Rainfed Cropping Systems to Improve Drought Tolerance for the High Plains

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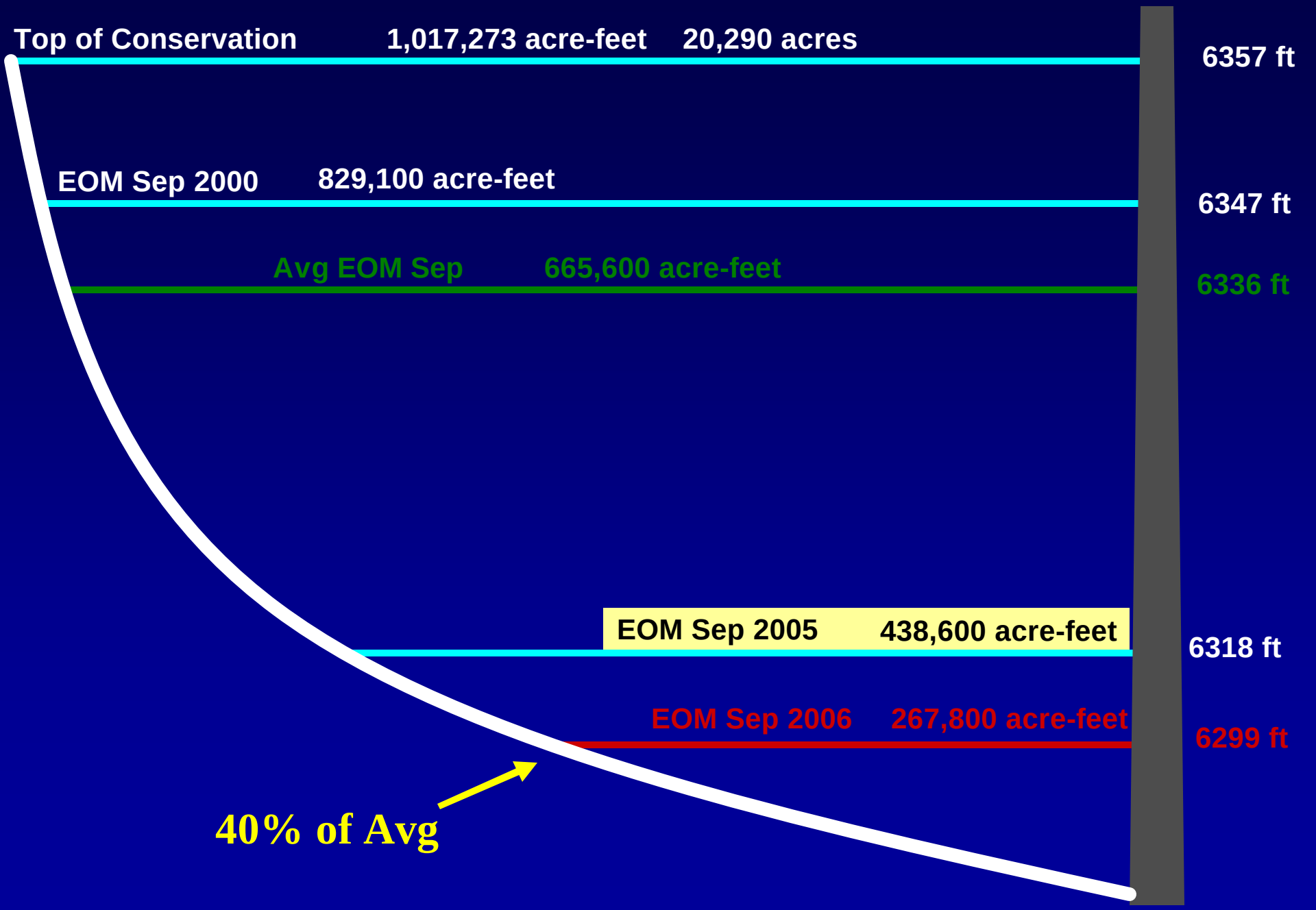
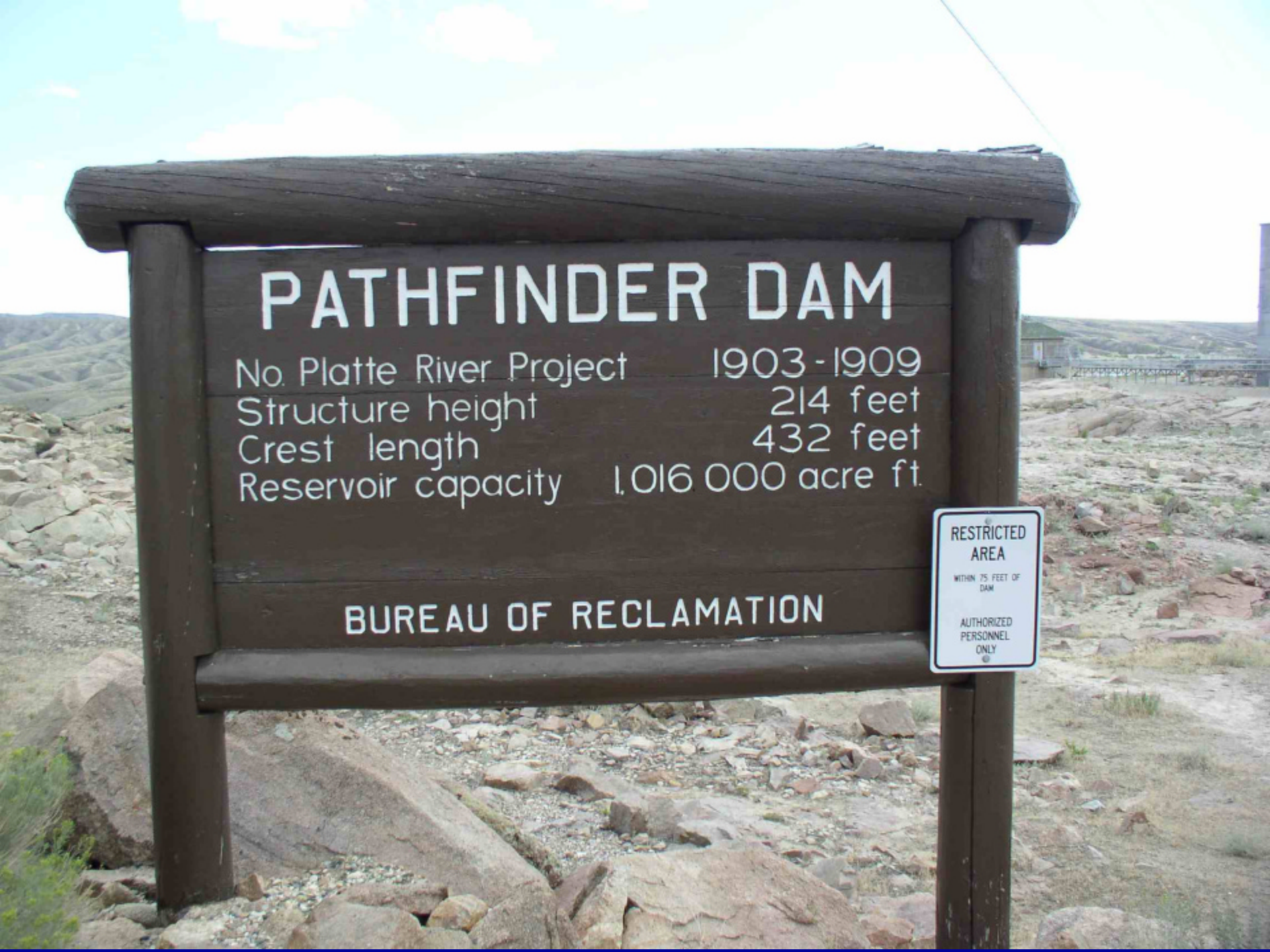
Elwood Reservoir

SEMINOE DAM
AND RESERVOIR
Kendrick Project 1936-39
Structure Height 295ft.
Crest Length 530ft.
Reservoir Capacity 1012000 A.F.
BUREAU OF RECLAMATION

Seminoe Reservoir




PATHFINDER DAM
No. Platte River Project 1903-1909
Structure height 214 feet
Crest length 432 feet
Reservoir capacity 1,016 000 acre ft.
BUREAU OF RECLAMATION
RESTRICTED AREA
WITHIN 75 FEET OF DAM
AUTHORIZED PERSONNEL ONLY

PATHFINDER DAM

This irrigation storage dam, the first on the North Platte, was built during the years 1905-1909. The dam was constructed from granite quarried within ¼ mile of this site. Only the facing stones were cut into rectanglar blocks. The interior of the dam consists of large, irregular chunks set in mortar. Most of the work required hand labor and horsepower as very little modern construction equipment was available.

U.S. DEPARTMENT OF THE INTERIOR
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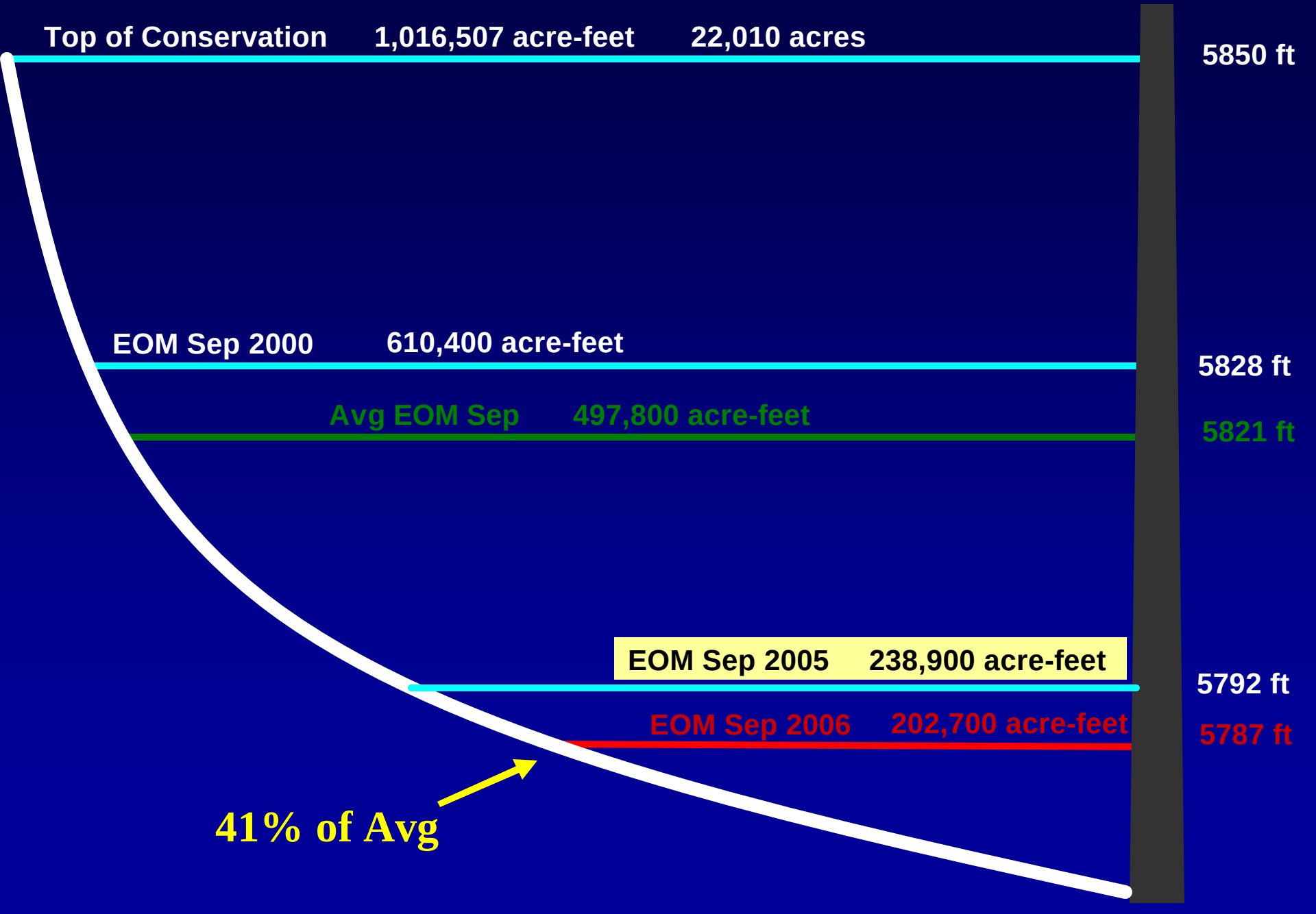
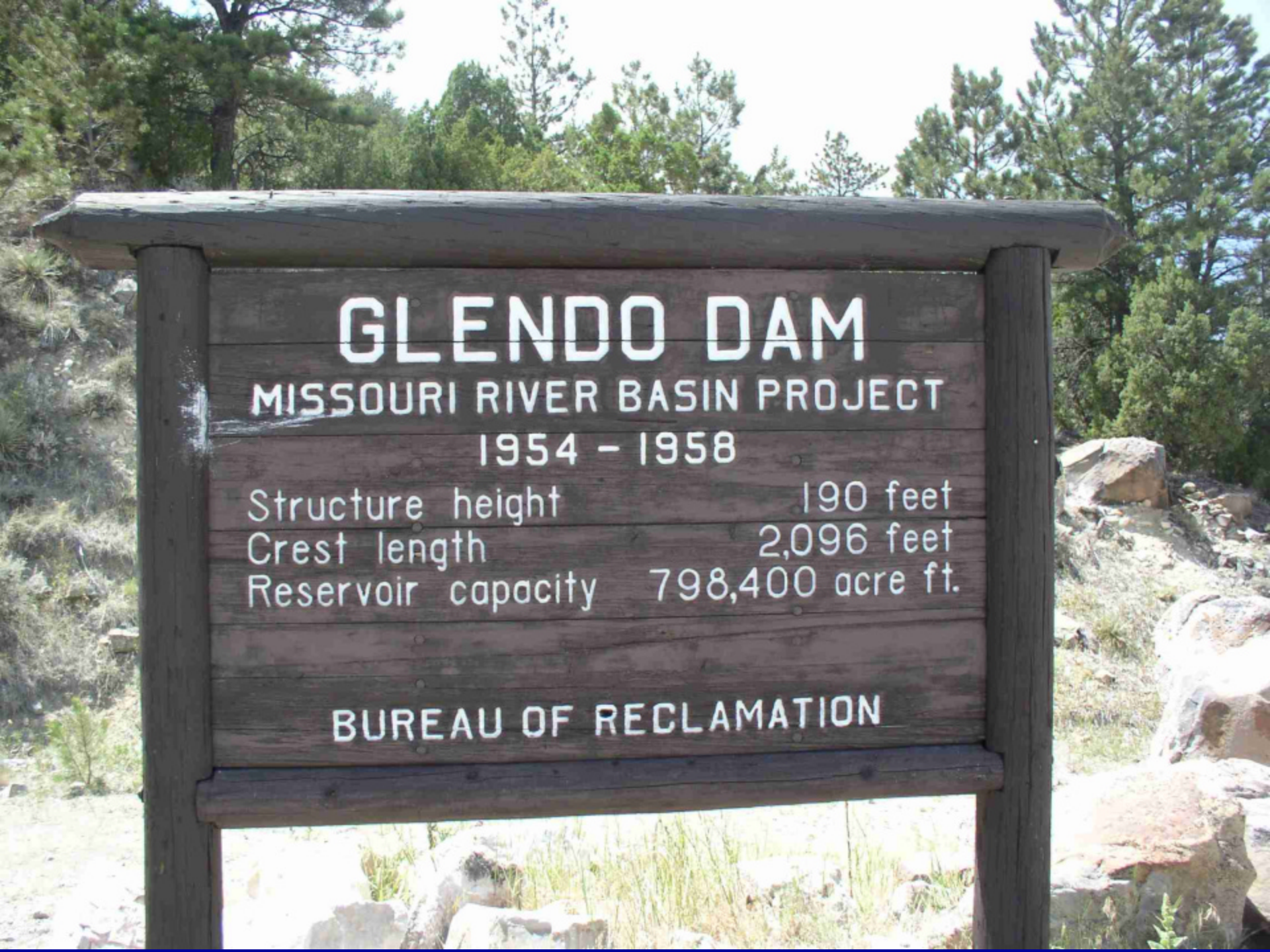
NORTH PLATTE PROJECT

Pathfinder Reservoir




GLENDO DAM
MISSOURI RIVER BASIN PROJECT
1954 - 1958
Structure height 190 feet
Crest length 2,096 feet
Reservoir capacity 798,400 acre ft.
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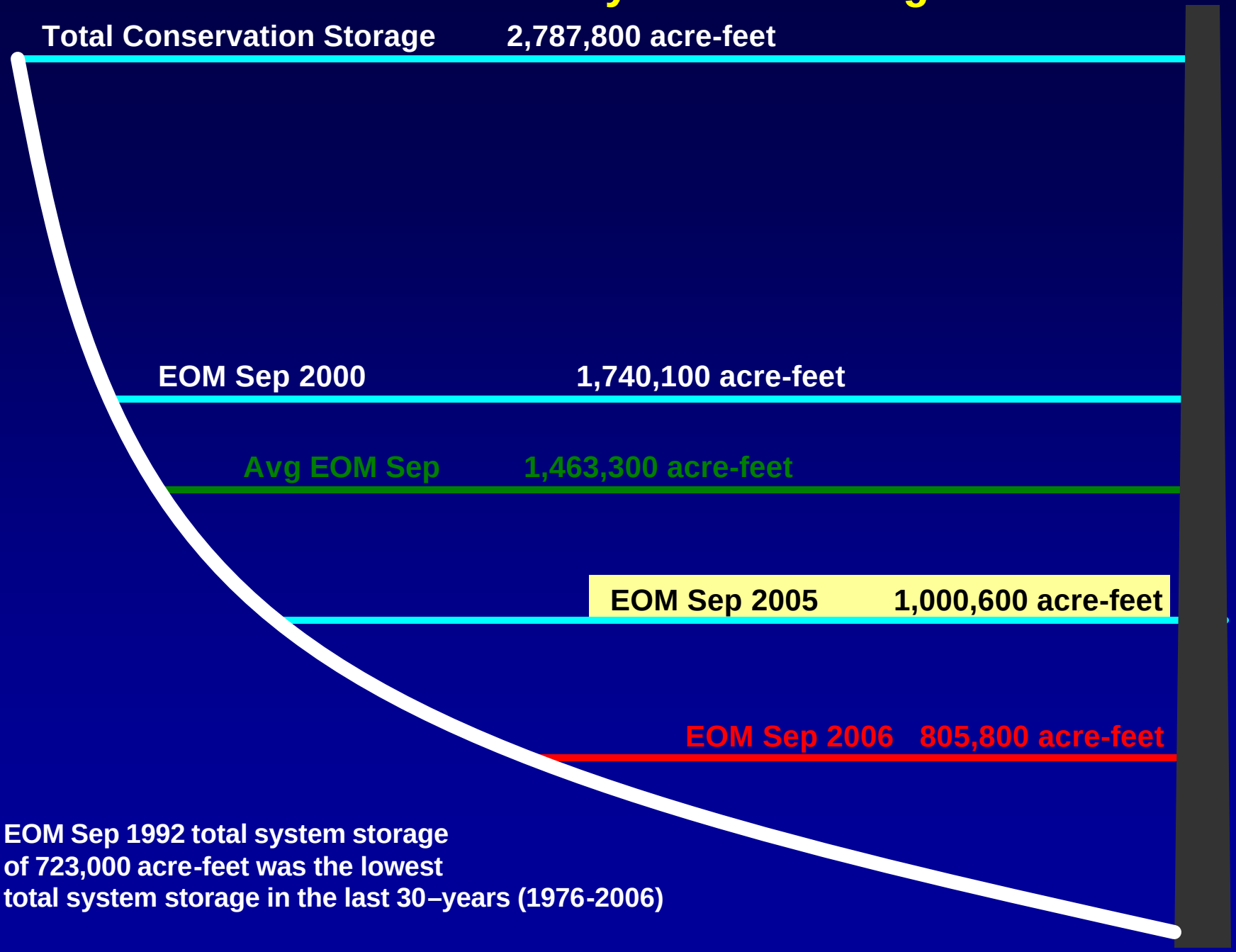
North Platte System Storage



EOM Sep 1992 total system storage of 723,000 acre-feet was the lowest total system storage in the last 30–years (1976-2006)

2002 South of North Platte, NE

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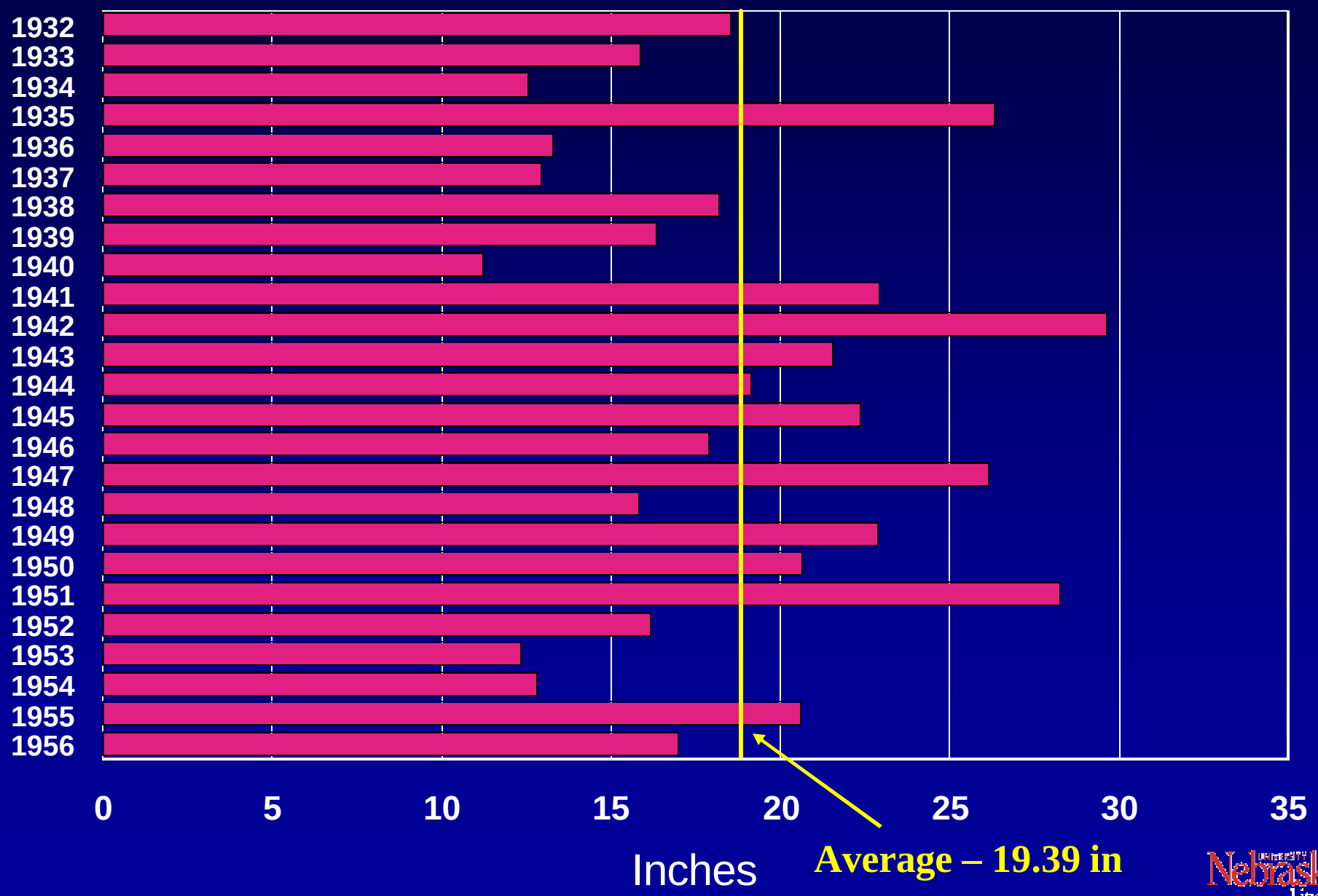
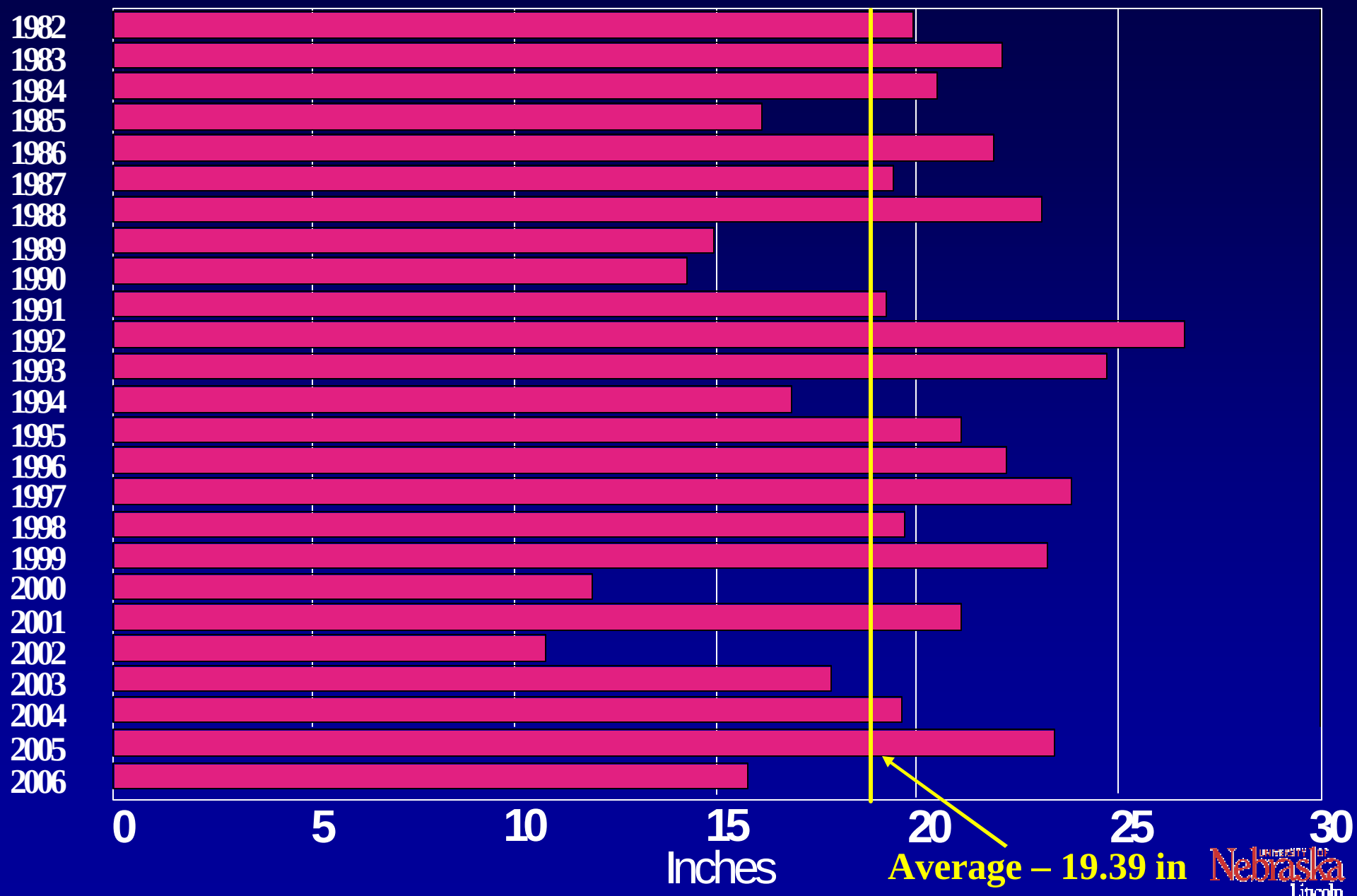
Annual Rainfall, Sept1 – Aug 31; North Platte, NE



Annual Rainfall, Sept1 – Aug 31; North Platte, NE



Cropping Systems

- Wheat Fallow
  - One Crop in Two Years
- Wheat - Corn, Grain Sorghum, Sunflower, or Proso Millet - Fallow
  - Two Crops in Three Years
- Wheat - Corn - Corn - Fallow
  - Three Crops in Four Years

“Very few dryland corn fields will be harvested for grain.”

- September 16, 2005 Crop Watch
  Doug Anderson, Extension Educator
  in Nuckolls and Thayer counties

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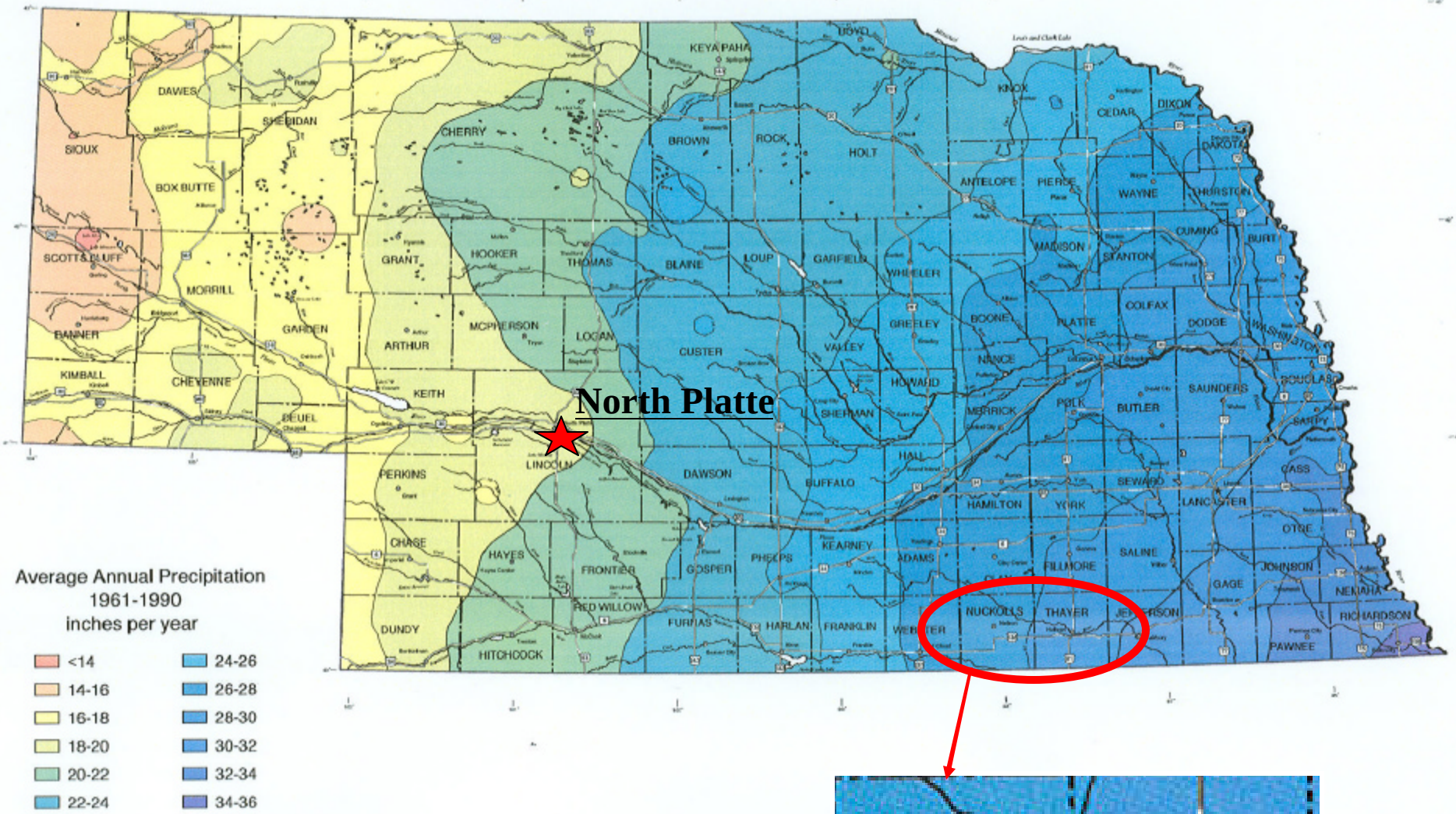

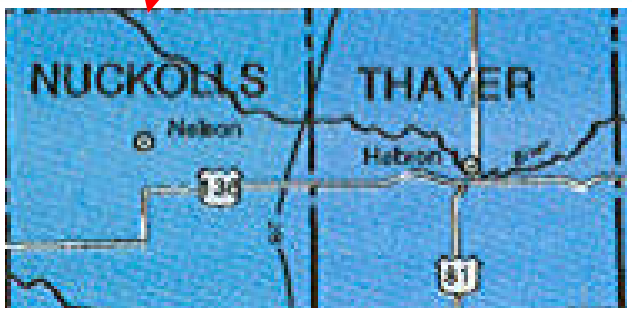

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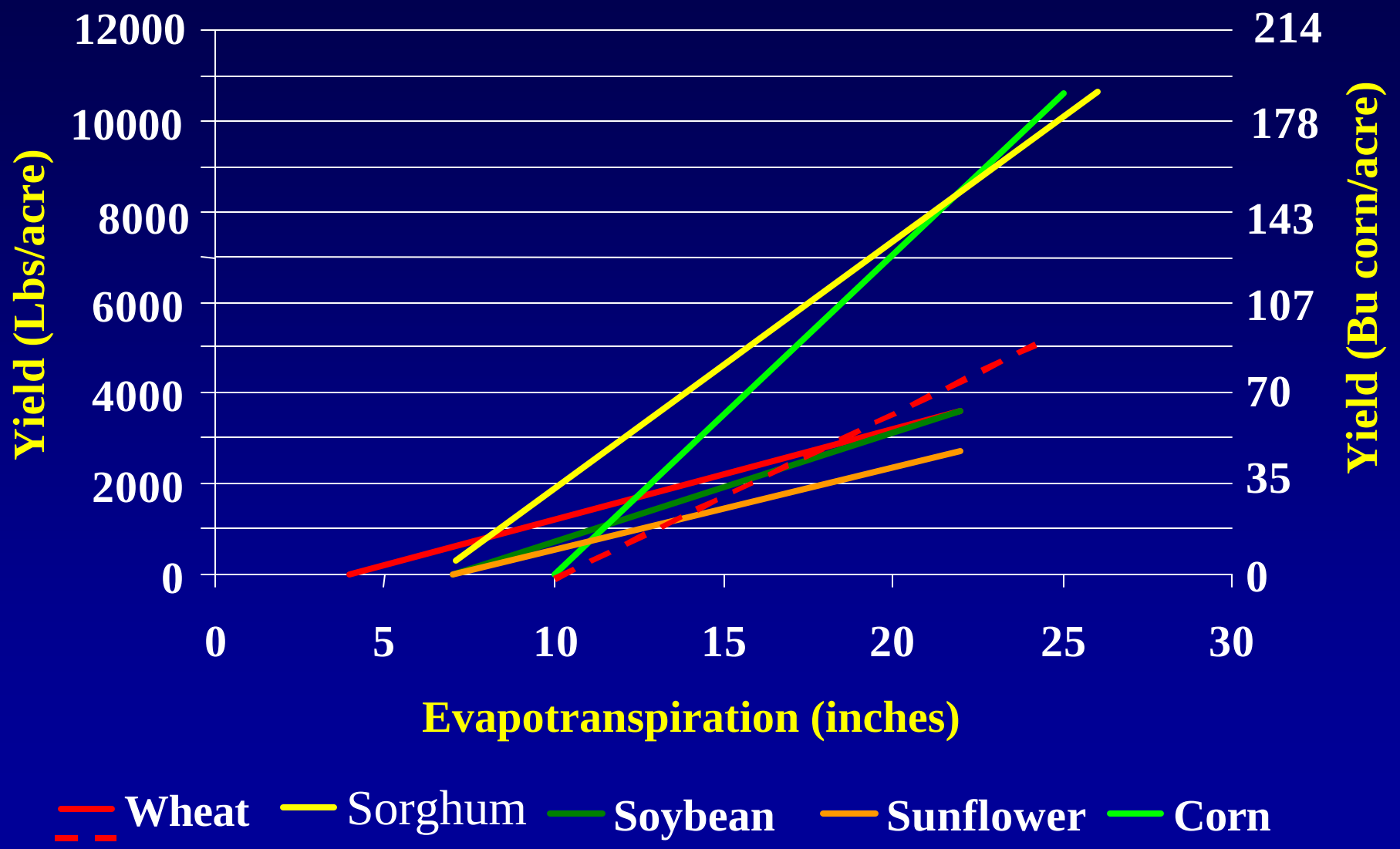
How Much Water Does It Take?



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Red Willow County
October 27, 2006

Red Willow County
October 27, 2006

Red Willow Ecofallow Corn - 2003

Brand	Hybrid	Yield (Bu/a)
DeKalb	DKC 58-78	98.8
Pioneer	33B51 ##	94.9
Roth	2097 ##	93.5
DeKalb	DKC 63-79	91.3
Garst	8578 IT ##	90.5
Asgrow	RX752 YG	89.0
Pioneer	34N44 ##	87.8
Garst	8590 ##	84.5
	Average:	91.3
	LSD 5%	NS

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Red Willow Ecofallow Sorghum - 2003

Brand	Hybrid	Yield (Bu/a)
Garst	5460	112.9
Sorghum Partners	NK5418	111.2
DeKalb	DKS36-00	110.9
Garst	5631Y	108.0
Triumph	TR 460	105.9
Sorghum Partners	KS585	103.5
Sorghum Partners	NK7655	98.0
Monsanto	X210	92.1
Asgrow	Pulsar	91.3
Sorghum Partners	K35-Y5	91.2
Sorghum Partners	1486	90.9
Sorghum Partners	NK7633	87.5
-----	UNL3016	81.5
Sorghum Partners	K73-J6	74.6
	Average:	97.1
	LSD 5%	14.5

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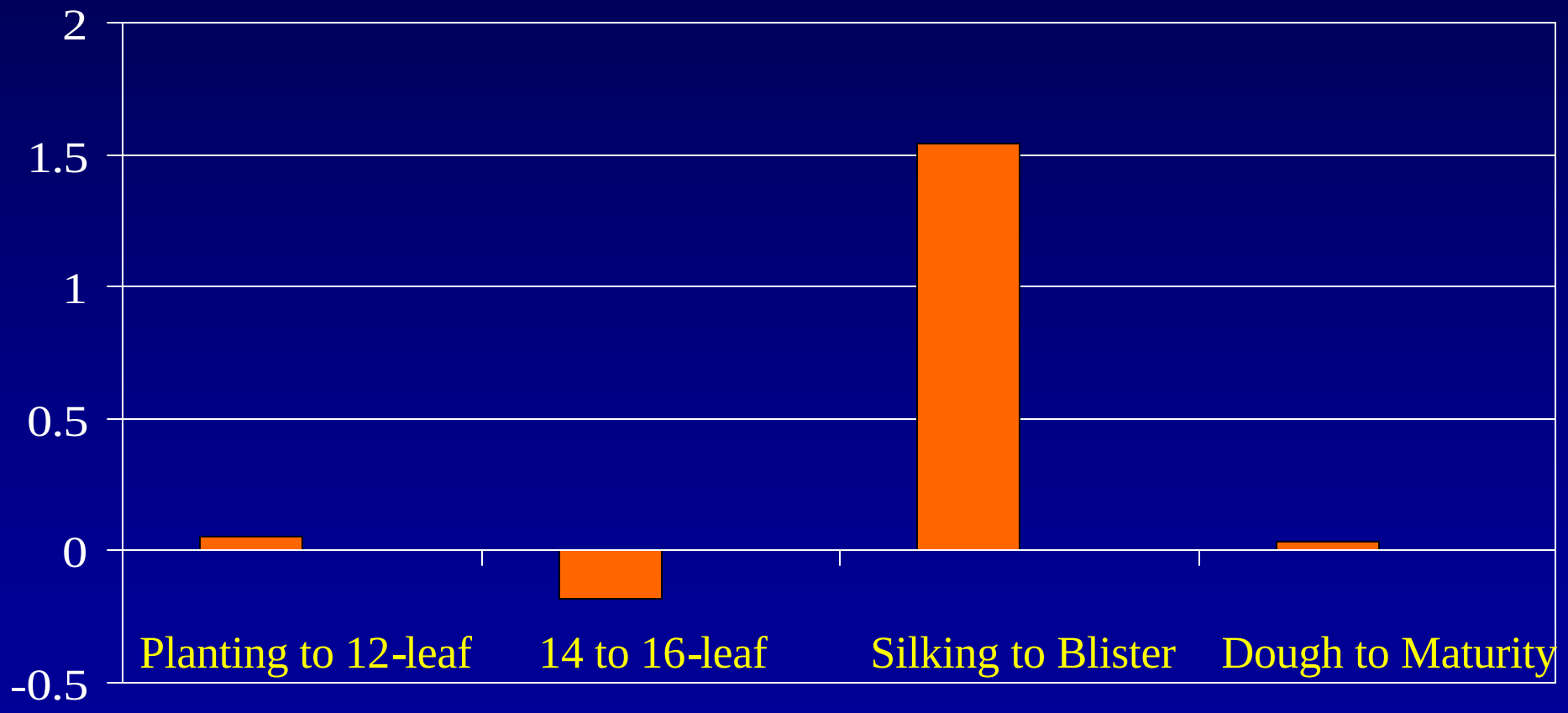
Drought Sensitivity Coefficient for Corn

(from Meyer et al. 1993)



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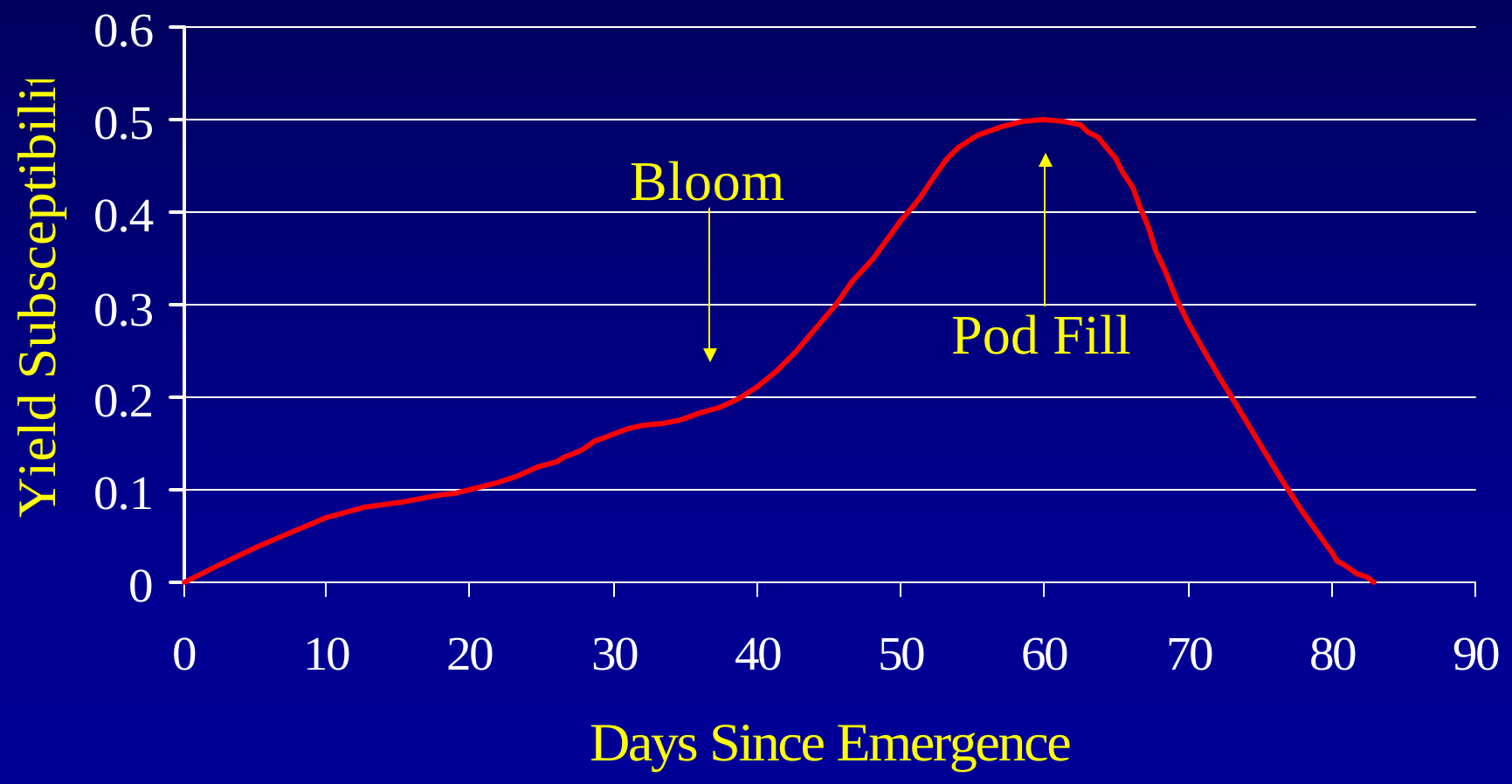
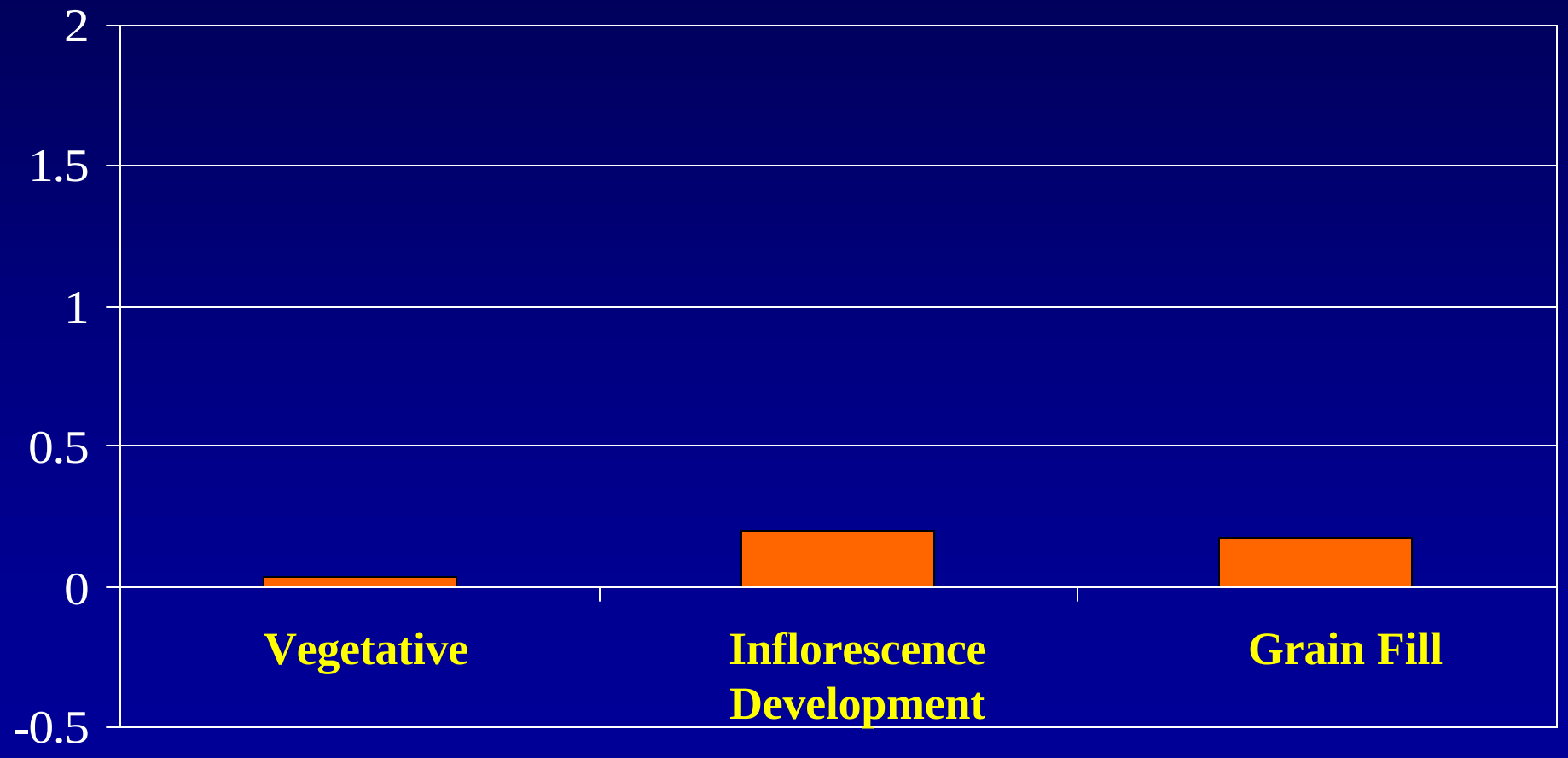
Yield Susceptibility for Soybeans

(from Sudar et al. 1981)



Drought Sensitivity Coefficient for Sorghum

(from Meyer et al. 1999)



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Akron Colorado

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$19.25 - $28.50

PARAMOUNT	5.3-8.0 oz	Emergence to 12″ sorghum	Requires COC or MSO additionally. UAN or AMS may be added. Best performance on annual grasses less than 2 inches tall. Works best on green foxtail. Cost: Paramount $19.25-$28.50; Paramount + atrazine $19.50-$30.50.
PARAMOUNT + ATRAZINE DF	5.3-8.0 oz 0.5-1.0 lb		
PEAK alone or with DICAMBA•	0.25-1.0 oz 2.0-8.0 oz	Sorghum 5-30″ Sorghum < 5 leaves	On soil above pH 7.5, carryover may injure soybean and other sensitive crops. Cost: $3.00-$16.00.
PERMIT	0.67-1.0 oz	Sorghum 2-leaf to layby (before head emergence)	May be tank mixed with AAtrex, Buctril, Banvel/Clarity, or 2,4-D. Cost: $11.80-$17.50.

$11.80 - $17.50

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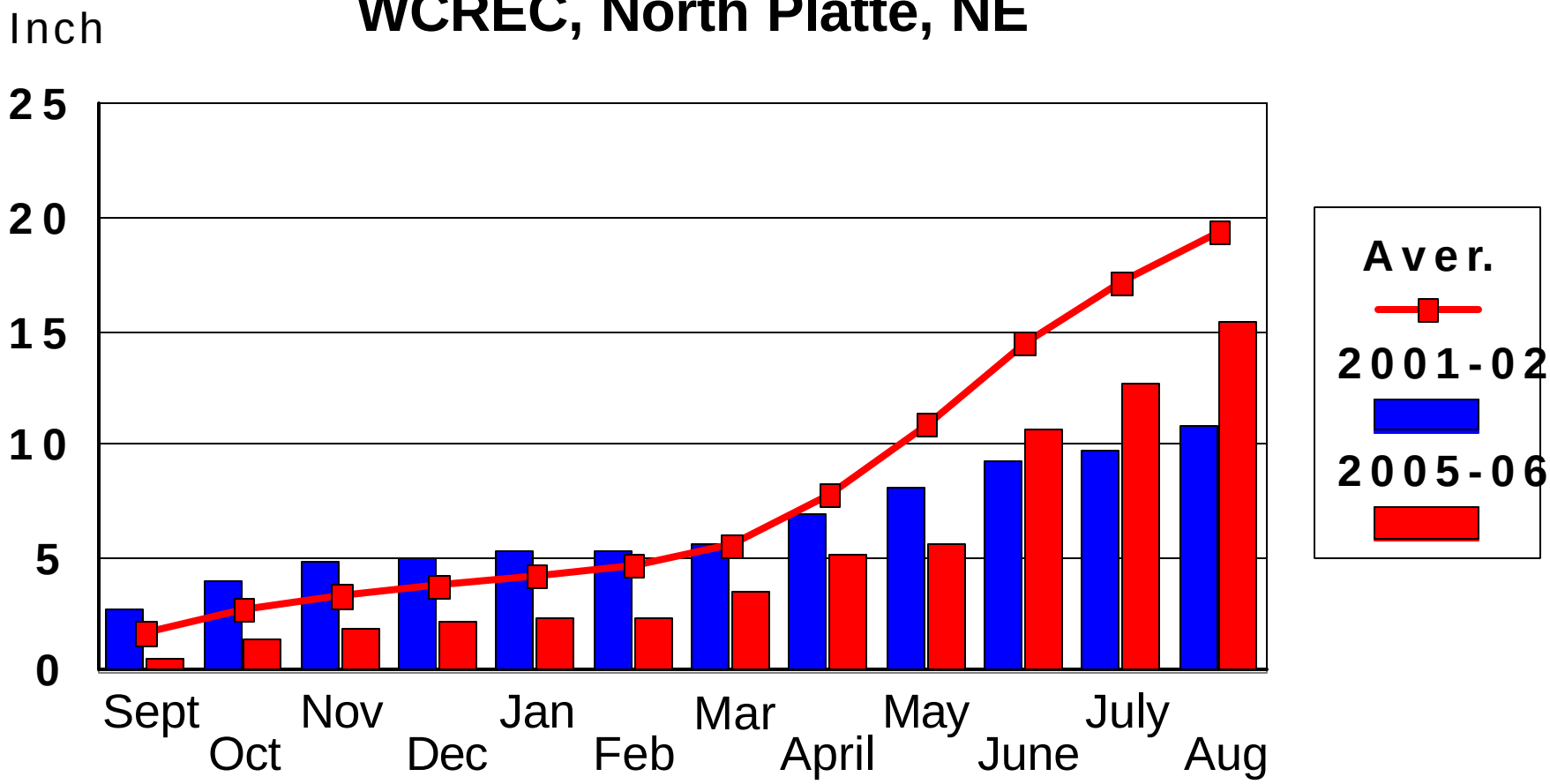
Rainfall Cumulative
September - August 2005-06

WCREC, North Platte, NE



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What Spurred My Interest in Rainfed Skip – Row Corn

- 2002 at North Platte- lowest precipitation since records were started in 1907
- A sorghum breeder asked me to plant experimental grain sorghum hybrids in area
  - Only grain produced in Hayes County plot was where sorghum rows were missing (missing grows were result of some experimental hybrids not producing viable stands) the adjoining rows would have sorghum
- Many rainfed producers in area last corn crop was in 1999
- With Roundup Ready Corn, weeds could be controlled economically

RR Corn 2

- RR 2 = NK-603 event recently employed
- RR = GA-21
  - RR hybrids still available in 2004 but not beyond
- RR 2 allows:
  - 50% higher glyphosate rates in corn
  - Application up to 48-inch corn

2006 Approximate Retail Price ($) per Unit of Selected Herbicides

Product	2006 Price ($) per unit	Product	2006 Price ($) per unit	Product	2006 Price ($) per unit
2,4-D amine	12.00/gal	Conclude Ultra	71.00/gal	Guardsman MAX	48.00/gal
2,4-D ester #4	15.00/gal	Crop Oil concentrate (COC)	4.80/gal	Harmony GT XP	13.00/oz
2,4-D ester #6	20.00/gal	Crossbow	60.00/gal	Harmony Xtra XP	14.00/oz
AAtrex 4L	13.00/gal	Curbit	50.00/gal	Harness	88.00/gal
AAtrex DF	2.80/lb	Curtail	40.00/gal	Harness 20G	2.50/lb
Accent	37.00/oz	Curtail M	46.00/gal	Harness Extra 5.6L	42.00/gal
Accent Gold	8.40/oz	Dacthal 75W	16.00/lb	Harness Extra 6L	55.00/gal
Accent WDG	7.00/oz	Define DF	21.00/lb	Hi-Dep	21.00/gal
Aim EW	187.00/qt	Degree Mini (120)	48.00/gal	Hoelon	75.00/gal
Alanap L	40.00/gal	Degree Extra	35.00/gal	Hornet WDG	59.00/lb
Ally	25.40/oz	Dicamba	76.00/gal	Hyvar XL	70.00/gal
Ally Extra	10.60/oz	Dimension	128.00/gal	INTRRO	22.00/gal
Amber Custom Pak	8.90/oz	Distinct	45.00/lb	Karmex 80W	4.40/lb
Ammonium Sulfate	0.17/lb	Diuron	4.20/lb	Kerb 50W	54.00/lb
Aquathol Super K	19.00/lb	Domain	13.80/lb	Keystone	40.00/gal
Aquathol 1.6E	73.00/gal	Double Play	37.00/gal	Keystone LA	48.00/gal
Arrow (clethodim)	148.00/gal	Dual Magnum	114.00/gal	Krenite	60.00/gal
Arsenal	308.00/gal	Dual II Magnum	121.00/gal	Krovar	12.80/lb
Assure II	146.00/gal	Durango (120)	30.00/gal	Laddock S-12	49.00/gal
Atrazine 4L	10.60/gal	Epic	39.00/lb	Landmaster BW	15.40/gal
Atrazine 90 DF	2.30/lb	Eptam 7E	37.60/gal	Lariat	22.00/gal
Authority 75DF	29.00/lb	Equip	11.60/oz	LeadOff Bulk	40.00/gal
Axiom	20.00/lb	Excort XP	21.60/oz	Lexar	41.00/gal
Backdraft SL	20.50/gal	Evik	7.10/lb	Liberty	71.00/gal
Balance Pro	7.50/oz	Exceed	12.40/oz	Libertz ATZ	56.00/gal
Banvel	76.00/gal	Expert	30.00/gal	Lightning	13.00/oz
Basagran	86.00/gal	Express	19.50/oz	Lumax	53.00/gal
Basis 75 DF	18.80/oz	Express XP	20.30/oz	Marksman	34.00/gal
Basis Gold	21.70/lb	Extreme	34.00/gal	Matrix	14.00/oz
Beacon	29.60/oz	Fallow Master Broad Spectrum	23.00/gal	Maverick	16.00/oz
Betamix	106.00/gal	Fallow Star	17.70/gal	MCPA Amine	17.50/gal
Beyond					
Bicep II Lite Magnum					
Bicep II Magnum					
Ultra Blazer					
Boundary 6.5 EC					
Bronate Advanced					
Buctril					
Buctril + Atrazine					
Bullet	22.00/gal	Fusion	166.00/gal	Olympus	11.00/oz
Butyrac 200	36.00/gal	Gangster	592.00/[illegible]	Olympus FLEX	4.00/oz
Callisto	586.00/gal	Garlon 3 lb A	79.00/[illegible]gal	Option	11.30/oz
Camix	61.00/gal	Garlon 4 lb E	103.0[illegible]/gal	Outlaw	30.60/gal
Canopy XL	38.00/lb	Gauntlet	[illegible]	Outlook	161.00/gal
Casoron 4G	2.35/lb	Glean	17.00/oz	Overdrive	50.00/lb
		Glyphosate (generic) w surfactant	13.44/gal or 0.105/oz		
Celebrity Plus	92.00/lb			Parallel (Metolachlor)	72.00/gal
Cimarron	23.00/oz			Paramount	50.00/lb
Cimarron MAX	290.00/case	G-Max Lite	62.00/gal	Partner	2.60/lb
Cinch	104.00/gal	Goal 2XL	100.00/gal	Peak	12.00/oz
Cinch ATZ	43.00/gal	Gramoxone Max	46.00/gal	Pendimax	22.70/gal
		Grazon P+D	33.00/gal		
Cinch ATZ Lite	56.00/gal	Guardsman	42.00/gal	Permit	17.20/oz
Clarity	103.00/gal			Phoenix	160.00/gal
Classic	14.00/oz			Plateau	315.00/gal
Cobra	158.00/gal			Poast	72.50/gal
Command	105.00/gal			Poast Plus	54.60/gal

Glyphosate (generic) w surfactant 13.44/gal or 0.105/oz

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Hopi Indian Reservation in Arizona - receives 8 to 10 inches of rainfall

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Skip Row Corn for Improved Drought Tolerance in Rainfed Corn
WCREC 2003

	Population (plants/a)	Yield (bu/a)	Pct increase
30” rows	19,500	41	-
30” rows*	14,700	41	-
30” rows*	11,200	45	10
2 - skip 1*	13,700	48	17
2 - skip 2*	9,700	54	32

*Plants and rows removed July 2

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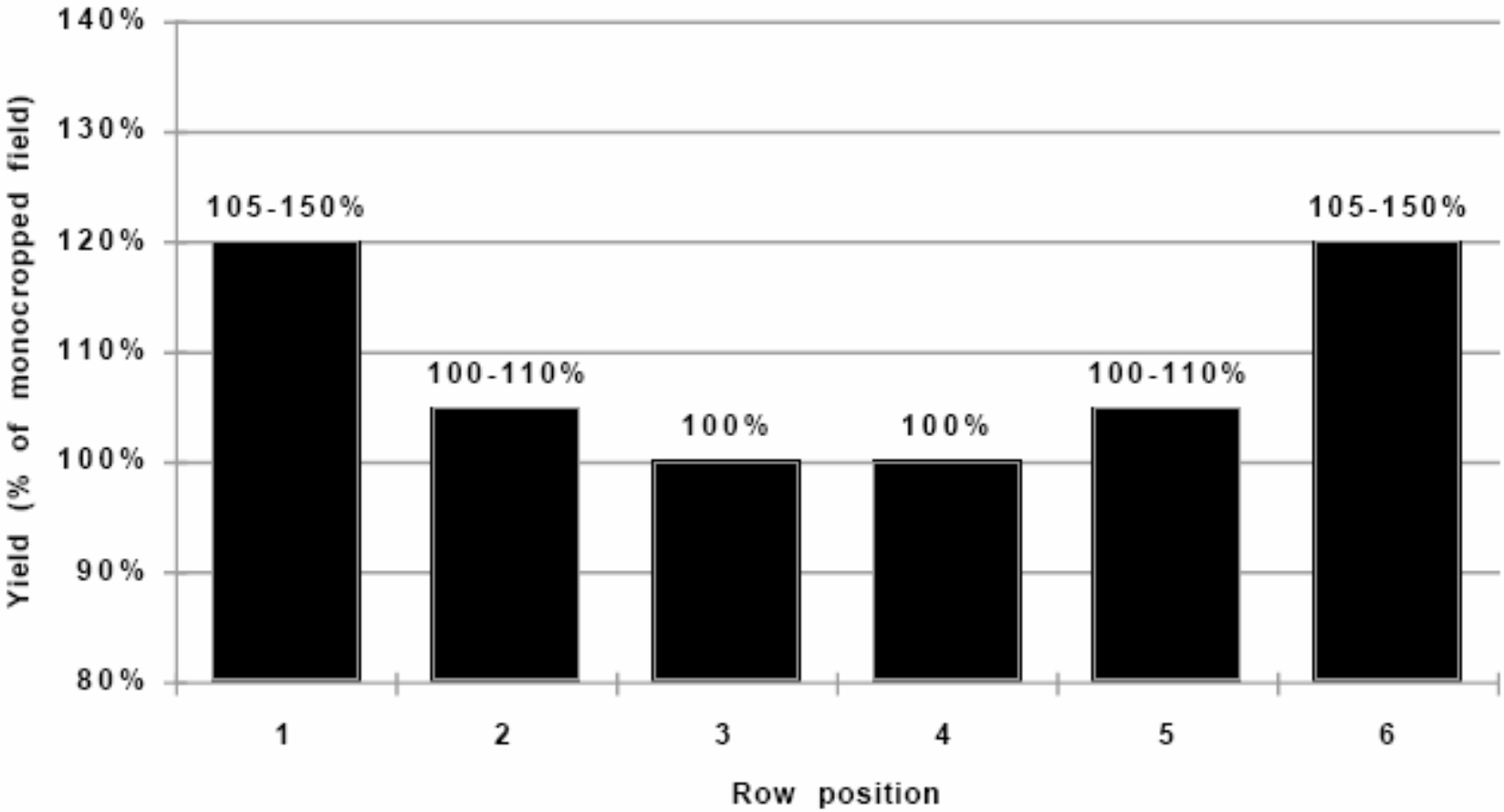
Skip Row Corn for Improved Drought Tolerance in Rainfed Corn

- Keep developing corn plants from using all of the available soil water too early in the growing season
- Water in the soil between widely spaced rows can't be reached by the plants until later in the season
- Water available to the plants in July and August
  - Most critical for grain formation

Skip Row Corn for Improved Drought Tolerance in Rainfed Corn

- For these trials, plants were removed July 2nd
- Research has shown that by this time corn will have used 6 inches of soil water
- Additional research is needed across the state and over a couple of years in order to estimate the benefits and costs to skip row management over a wide range of climatic conditions

Figure 1. Effect of corn row position (for a six-row strip) on corn yield, expressed as a percent of yields typically observed with monocrop corn management. The number on top of each column indicates the range of yields (compared with monocropped yields) observed at each position.



CRP-17; Iowa State University

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Yield Possibilities for Skip-Row Corn in Plant-Two, Skip-Two or Plant-One, Skip One

Plant 2 rows	Stand in 2 rows planted	Stand in 4 rows (only 2 planted)	Ear wt/lb yield/bu	Ear wt/lb yield/bu	Ear wt/lb yield/bu	Ear wt/lb yield/bu
11,000	10,000	5,000	0.5 = 36	0.6 = 43	0.62 = 44	0.7 = 50
15,550	14,000	7,000	0.5 = 50	0.6 = 60	0.62 = 62	0.7 = 70
20,000	18,000	9,000	0.5 = 64	0.6 = 77	0.62 = 80	0.7 = 90
24,450	22,000	11,000	0.5 = 79	0.6 = 94	0.62 = 100	0.7 = 110
28,900	26,000	13,000	0.5 = 93	0.6 = 111	0.62 = 120	0.7 = 130
33,333	30,000	15,000	0.5 = 107	0.6 = 129	0.62 = 140	0.7 = 150

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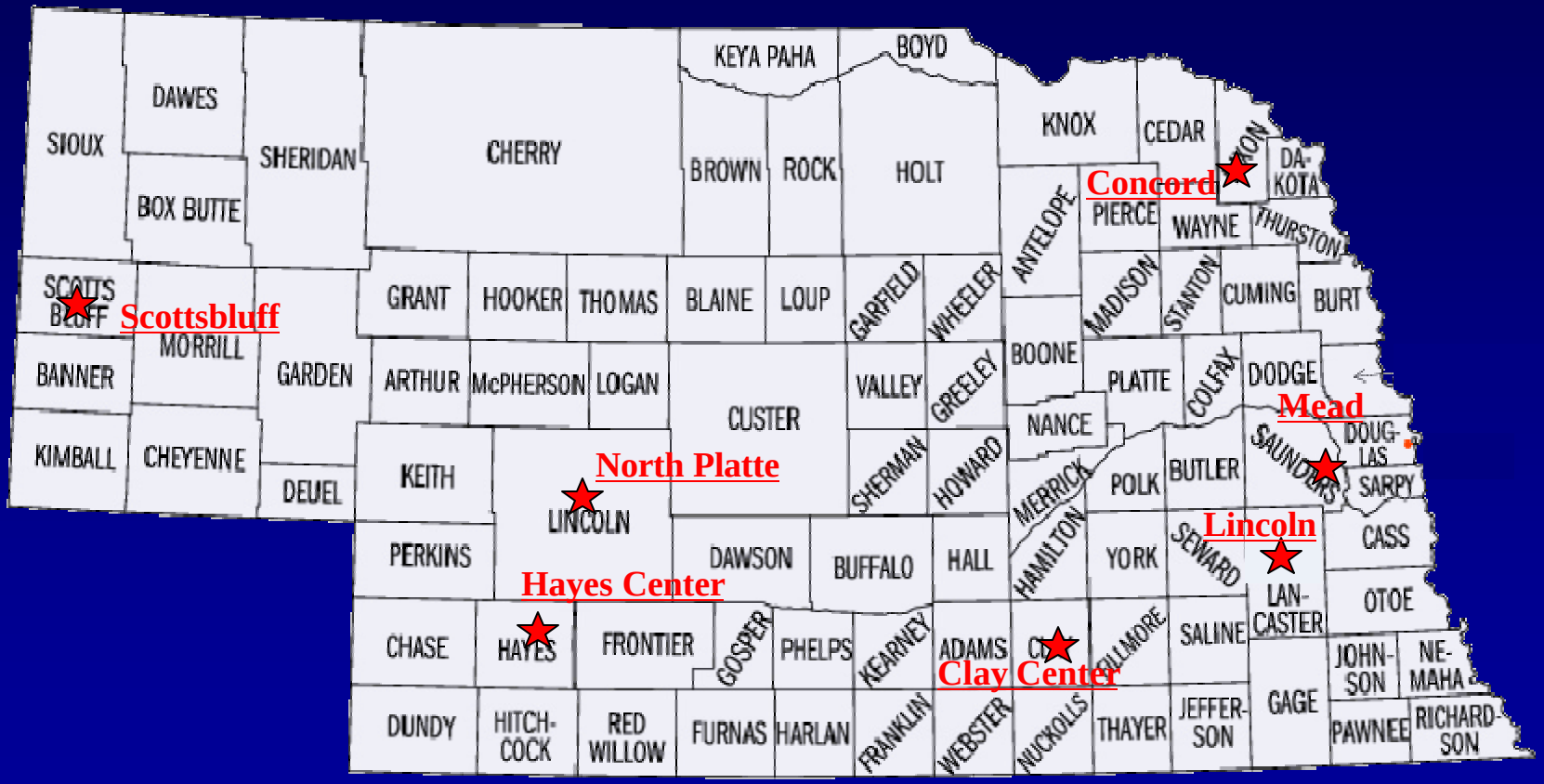
2004 Skip Row Plot Locations
Nebraska



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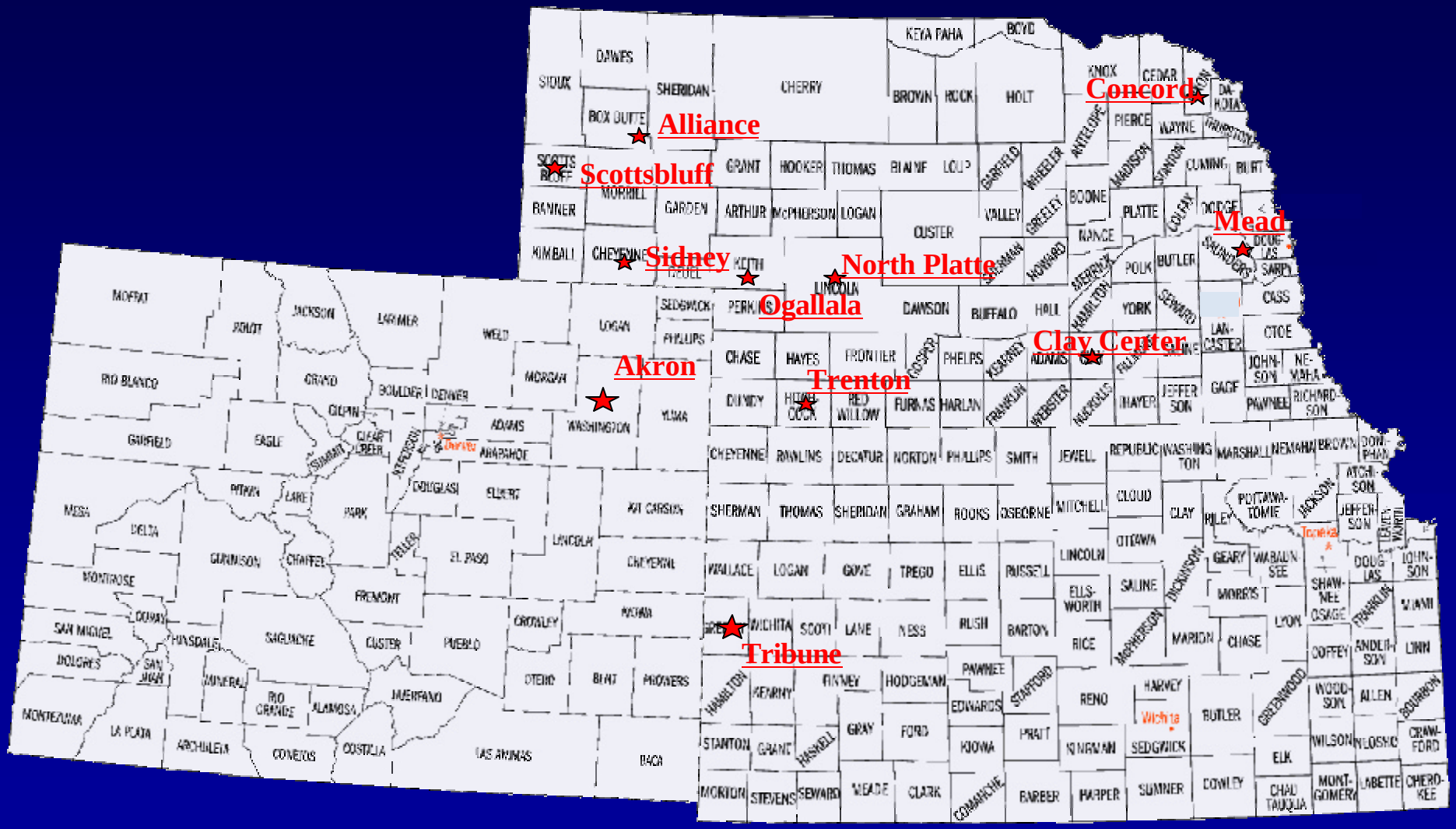
2005 Skip Row Plot Locations



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Planting Scheme for Eastern Sites

Clay Center, Lincoln, Mead, Concord

Planting Pattern	Population (plants per acre)
Solid	30,000
Solid	22,500
Solid	15,000
Plant 2 Skip 1	30,000
Plant 2 Skip 1	22,500
Plant 2 Skip 1	15,000
Plant 2 Skip 2	30,000
Plant 2 Skip 2	22,500
Plant 2 Skip 2	15,000
Plant 1 Skip 1	30,000
Plant 1 Skip 1	22,500
Plant 1 Skip 1	15,000

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Planting Scheme for Western Sites

Scottsbluff, Alliance, Sidney, Ogallala, North Platte, Hayes Center, Trenton, Akron, Tribune

Planting Pattern	Population (plants per acre)
Solid	20,000
Solid	15,000
Solid	10,000
Plant 2 Skip 1	20,000
Plant 2 Skip 1	15,000
Plant 2 Skip 1	10,000
Plant 2 Skip 2	20,000
Plant 2 Skip 2	15,000
Plant 2 Skip 2	10,000
Plant 1 Skip 1	20,000
Plant 1 Skip 1	15,000
Plant 1 Skip 1	10,000

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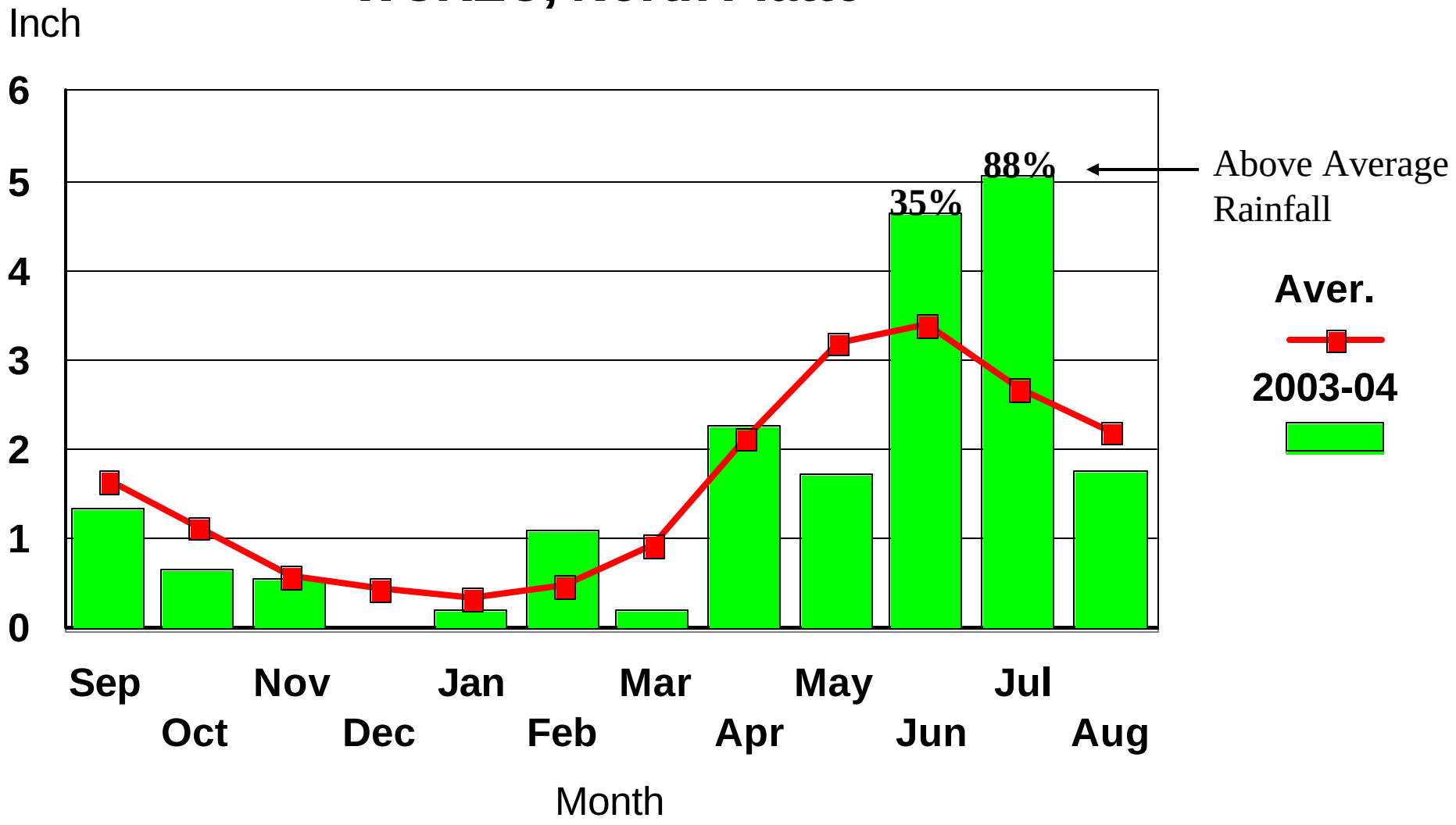
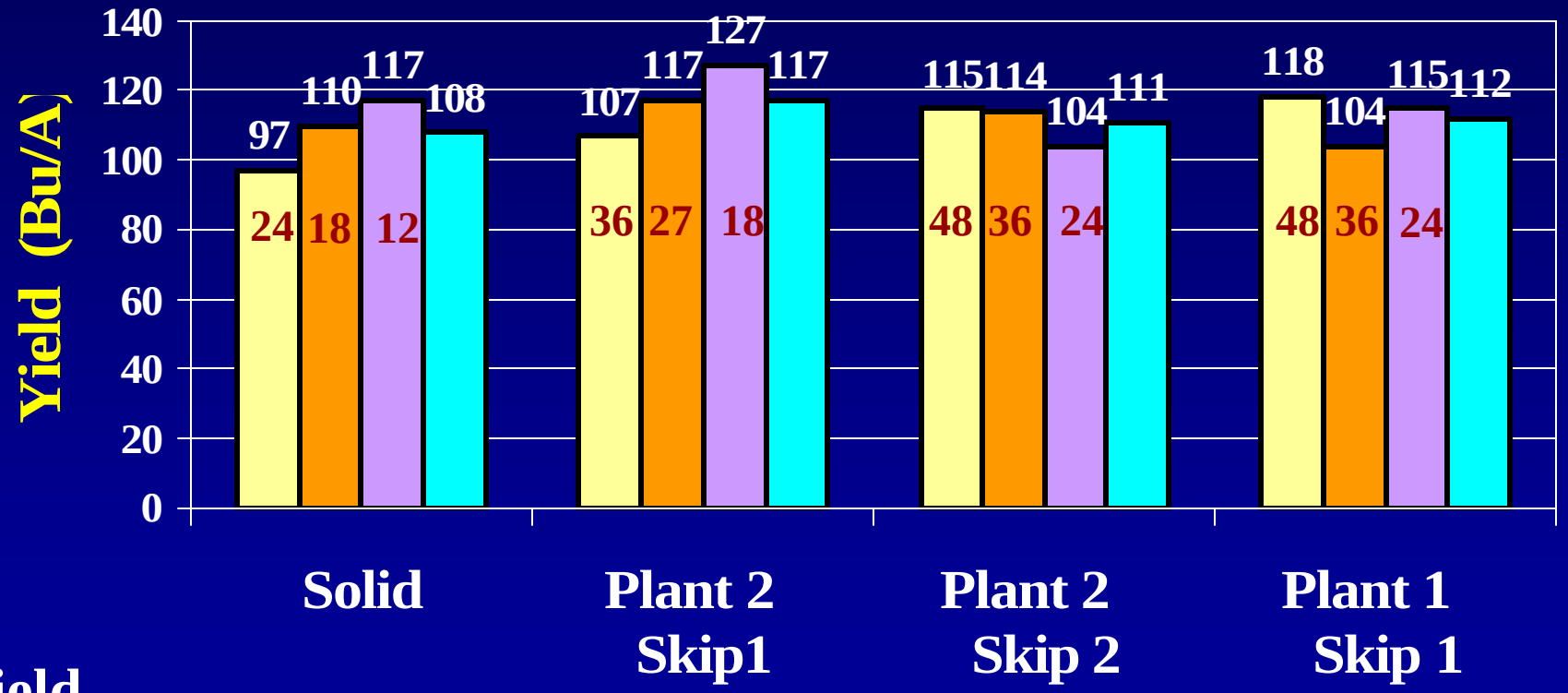
Rainfall - 2003-04
WCREC, North Platte



Skip-Row Rainfed Corn 2004

30”Rows

WCREC, North Platte



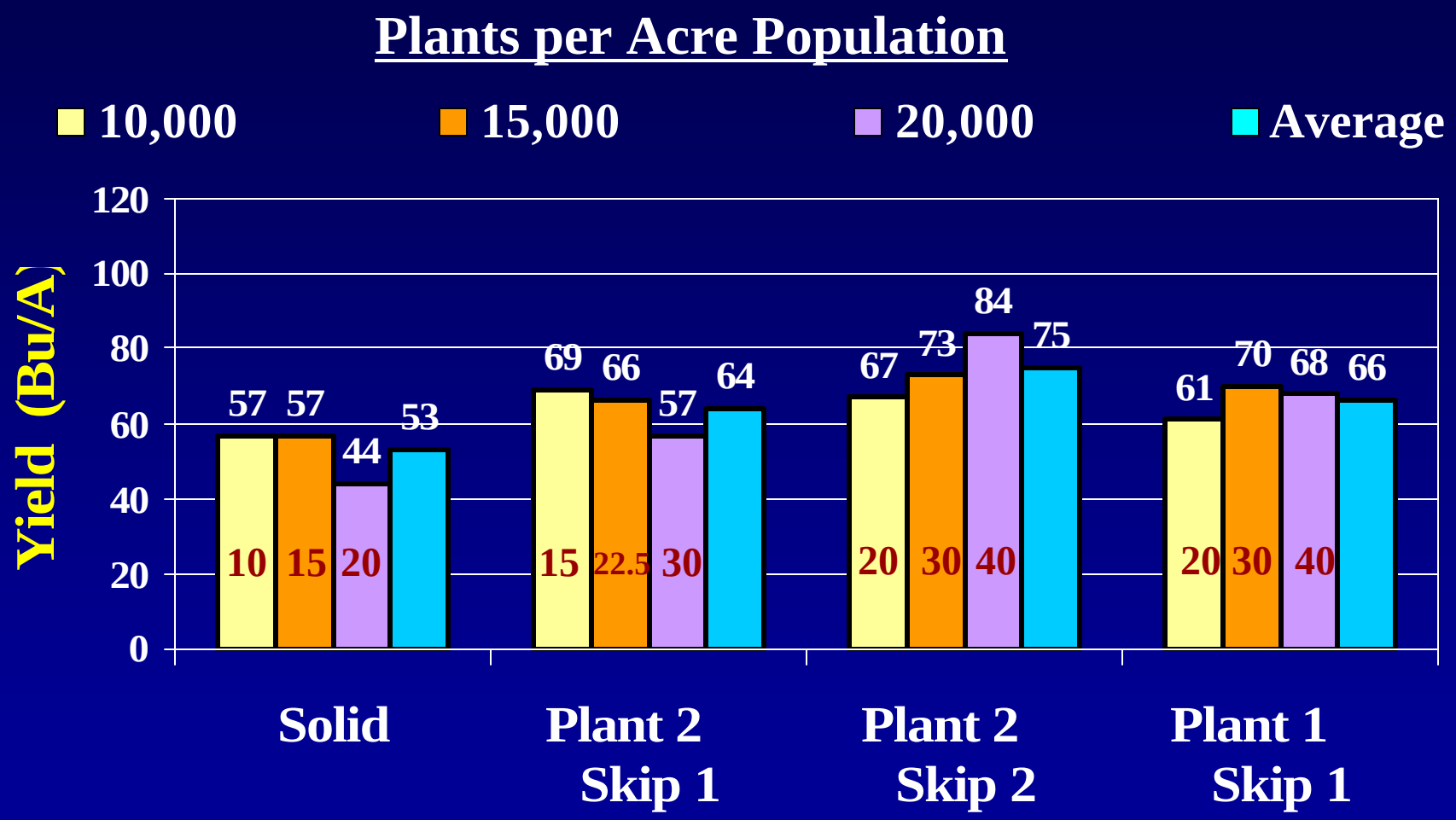
Yield

In-row population in 1,000’s

Average

Skip-Row Rainfed Corn 2005

30”Rows – Trenton



Yield

In-row population in 1,000’s

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Ogallala 2006

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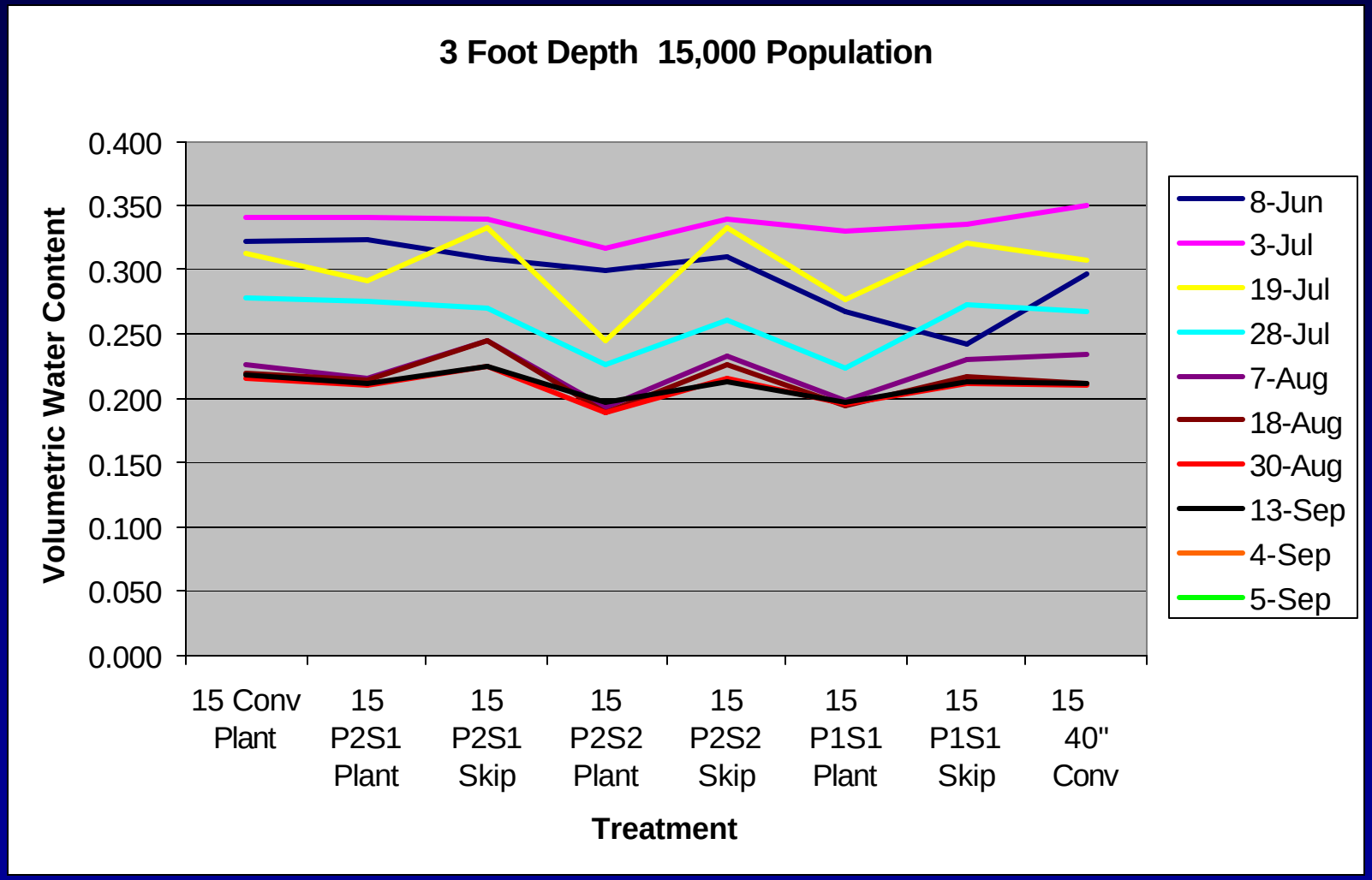
North Platte Skip Row Moisture - 2006



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2006 Chappell, NE

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Skip Row Rainfed Corn
Chappell, NE 2006

	Population	Yield Bu/a
Conventional	14,000	37
Plant 2 Skip 2	10,000 (20,000 in row)	57

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2005 Grant, NE
Winter Wheat - 2004

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2005 Grant, NE
Winter Wheat - 2004

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2005 Grant, NE
Corn - 2004

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2005 Grant, NE
Corn - 2004

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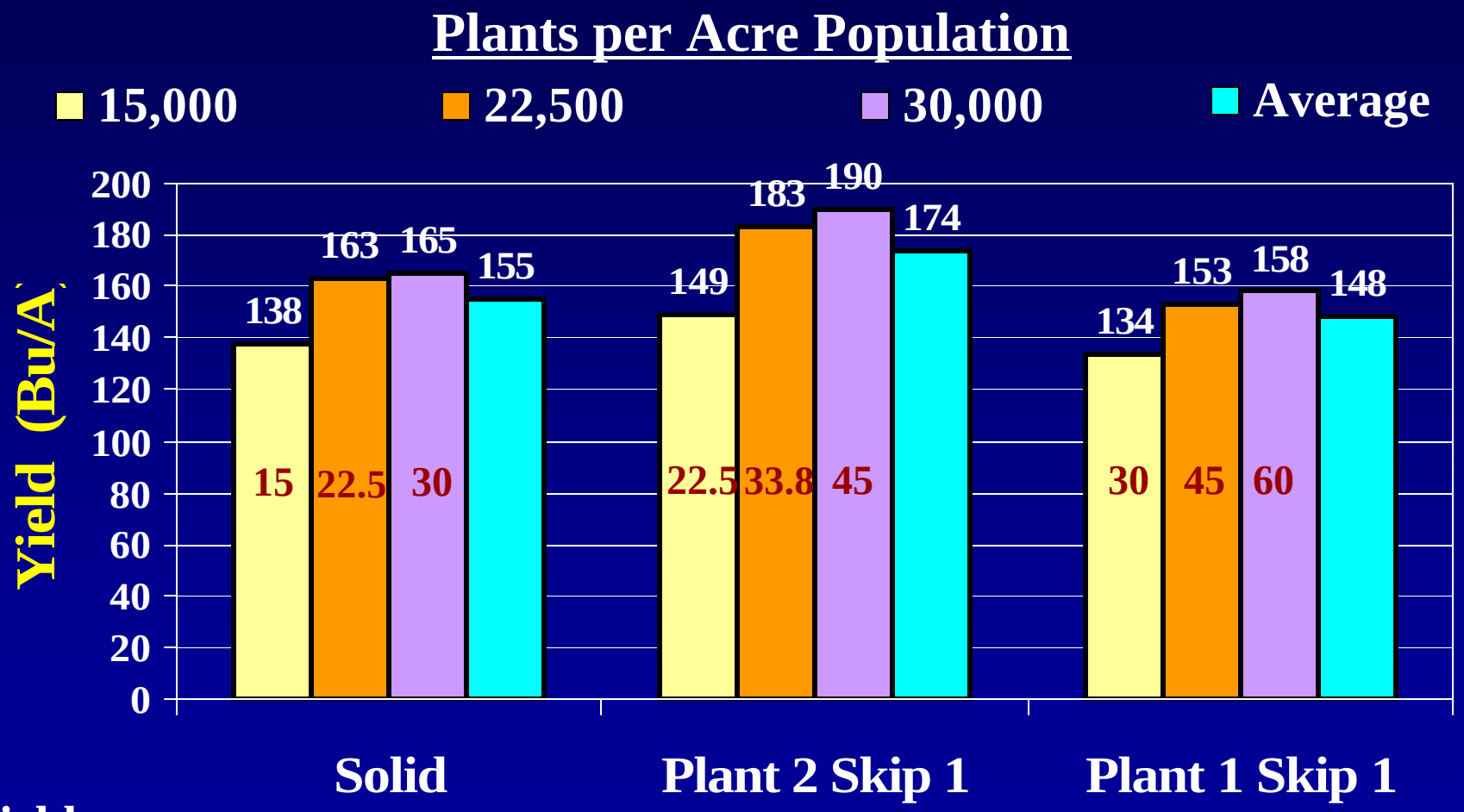
Skip-Row Rainfed Corn 2006

30”Rows –Wheat Stubble - SCAL



Yield

In-row population in 1,000’s

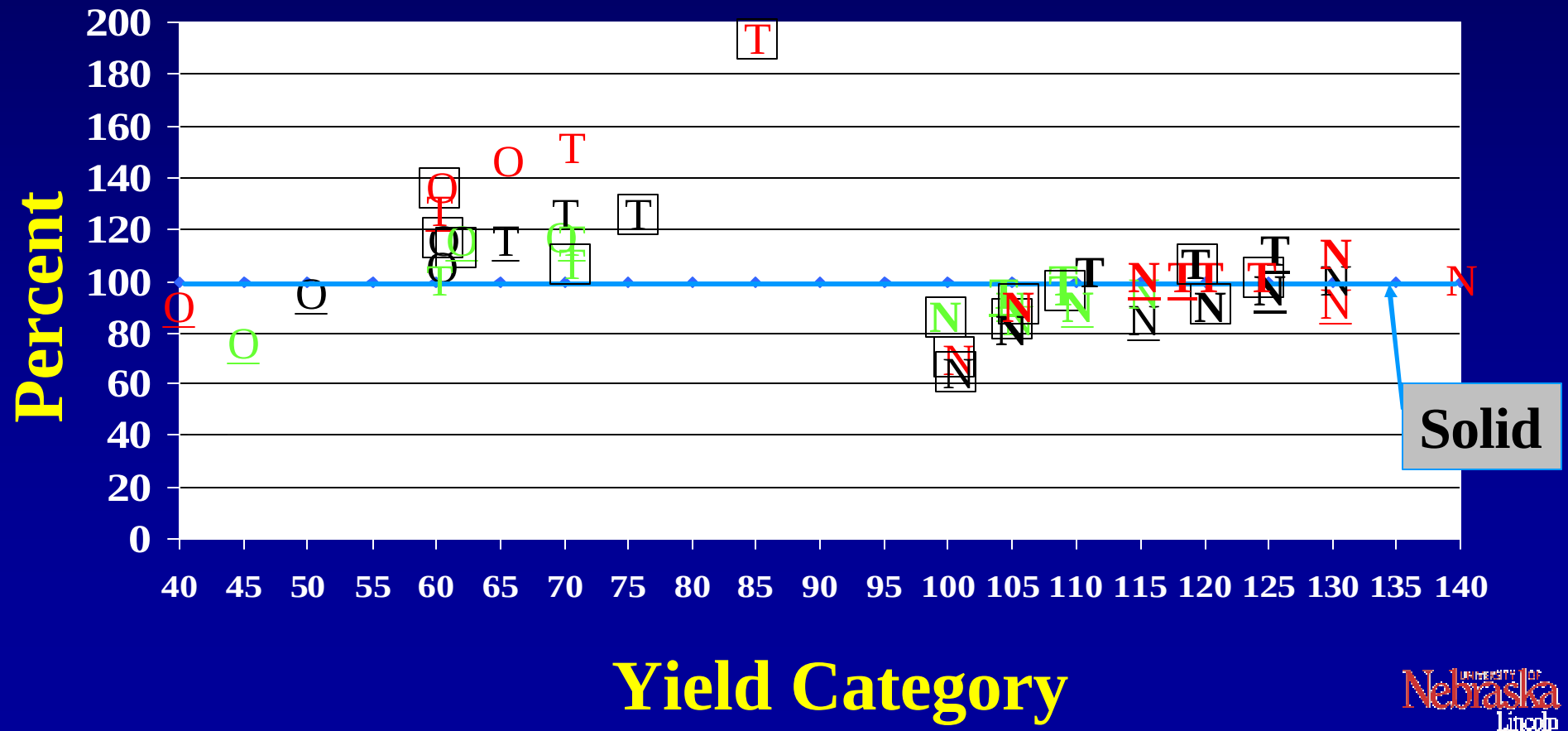
2005 & 2006 Yield Comparisons

10,000
15,000
20,000

Plant 2 Skip 1
Plant 2 Skip 2
Plant 1 Skip 1

2005
N = North Platte
T = Trenton
O = Ogallala

2006
N = North Platte
T = Trenton



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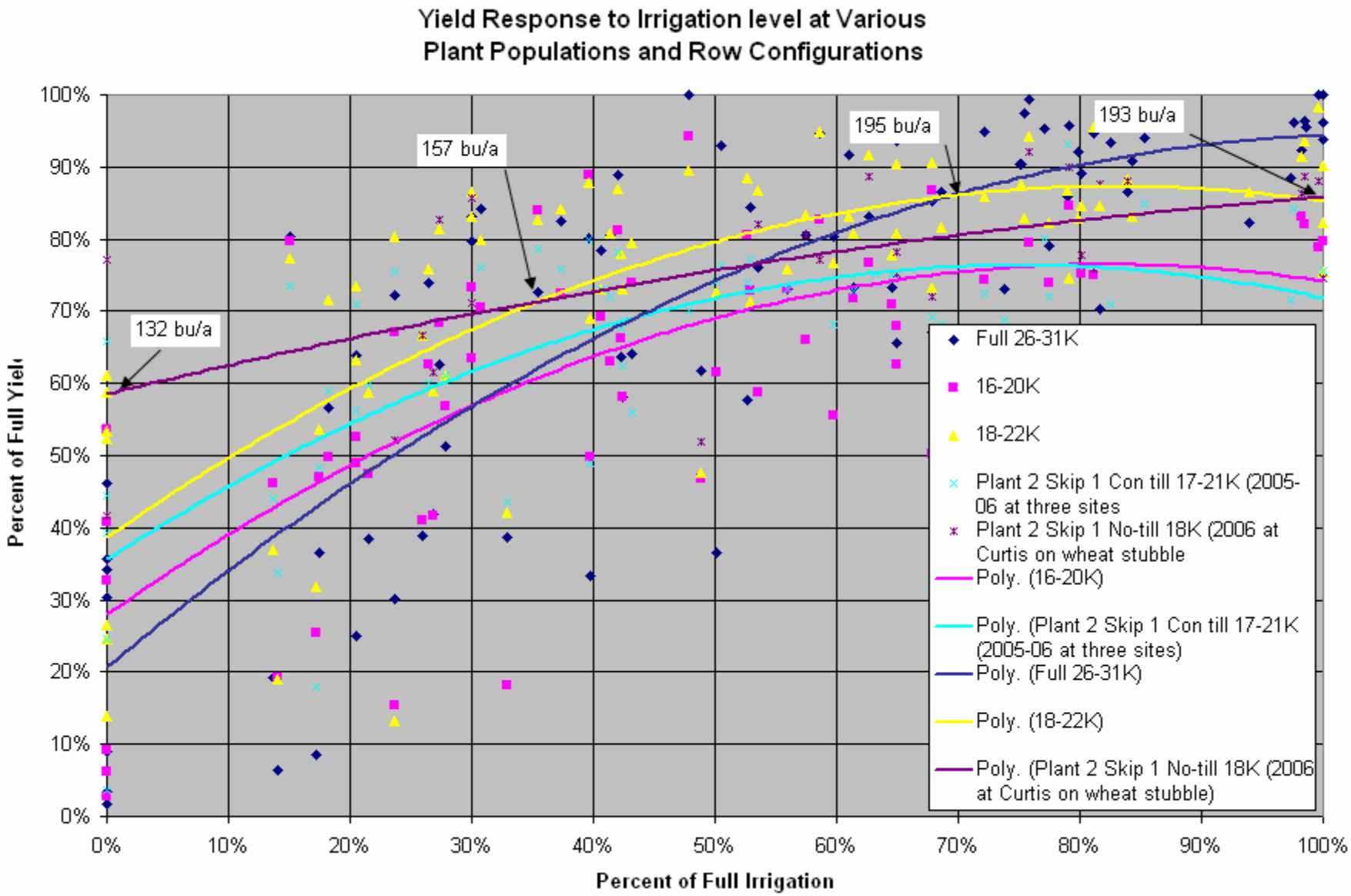
Narrow Gage Wheel (From Drill)

Problems with Skip Row

1. Plant 2 Skip 1
   - You may sacrifice yield when conventional yields are 130 to 160 bushels/acre or greater
2. Plant 2 Skip 2
   - You may sacrifice yield when conventional yields are 90 to 120 bushels/acre or greater
3. Crop Insurance
4. Farm Service Agency certifying acres



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