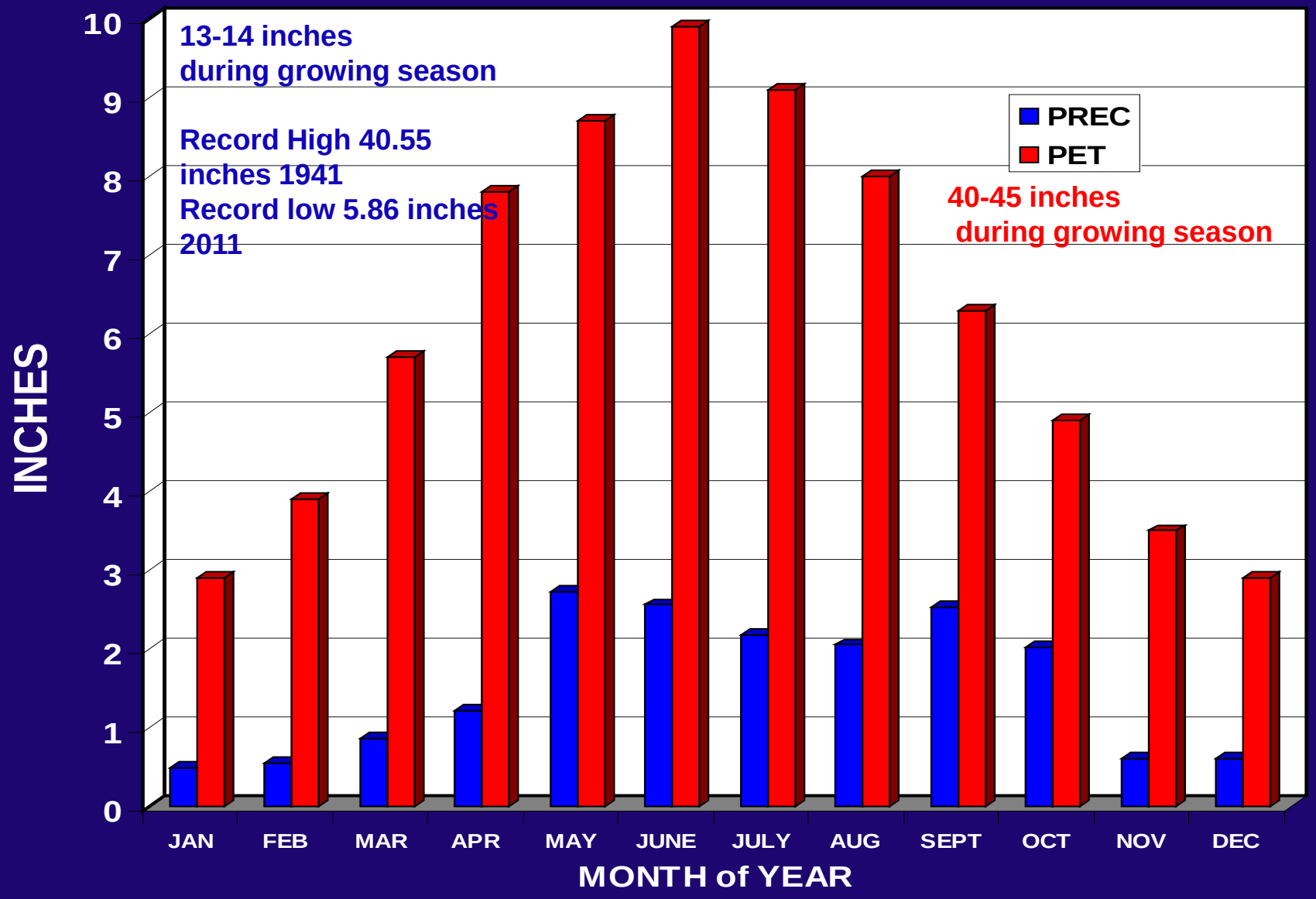
PET

Potential Evapotranspiration

What atmospheric factors determine the daily conversion of liquid water to water vapor resulting in water loss from surface water and soil –plant system

SOUTHERN HIGH PLAINS



POTENTIAL EVAPORATION RATE

- **Water, like most liquid substances can exist in three states (Solid, Liquid, & Vapor)**
- **Radiation Load**

  Provides energy to convert liquid water to vapor

  Heat of Vaporization = 2.45 MJ/Liter. Average daily net radiation ranges from 20-30 MJ/m^2/day=0.32-0.48 acre inches/day
- **Temperature and Humidity**

  Establishes the Vapor Pressure Deficit of the air surrounding the crop, Relative Humidity = Water concentration of air relative to water holding capacity
- **Wind Speed**

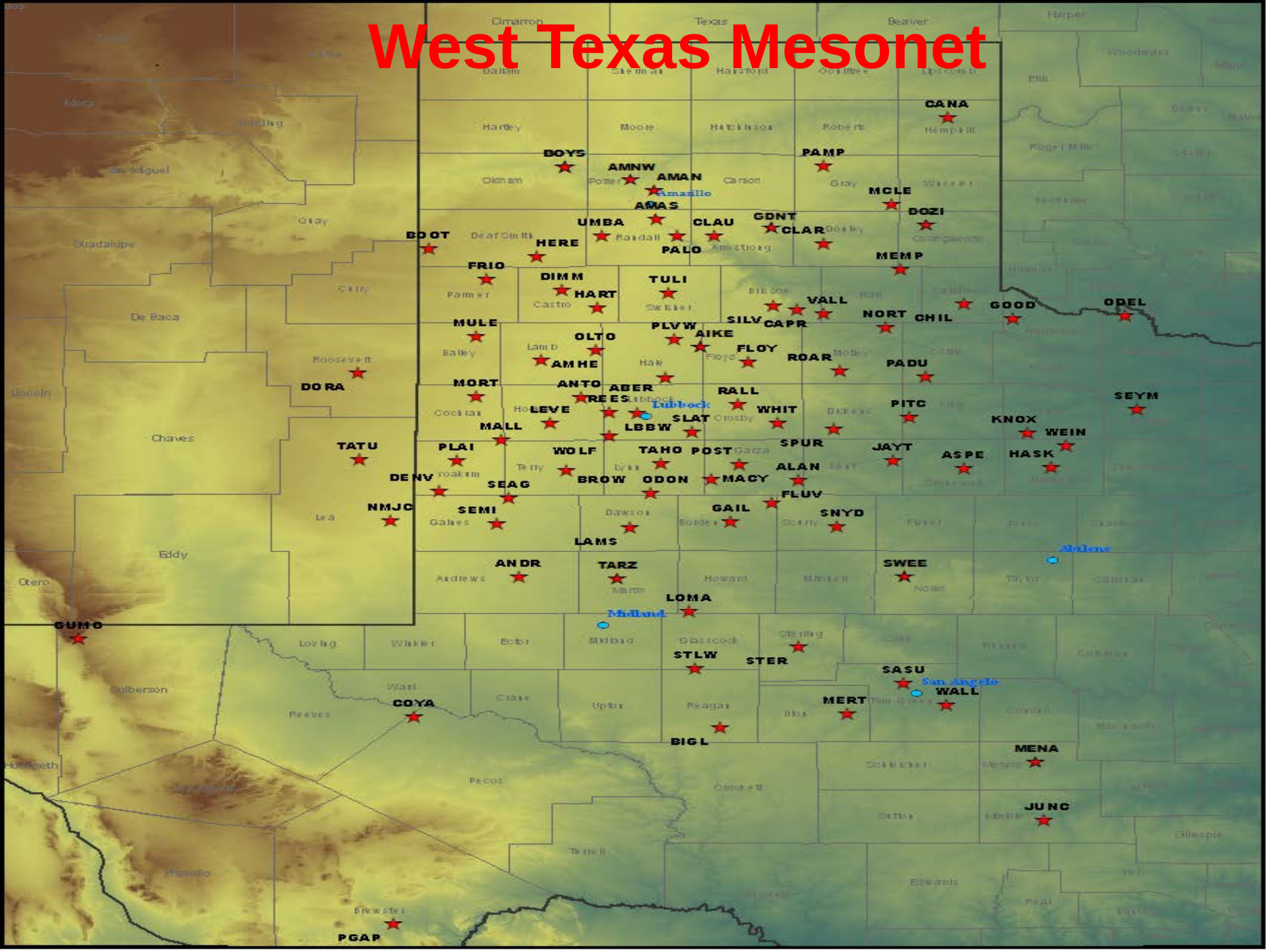
  Reduces boundary layer resistance, Wind Speed of 10 MPH are adequate

POTENTIAL EVAPOTRANSPIRATION

MODIFIED PENMAN EQUATION

$$ET_o = c[W\text{-}R_n + (1\text{-}w) - f(u) - (e_a\text{-}e_d)]$$

ET_o = potential crop evapotranspiration (mm/day)
W = temperature-related weighting factor
R_n = net radiation in equivalent evaporation (mm/day)
$f(u)$ = wind related function
$(e_a\text{-}e_d)$ = vapor pressure deficit of the air at mean air temperature
c = adjustment factor to compensate for the effect of day and night weather conditions.

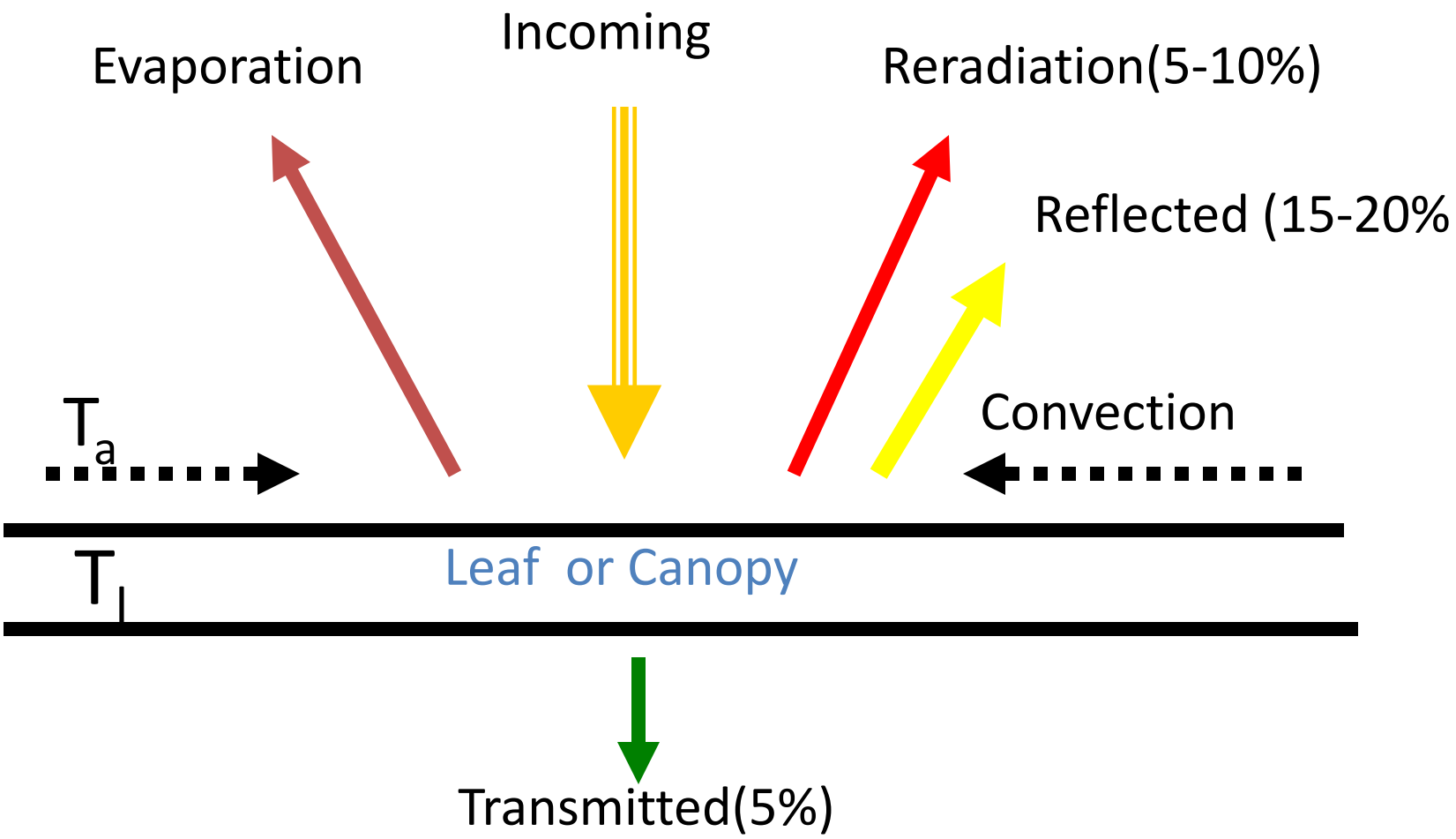

West Texas Mesonet
CANA
BOYS
PAMP
AMNW
AMAN
Amarillo
MCLE
AMAS
DOZI
UMBA
CLAU
GDNT
CLAR
BOOT
HERE
PALO
MEMP
FRIO
DIMM
TULI
HART
VALL
GOOD
ODEL
NORT
CHIL
SILV
CAPR
MULE
PLVW
AIKE
OLTO
FLOY
ROAR
PADU
AMHE
DORA
MORT
ANTO
ABER
REES
RALL
SEYM
Lubbock
LEVE
WHIT
PITC
SLAT
KNOX
MALL
LBBW
WEIN
SPUR
TATU
PLAI
WOLF
TAHO
POST
JAYT
ASPE
HASK
ALAN
DENV
BROW
ODON
MACY
SEAG
FLUV
NMJC
SEMI
GAIL
SNYD
LAMS
Abilene
ANDR
TARZ
SWEE
LOMA
Midland
GUMO
STLW
STER
SASU
San Angelo
WALL
COYA
MERT
BIGL
MENA
JUNC
PGAP

TEXAS TECH - WEST TEXAS MESONET Daily Summary Page
Data For Monday 01/12/2015
Data beginning at 12:00 AM CST Monday 01/12/2015
Generated 08:59 AM CST, Mon Jan 12, 2015

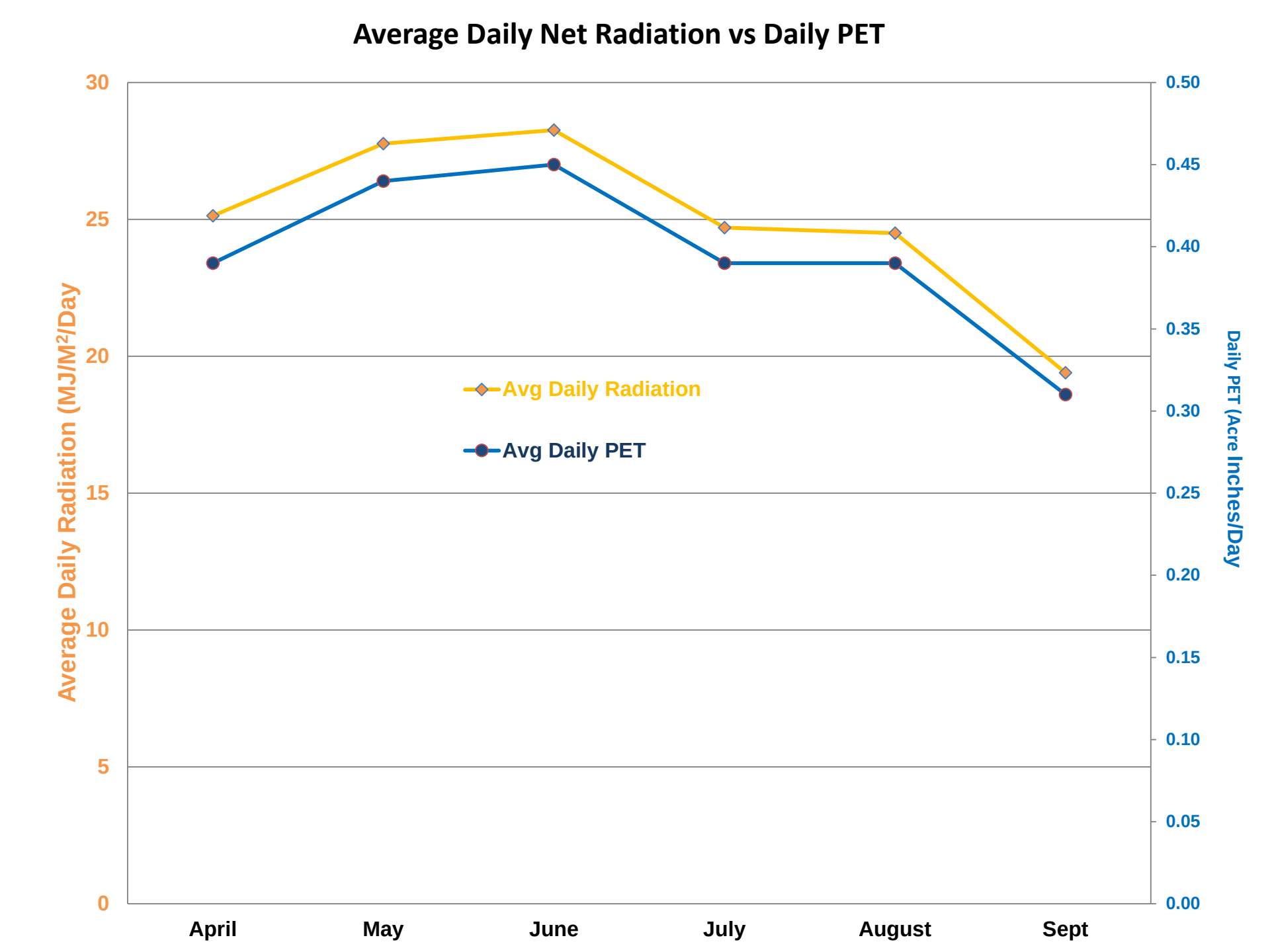
West Texas Mesonet Home, Current Data Menu, National Weather Service Lubbock, Soil Data, Latest Observation Page, << <, Version >, >>

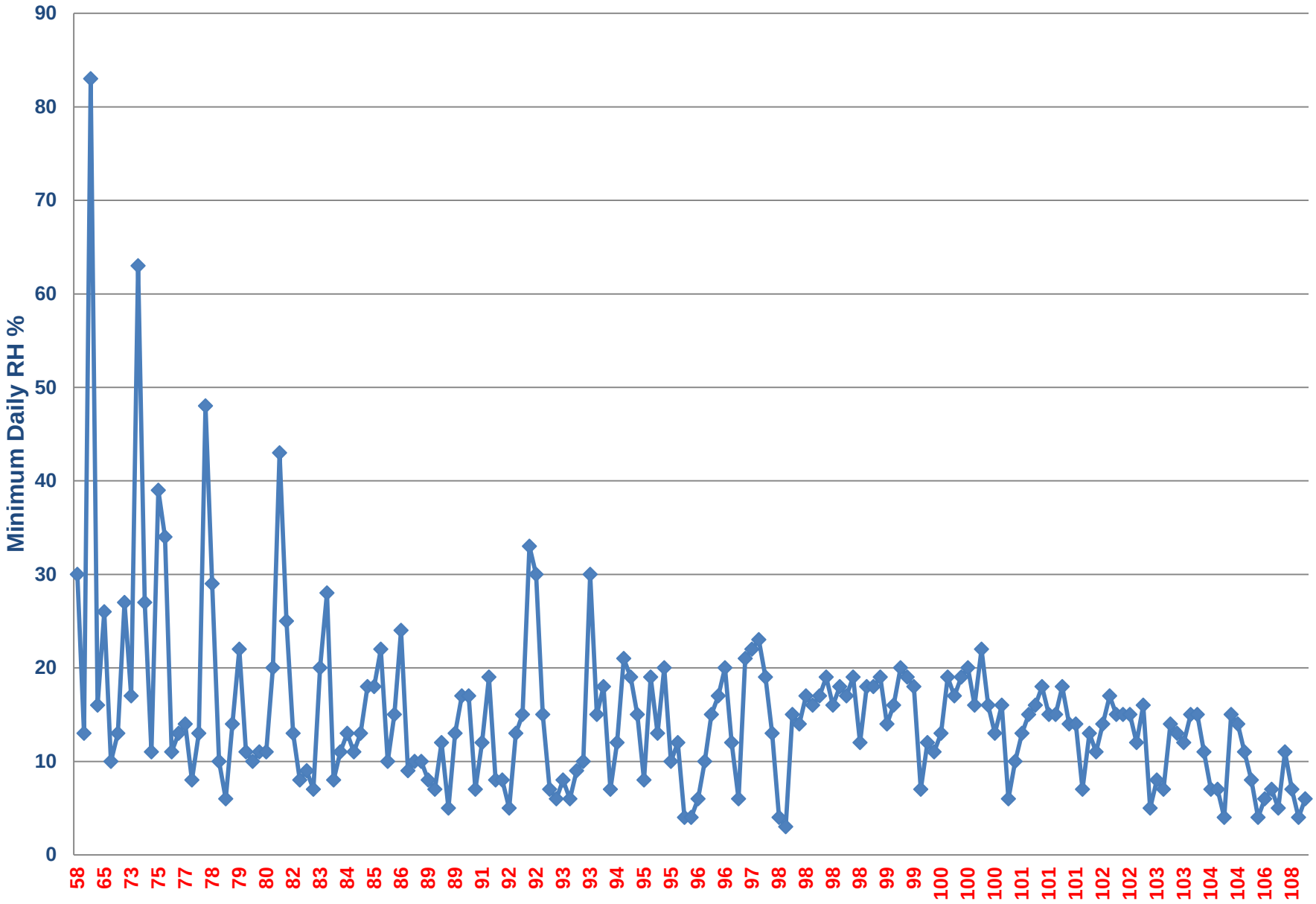
Station	Time of Last	Max Temp (F)	Daytime High (F)	Min Temp (F)	Max/Min Dew Pt. (F)	Max/Min RH (%)	Prevailing Wind Direction and Daily Average Speed (mph) @ 33ft	Avg Wind @ 6.5ft (mph)	Peak Gust @ 33ft (mph)	Potential Evapotranspiration mm/day or in/day	Total Rain (in)	Sum Solar Rad MJ/m²
Abernathy 5ENE	0855AM	33 @ 03:50 AM	30.3 @ 06:00 AM	27 @ 08:50 AM	32/27	100/95	NE 14.5	10.3	30mph 030° 06:35 AM	0.2 or 0.01	0.00	.0
Aiken 3WSW	0855AM	34 @ 12:00 AM	30.0 @ 06:00 AM	26 @ 08:54 AM	33/24	100/89	NE 18.2	14.5	31mph 024° 05:25 AM	0.4 or 0.01	0.00	.0
Amarillo 7SSE	0856AM	33 @ 01:34 AM	25.2 @ 06:00 AM	23 @ 08:29 AM	28/20	95/82	N 14.6	10.3	30mph 019° 03:29 AM	0.6 or 0.02	0.00	.0
Amarillo 9NNE	0855AM	29 @ 12:14 AM	25.7 @ 06:03 AM	23 @ 08:54 AM	26/18	96/80	N 12.3	8.8	29mph 019° 04:29 AM	0.6 or 0.02	0.00	.1
Amarillo 15NNW	0855AM	32 @ 12:00 AM	26.5 @ 06:00 AM	25 @ 07:51 AM	27/21	94/79	N 12.4	9.1	25mph 015° 04:59 AM	0.6 or 0.02	0.00	.0
Amherst 1NE	0855AM	35 @ 03:10 AM	29.2 @ 06:30 AM	27 @ 08:35 AM	31/25	97/80	NE 14.1	10.2	29mph 019° 06:20 AM	0.5 or 0.02	0.00	.0
Andrews 2E	0855AM	47 @ 12:00 AM	34.9 @ 06:00 AM	33 @ 08:20 AM	34/32	96/59	W 11.3	6.3	25mph 036° 07:20 AM	1.1 or 0.04	0.00	.0
Anton 6SSW	0855AM	34 @ 01:10 AM	30.4 @ 06:25 AM	28 @ 08:50 AM	31/27	100/89	NE 12.9	9.3	27mph 015° 08:40 AM	0.4 or 0.02	0.00	.0
Aspermont 3NE	0855AM	38 @ 03:35 AM	35.8 @ 06:20 AM	34 @ 08:50 AM	38/32	100/91	N 12.9	8.2	26mph 033° 04:30 AM	0.4 or 0.02	0.00	.0
Big Lake 1WNW	0856AM	43 @ 12:10 AM	39.4 @ 07:36 AM	34 @ 08:35 AM	40/33	98/87	S 5.5	3.0	23mph 027° 08:05 AM	0.5 or 0.02	0.00	.1
Bootleg 11WNW	0858AM	34 @ 12:01 AM	25.8 @ 06:02 AM	24 @ 08:57 AM	26/22	94/71	N 12.6	8.8	24mph 024° 06:52 AM	0.7 or 0.03	0.00	.0
Brownfield 2S	0855AM	41 @ 12:35 AM	32.9 @ 06:00 AM	28 @ 08:45 AM	33/27	100/73	NE 14.2	10.2	27mph 031° 07:20 AM	0.8 or 0.03	0.00	.0
Canadian 6E	0856AM	30 @ 02:13 AM	24.7 @ 06:02 AM	21 @ 08:35 AM	29/16	97/81	N 14.5	10.4	30mph 008° 08:34 AM	0.5 or 0.02	0.00	.1
Canyon 13E PDCSP	0856AM	38 @ 12:03 AM	26.2 @ 06:01 AM	24 @ 08:54 AM	28/20	91/64	N 11.3	6.8	27mph 012° 03:44 AM	0.9 or 0.03	0.00	.0
Childress 2NNE	0855AM	34 @ 07:15 AM	Same	31 @ 01:00 AM	33/26	100/81	N 14.0	9.7	27mph 019° 06:20 AM	0.5 or 0.02	0.00	.0
			28.0 @									

ENERGY BALANCE of a LEAF

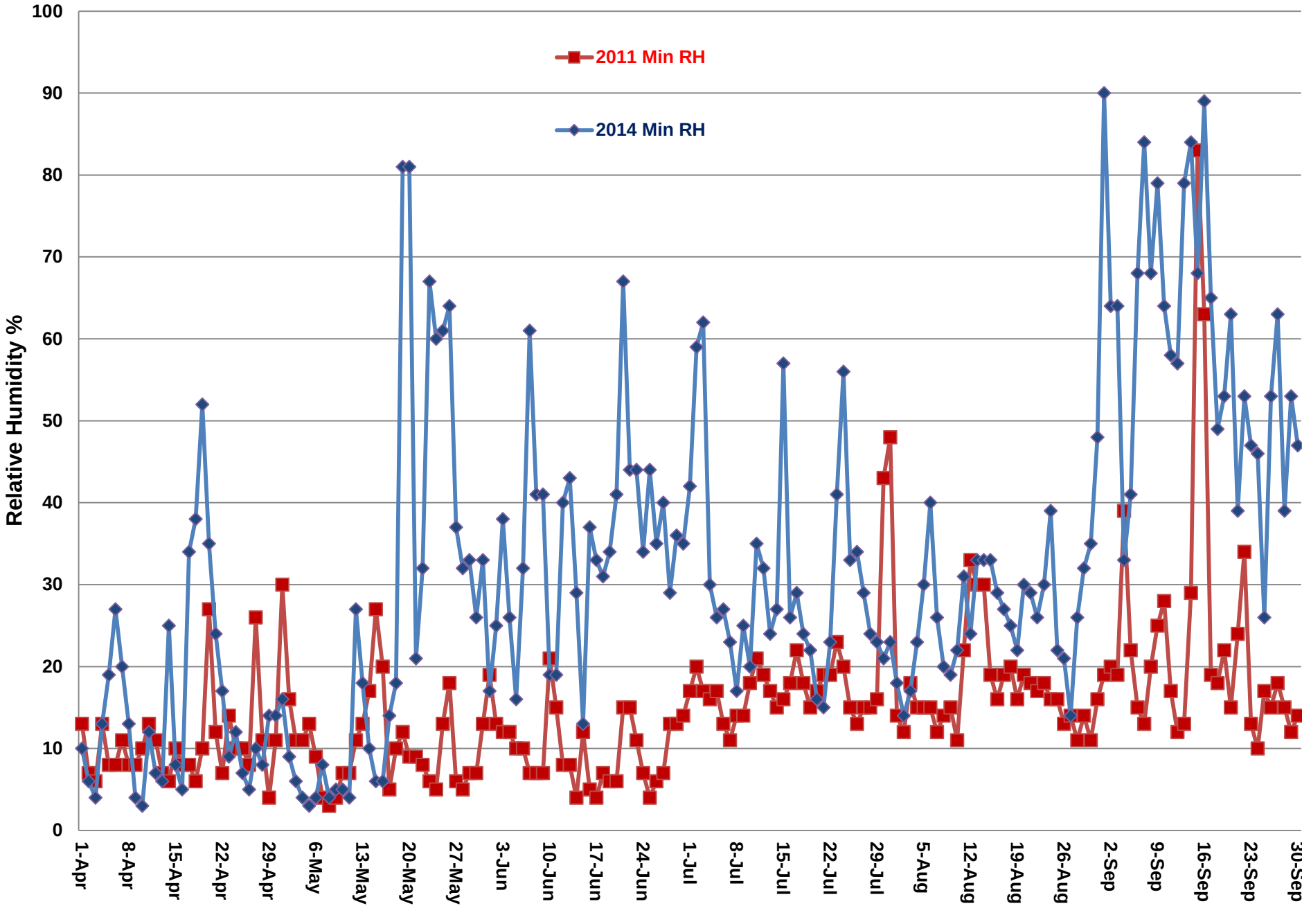


$$R_{net} = R_{inc} - R_{ref} - R_{trans} - R_{rerad} = \text{Evaporation}$$

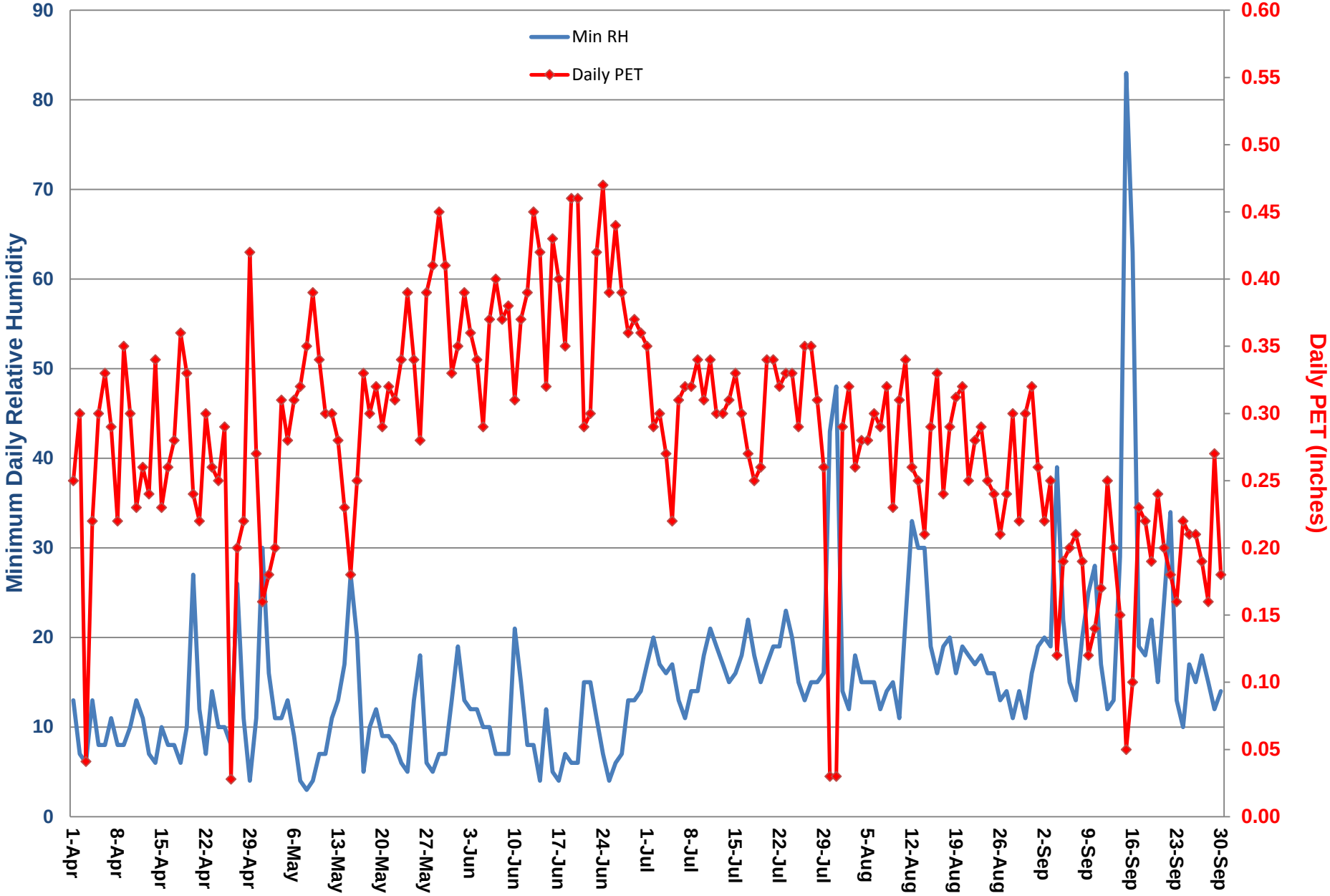

Average Daily Net Radiation vs Daily PET
Average Daily Radiation (MJ/M²/Day
Daily PET (Acre Inches/Day
30
25
20
15
10
5
0
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Avg Daily Radiation
Avg Daily PET
April
May
June
July
August
Sept

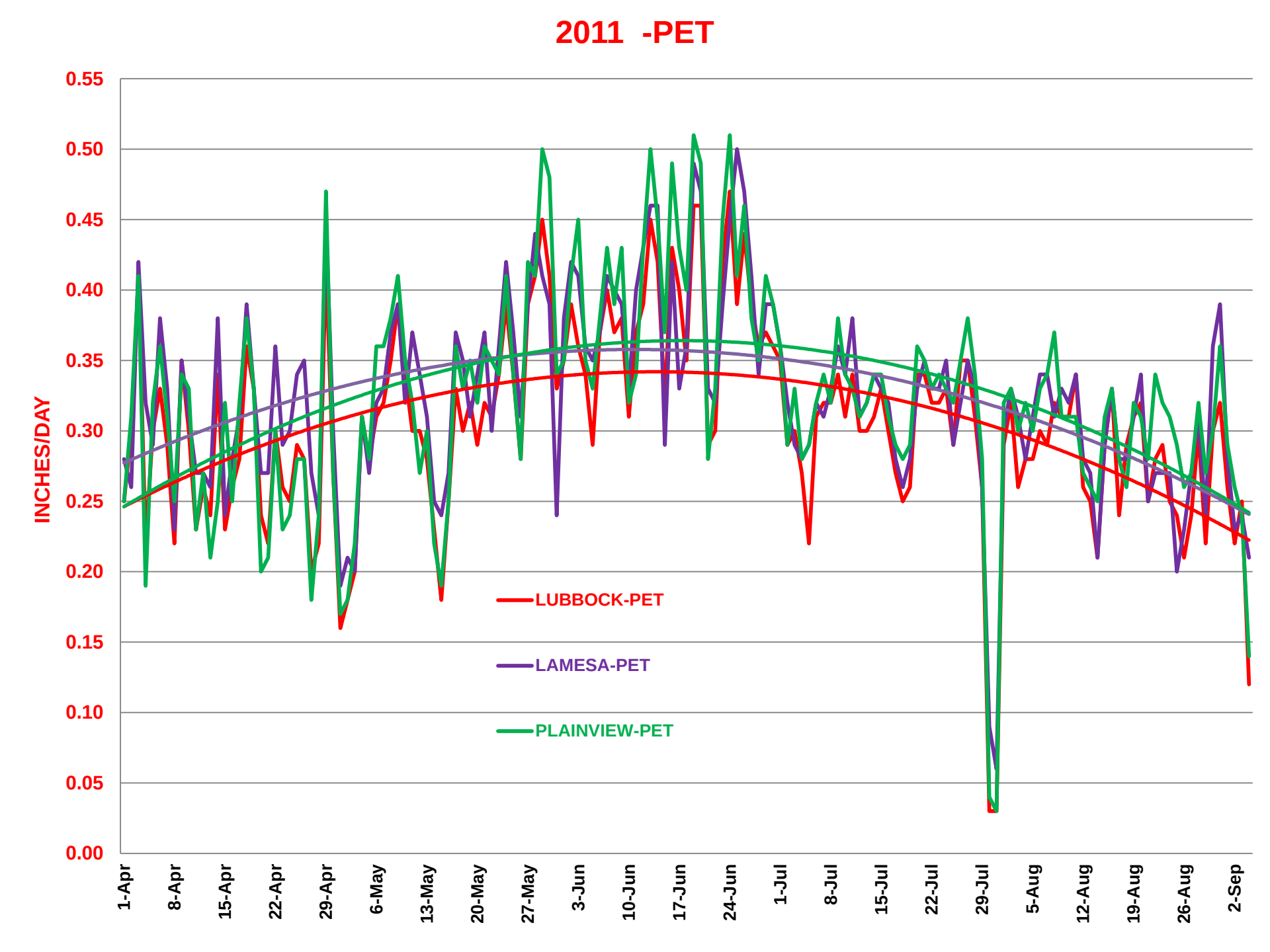

2011 Minimum Daily RH vs Maximum Daily Temperature
Minimum Daily RH %
90
80
70
60
50
40
30
20
10
0
58 65 73 75 77 78 79 80 82 83 84 85 86 89 89 91 92 92 93 93 94 95 95 96 96 97 98 98 98 98 99 99 100 100 100 101 101 101 102 102 103 103 104 104 106 108

2011 vs 2014 Daily Minimum Relative Humidity

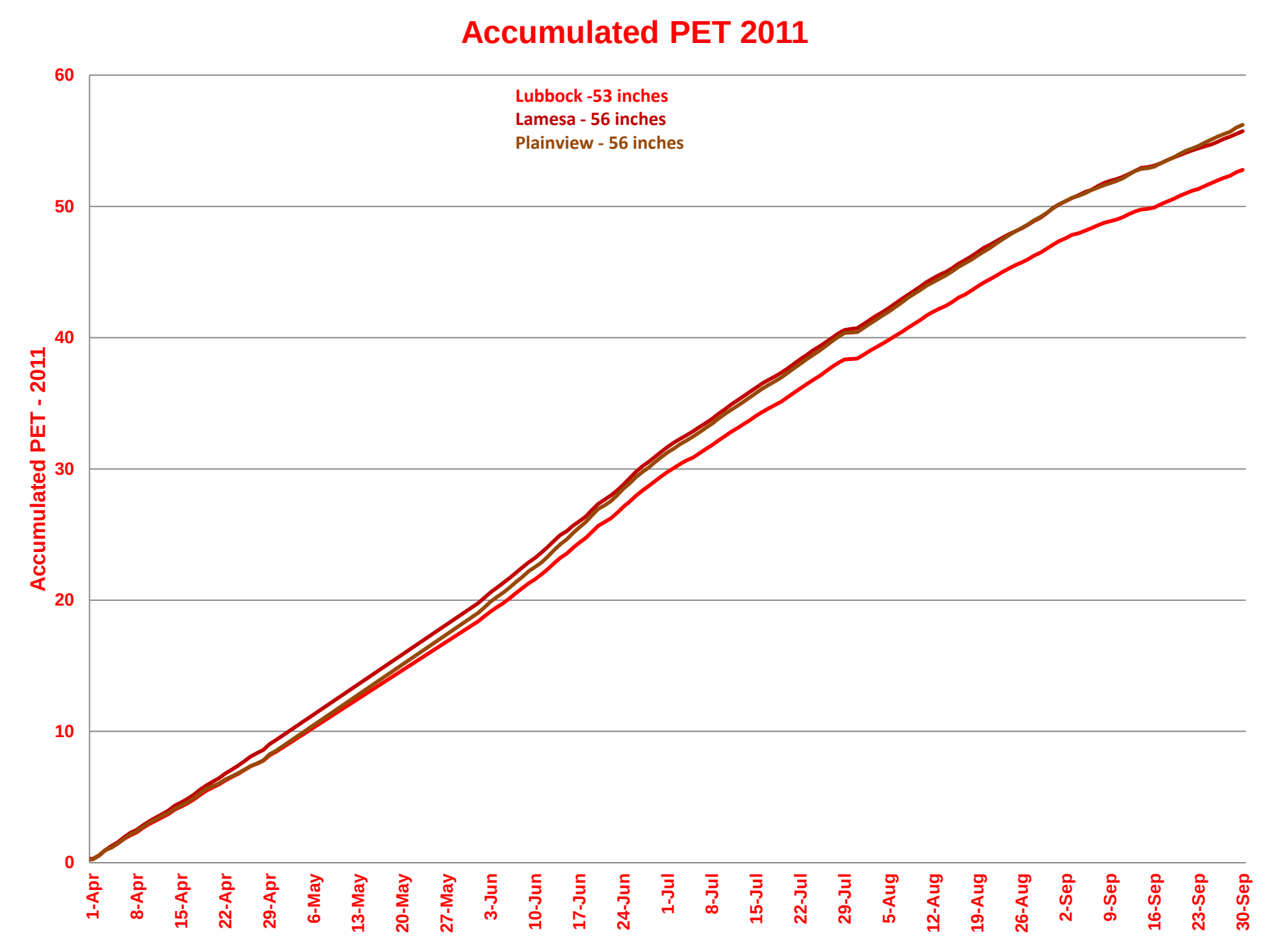


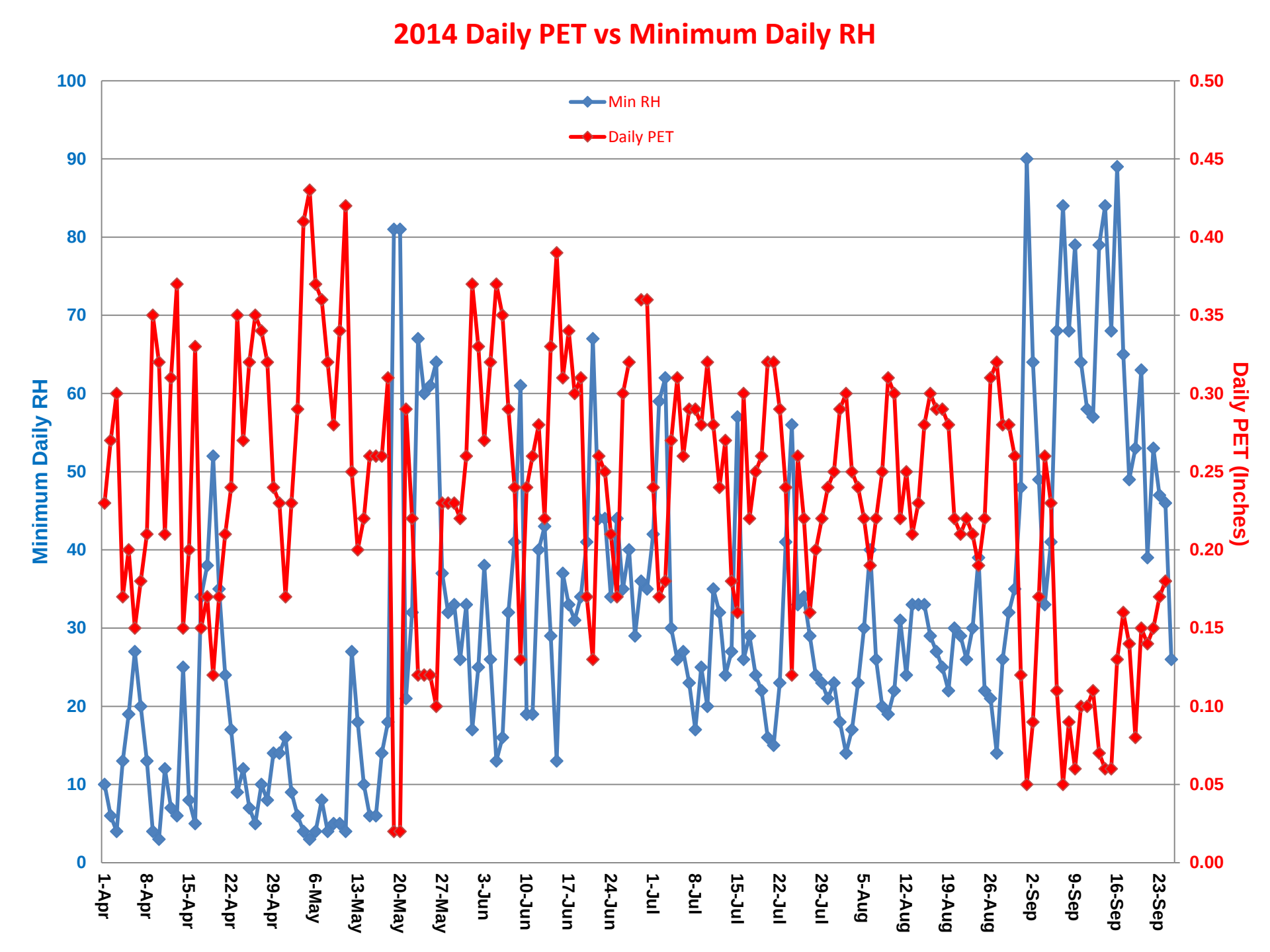
2011 Daily PET vs Minimum Daily Relative Humidity

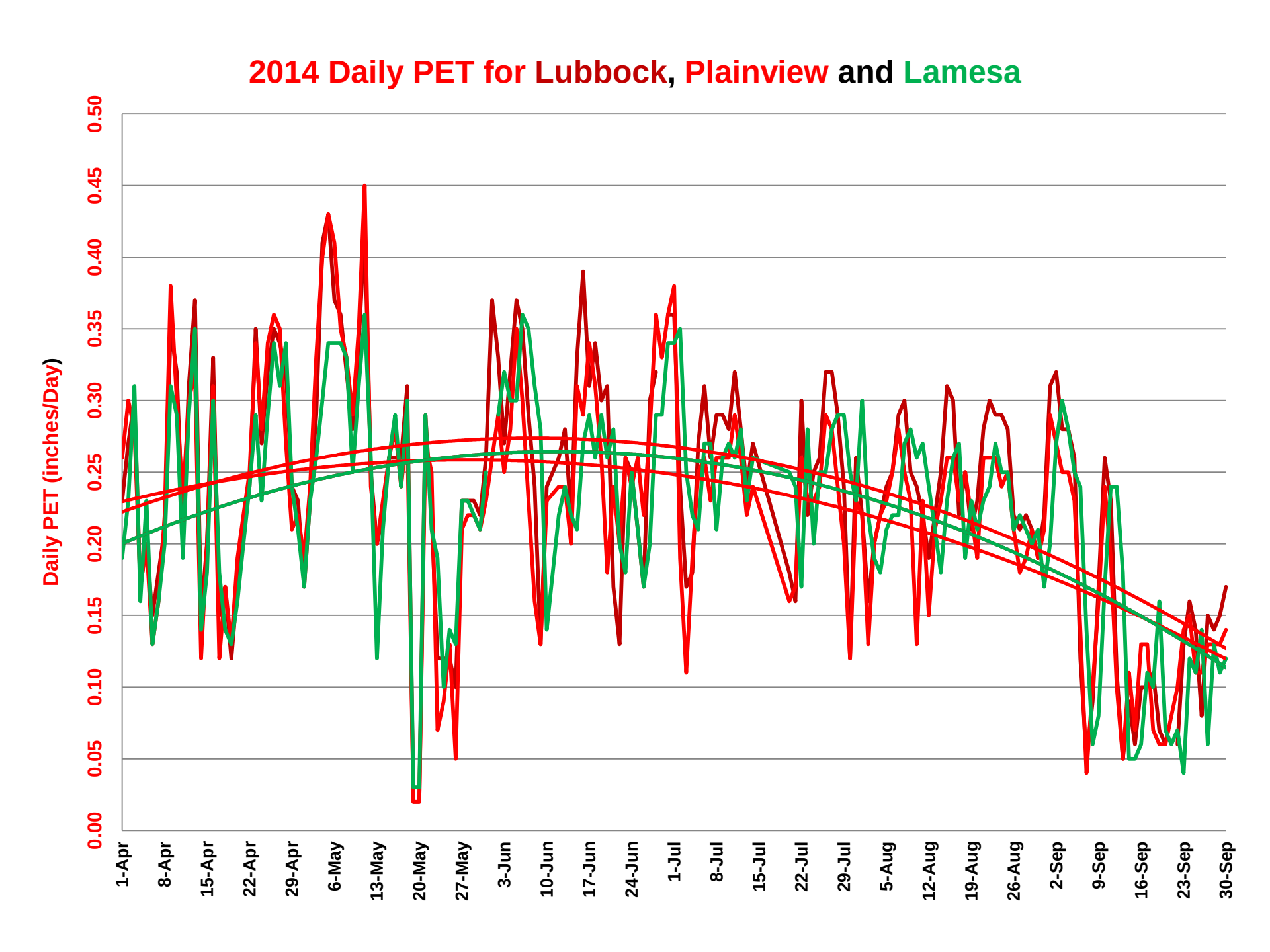


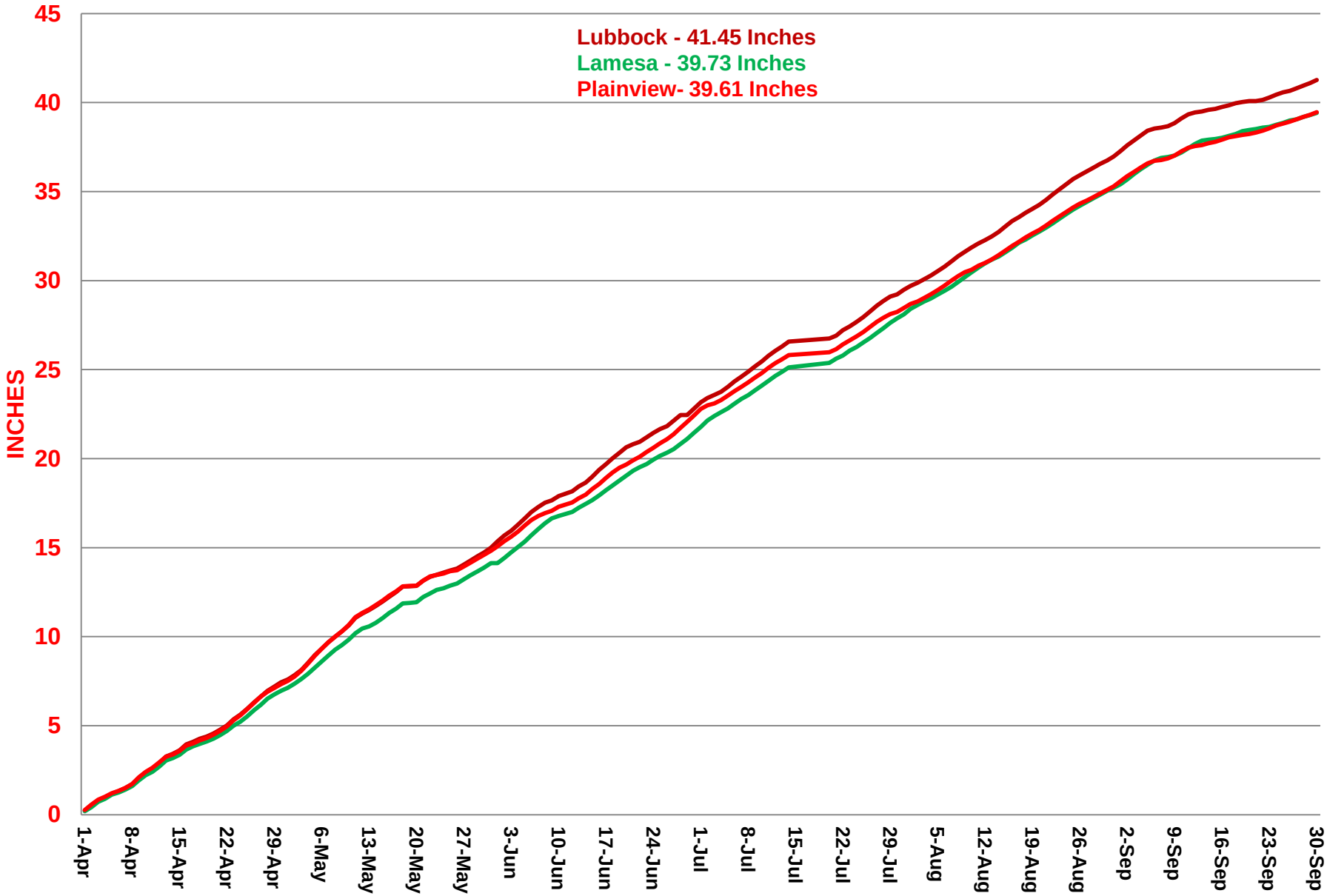

2011 -PET
INCHES/DAY
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1-Apr
8-Apr
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
LUBBOCK-PET
LAMESA-PET
PLAINVIEW-PET

Accumulated PET 2011




2014 Daily PET vs Minimum Daily RH
Min RH
Daily PET
Minimum Daily RH
Daily PET (Inches)
100
90
80
70
60
50
40
30
20
10
0
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1-Apr
8-Apr
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep


2014 Daily PET for Lubbock, Plainview and Lamesa
Daily PET (inches/Day)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
1-Apr
8-Apr
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep


2014 Accumulated PET
Lubbock - 41.45 Inches
Lamesa - 39.73 Inches
Plainview- 39.61 Inches
INCHES
45
40
35
30
25
20
15
10
5
0
1-Apr
8-Apr
15-Apr
22-Apr
29-Apr
6-May
13-May
20-May
27-May
3-Jun
10-Jun
17-Jun
24-Jun
1-Jul
8-Jul
15-Jul
22-Jul
29-Jul
5-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep

CROP WATER USE

- PHYSICAL CONDITIONS
  - PET
- BIOLOGICAL CONDITIONS
  - Leaf Area Index
  - Stomatal Conductance
  - Canopy Architecture
- AGRONOMIC CONDITIONS
- Row Spacing:Narrow Rows Reduce Soil Evaporation, Increase Crop Water Use
- Row Orientation :North-South Rows Reduce Wind Movement Through Crop, Increase Crop Canopy Light Interception, Circular Rows Best for Pivots
- Soil Surface Crop Residue Management: Increases Infiltration, Reduces Soil Evaporation

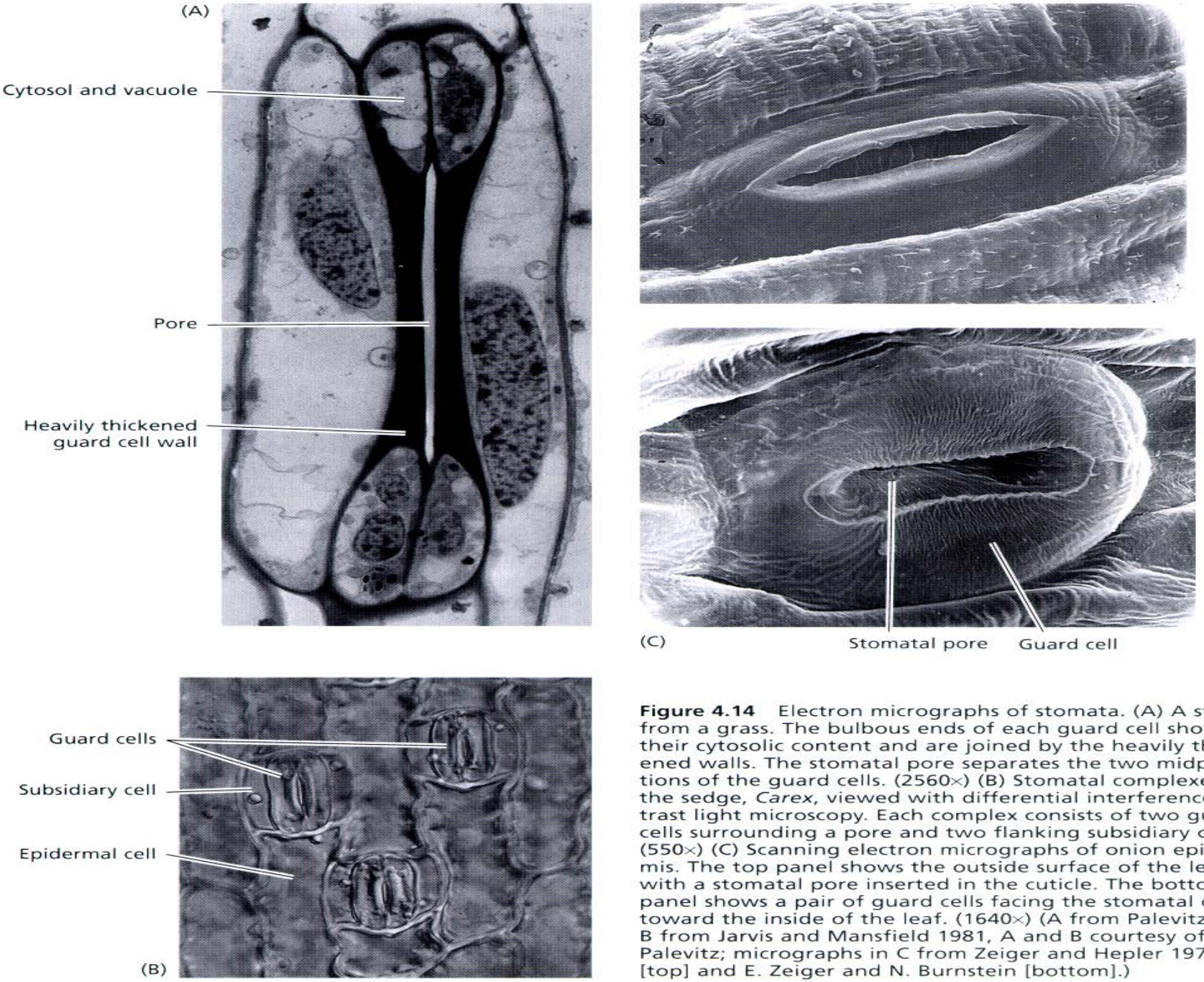


Figure 4.14 Electron micrographs of stomata. (A) A stoma from a grass. The bulbous ends of each guard cell show their cytosolic content and are joined by the heavily thickened walls. The stomatal pore separates the two midportions of the guard cells. (2560×) (B) Stomatal complexes of the sedge, *Carex*, viewed with differential interference contrast light microscopy. Each complex consists of two guard cells surrounding a pore and two flanking subsidiary cells. (550×) (C) Scanning electron micrographs of onion epidermis. The top panel shows the outside surface of the leaf, with a stomatal pore inserted in the cuticle. The bottom panel shows a pair of guard cells facing the stomatal cavity, toward the inside of the leaf. (1640×) (A from Palevitz 1981, B from Jarvis and Mansfield 1981, A and B courtesy of B. Palevitz; micrographs in C from Zeiger and Hepler 1976 [top] and E. Zeiger and N. Burnstein [bottom].)

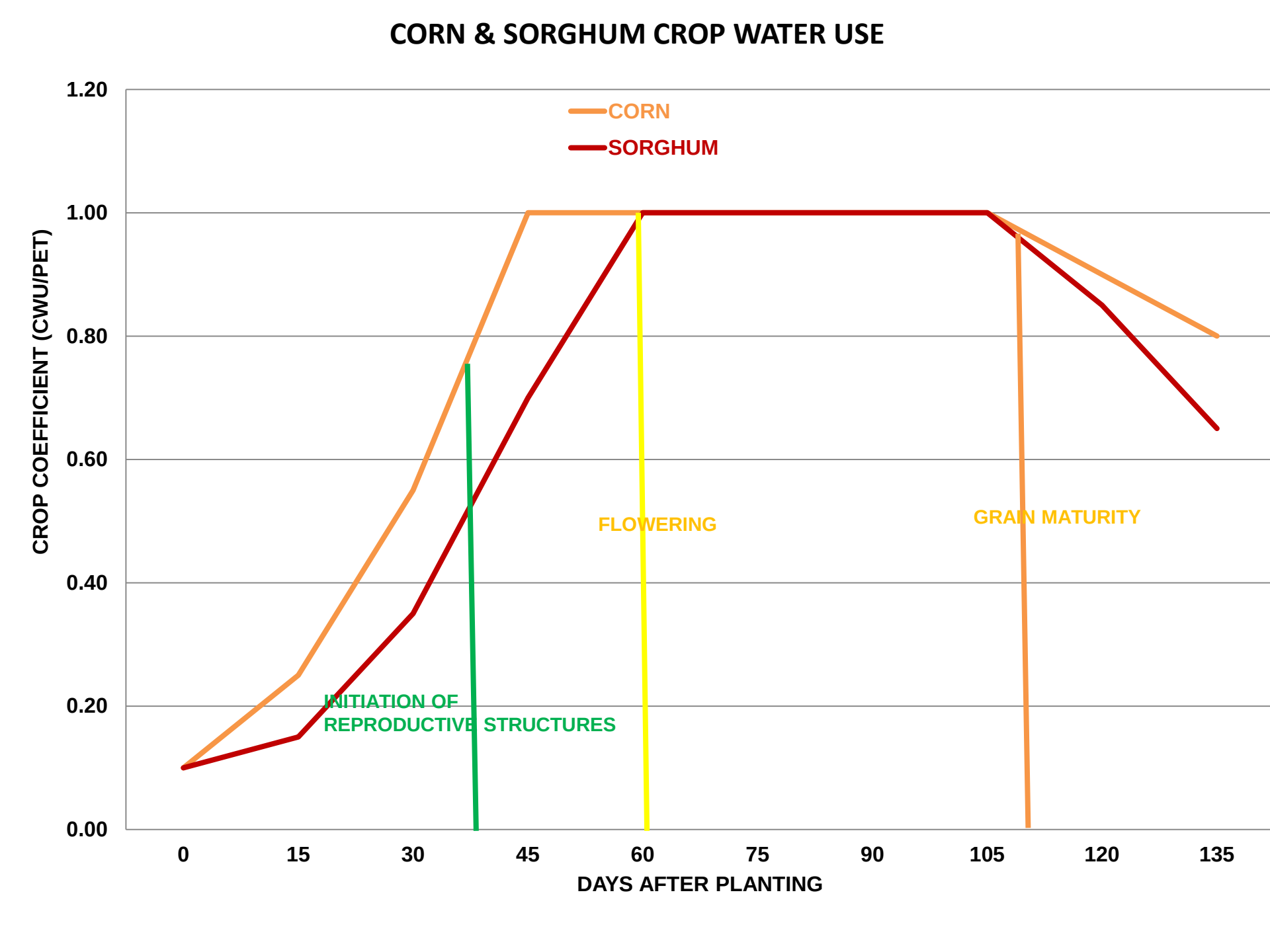

40 Inch Rows


30 Inch Rows

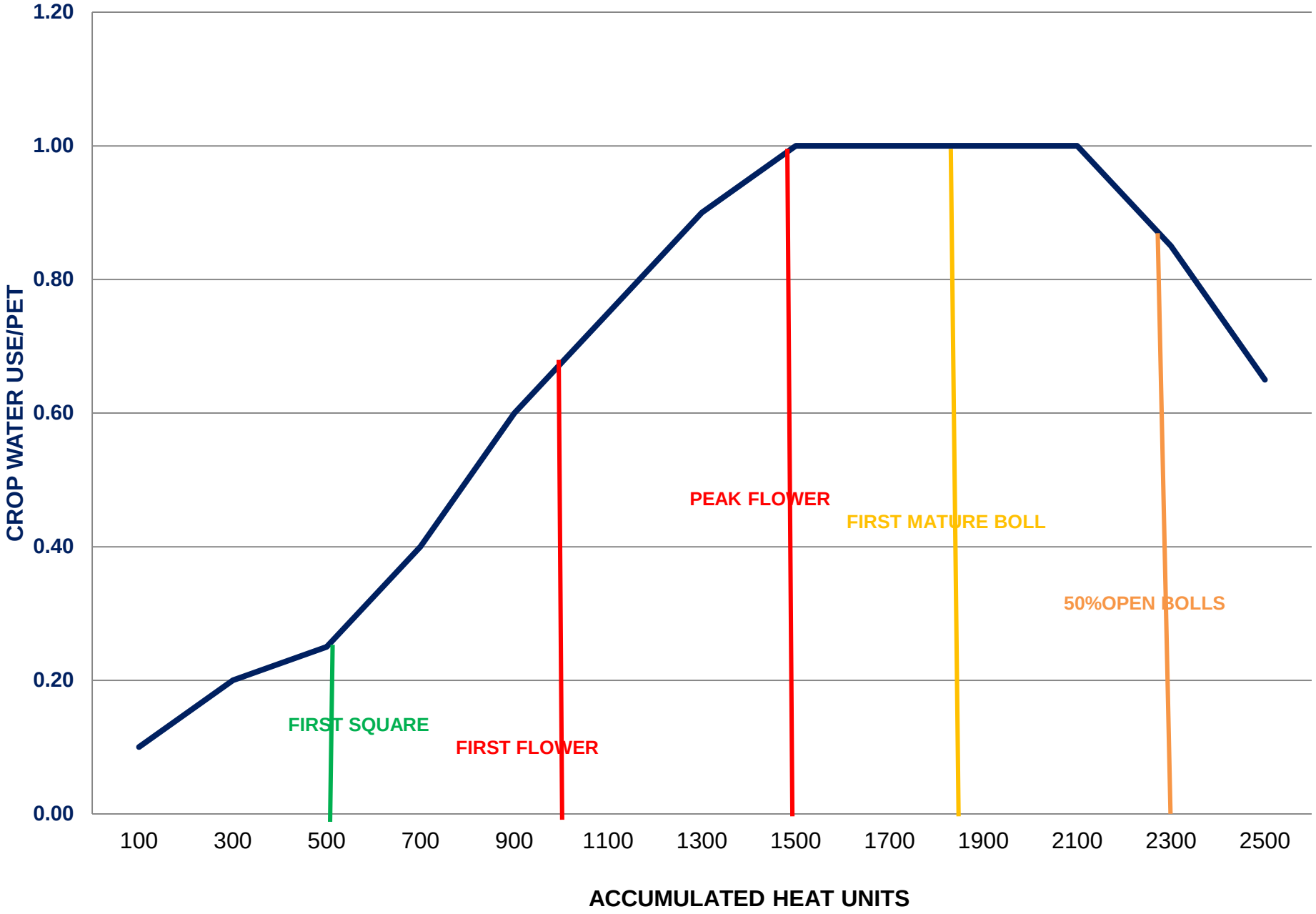
CROP COEFFICIENTS

$$Kc = ET_c / ET_p$$

Kc = **crop specific,**
varies with stage of development
amount of ground cover, and
soil water availability


CORN & SORGHUM CROP WATER USE
CROP COEFFICIENT (CWU/PET)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
CORN
SORGHUM
INITIATION OF
REPRODUCTIVE STRUCTURES
FLOWERING
GRAIN MATURITY
0
15
30
45
60
75
90
105
120
135
DAYS AFTER PLANTING

CROP COEFFICIENTS-COTTON



IRRIGATION WATER SUPPLY

27,000 gallons/acre inch

Gallons/Min/Acre	Acre Inches/Day
1.0	0.053
2.0	0.107
3.0	0.160
4.0	0.214
5.0	0.267
6.0	0.320
7.0	0.373

Atmospheric Conditions Determine the Rate of Water Evaporation on Daily and Seasonal Basis

Crop Type, Stage of Growth, and Agronomic Practices such as Row Spacing, Residue Management, Irrigation System and Water Supply Determine Daily Crop Water Use