

Seasonal Forage Yield and Quality Patterns

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Which factor has the greatest effect on rangeland forage yield?

- 1. Species composition**
- 2. Plant vigor**
- 3. Precipitation**
- 4. Temperature**

Seasonal Forage Yield Patterns

- **Precipitation**
- **Species composition – proportion of cool- and warm-season species**
- **Temperature**
- **Plant vigor**
- **Other environmental factors** (insects, hail, etc.)

Factors Affecting Forage Yield

▣ **Precipitation.**

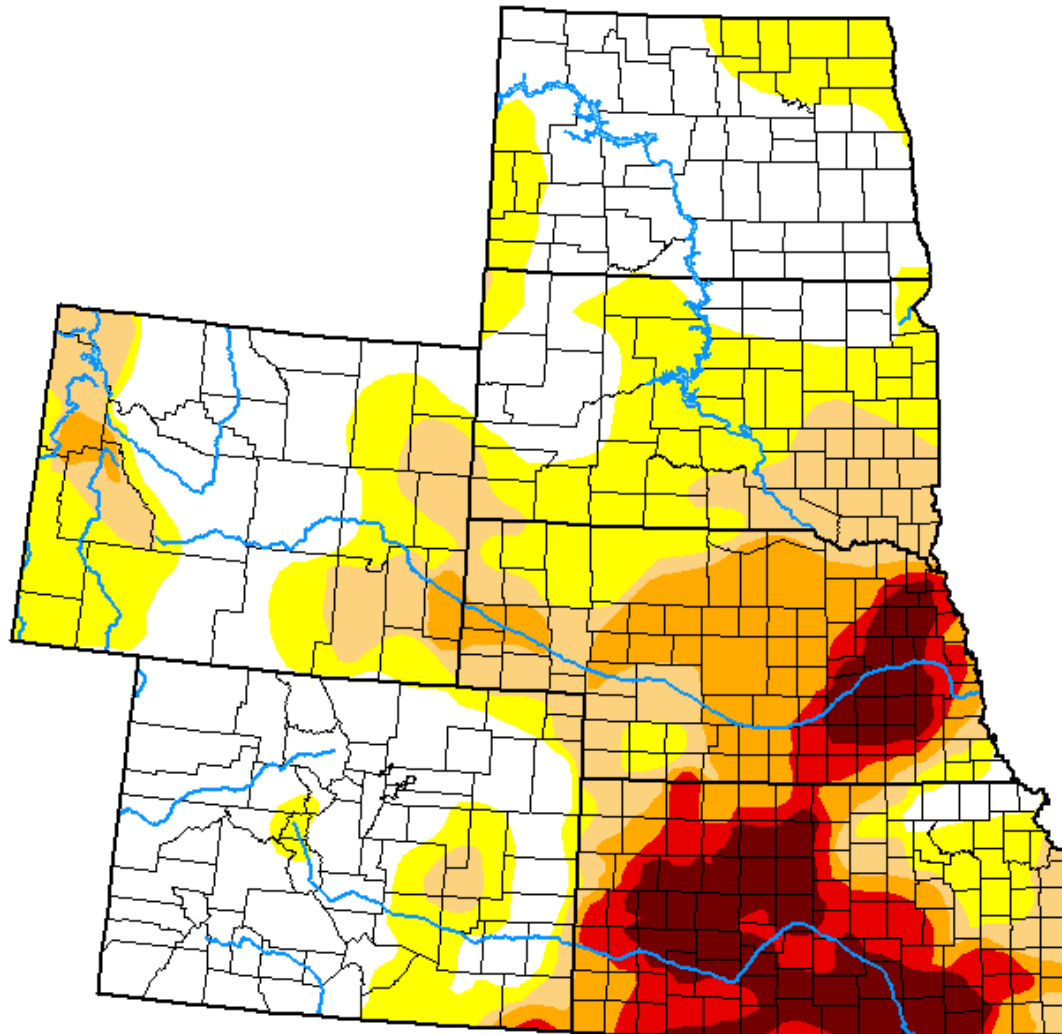


U.S. Drought Monitor High Plains







May 30, 2023

(Released Thursday, Jun. 1, 2023)

Valid 8 a.m. EDT



Intensity:

-  None
-  D0 Abnormally Dry
-  D1 Moderate Drought
-  D2 Severe Drought
-  D3 Extreme Drought
-  D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

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U.S. Drought Monitor

High Plains

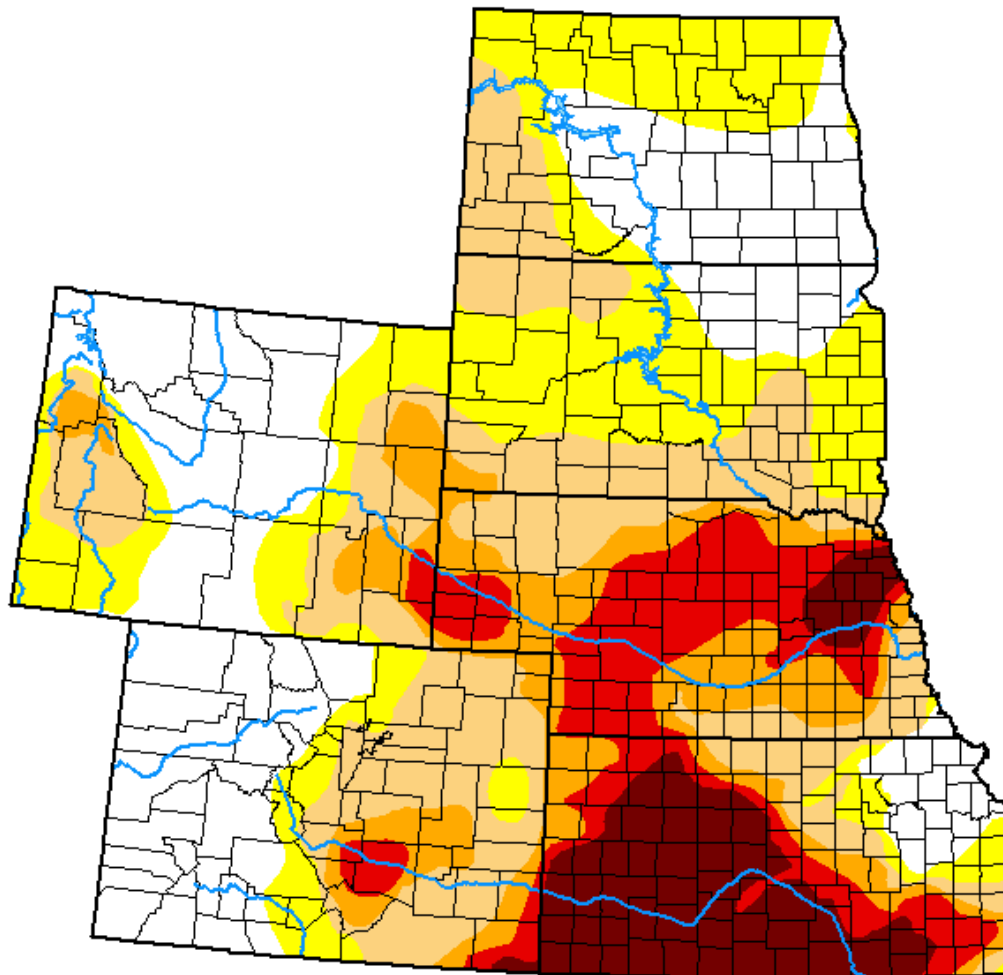
April 25, 2023

(Released Thursday, Apr. 27, 2023)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	28.21	71.79	50.53	28.40	17.82	8.52
Last Week <i>04-18-2023</i>	27.64	72.36	49.64	27.95	14.74	8.13
3 Months Ago <i>01-24-2023</i>	15.12	84.88	64.87	33.80	17.23	7.57
Start of Calendar Year <i>01-03-2023</i>	13.54	86.46	66.35	37.03	18.35	7.83
Start of Water Year <i>09-27-2022</i>	7.60	92.40	66.34	33.68	15.17	5.92
One Year Ago <i>04-26-2022</i>	14.33	85.67	75.36	47.03	11.67	0.44



Intensity:



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Author:

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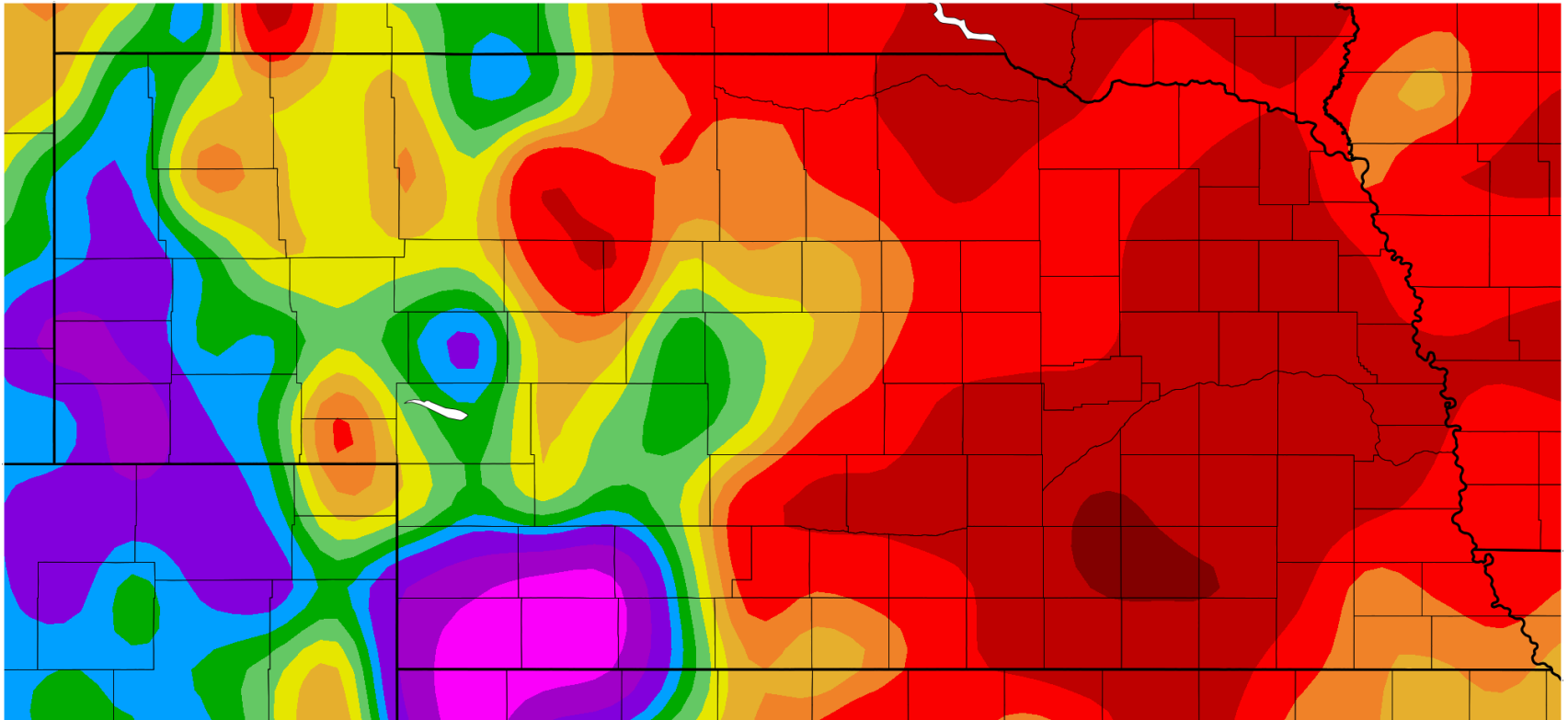


droughtmonitor.unl.edu

Percent of Normal Precipitation (%)

3/7/2023 – 6/4/2023

(Last 3 months)

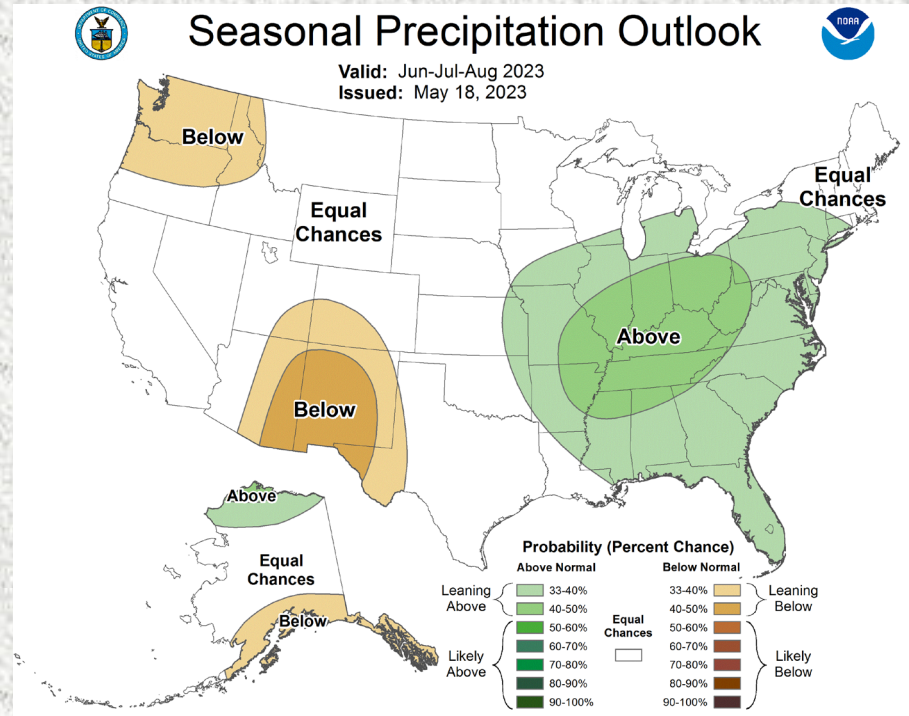
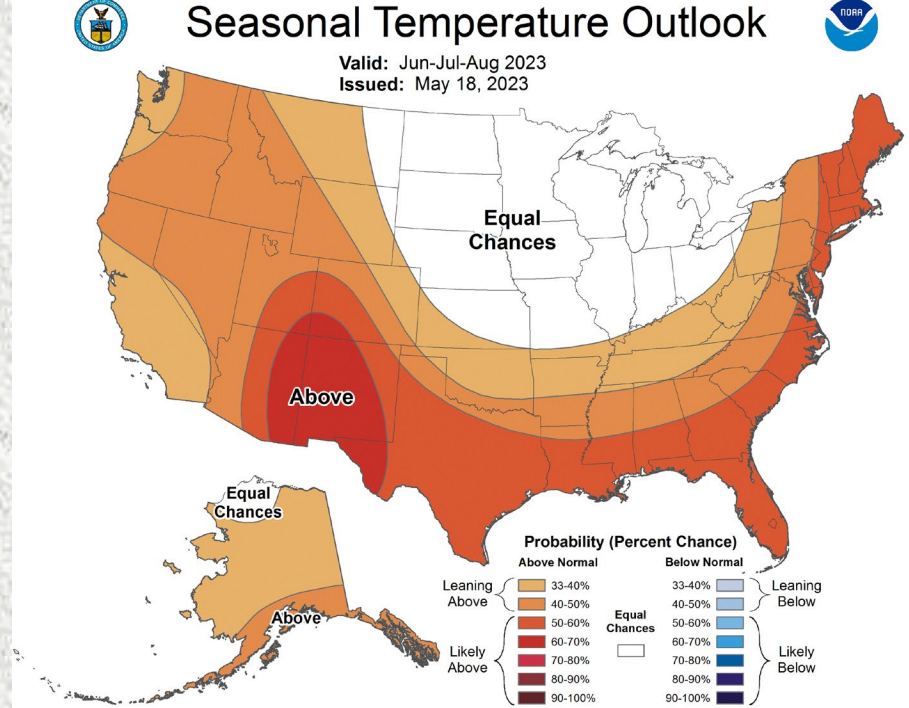


Long-term Forecasts

June
July
August
2023

Average
temperatures and
average
precipitation.

June
July
August
2023

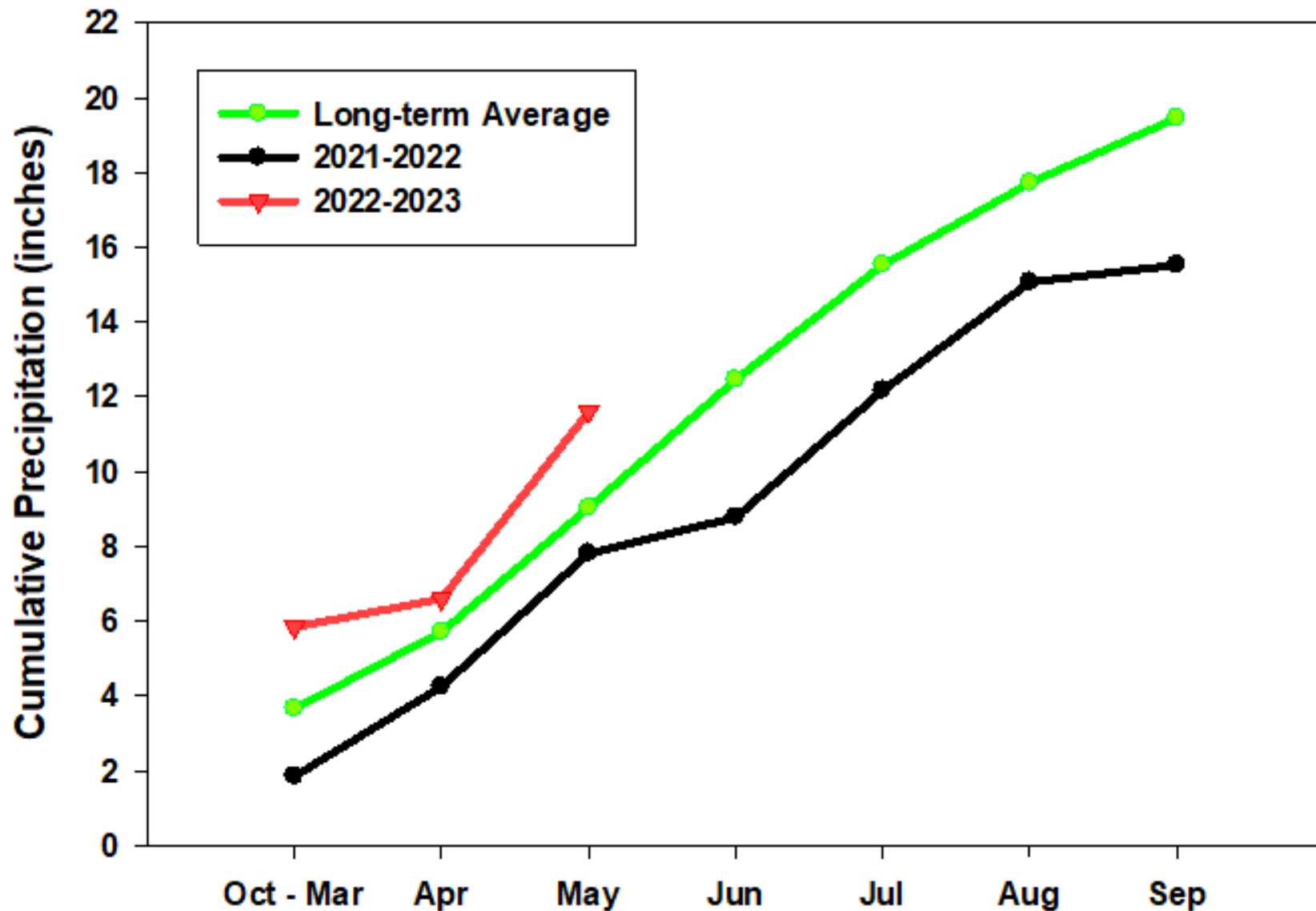


Nebraska Ranch Practicum: Precipitation Records: 2023

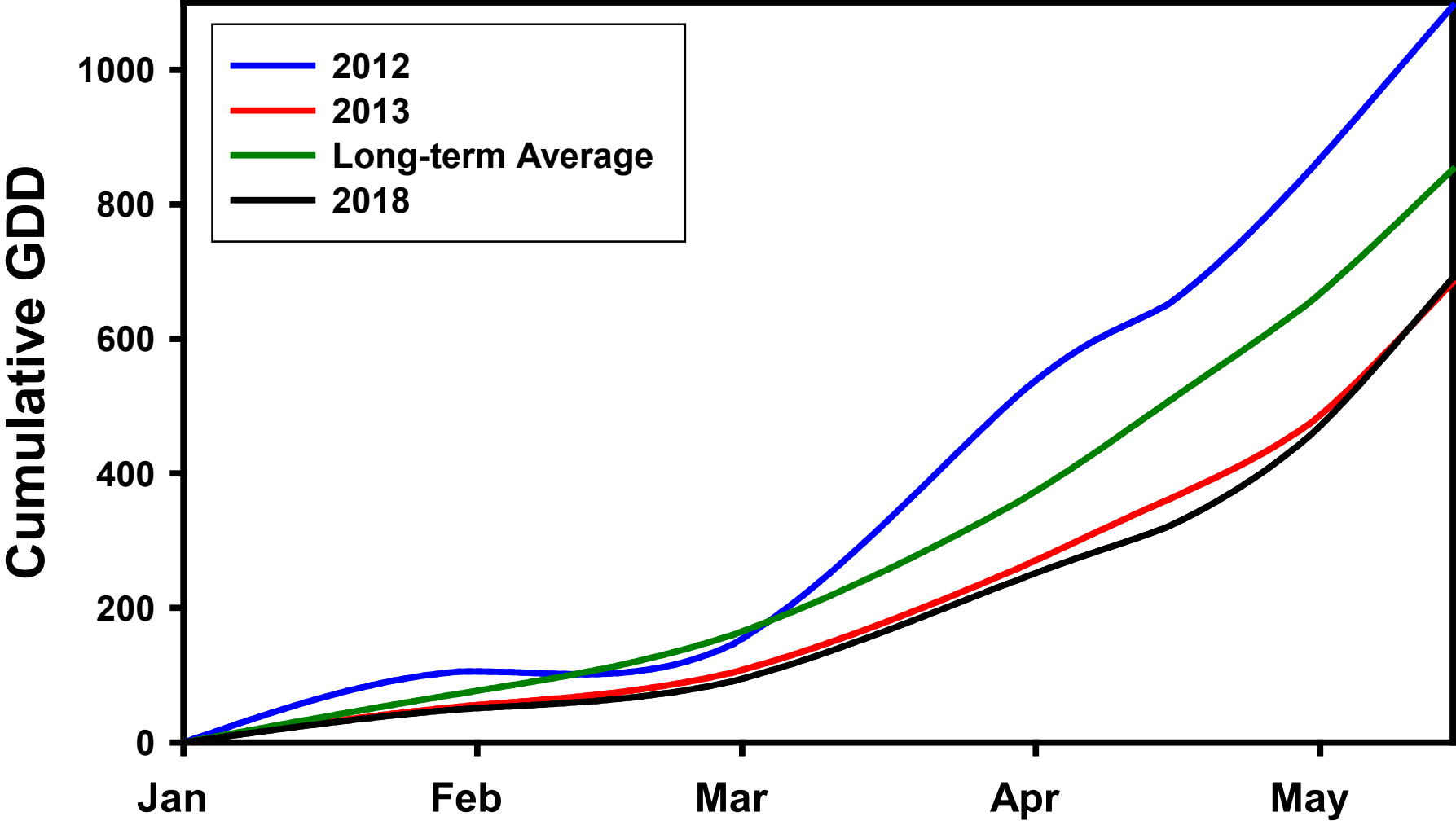
GSL Precipitation (inches)

Month	Average	2021-2022	2022-2023	2022-2023 Cumulative
Oct. – Mar.	3.66	1.85	5.84	5.84
April	2.05	2.4	0.76	6.60
May	3.32	3.56	5.00	11.6
June	3.43	0.97		
July	3.07	3.39		
August	2.19	2.9		
September	1.74	0.46		
Total	19.46	15.53		

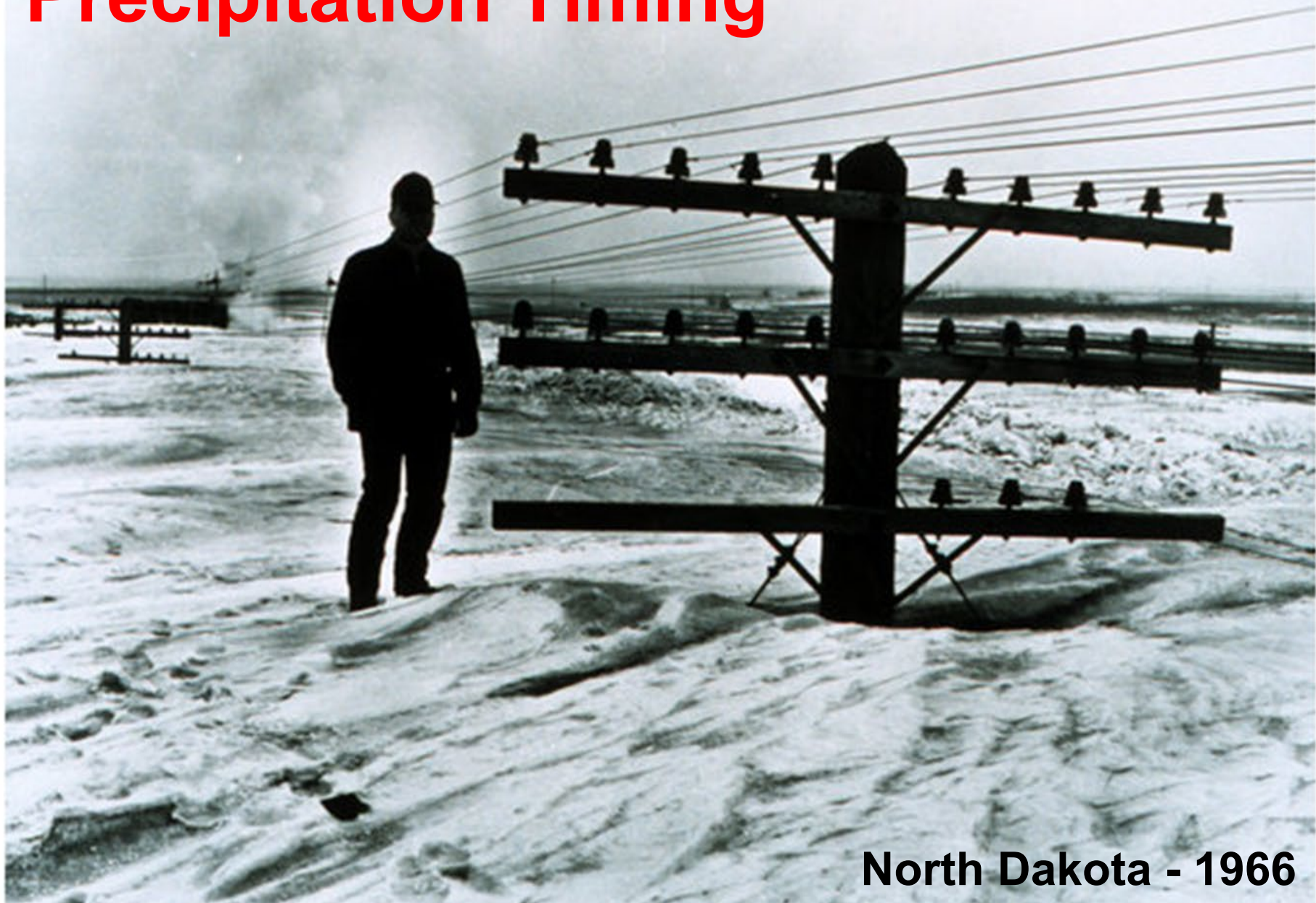
GSL Cumulative Precipitation 2022 - 2023



Long-term average, 2012, 2013, and 2018 cumulative growing-degree days (GDD₄₀) through May 15 at the Gudmundsen Sandhills Lab.



Precipitation Timing



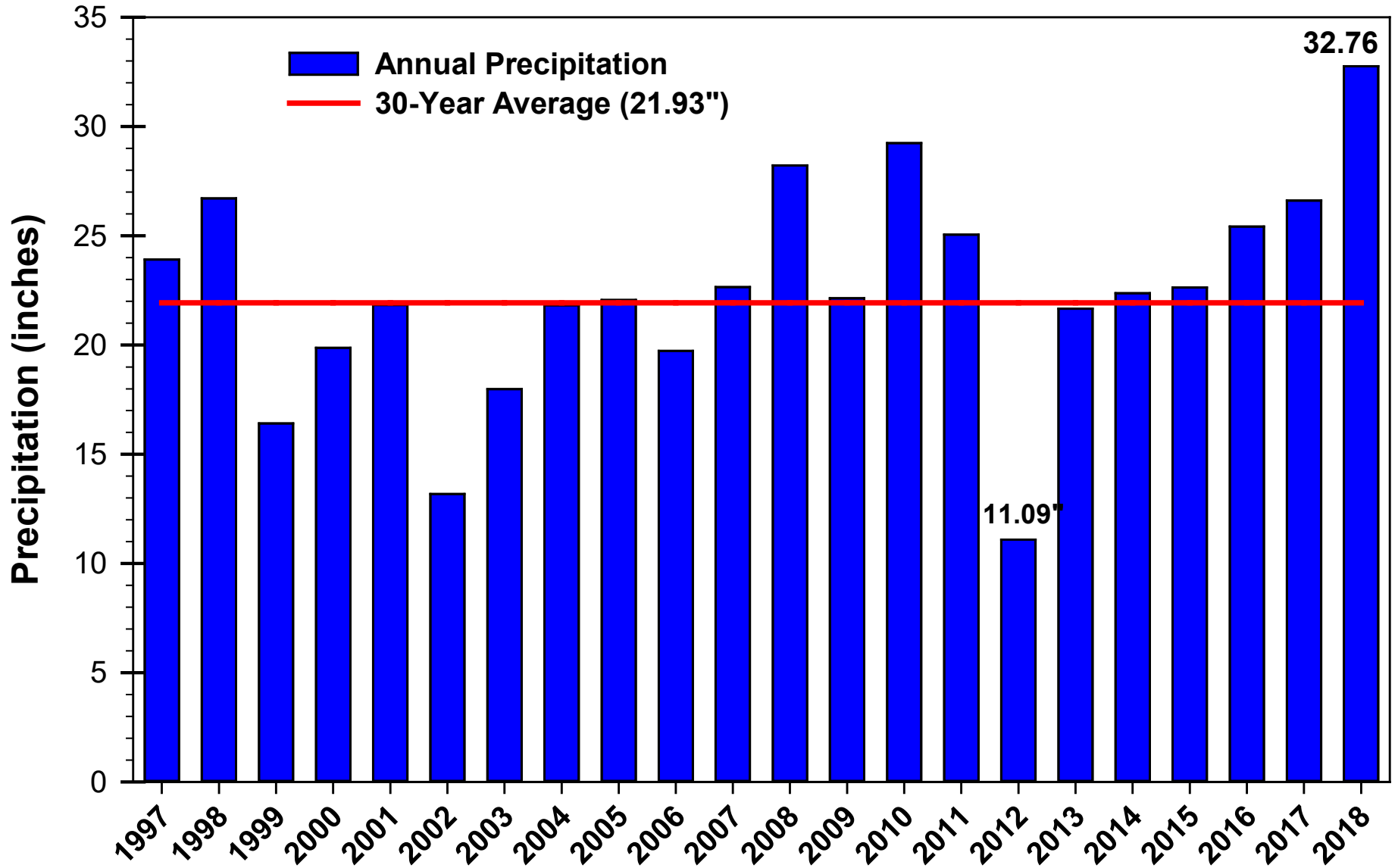
North Dakota - 1966



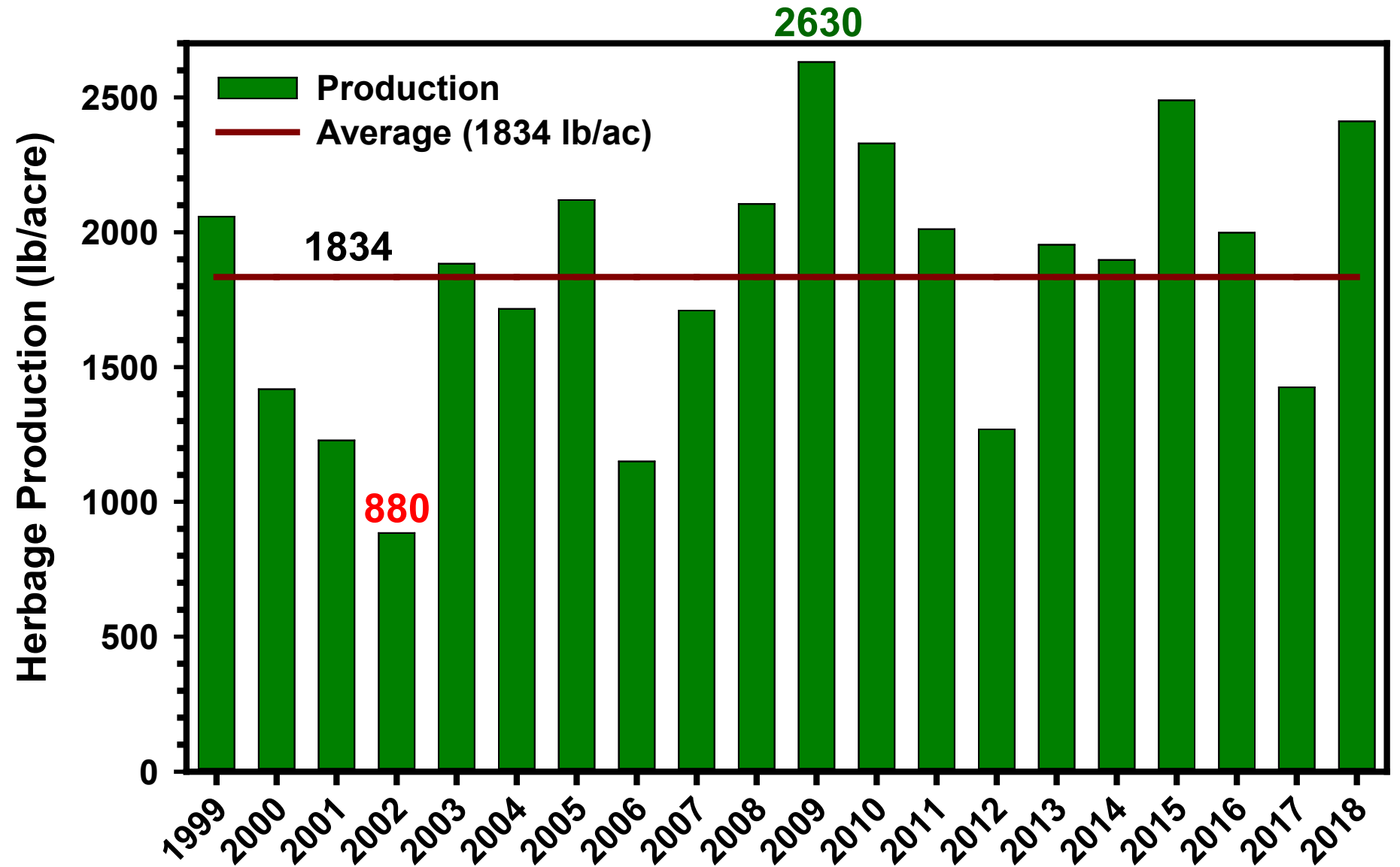
In the NE Sandhills, 5 inches of rain evenly spread across which month will have the greatest effect on rangeland production?

- 1. April**
- 2. June**
- 3. August**

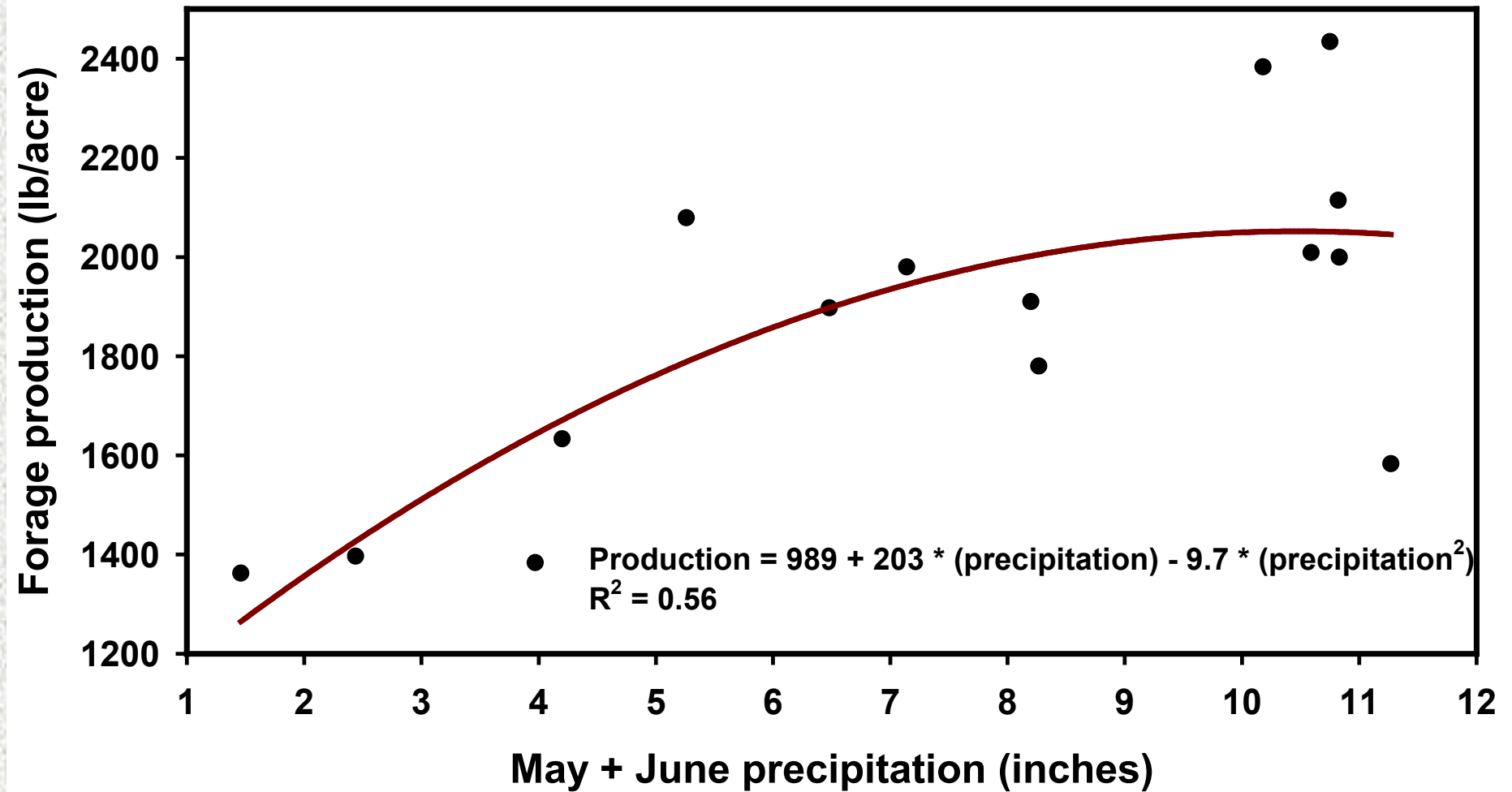
Annual and 30-year average annual precipitation at the UNL Barta Brothers Ranch, Rose, NE (1997-2018)



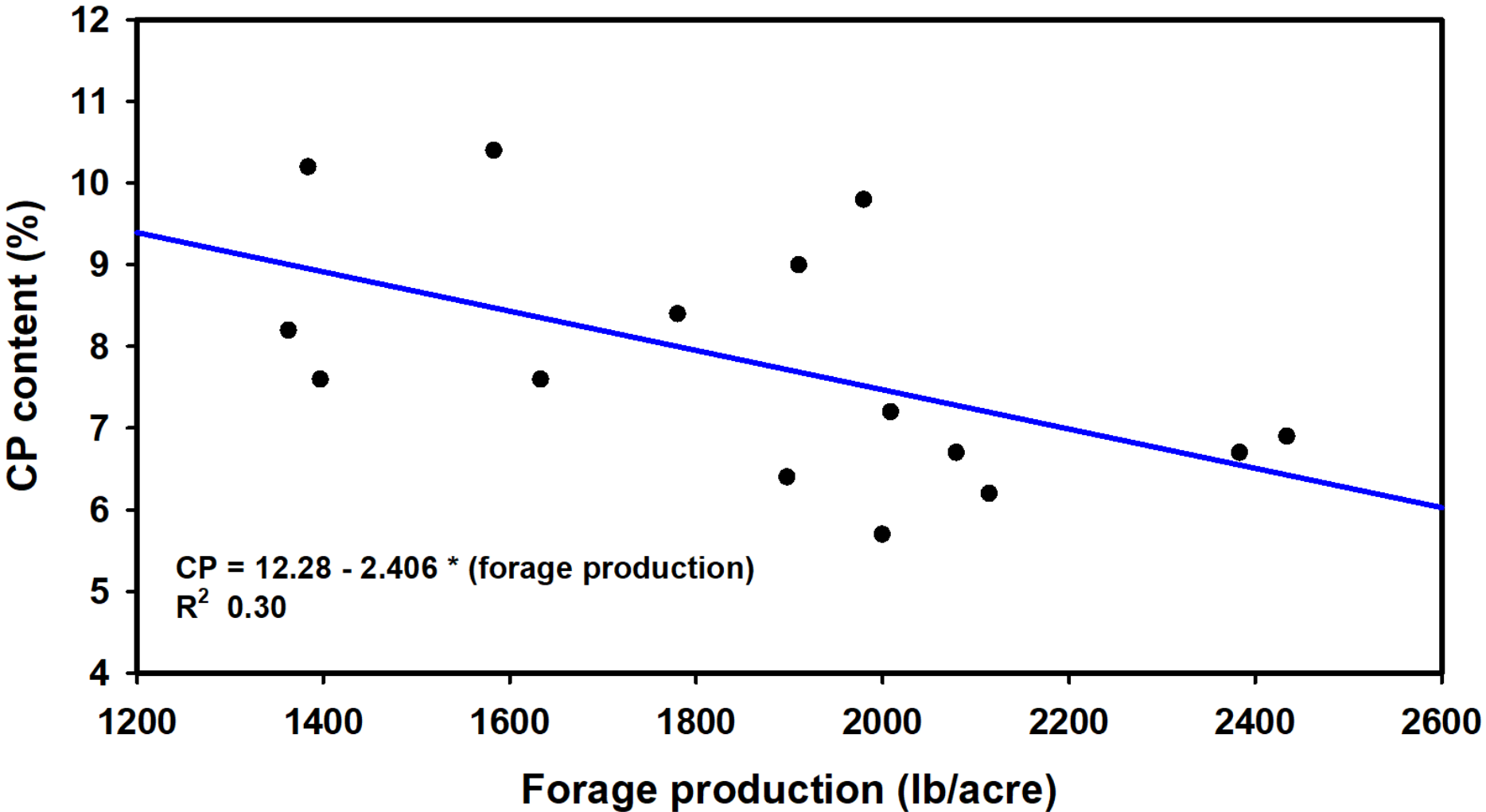
UNL-Barta Brothers Ranch: Herbage Production 1999 - 2018



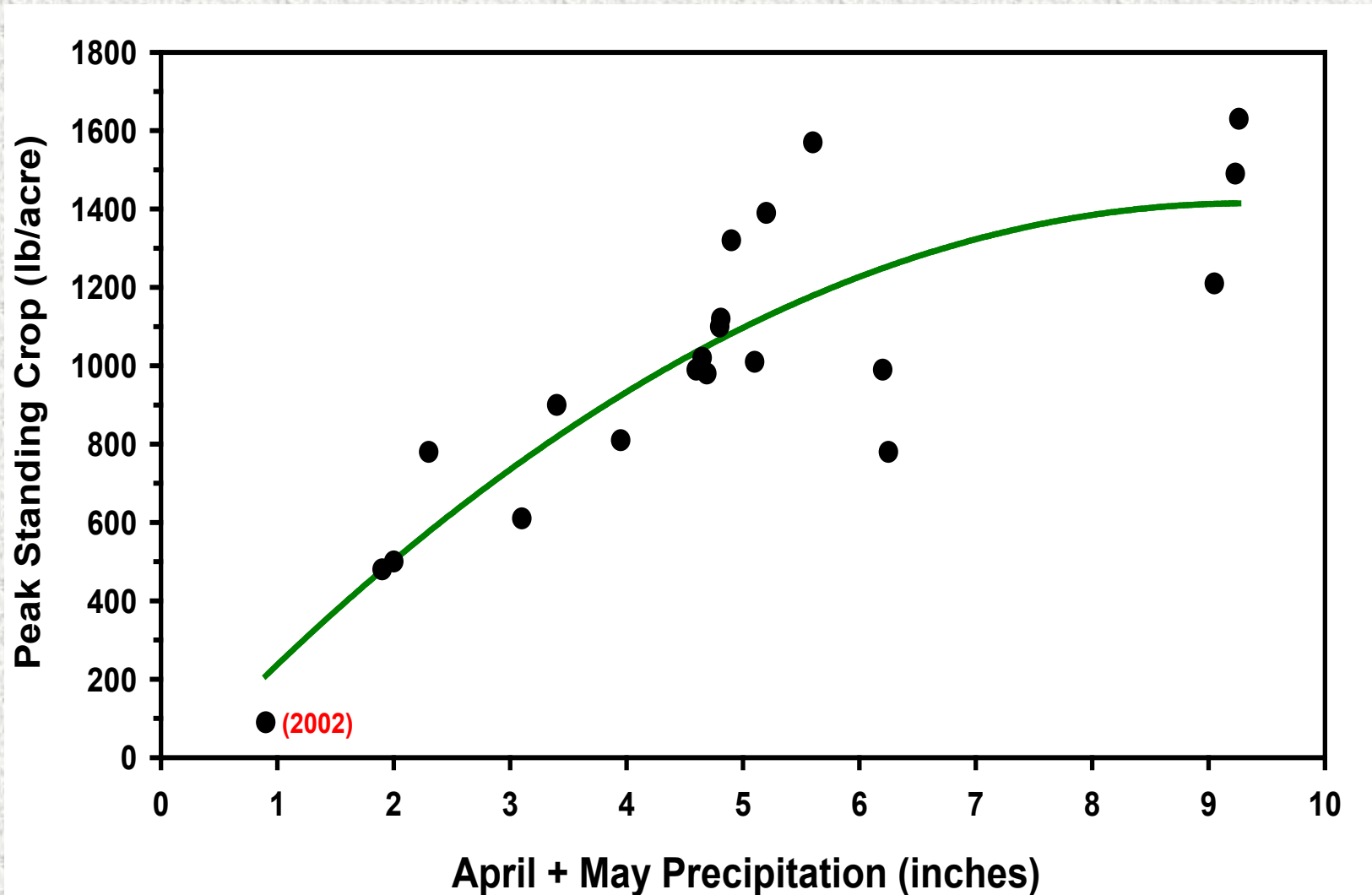
Relationship of forage production and May + June precipitation on upland Sandhills range, GSL.



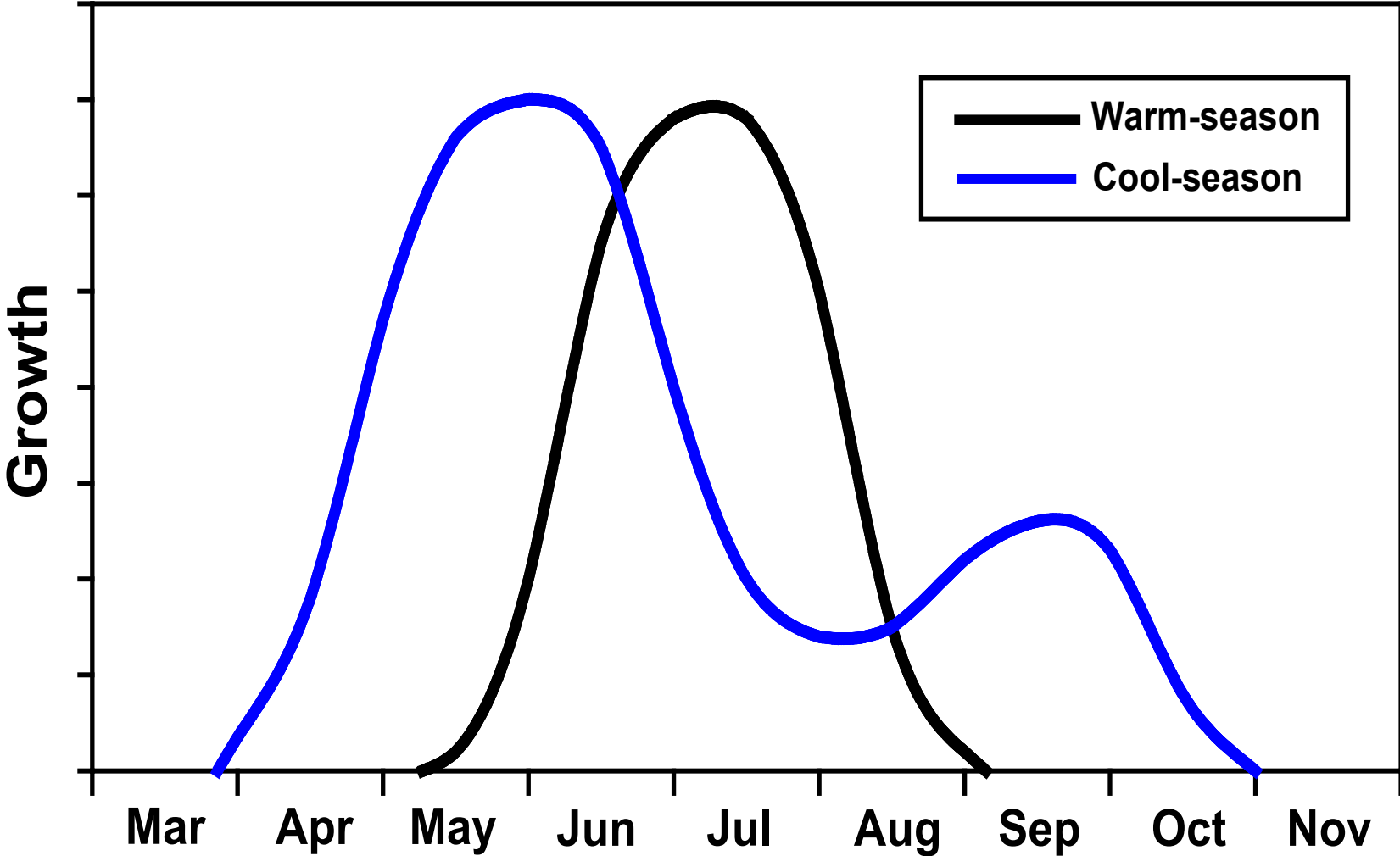
Relationship of forage production and September crude protein content of cow diets collected on upland Sandhills range.



Influence of April + May precipitation on peak standing crop, Cheyenne, WY, 1982 - 2002. (from : Derner et al. 2002)



Growth Periods of Cool and Warm-Season Forages



Cool-Season Plants (C_3)

- **Fix CO_2 with the C_3 photosynthetic mechanism throughout the cells of the leaf.**
 - **Optimum temperature: 65 to 75° F.**
 - **Increase in photosynthesis up to 1/4 to 1/2 full sunlight.**
-

Common Nebraska Rangeland Cool-Season Plants

Sedges (grass-like)

Prairie junegrass

Porcupine grass

Kentucky bluegrass

Needle-and-thread

Western wheatgrass

Scribner panicum

Downy brome

Warm-Season Plants (C₄)

- **Fix CO₂ in mesophyll cells as organic acids; then after transport to bundle sheath cells, refix carbon with C₃ mechanism.**
 - **Optimum temperature: 90 to 95° F.**
 - **Increase in photosynthesis to full sunlight.**
 - **More water- and nitrogen-use efficient than cool-season plants.**
-

Common Nebraska Rangeland Warm-Season Plants

Prairie sandreed

Sand bluestem

Blue grama

Sand dropseed

Big bluestem

Little bluestem

Switch grass

Hairy grama

Sideoats grama

Indian grass

Other Nebraska Forage Plants

Cool-Season

Smooth bromegrass

Crested wheatgrass

Inter. & Tall wheatgrasses

Orchardgrass

Oats, wheat, rye

Warm-Season

Sorghum

Sudangrass

Millet

Corn

Cool- and Warm-Season Composition:

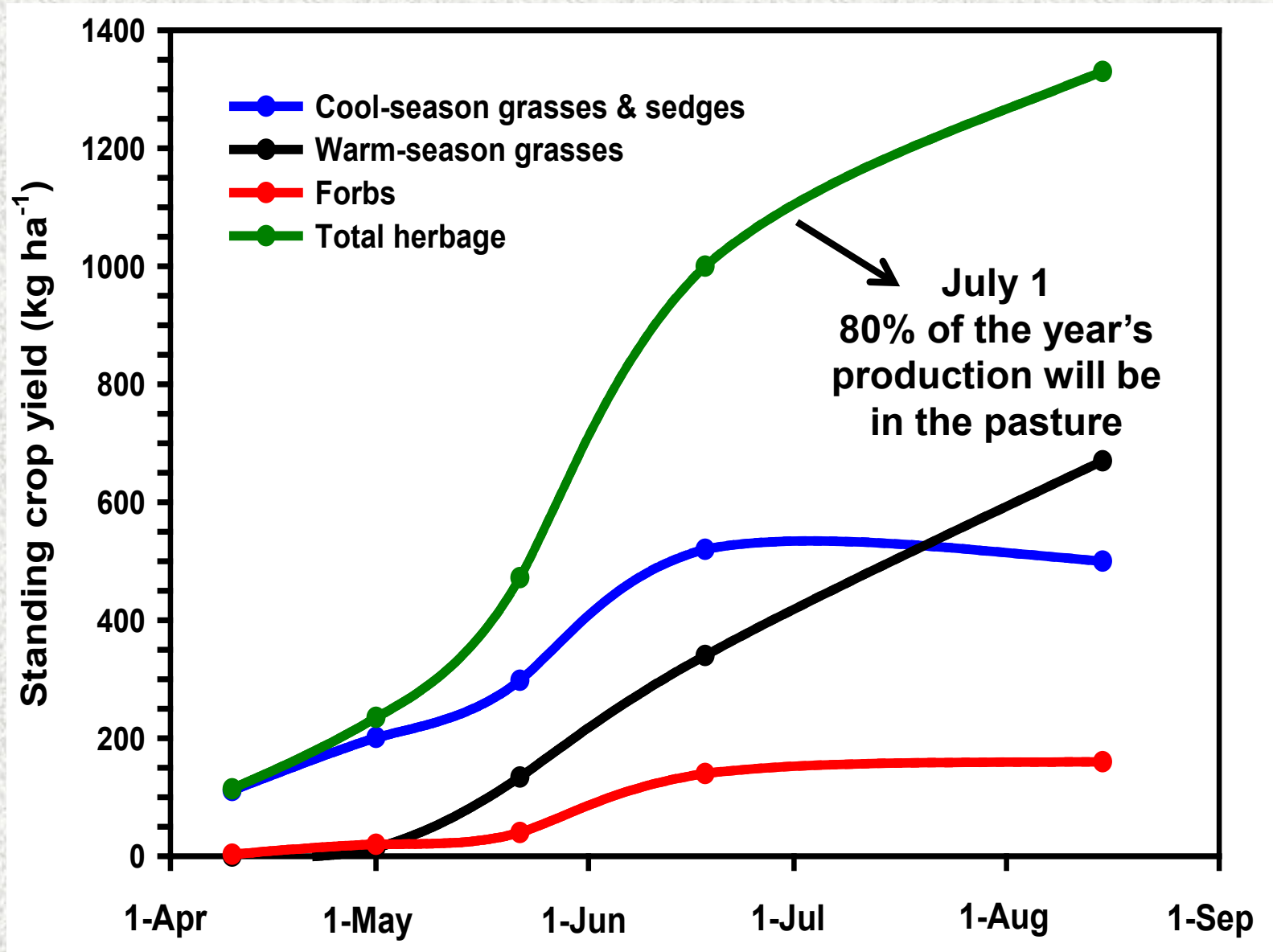
Subirrigated Meadow:

30 to 90% cool-season.

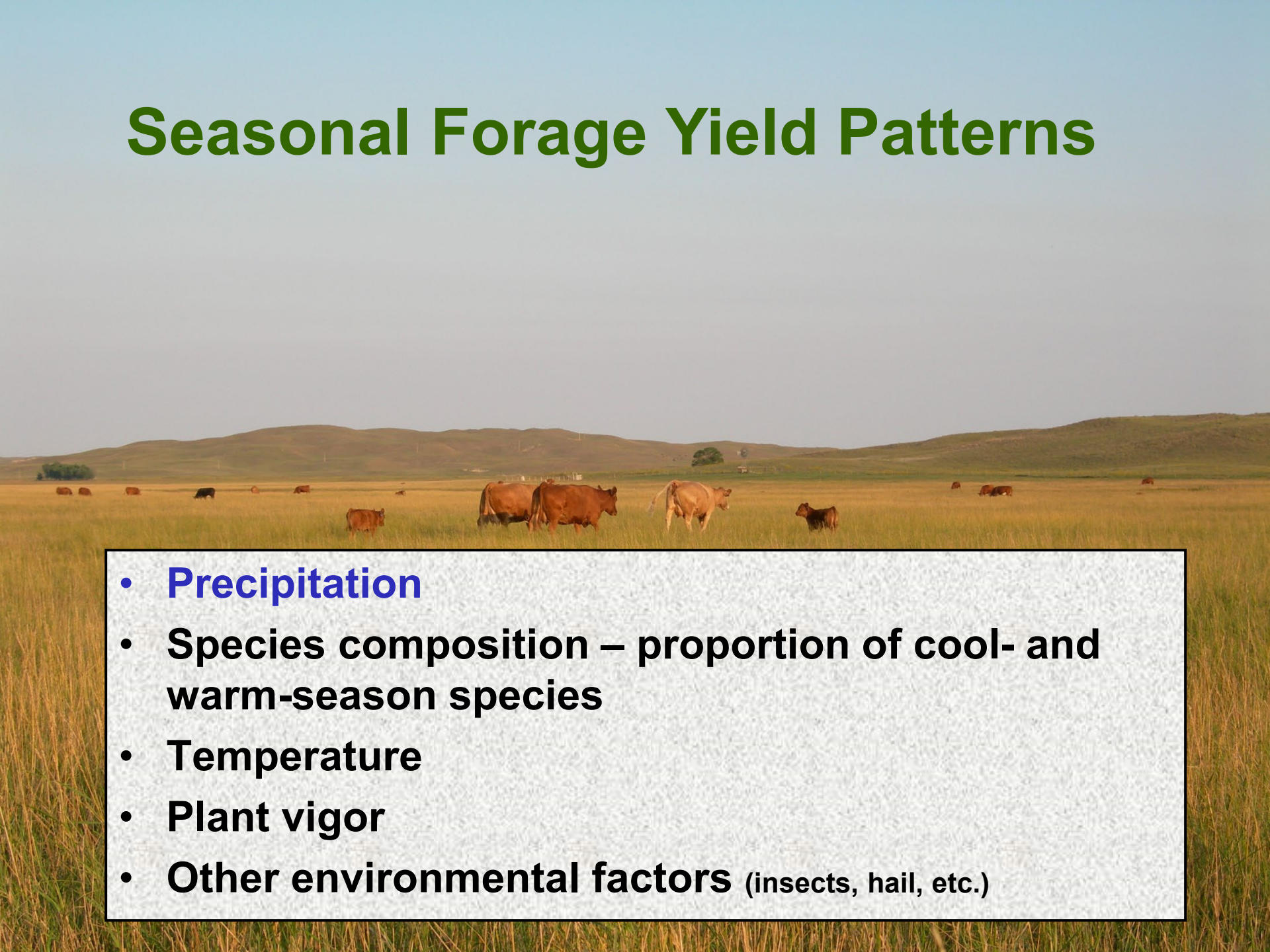
Upland Range:

10 to 50% cool-season.

Seasonal standing crop yield on a sands range site, 2000 & 2001, GSL.



Seasonal Forage Yield Patterns

- 
- **Precipitation**
 - **Species composition – proportion of cool- and warm-season species**
 - **Temperature**
 - **Plant vigor**
 - **Other environmental factors** (insects, hail, etc.)

Factors Affecting Forage Quality

- **Stage of maturity (season).**
 - **Nutritive value declines with plant age.**
 - **Decreases in protein and digestibility.**
 - **Increases in fiber lignin and cell wall components.**
-



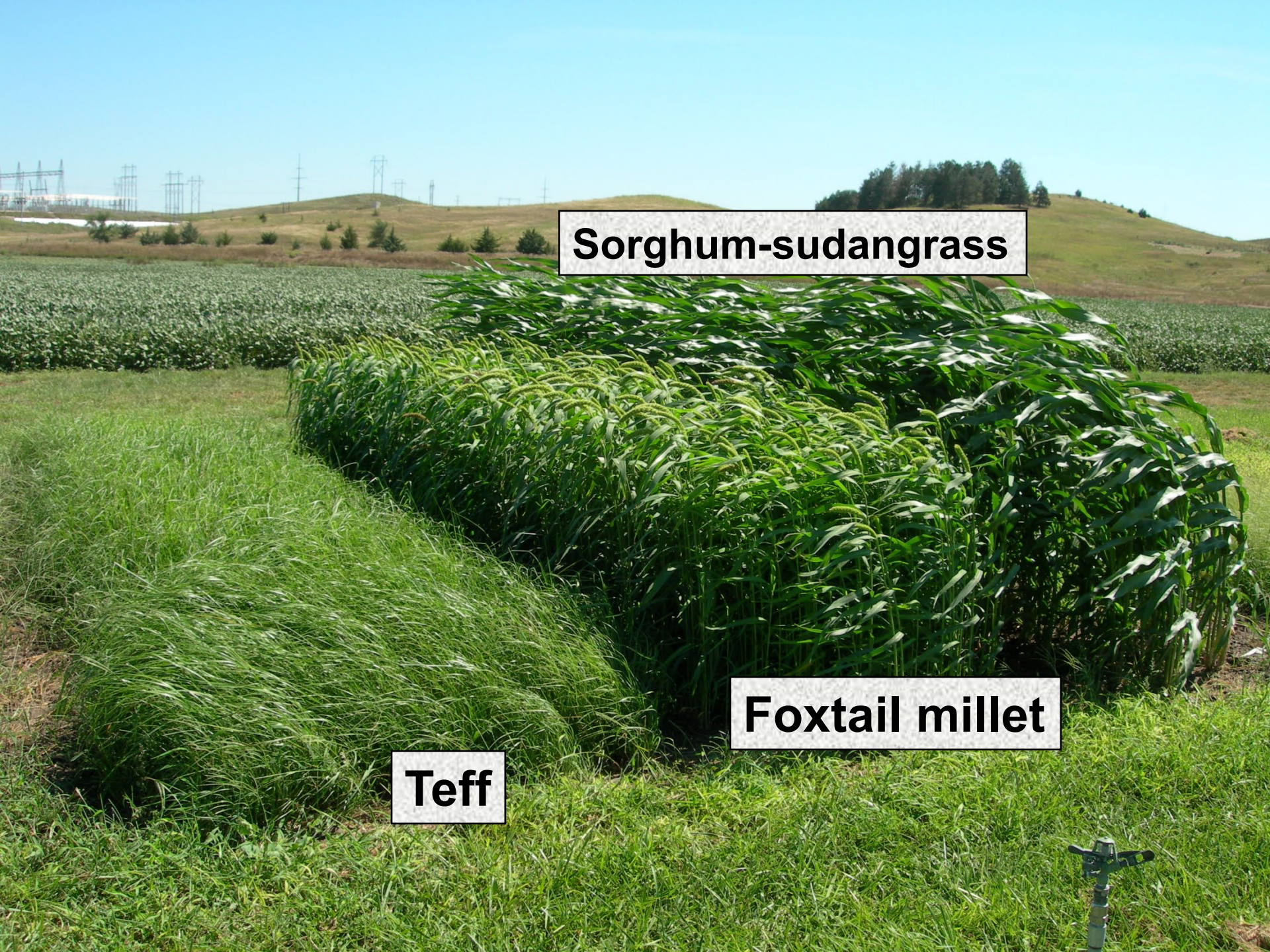
Effect of growth stage on crude protein (CP) content of alfalfa.

Stage	CP (%)	lb CP/ton
Immature	21	420
Pre-bloom	19	380
Early-bloom	18	360
Mid-bloom	17	340
Full-bloom	16	320
Mature	13	260

From: Nichols, 1989

Factors Affecting Forage Quality

- **Plant type / species.**
 - **Leaf : Stem proportion.**
 - **Composition (e.g. lignin, hemicellulose).**
-



Sorghum-sudangrass

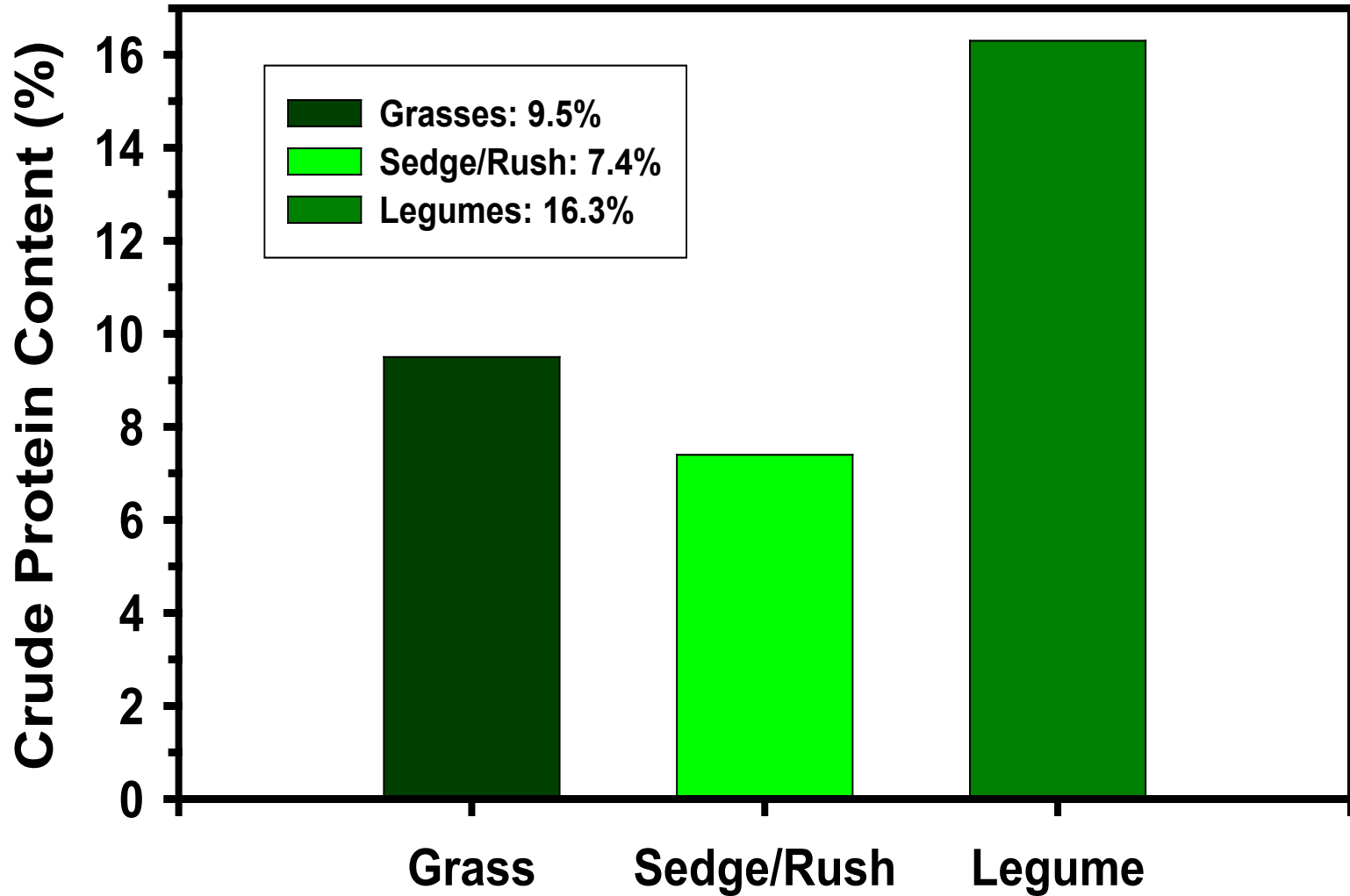
Foxtail millet

Teff

Crude protein (CP), acid detergent fiber (ADF) and total digestible nutrients (TDN), 2007, North Platte.

	1 st Harvest		
	CP	ADF	TDN
Forage Entry	----- % -----		
<i>'Tiffany'</i> teff	18.1	34	65
<i>'White Wonder'</i> foxtail millet	12.8	43	55
<i>'BMR 727'</i> sorghum-sudangrass	8.0	44	54

Crude protein content (%) of subirrigated meadow hay components. Samples harvested July 15, 1998 and 1999.



General Forage Quality Groups

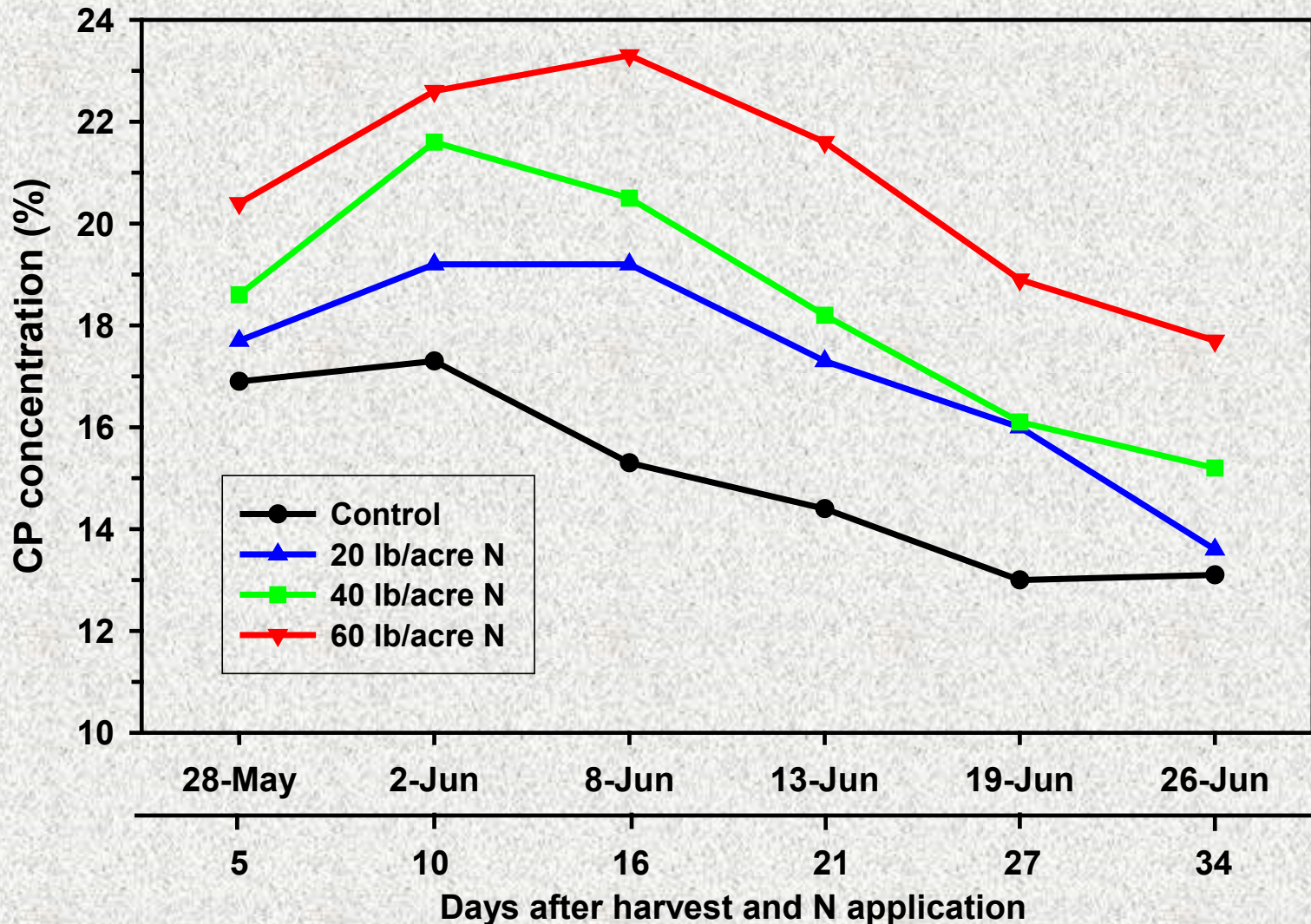
(Highest to Lowest)

- **Legumes**
 - **Cool-season annuals**
 - **Warm-season annuals**
 - **Cool-season perennials**
 - **Warm-season perennials**
-

Factors Affecting Forage Quality

- **Soil fertility.**
 - **Nitrogen and crude protein.**
 - **Other elements: effect mainly on yield and mineral content of forage.**
-

Effect of N fertilization and time on crude protein (CP) concentration of irrigated orchardgrass.*

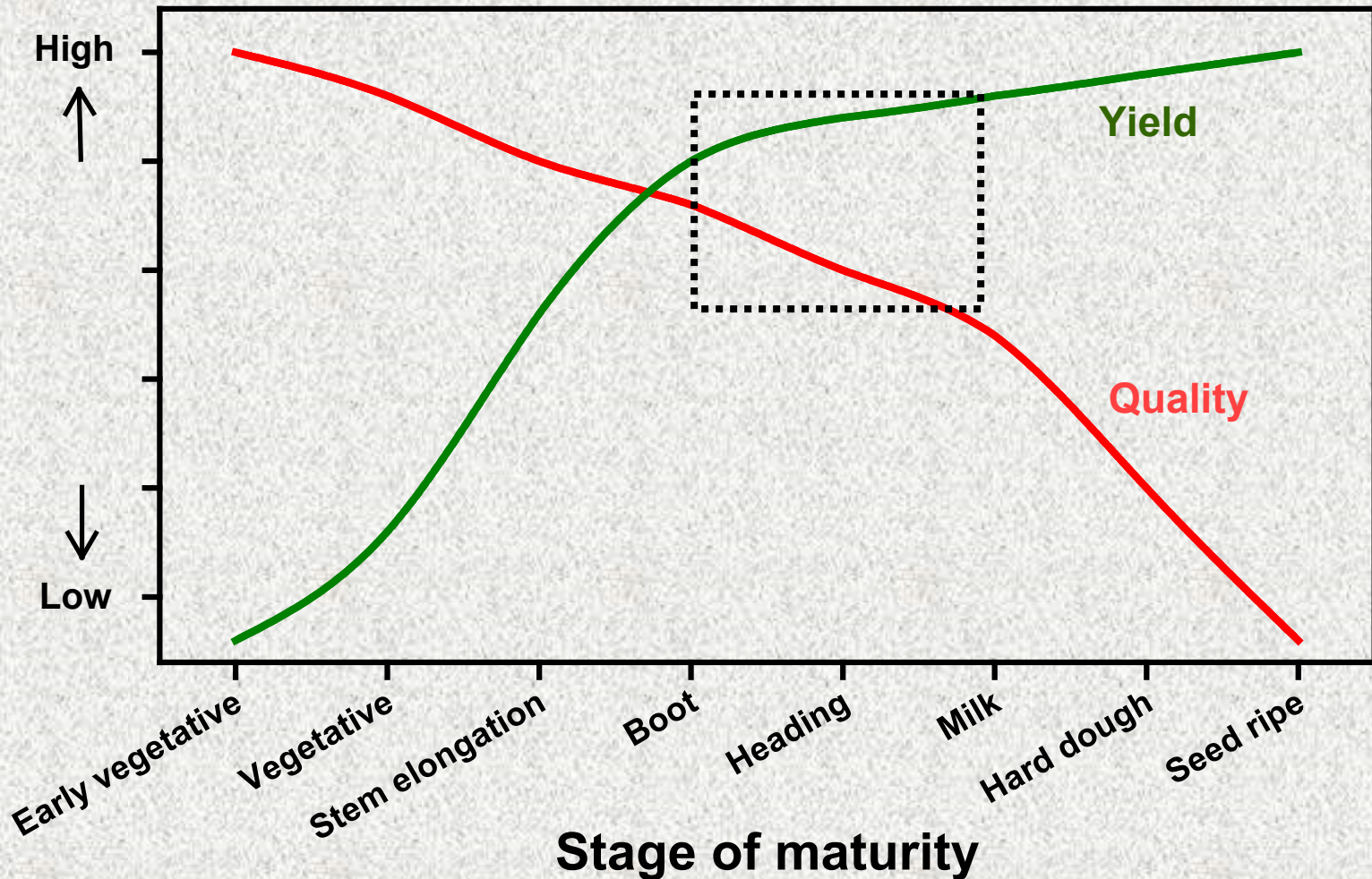


* Orchardgrass first harvested (6-inch stubble height) and N (ammonium nitrate) applied on 23-May.

Factors Affecting Forage Quality

- **Climate / environmental conditions.**
 - **Cold versus warm.**
 - **Wet versus dry.**
 - **Sunlight.**
-

Generalized relationship between forage yield and forage quality as affected by stage of maturity



Seasonal Forage Yield and Quality Patterns

- **Forage Yield:**

- Precipitation, pasture species composition (cool- and warm-season proportion), plant vigor, temperature, and other environmental factors.

- **Forage Quality:**

- Stage of maturity (season), plant species, soil fertility, and environmental conditions.
-