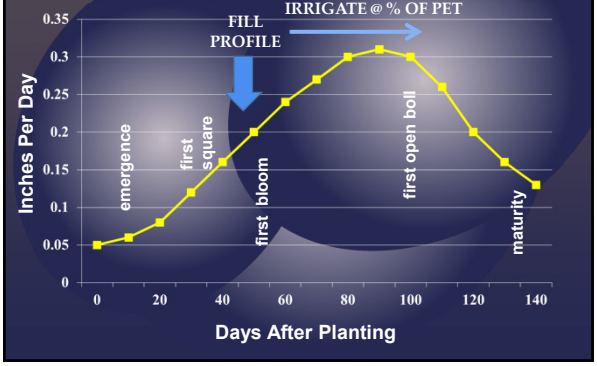
COTTON WATER DEMAND AT 100% OF PET



PRE-FLOWER IRRIGATION STRATEGY



FLOWER TO 1ST OPEN BOLL IRRIGATION STRATEGY



Irrigation Capacity During Peak Water Demand in Relationship to Potential Evapotranspiration for Cotton

% PET	@100% PET Inches/Day	@100% PET Inches/Wk	Inches/ Week @ % of PET
90%	0.32″	2.24″	2.02″
60%	0.32″	2.24″	1.34″
30%	0.32″	2.24″	0.67″

PUSH WATER DEEP INTO THE SOIL PROFILE – LEPA

REVIEW OF IRRIGATION STRATEGY

Irrigation	Pre-Water	Pre-Bloom	One Irrigation Prior to PET Irrigations	PET Irrigations
Rainfed	Irrigate top 18-24″	Keep water in root zone	Apply 1-2″ of water or capacity	No Irrigations, Rainfed only
30%	Irrigate top 18-24″	Keep water in root zone	Apply 1-2″ of water or capacity	Irrigate at 30% PET
60%	Irrigate top 18-24″	Keep water in root zone	Apply 1-2″ of water or capacity	Irrigate at 60% PET

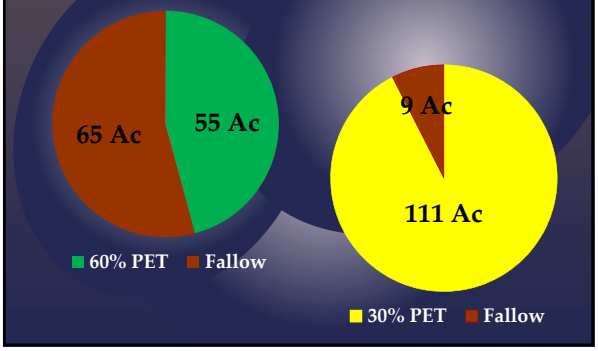
QUESTIONS SO FAR?

UNDERSTANDING THE RELATIONSHIP BETWEEN YIELD POTENTIAL AND WATER

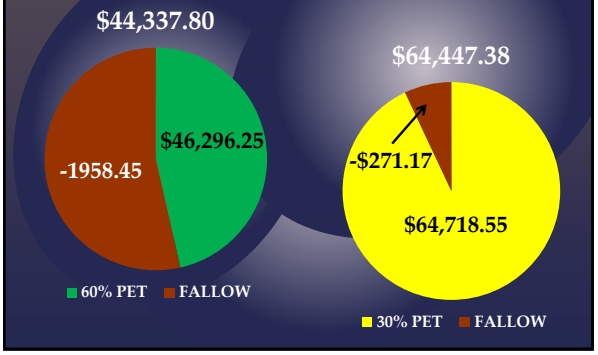
AVERAGE YIELDS PER IRRIGATION REGIMEN – AGRI-SEARCH DATA

YEAR	SITE	# VAR.	POUNDS LINT PER ACRE			
			RF	30%	60%	90%
2012	OLT	7	327	824	1286	1523
2013	EDM	8	598	801	1210	1435
2014	EDM	12	786	1067	1388	1486
		AVG.	570	897	1295	1481

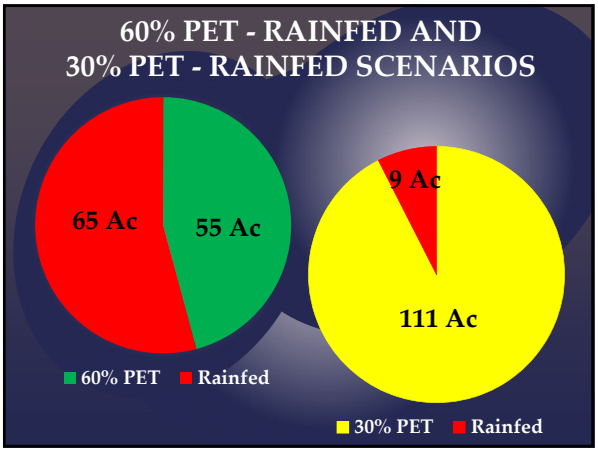
PET / FALLOW SCENARIOS
200 Gallon Per Minute Pivot



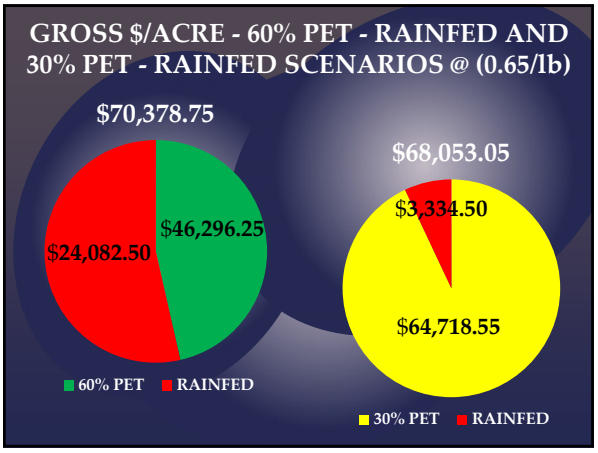
GROSS $ PER ACRE @ (0.65/lb)
PET/FALLOW SCENARIOS

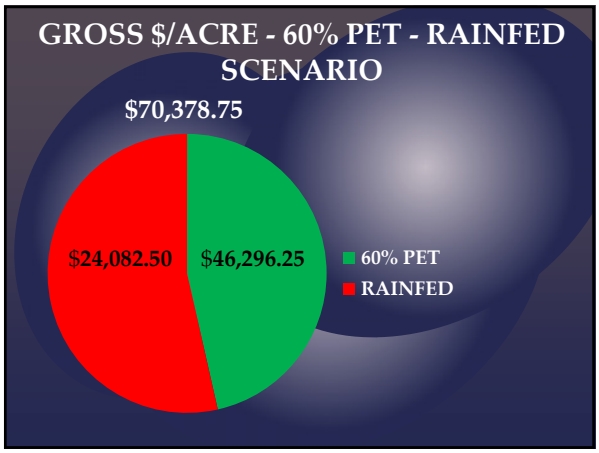


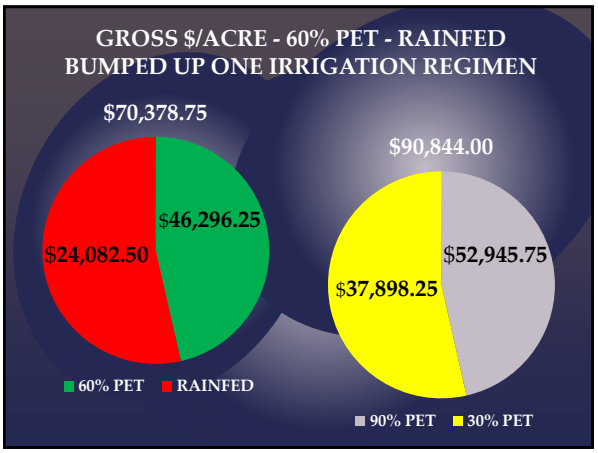
60% PET - RAINFED AND
30% PET - RAINFED SCENARIOS

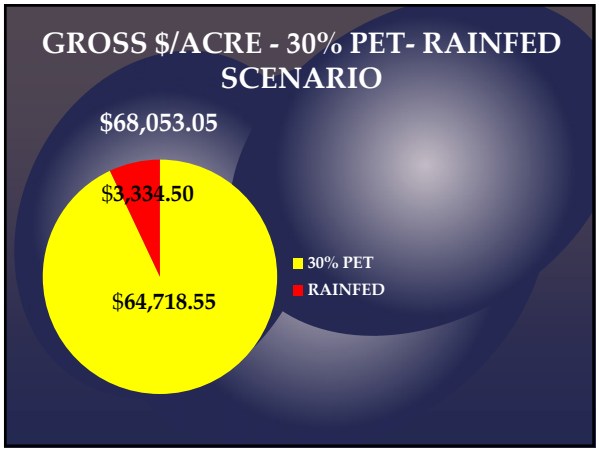


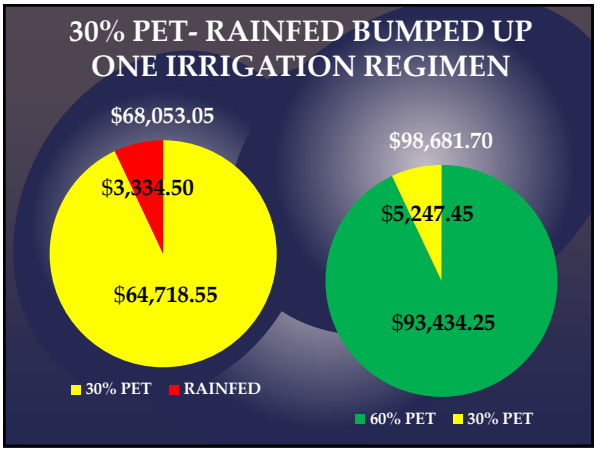
GROSS $/ACRE - 60% PET - RAINFED AND
30% PET - RAINFED SCENARIOS @ (0.65/lb)

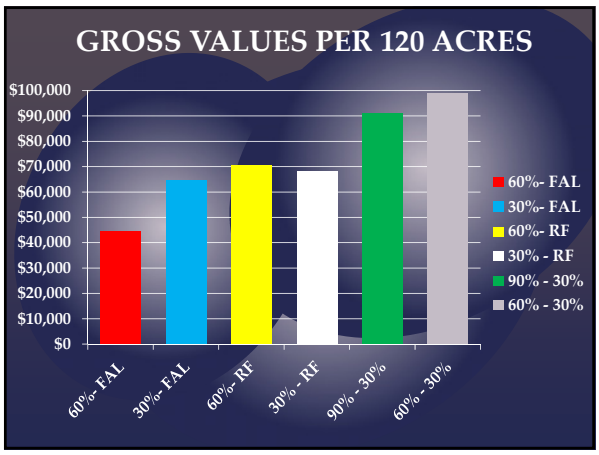


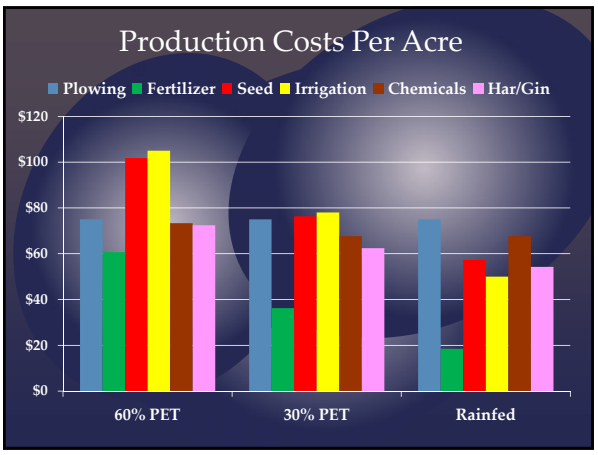

GROSS $/ACRE - 60% PET - RAINFED SCENARIO
$70,378.75
$24,082.50
$46,296.25
60% PET
RAINFED

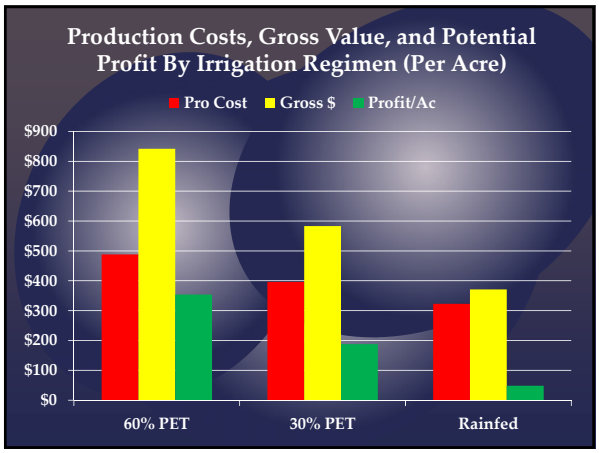

GROSS $/ACRE - 60% PET - RAINFED BUMPED UP ONE IRRIGATION REGIMEN
$70,378.75
$24,082.50
$46,296.25
60% PET
RAINFED
$90,844.00
$37,898.25
$52,945.75
90% PET
30% PET

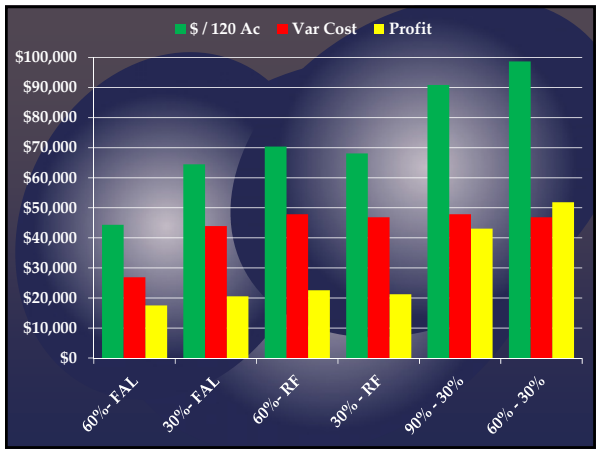

GROSS $/ACRE - 30% PET- RAINFED SCENARIO
$68,053.05
$3,334.50
$64,718.55
30% PET
RAINFED


30% PET- RAINFED BUMPED UP ONE IRRIGATION REGIMEN
$68,053.05
$3,334.50
$64,718.55
30% PET
RAINFED
$98,681.70
$5,247.45
$93,434.25
60% PET
30% PET


GROSS VALUES PER 120 ACRES
$100,000
$90,000
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
60%- FAL
30%- FAL
60%- RF
30% - RF
90% - 30%
60% - 30%


Production Costs Per Acre
Plowing
Fertilizer
Seed
Irrigation
Chemicals
Har/Gin
$120
$100
$80
$60
$40
$20
$0
60% PET
30% PET
Rainfed

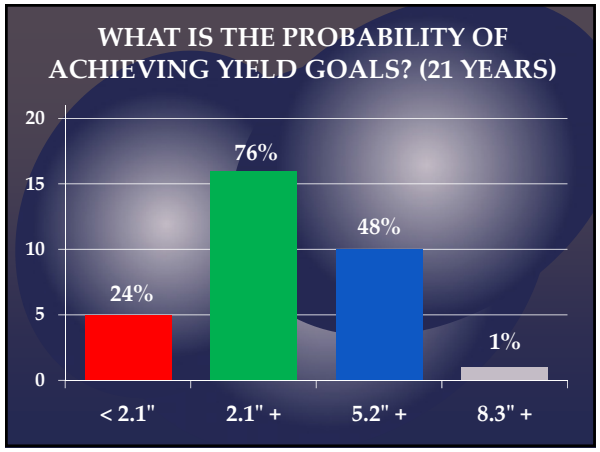




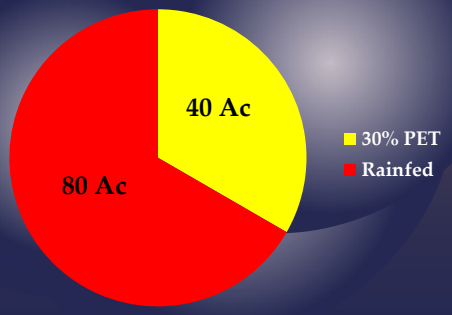
HOW MUCH WATER DOES IT TAKE TO JUMP UP ONE PET REGIMEN?

% PET	2012 IRR.*	2013 IRR.*	2014 IRR.*	AVG.
RAINFED	1.4″	2.8″	2.0″	2.1″
30% PET	2.7″	3.3″	3.3″	3.1″
60% PET	5.5″	6.6″	6.5″	6.2″
90% PET	8.2″	9.9″	9.8″	9.3″
RAIN	1.4″	2.8″	2.0″	2.1″

*POST FLOWER RAIN AND IRRIGATION



2017 CLEMENTS WEST – LOCKNEY, TX 30% - Rainfed



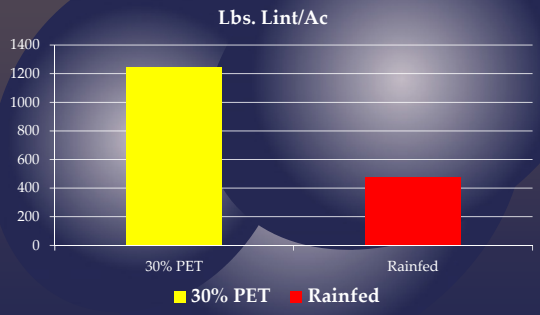
CLEMENTS WEST– WATER MANAGEMENT

GROWTH STAGE	30% PET	RAINFED	RAINFALL
Pre-plant	0.75″	0.75″	6.0″
Pre Flower	2.0″	0″	4.75″
Post Flower	2.0″	0″	6.1″

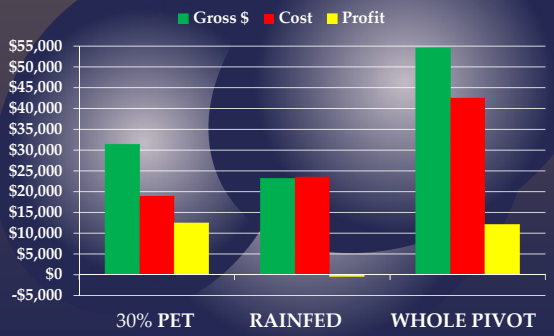
2017 CLEMENTS – LOCKNEY, TX PRODUCTION COSTS/ACRE

INPUT	RAINFED	30% PET
FERTILIZER	$27.75	$27.75
SEED	$61.36	$88.63
PLOWING	$37.00	$37.00
CHEMICALS	$112.82	$124.73
IRRIGATION	$11.25	$71.25
HARVEST	$37.80	$99.60
GINNING	$9.58	$24.90
TOTAL	$294.56	$473.86

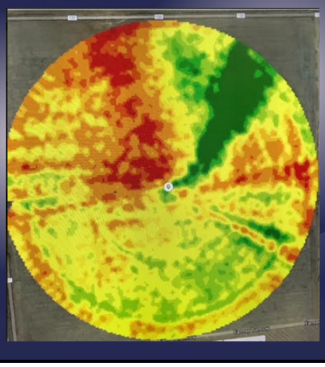
Yield – Clements Farm



Profit and Loss Profile – Clements Farm



WHY WAS THE RAINFED PORTION OF THE PIVOT NOT PROFITABLE?

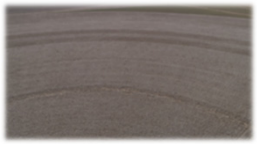


TAKE AWAY MESSAGES

- The TAWC website was very important to know how much water should be applied and when.
- Always use the most productive ground for allocation of water.
- Less inputs can be used in the rainfed portion of the pivot as compared to the 30 or 60% PET portions.

THANK YOU FOR YOUR ATTENTION!

Texas Alliance for Water Conservation



Glenn Schur

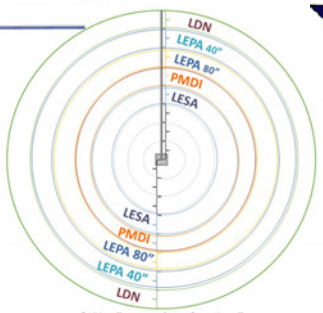
TAWC Producer

Pivot Irrigation Technology Demonstration

Pivot Irrigation Technology

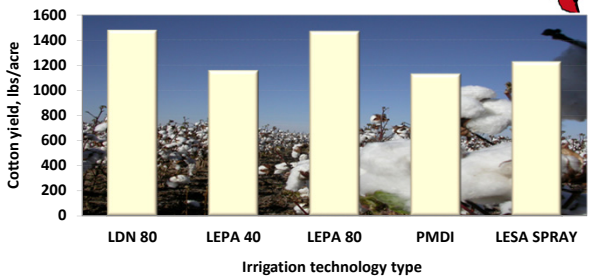
2017 Demonstration

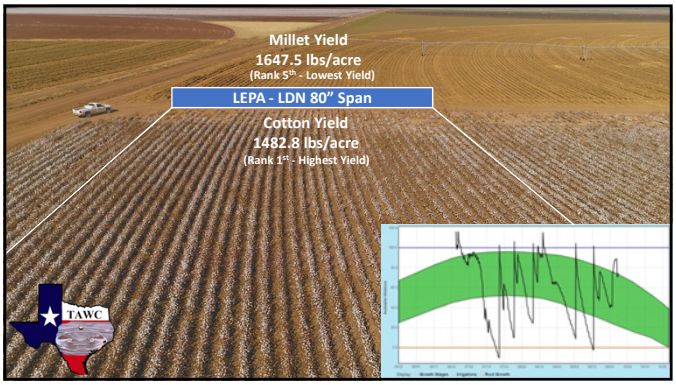
- LDN
  - Low drift nozzels
- LEPA
  - 40"
  - 80"
- PMDI
  - Precision Mobile Drip Irrigation
- LESA
  - Broadcast spray 80"

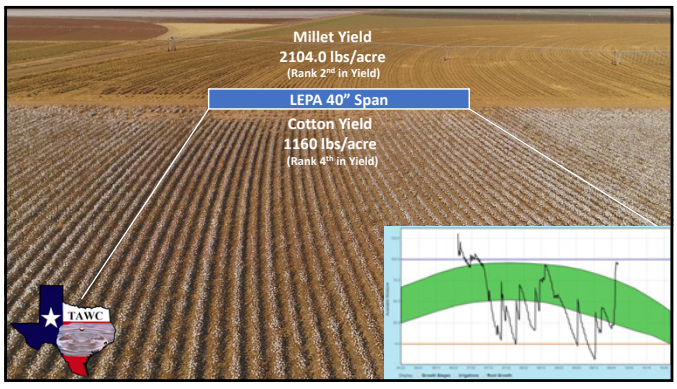


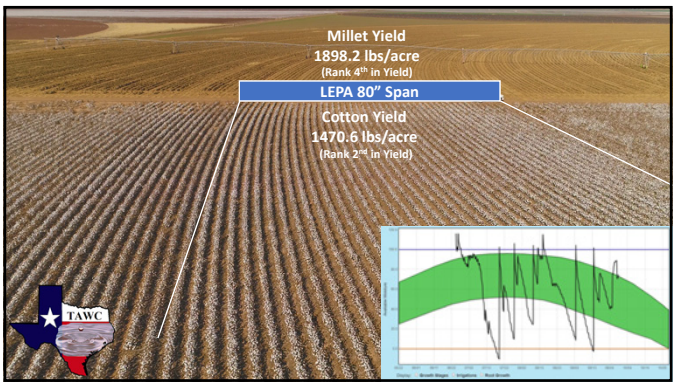
*450 gallon per minute from 3 wells

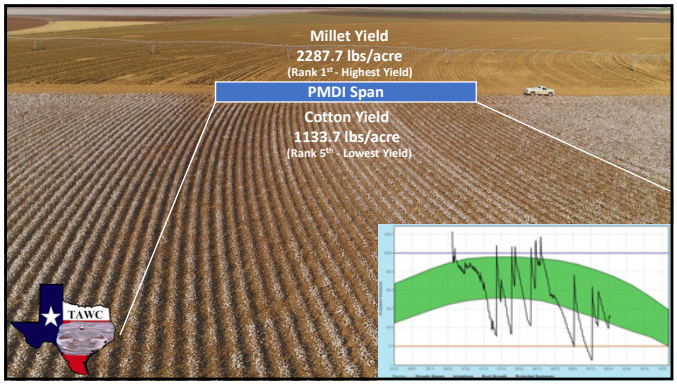
Irrigation Technology Demonstration

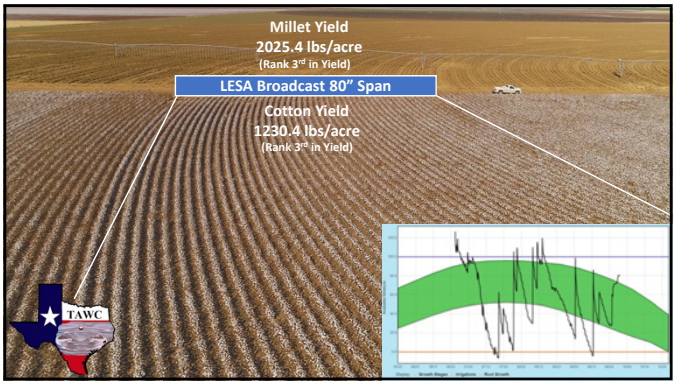




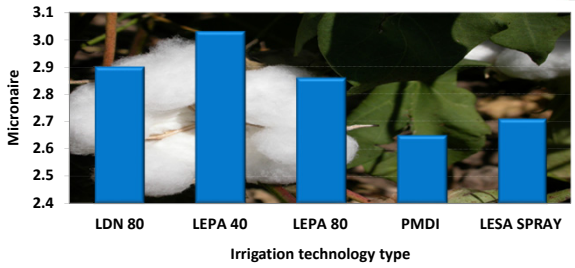




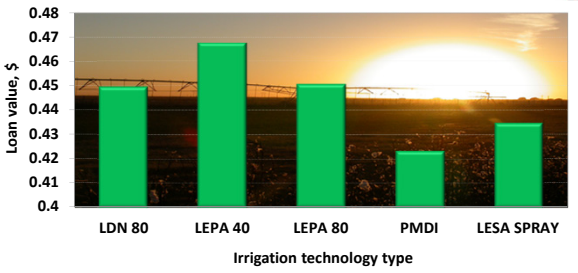




Irrigation Technology Demonstration



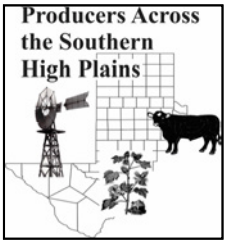
Irrigation Technology Demonstration



Summary

- Different irrigation delivery systems produced different yield results, even in a wet year.
- The two irrigation delivery systems that produced the highest yields, delivered water on every other row basis.
- In a wet year such as we experienced in 2017, the dry row on LEPA 80 and LDN 80 minimized vegetative growth.
- It has been my experience that every other row LEPA or LDN irrigation always produces the best yields regardless of how much or how little rainfall you receive.

Thank You!



Questions?

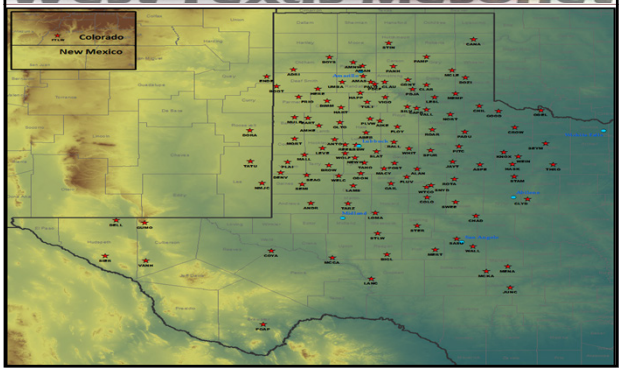
WWW.MESONET.TTU.EDU

West Texas Mesonet

WEST TEXAS MESONET

West Texas Mesonet – Map

111 Completed Stations – January 2018



Site Photo

Crowell 1E – Foard County

Site Photo

Bootleg 11WNW - Deaf Smith County

Site Photo

ENDEE 2SW – Quay County, New Mexico

Instrumentation

- **The following data are collected at each mesonet station every one to five minutes depending on the datalogger at each station:**
- 10-meter wind speed and direction (average and 3-second peak wind speed)
- 9-meter temperature
- 20-ft wind speed (fire weather) and 2-meter wind speed
- 2-meter temperature
- 1.5-meter temperature and relative humidity (including dewpoint calculation)
- barometric pressure (using digital barometer: calculations include station pressure and altimeter)
- rainfall (total for the 5-minute period and an hourly summation product)
- 2-meter solar radiation (Kipp and Zonen SP-Lite2 and CM-3)

Instrumentation

West Texas Mesonet

- **The following data are collected at most mesonet stations every 15 minutes:**
- Soil Temperature at 5cm (~2 inches) under sod-covered ground
- Soil Temperature at 10cm (~4 inches) under sod-covered ground
- Soil Temperature at 20cm (~8 inches) under sod-covered ground
- Soil Temperature at 5cm (~2 inches) for bare ground
- Soil Temperature at 20cm (~8 inches) for bare ground
- Soil Moisture at 5cm (~2 inches) (all of these are sod-covered ground)
- Soil Moisture at 20cm (~8 inches)
- Soil Moisture at 60cm (~24 inches)
- Soil Moisture at 75cm (~30 inches)
- Leaf Wetness

Instrumentation
Fluvanna 3W WTM Station

West Texas Mesonet

Users/Importance

West Texas Mesonet

- Users:
  - **Agriculture**
  - **Wind Power Industry**
  - **National Weather Service**
  - **NOAA Weather Radio**
  - **Media Outlets**
  - **And Many More….**
  - Schools
  - Community Leaders
  - Emergency Management
  - General Public
- Real-time Data Access: Real-time mesonet information (data and products) is free to anyone on the web page at www.mesonet.ttu.edu .
  - Average web hits per day: ***73,000***
  - Average Apple IOS/Android APP users per day: ***5,000***
- Maintenance: Each station is visited every two months to complete routine maintenance. When an instrument fails, we replace it as soon as possible. If a station is not sending quality data, it is not helping anyone.
- New Stations: We attempt to add 8-9 new mesonet stations each year. Funding determines the number of new stations. We try and fill in data holes with new locations…most new locations are requests from the National Weather Service, state agencies, or private ranches.

NWS Partnership

West Texas Mesonet

- The West Texas Mesonet and the National Weather Service share a unique relationship. The West Texas Mesonet provides high quality meteorological and agricultural information to a region with otherwise sparse data sources. The NWS relays WTM data to the media and surrounding community through warnings, forecasts, local storm statements, weather radio, and other reports.
- The NWS Lubbock, in conjunction with Southern Region Headquarters, helps with the communication costs at several stations in the WTM domain.
- We look forward to a continuing partnership with the National Weather Service as we expand the West Texas Mesonet into other regions and additional NWS County Warning Areas.

WTM PRODUCTS

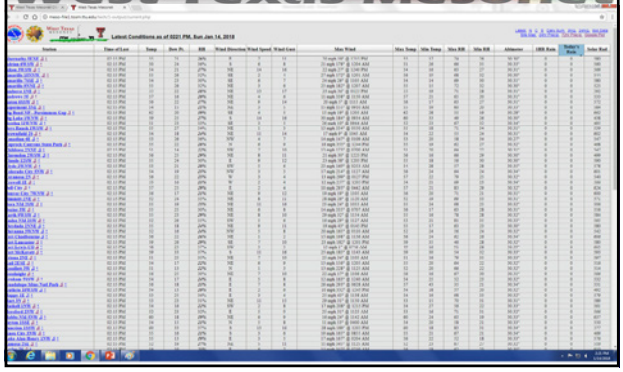
WWW.MESONET.TTU.EDU

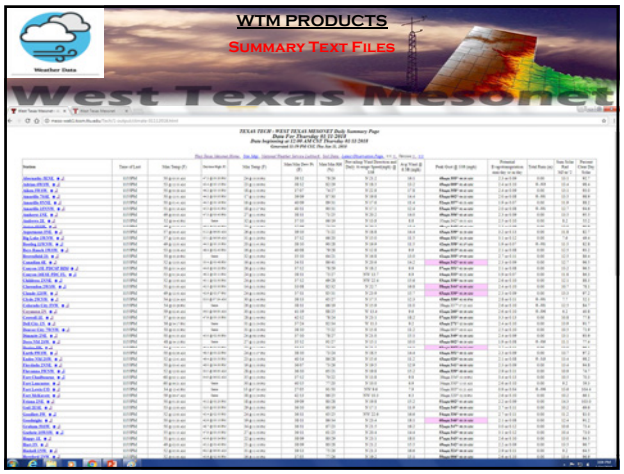
West Texas Mesonet

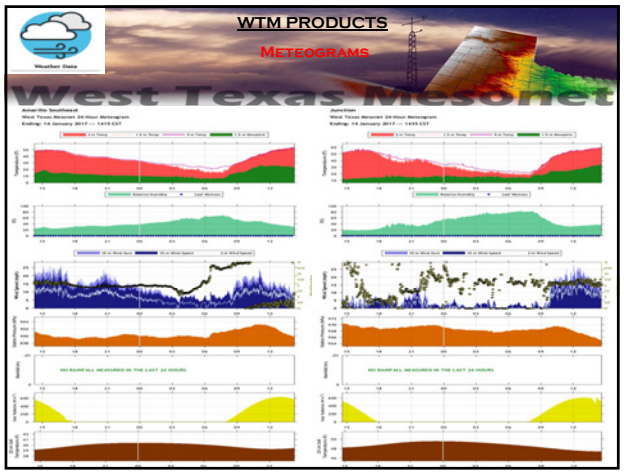
WTM PRODUCTS

Current Data/Summary Data

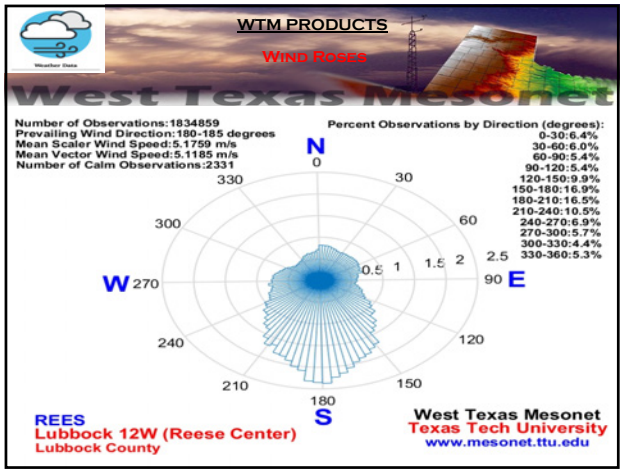
West Texas Mesonet



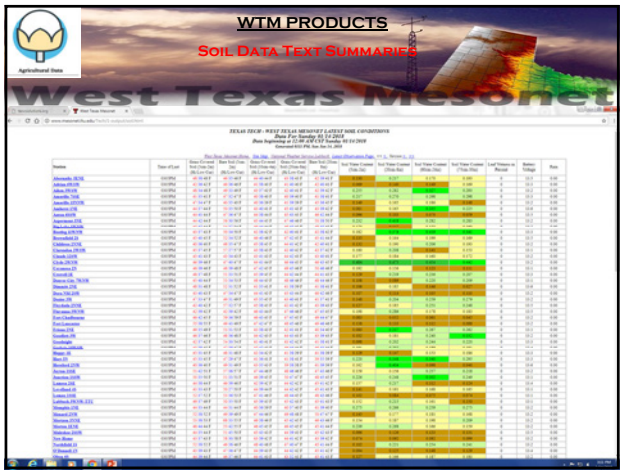

WTM PRODUCTS
Summary Text Files
West Texas Mesonet

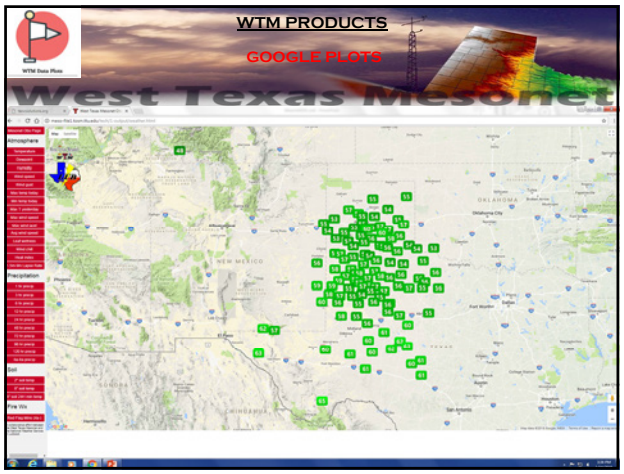

WTM PRODUCTS
Meteograms
West Texas Mesonet

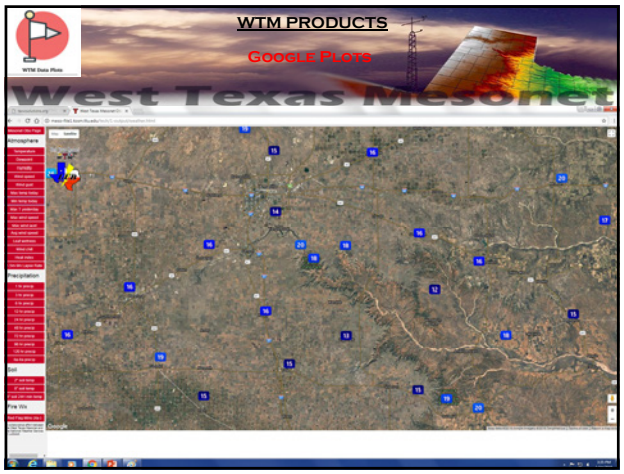

WTM PRODUCTS
Single Site Data Plots/Climate Summary
West Texas Mesonet
Anton 6SSW
56 °F
West Texas Mesonet
Last 24h Temps
Last 24h Winds
National Weather Service Lubbock forecast for Anton 6SSW

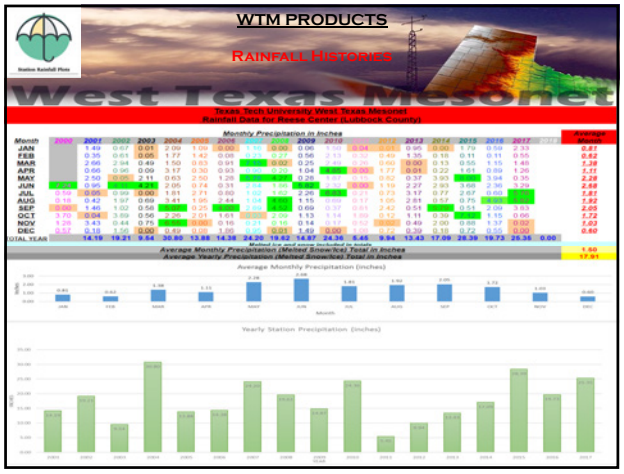

WTM PRODUCTS
Wind Roses
West Texas Mesonet
Number of Observations:1834859
Prevailing Wind Direction:180-185 degrees
Mean Scalar Wind Speed:5.1759 m/s
Mean Vector Wind Speed:5.1185 m/s
Number of Calm Observations:2331
Percent Observations by Direction (degrees):
0-30:6.4%
30-60:6.0%
60-90:5.4%
90-120:5.4%
120-150:9.9%
150-180:16.9%
180-210:16.5%
210-240:10.5%
240-270:6.9%
270-300:5.7%
300-330:4.4%
330-360:5.3%
REES
Lubbock 12W (Reese Center)
Lubbock County
West Texas Mesonet
Texas Tech University
www.mesonet.ttu.edu

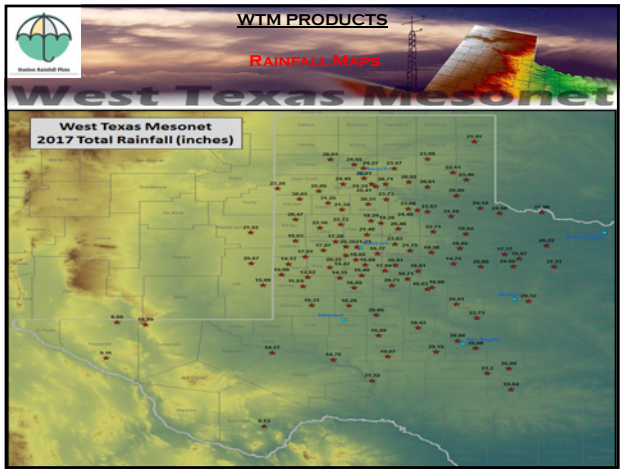

WTM PRODUCTS
Clickable Map Weather/Soil
West Texas Mesonet
Clickable Observations Map
Current Soil Observations

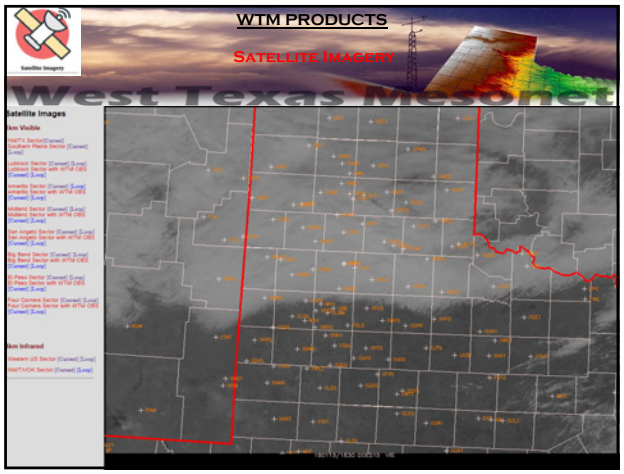

WTM PRODUCTS
Soil Data Text Summaries
West Texas Mesonet

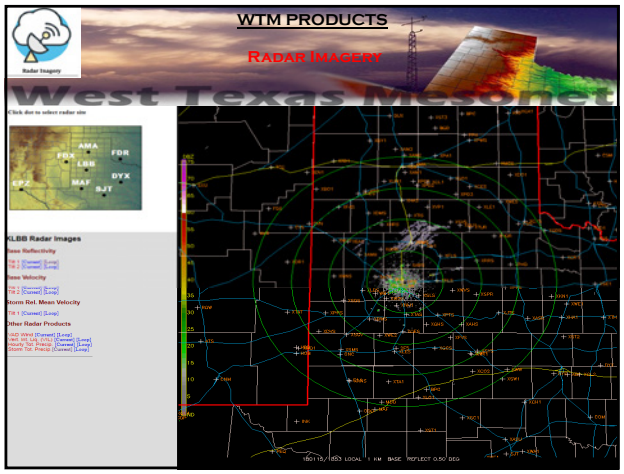

WTM PRODUCTS
GOOGLE PLOTS
West Texas Mesonet


WTM PRODUCTS
GOOGLE PLOTS
West Texas Mesonet


WTM PRODUCTS
RAINFALL HISTORIES
West Texas Mesonet
Texas Tech University West Texas Mesonet
Rainfall Data for Reese Center (Lubbock County)
Monthly Precipitation in Inches
Average Monthly Precipitation (Melted Snow/Ice) Total in Inches
Average Yearly Precipitation (Melted Snow/Ice) Total in Inches
Average Monthly Precipitation (inches)
Yearly Station Precipitation (inches)


WTM PRODUCTS
RAINFALL MAPS
West Texas Mesonet
West Texas Mesonet
2017 Total Rainfall (inches)

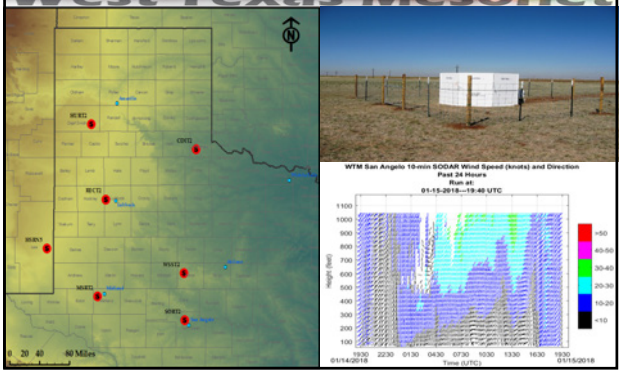

WTM PRODUCTS
SATELLITE IMAGERY
West Texas Mesonet
Satellite Images


WTM PRODUCTS
RADAR IMAGERY
West Texas Mesonet
KLBB Radar Images

WTM PRODUCTS

SODAR Data

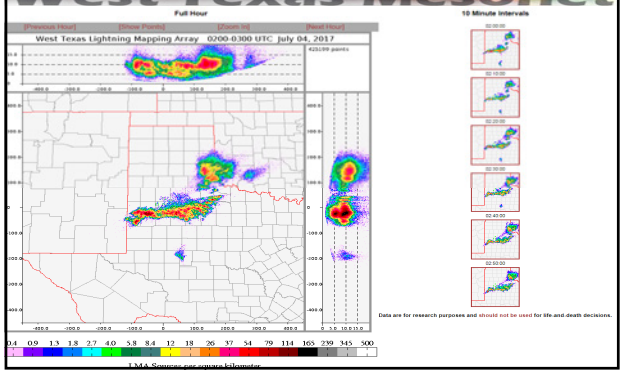
West Texas Mesonet



TTU LMA

West Texas Lightning Mapping Array

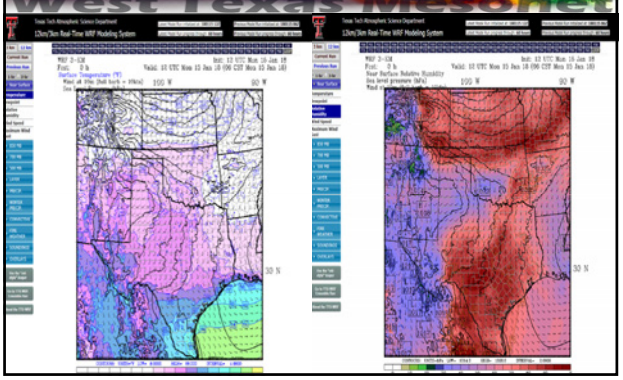
West Texas Mesonet



TTU WRF MODEL

TTU ATMOSPHERIC SCIENCES

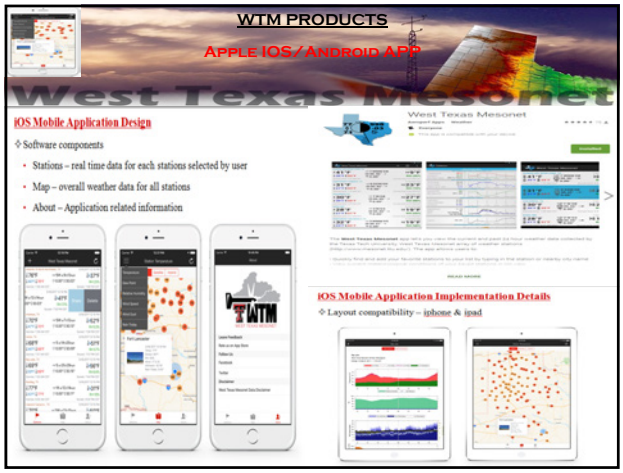
West Texas Mesonet



WTM PRODUCTS

Apple IOS / Android APP

West Texas Mesonet



WTM FUTURE PRODUCTS/SENSORS

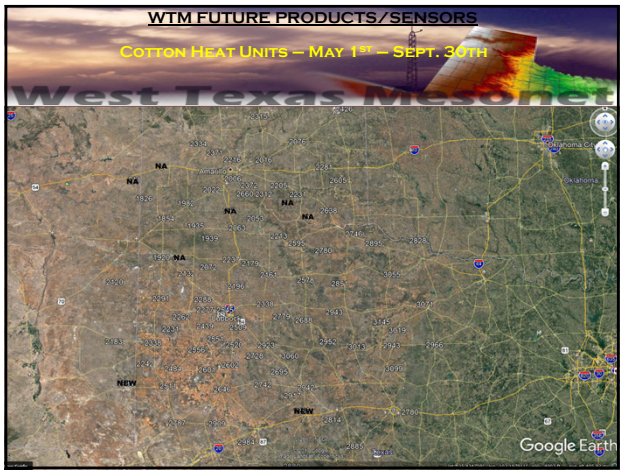
West Texas Mesonet

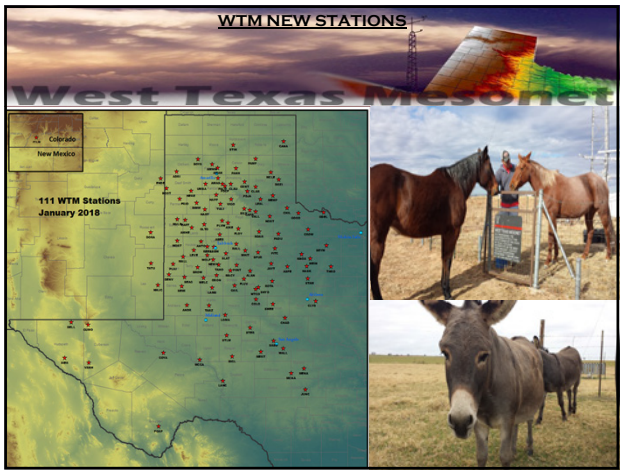
- Upgrade IOS app for new design….early 2018.
- Add user-defined HEAT UNITS to IOS app and web-based products…2018.
- Add ET data to IOS app and web-based products…2018-2019.
- Upgrade water content sensors…2018-2020.
- Add 20-ft wind sensor to all stations…2018-2020.
- Upgrade dataloggers at all stations for one-minute observations…2018-2021.
- What products do you want to see?

WTM FUTURE PRODUCTS/SENSORS

Cotton Heat Units – May 1st – Sept. 30th

West Texas Mesonet




WTM NEW STATIONS
West Texas Mesonet
Colorado
New Mexico
111 WTM Stations
January 2018


West Texas Mesonet Contact information

General Notes

The TAWC project was made possible through a grant from the
Texas Water Development Board

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