Planting Considerations for Short-Season Environments

2nd Annual Great Plains Cotton Conference

February 23-24, 2021

Seth Byrd - OSU

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Factors to Consider

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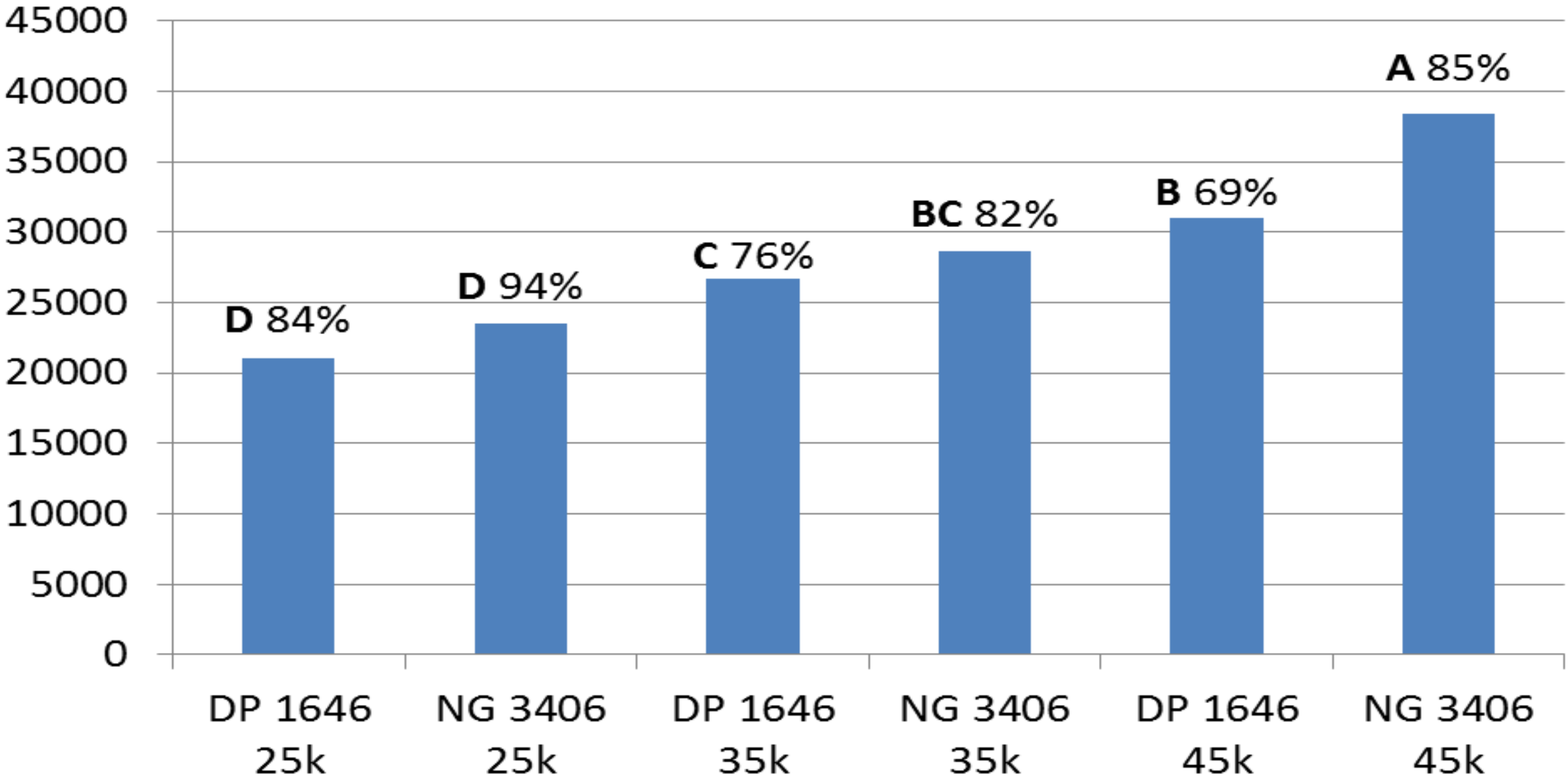
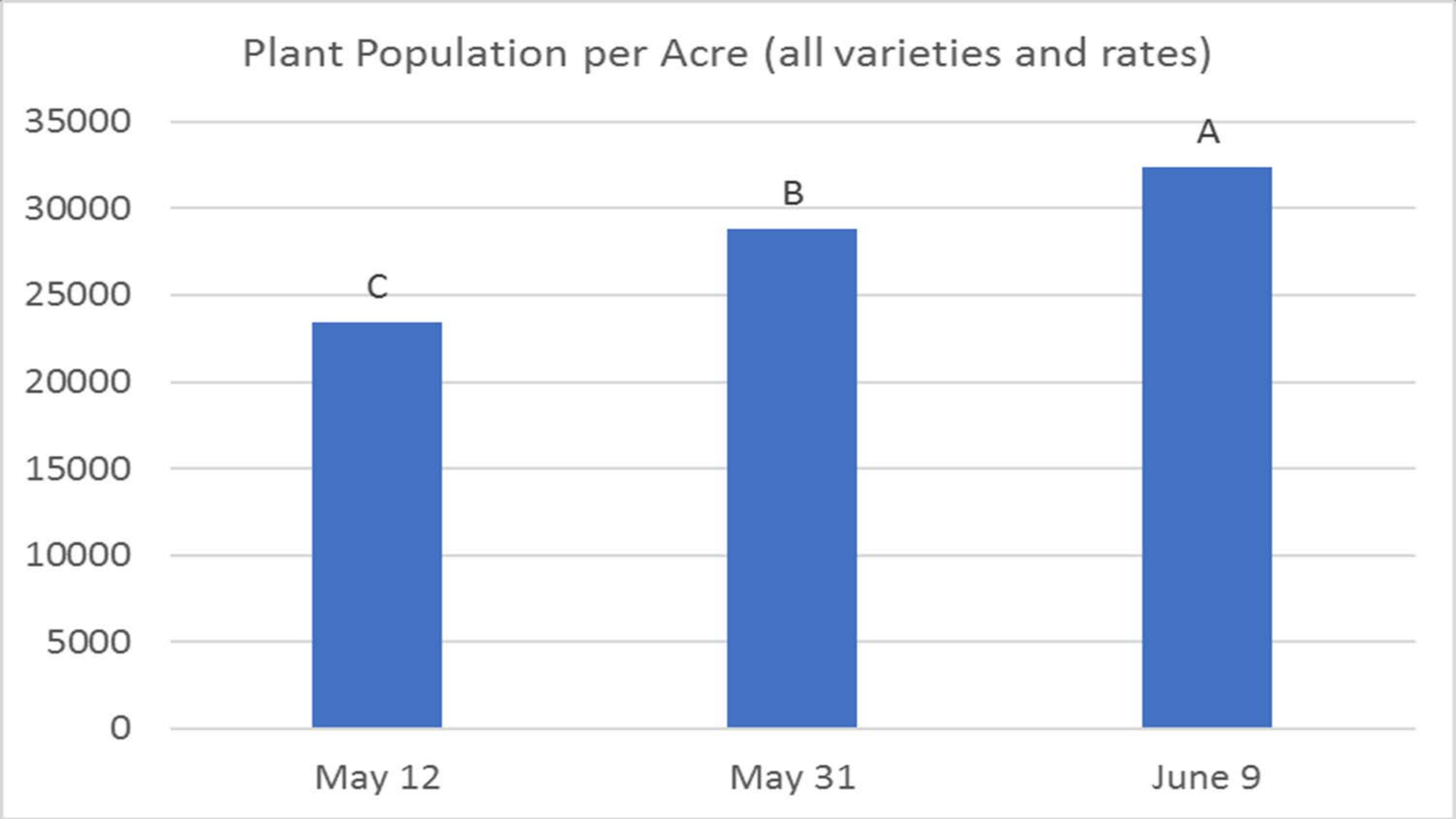
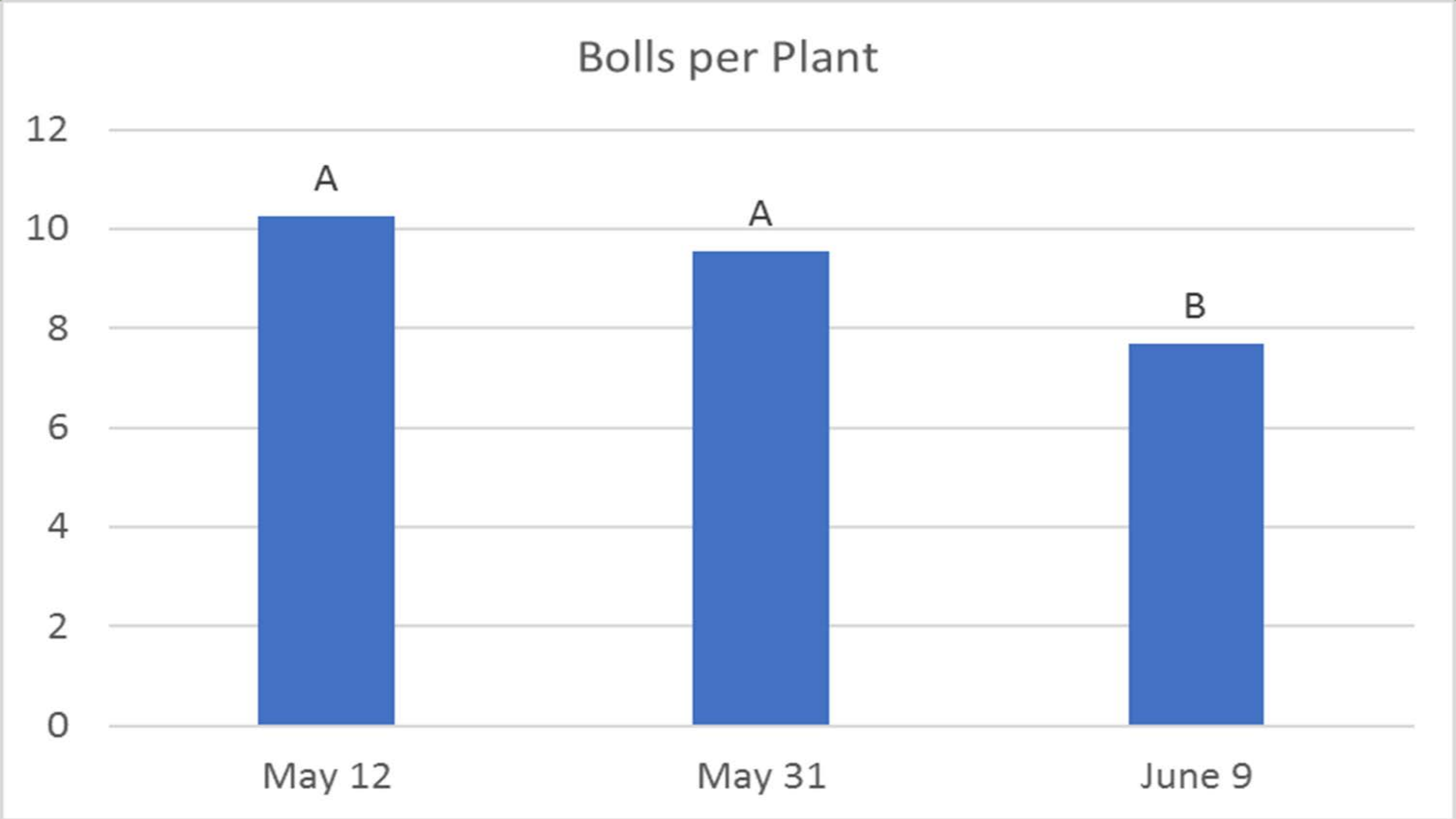
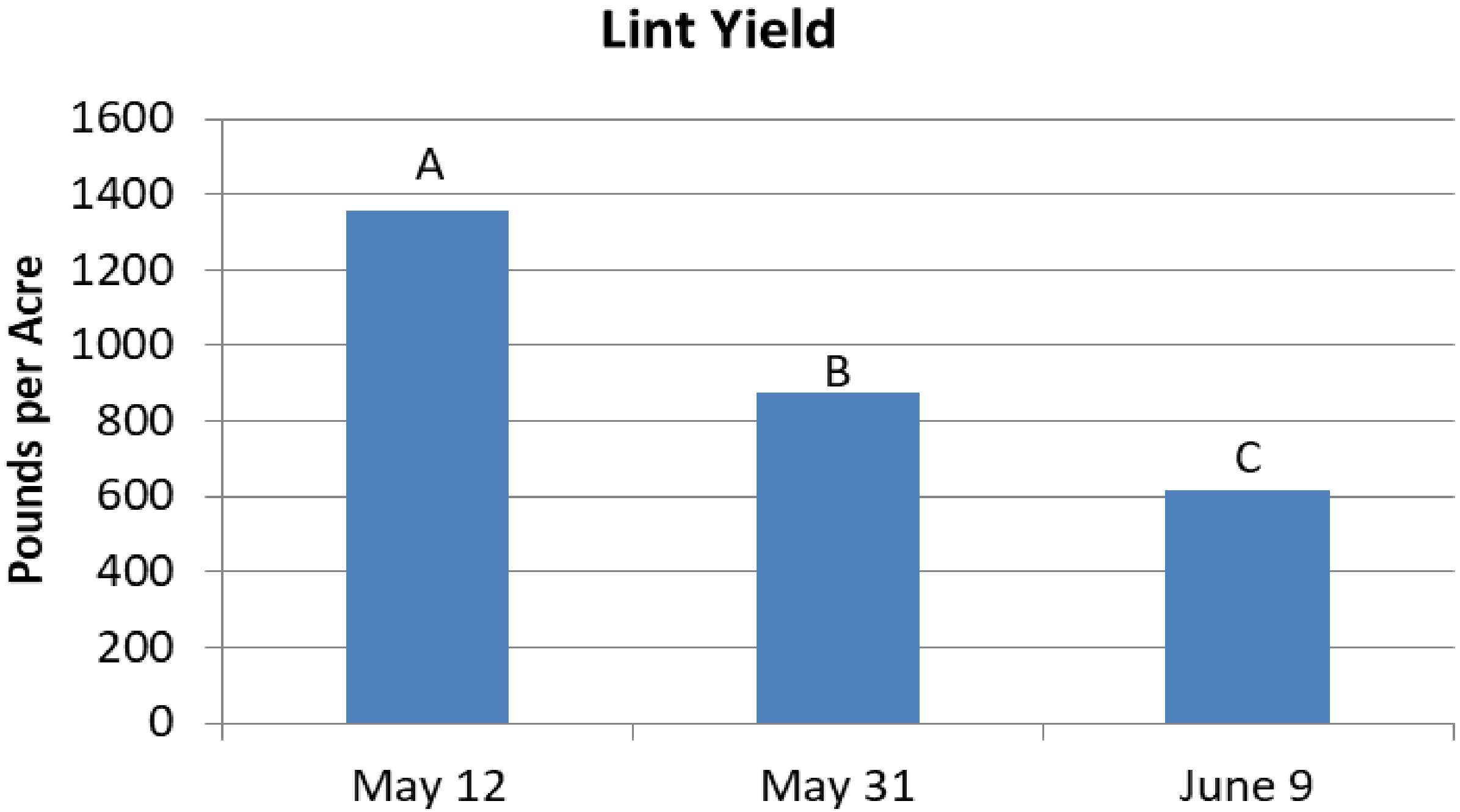
- Planting Date – balance cooler conditions and stand loss to gain time, heat units, and maximize effective flowering
- Variety characteristics – seed characteristics (seed quality, oil content, etc.), seedling vigor, maturity/stress response
- Planting conditions & practices – balancing environmental conditions, planter setup, planting depth

Plant Population per Acre (All Dates)

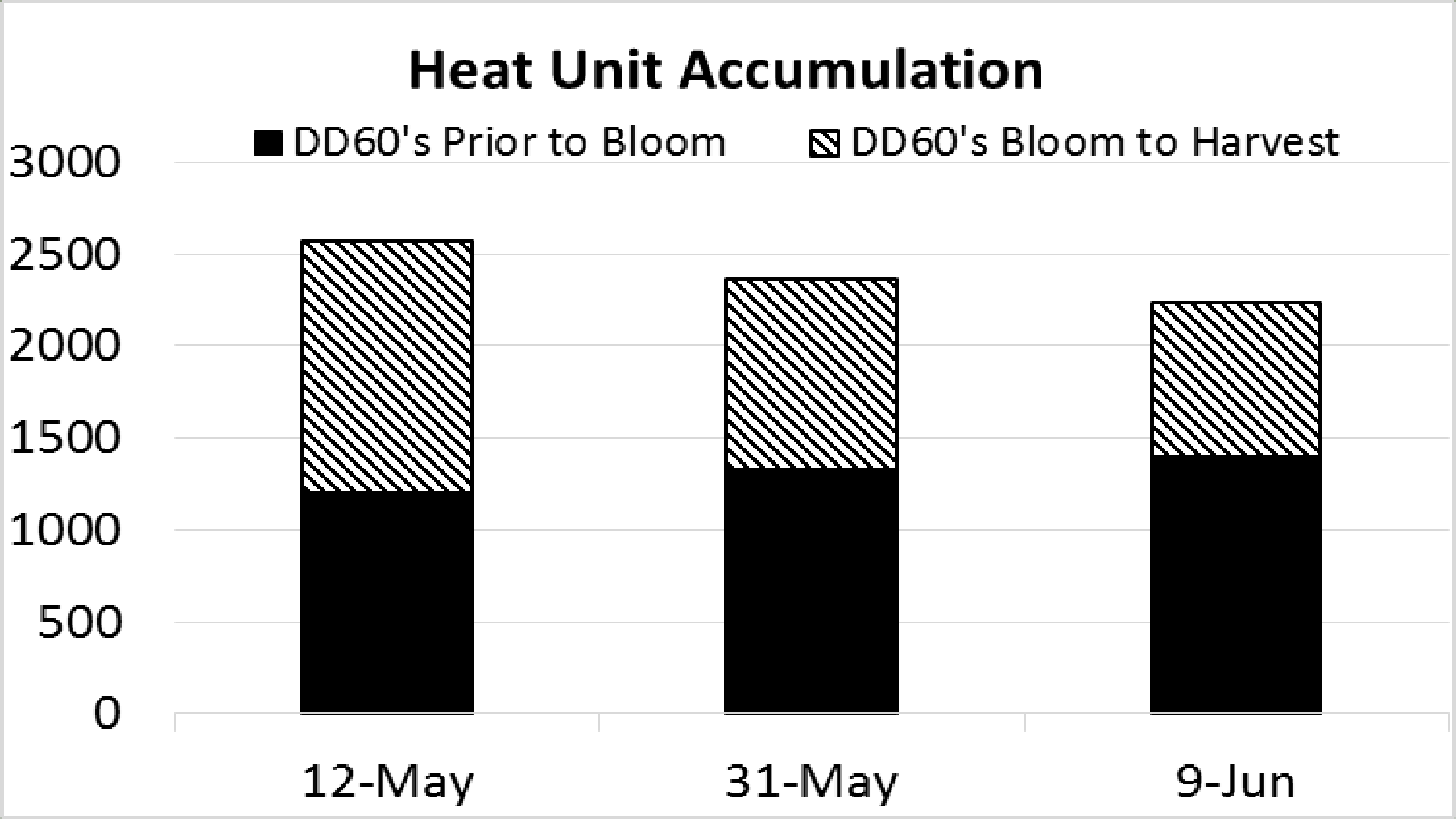



Plant Population per Acre (all varieties and rates)
35000
30000
25000
20000
15000
10000
5000
0
C
B
A
May 12
May 31
June 9


Bolls per Plant
12
10
8
6
4
2
0
A
A
B
May 12
May 31
June 9


Lint Yield
Pounds per Acre
1600
1400
1200
1000
800
600
400
200
0
A
B
C
May 12
May 31
June 9

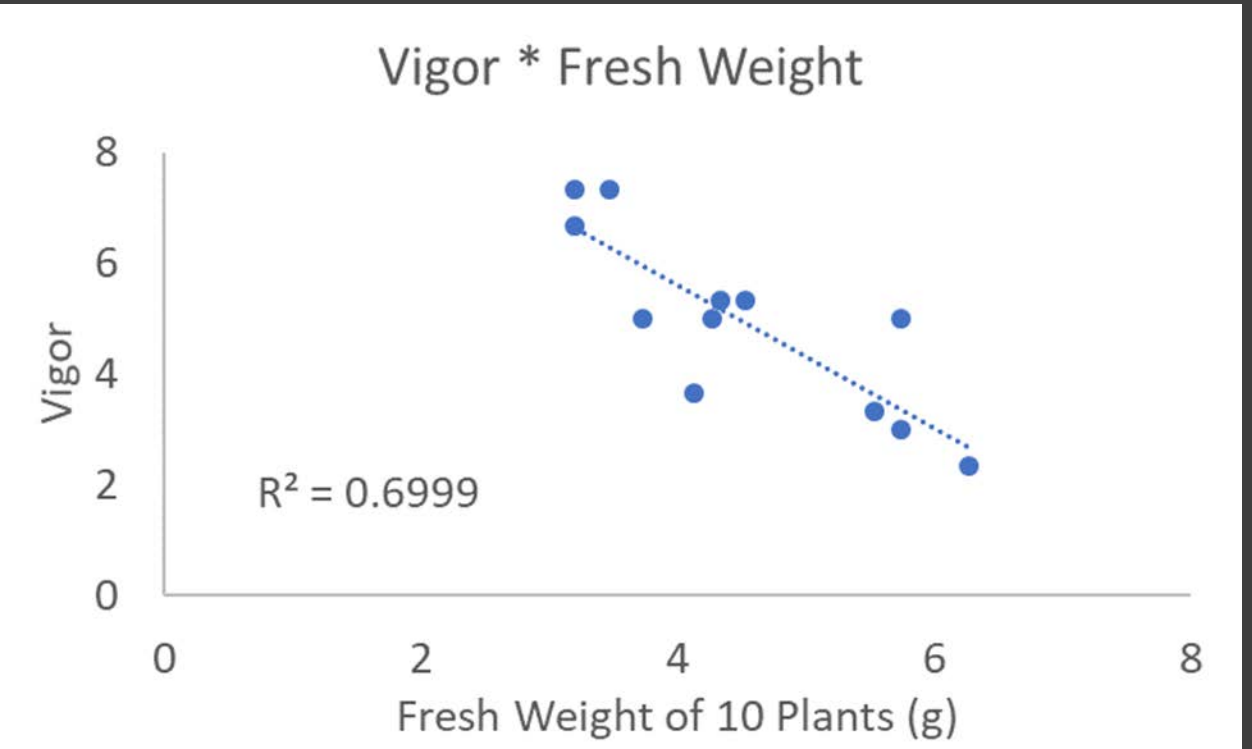
Average Lint Yield	25k Seed Acre^{-1}	35k Seed Acre^{-1}	45k Seed Acre^{-1}
Planted 5/12/17			
DP 1646 B2XF	1322 ab	1513 a	1189 bc
NG 3406 B2XF	1421 a	1321 ab	1365 ab
Planted 5/31/17			
DP 1646 B2XF	1071 cd	718 e-g	899 de
NG 3406 B2XF	803 ef	910 de	834 ef
Planted 6/9/17			
DP 1646 B2XF	527 g	624 fg	554 g
NG 3406 B2XF	694 e-g	629 fg	661 fg
Average	***973***	***952***	***917***

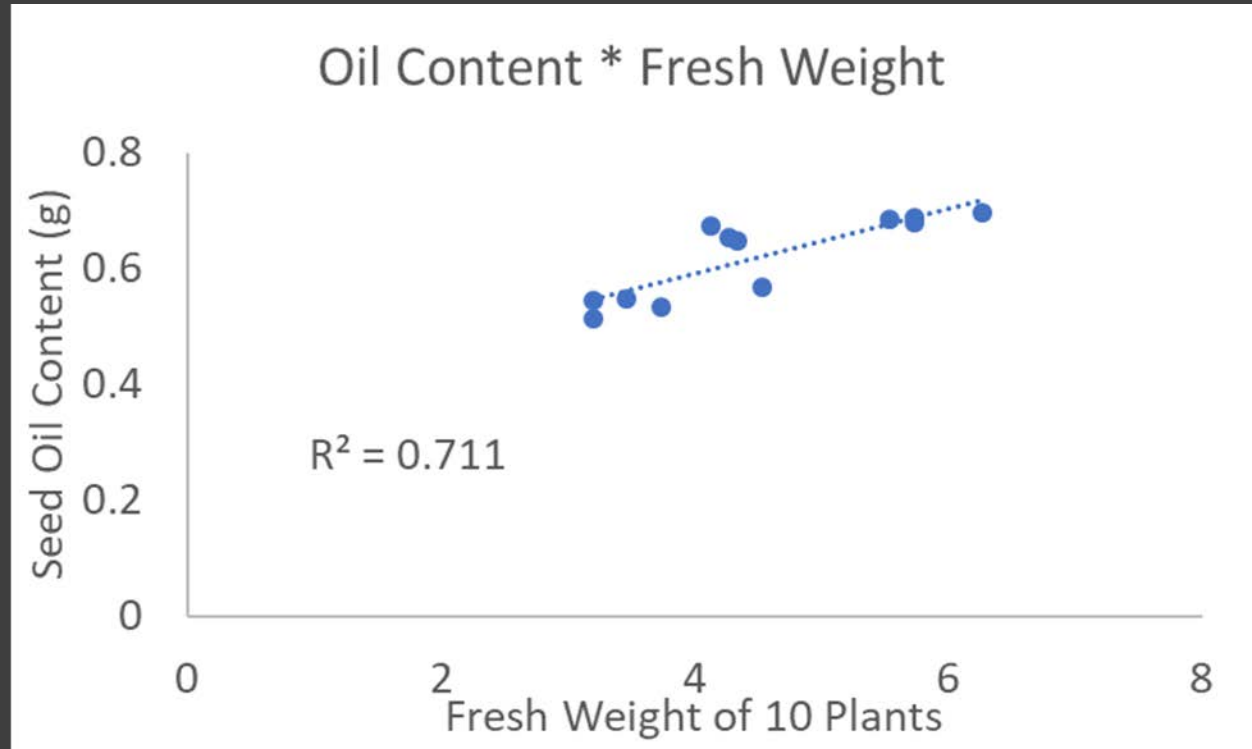

Heat Unit Accumulation
DD60's Prior to Bloom
DD60's Bloom to Harvest
3000
2500
2000
1500
1000
500
0
12-May
31-May
9-Jun

Seed Characteristics and Seedling Vigor

AGRICULTURE

- 2017 - Cool cloudy August-September + hit and miss planting season = favorable for early maturing and vigorous varieties?





Seed Characteristics and Seedling Vigor

Variety	Lint Yield Group	Seed Oil Content Group	Fresh Weight Group
NG 4689 B2XF	A	AB	A
NG 3406 B2XF	A	BC	BCD
FM 1830 GLT	AB	FG	CDE
FM 1888 GL	ABC	E	B
FM 1911 GLT	ABC	A	A
NG 3699 B2XF	ABC	AB	A
FM 2322 GL	BCD	G	E
DP 1646 B2XF	BCD	EF	E
DP 1522 B2XF	BCD	CD	BC
CG 9598 B3XF	BCD	EF	DE
NG 3640 XF	CD	AB	A
DP 1549 B2XF	D	D	BC

Seed Characteristics and Seedling Vigor

Variety	Lint Yield Group	Seed Oil Content Group	Fresh Weight Group
NG 4689 B2XF	A	AB	A
NG 3406 B2XF	A	BC	BCD
FM 1830 GLT	AB	FG	CDE
FM 1888 GL	ABC	E	B
FM 1911 GLT	ABC	A	A
NG 3699 B2XF	ABC	AB	A
FM 2322 GL	BCD	G	E
DP 1646 B2XF	BCD	EF	E
DP 1522 B2XF	BCD	CD	BC
CG 9598 B3XF	BCD	EF	DE
NG 3640 XF	CD	AB	A
DP 1549 B2XF	D	D	BC

Planting Conditions and Practices

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- Ideal environmental conditions are key (moisture & temperature)
- Planter setup – adjust field to field or address changing conditions to optimize performance and prevent lost time
- Planting depth – risk chasing moisture? Conditions, forecast, and variety

Poor Texas Panhandle Plant Stands

Jourdan M. Bell
Texas A&M AgriLife
Amarillo

	Dallam	Gray	Hansford	Hutchinson	Moore-NPGCD	Sherman-Cartrite	Sherman-Slough
Planted Seeds/Acre	45,000	45,000	35,000	80,000	50,000	50,000	65,000
	---- Measured plants/acre----						
CP9210 B3XF	26,281	-----	-----	-----	-----	-----	-----
DG3109 B2XF‡	-----	-----	17,134	-----	-----	-----	-----
DG3317 B3XF‡	-----	-----	-----	-----	-----	-----	30,202
DG3385 B2XF‡	-----	-----	-----	-----	28,532	-----	-----
DG3470 B3XF‡	-----	-----	18,731	-----	-----	28,895	-----
DP1612 B2XF‡	33,686	-----	-----	-----	-----	-----	-----
DP1820 B3XF	25,120	19,602	-----	37,897	22,216	22,796	28,867
DP1822 XF	----*	-----	26,354	-----	-----	-----	-----
DP1908 B3XF	28,750	-----	-----	-----	13,504	-----	-----
DP1909 B3XF	-----	-----	20,473	-----	-----	-----	-----
DP2012 B3XF	25,991	20,909	23,522	35,719	-----	20,183	31,799
FM1320 GL‡	-----	17,424	-----	-----	-----	-----	-----
FM1621 GL	-----	21,490	22,796	34,848	-----	-----	-----
FM1888 GL	-----	22,216	22,869	53,797	-----	-----	-----
FM2202 GL	-----	-----	20,909	-----	-----	-----	-----
FM2398 GLTP	-----	29,330	-----	47,045	-----	-----	-----
NG2982 B3XF	31,799	25,846	26,136	37,462	26,354	31,218	34,412
NG3406 B2XF‡	26,281	-----	-----	-----	-----	-----	-----
NG3500 XF	22,942	21,780	22,361	28,314	-----	15,682	31,073
NG3930 B3XF	31,218	29,621	26,136	53,143	30,492	25,730	40,366
NG3956 B3XF	30,202	22,216	25,846	49,005	25,918	21,490	34,993
ST4480 B3XF	25,120	18,586	22,216	39,204	-----	15,972	29,476
Trial Average	**27,944**	**22,638**	**22,729**	**41,643**	**24,503**	**22,746**	**32,648**

TEXAS A&M AGRILIFE RESEARCH | EXTENSION

	Dallam	Gray	Hansford	Hutchinson	Moore-NPGCD	Sherman-Cartrite	Sherman-Slough
Planted Seeds/Acre	**35,000**	**45,000**	**66,000**	**66,000**		**55,000**	**54,000**
	----- plants/acre as a % of planted seed-----						
CP9210 B3XF	0.58	-----	-----	-----	-----	-----	-----
DG3109 B2XF‡	-----	-----	0.49	-----	-----	-----	-----
DG3317 B3XF‡	-----	-----	-----	-----	-----	-----	0.46
DG3385 B2XF‡	-----	-----	-----	-----	0.57	-----	-----
DG3470 B3XF‡	0.75	-----	0.54	-----	-----	0.58	-----
DP1612 B2XF‡	0.56	0.44	-----	0.47	0.44	0.46	0.44
DP1820 B3XF	-----	-----	0.75	-----	-----	-----	-----
DP1822 XF	0.64	-----	-----	-----	0.27	-----	-----
DP1908 B3XF	-----	-----	0.58	-----	-----	-----	-----
DP1909 B3XF	0.58	0.46	0.67	0.45	-----	0.40	0.49
DP2012 B3XF	-----	0.39	-----	-----	-----	-----	-----
FM1320 GL‡	-----	0.48	0.65	0.44	-----	-----	-----
FM1621 GL	-----	0.49	0.65	0.67	-----	-----	-----
FM1888 GL	-----	-----	0.60	-----	-----	-----	-----
FM2202 GL	-----	0.65	-----	0.59	-----	-----	-----
FM2398 GLTP	0.71	0.57	0.75	0.47	0.53	0.62	0.53
NG2982 B3XF	0.58	-----	-----	-----	-----	-----	-----
NG3406 B2XF‡	0.51	0.48	0.64	0.35	-----	0.31	0.48
NG3500 XF	0.69	0.66	0.75	0.66	0.61	0.51	0.62
NG3930 B3XF	0.67	0.49	0.74	0.61	0.52	0.43	0.54
NG3956 B3XF	0.56	0.41	0.63	0.49	-----	0.32	0.45
ST4480 B3XF	0.62	0.50	0.65	0.52	0.49	0.45	0.50
Trial Average	**0.62**	**0.50**	**0.65**	**0.52**	**0.49**	**0.45**	**0.50**

Plant Stand Concerns

- 6-years of Panhandle AgriLife data demonstrates that final stands are 30-75% of the planted population.
- Average Annual Germination is 50%
- Avg Seed Cost $330/Bag
- Planting 50,000 Seeds per Acre = $75/Acre Seed Cost
- At 50% germination, you **lost** ~$37.50/acre the minute you put your planter in the ground.
- Producers are inquiring about PGR + microbial seed treatments to improve germination and seedling vigor

Will PGR based seed treatments help?

- PGR seed treatments marketed to producers to improve germination, emergence, root mass, and plant vigor
  - All good selling points for northern production environment
  - Variable yield repsonses
- After re-evaluating past variable responses, it was hypothesized that preplant soil nitrogen may affect microbial activity the seed treatment response.
- The 2020 plan of work was modified to include a preplant N treatment: plots were blocked to include preplant N + seed treatment or no preplant N + seed treatment.

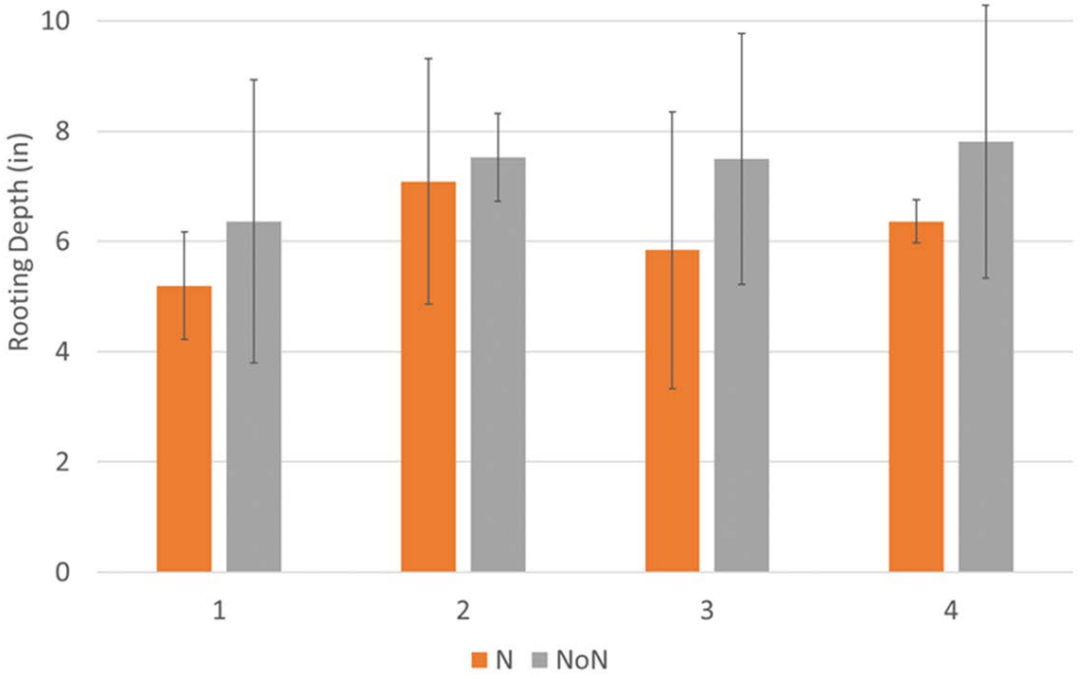
Justification

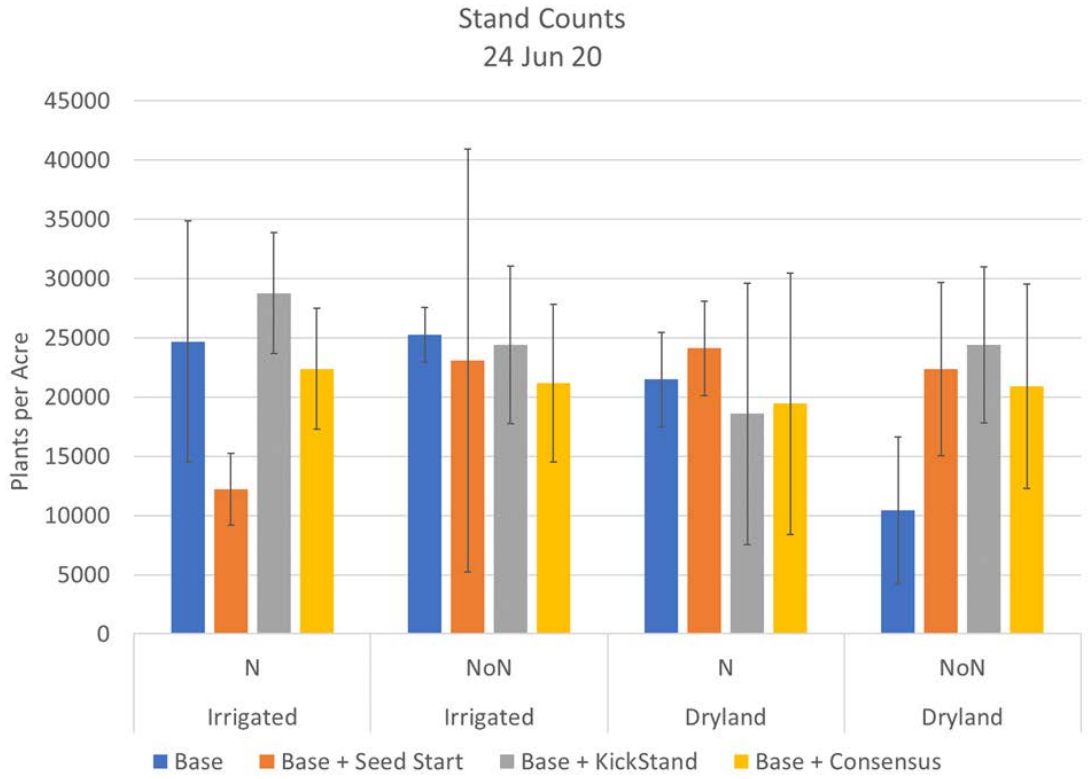
- Typical stand takes about 14 days to establish
- GDD accumulation during the seedling stage is critical to the final yield potential (Cathey, 1986).
- PGRs marketed to increased rate of maturation and enhance early season vigor by increasing rooting and shoot development (Oosterhuis and Zhao, 1994).
- Nitrogen fertilization may temporarily affect soil pH due to acidification from nitrification (Pierre, 1928)
- Nitrogen fertilization influences the soil microbial community (Chen et al., 2018; Allison and Martiny, 2008), but the level of change is inconsistent (Ramirez et al., 2010)

Seed Treatments

Three seed treatments marketed as biological enhancement products with a PGR for faster germination and bigger seedling root system and one untreated check were compared:

- Base (base insecticide and fungicide only: Metalaxyl + Pyraclostrobin + Myclobutanil + Imidacloprid + Fluxapyroxad + Tioxazafen)
- Base + Seed Start (Soil Mender: a proprietary blend of microbes, micronutrients, and full PGR package)
- Base + KickStand (Helena Chemical: an Indole-3-butyric Acid (0.0135%) plus a proprietary blend of ammonia and salts of carboxylic acid (99.9865%))
- Base + Consensus (Loveland: a proprietary blend of Indole-3-butyric acid, Chitosan, and Salicylic Acid)



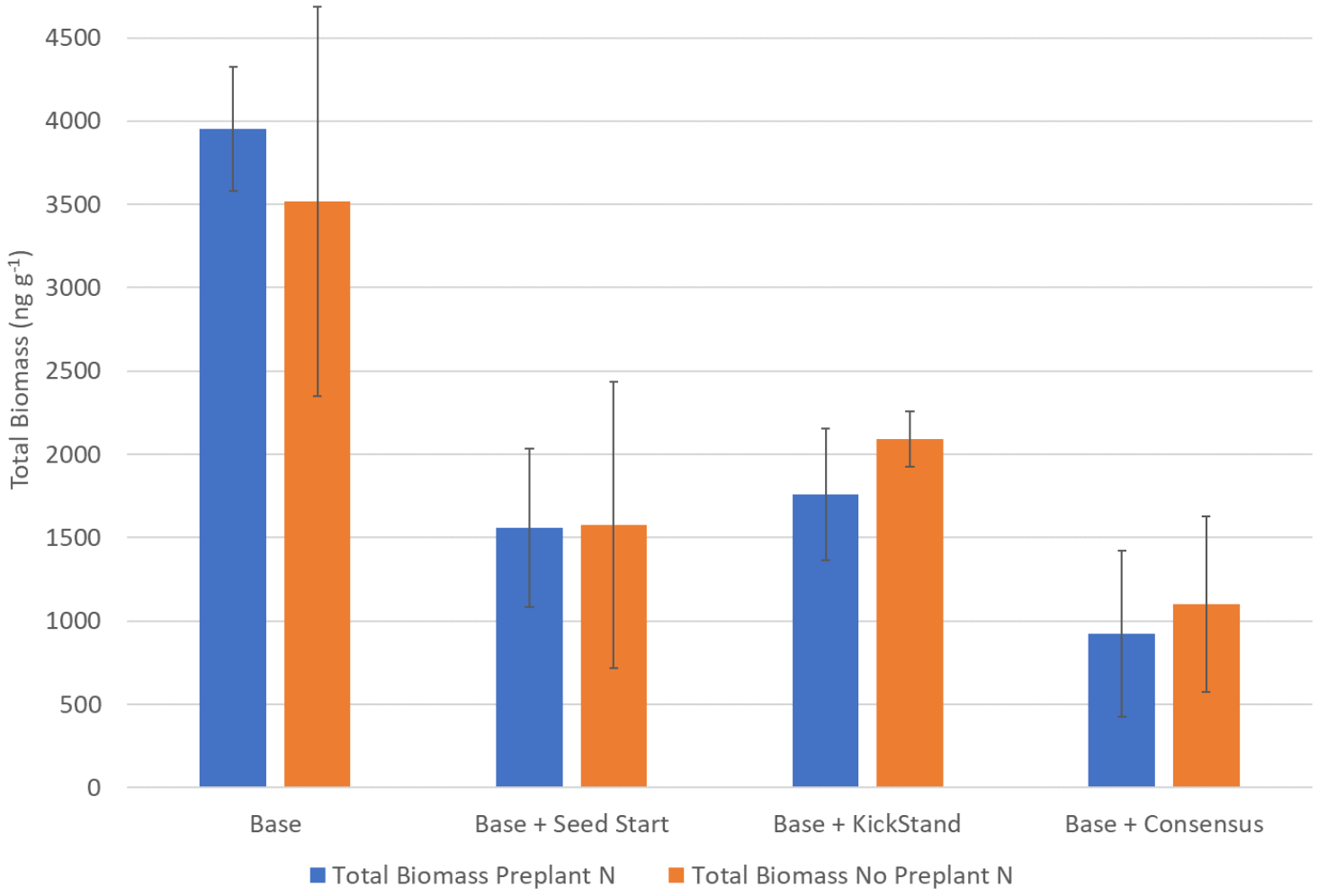


Neither stand nor rooting depth responded to treatments.

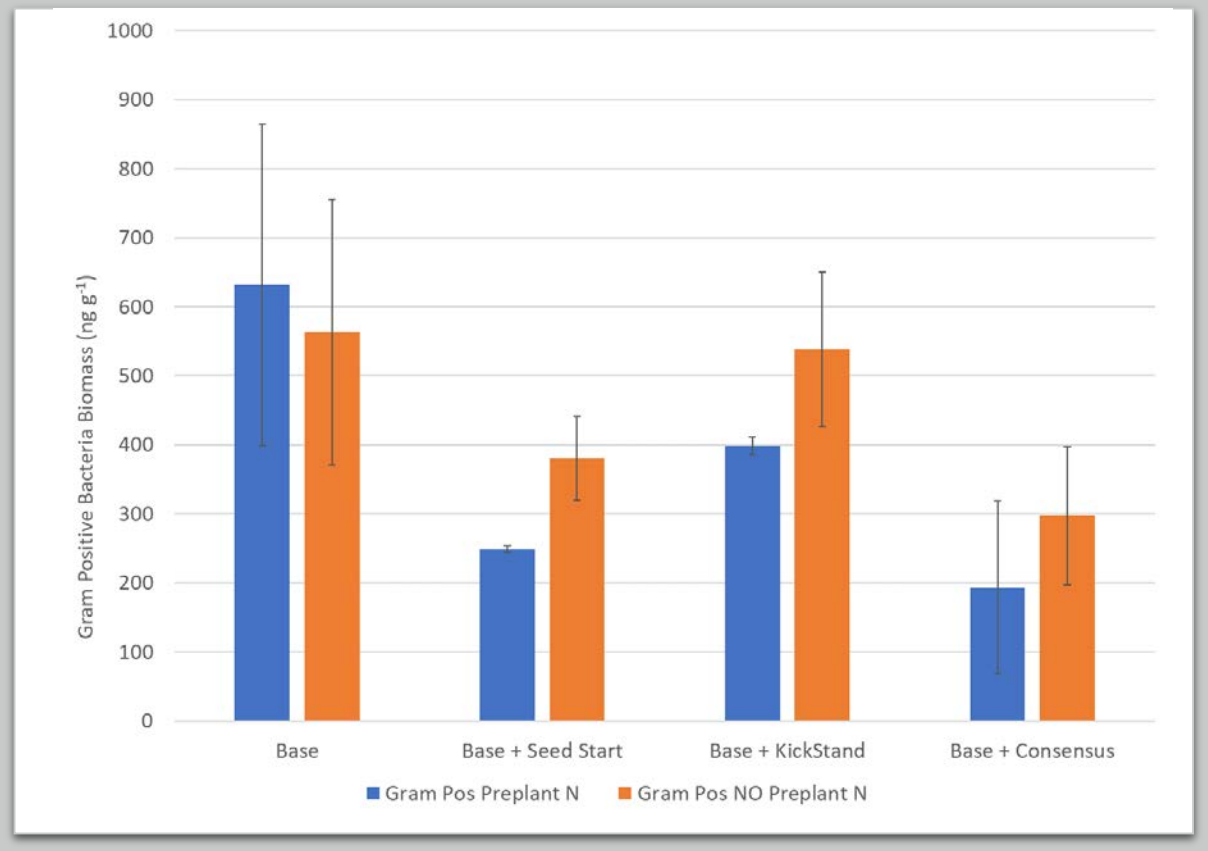
Variability in plant stands consistent with previous years.

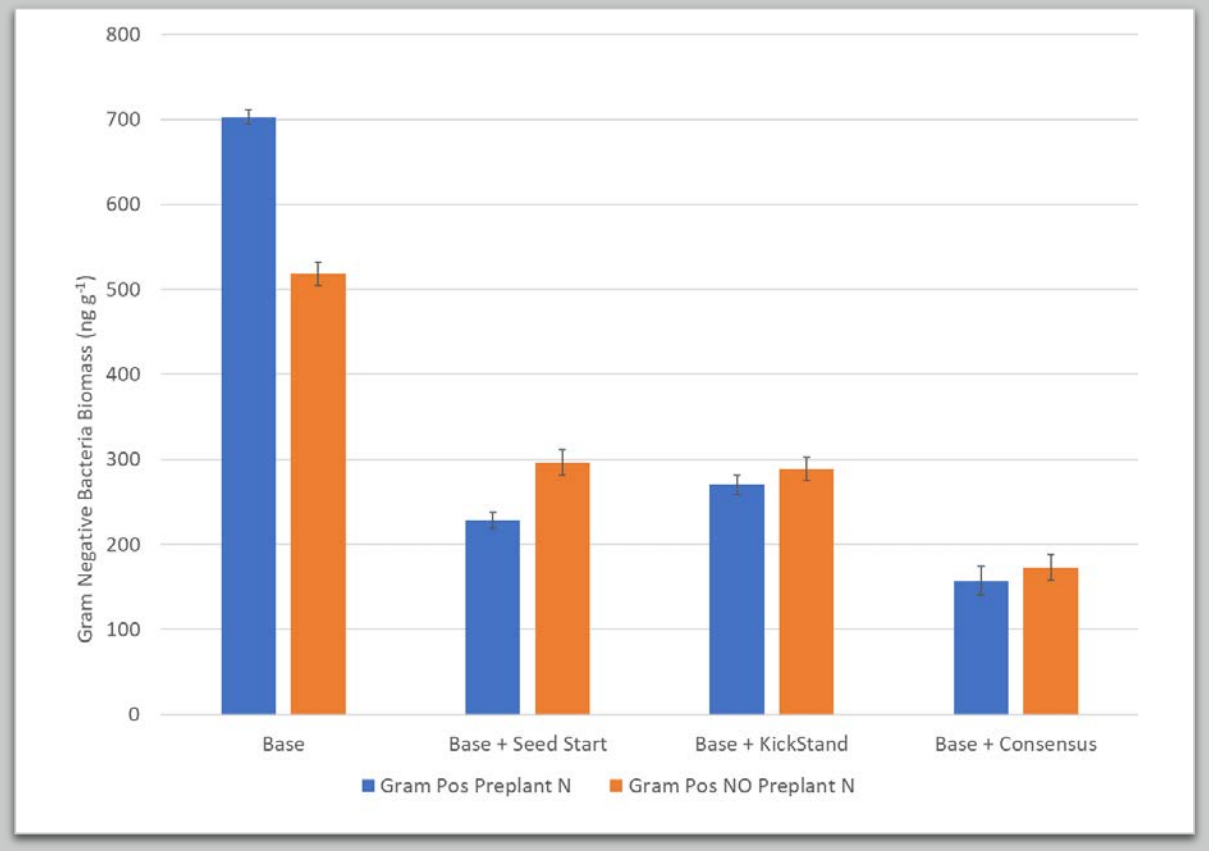
Why do we see variable yield response?

Does preplant fertilizer and seed treatments affect soil bacteria?



Total Biomass from PLFA analysis responded to seed treatment





- Total biomass includes gram positive and gram negative bacteria
- Gram Positive bacteria are larger bacteria with a thick cell wall and they tend to resist water stress.
- Gram negative bacteria are the smallest and tend to be more sensitive to water stress.
  - Gram negative bacteria all significantly inhibited by seed treatment.
- Will this affect water use and yield?

Variety	Lint Yield --- lb/acre ---	Turnout --%--	Seed Yield --- lb/acre ---	Micro-naire	Fiber Length (in.)	Uniformity --%--	Strength (g/tex)	Leaf	Lint loan Value cents/lb	Lint Value --- $/acre ---
Base	857 b	0.28	1209	4.4	1.1	80.7	28.7	1	54.38	465.98
Base + Seed Start	1058 a	0.27	1478	4.3	1.1	81.3	30.3	1	46.88	588.84
Base + KickStand	1115 a	0.29	1497	4.5	1.1	80.8	29.5	1	54.98	584.89
Base + Consensus	1026 a	0.29	1438	4.5	1.1	80.9	29.8	1	55.81	568.79
Test Average	**1014**	**0.28**	**1405**	**4.4**	**1.1**	**80.9**	**29.6**	**1**	**53.01**	**552.13**
CV, %	13.0	8.9	15.1	4.0	1.9	0.8	2.8	17.5	21.6	16.2
p-value	0.0238	0.6025	0.2622	0.3202	0.2184	0.8055	0.0311	0.2392	0.5220	0.1001
LSD	166	NS	NS	NS	NS	NS	2.3	NS	NS	112.4

- No significant yield response to fertilizer
- No difference in soil water uptake between treatments
- Positive yield response in 2020 to seed treatment but….
- No response 2019, hailed out in 2018, positive response in 2017
  - In consitent response

Research funded by: COTTON INCORPORATED

Planting Conditions for Rapid Germination and Emergence

- Minimum soil temperature 60-62 degrees
- Favorable 5 day forecast
  - minimum temperature 50 degrees
  - maximum temperature > 75 degrees
- Plant in a firm moist seedbed
- Proper and uniform seeding rate (30” rows)
  - 3-4 seeds per foot irrigated
  - 2.5-3.5 seeds per foot dryland/fallow

Imbibitional Chilling Injury

- Seed subjected to cold the first 2-3 days after planting, OR when the seed is imbibing moisture from the soil.
  - Seed contains lipids which must be converted to energy
  - Cell membranes must develop properly
- Soil temperatures of ≤ 50° F can damage seedlings
- Soil temperatures of ≤ 41° F may kill or cause severe injury
- Symptoms include curling, shortening and thickening of the root
- Injury during this stage usually kills the root tip meristematic tissue, cessation of normal taproot growth and compensatory lateral root development.

Boman & Goodson, OSU Cotton Comments 4/19/2012.
http://cotton.okstate.edu/cotton-comments-newsletters

Imbibitional Chilling Injury

Boman & Goodson, OSU Cotton Comments 4/19/2012.
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Imbibitional Chilling Injury

Cotton seedlings exhibiting chilling injury

Boman & Goodson, OSU Cotton Comments 4/19/2012.
http://cotton.okstate.edu/cotton-comments-newsletters

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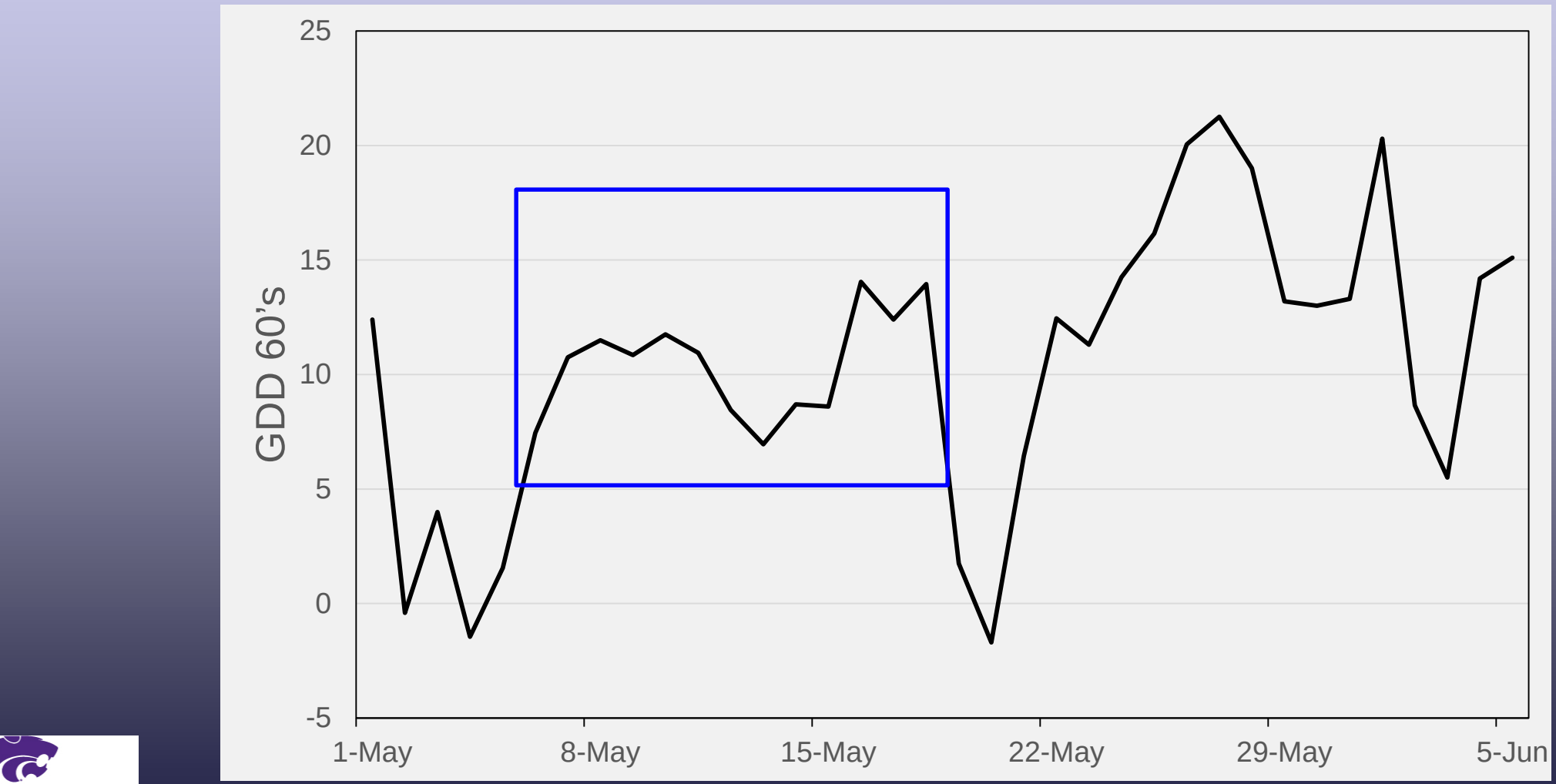
GDD60's – Moscow 2018



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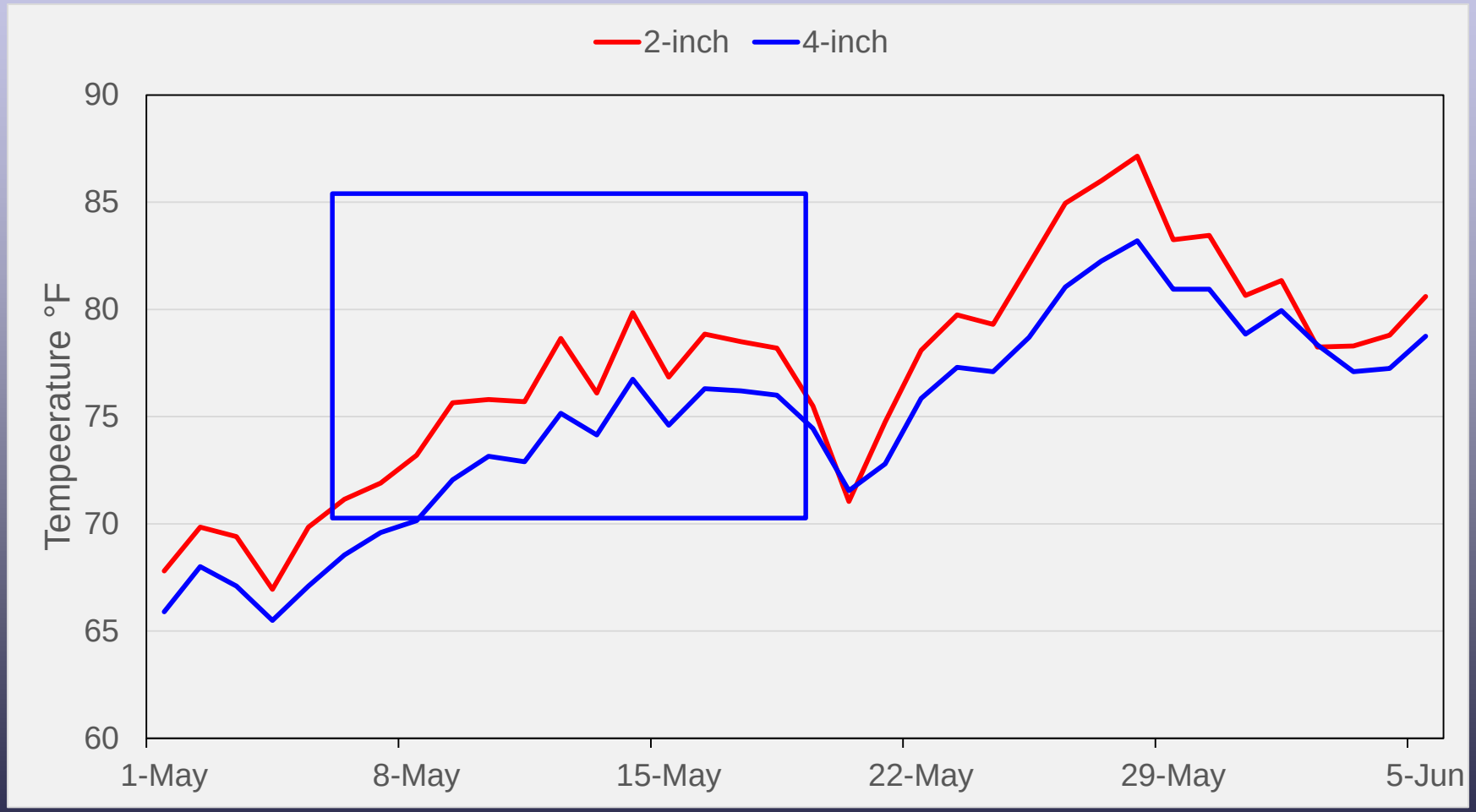
Soil Temperatures – Moscow, 2018



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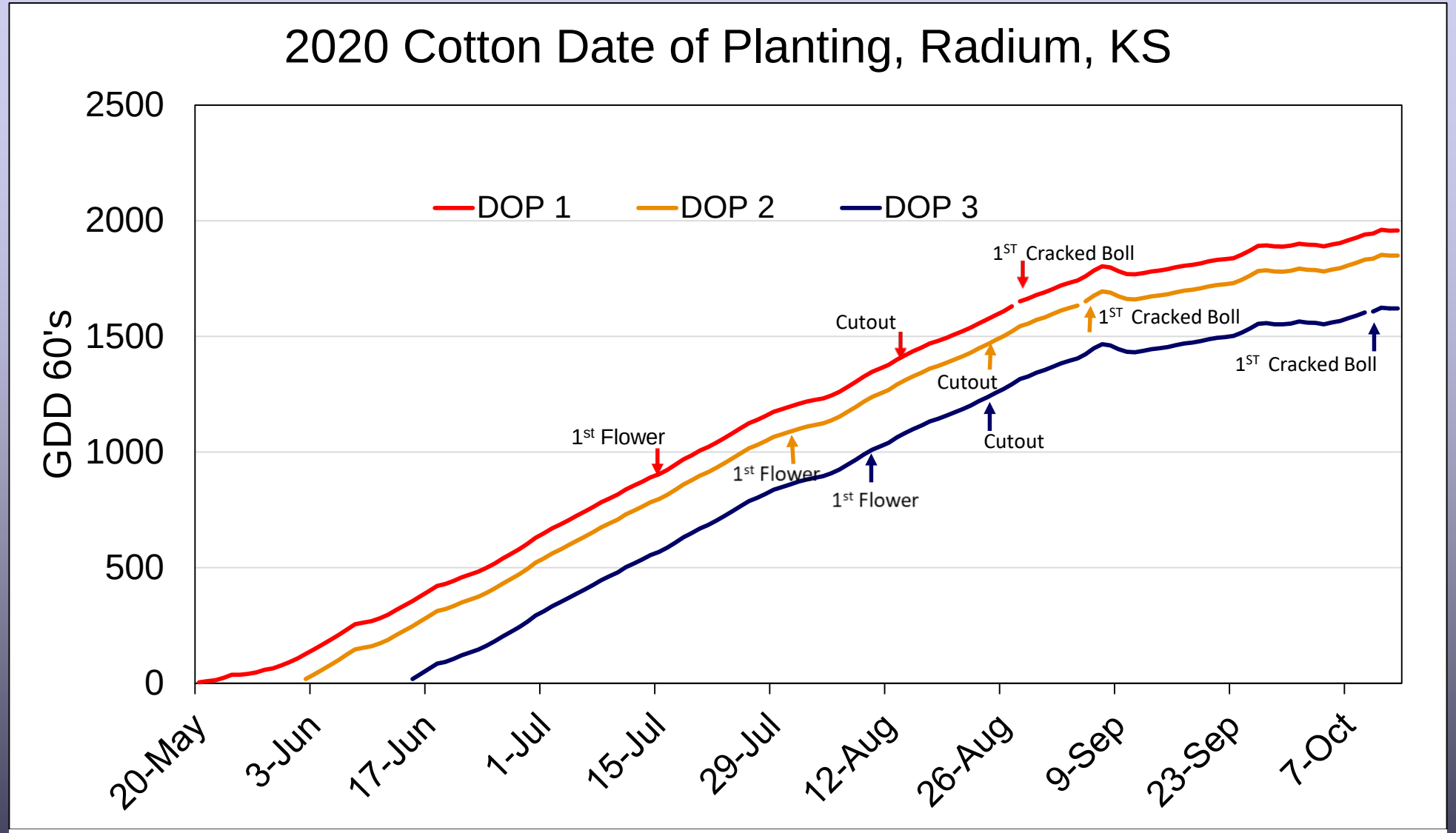

Figure 1. Heat Unit accumulation and stages of cotton development over the course of the 2020 growing season for cotton planted at three different planting dates near Radium, KS. **38.120794, -98.895808**

2020 Cotton Date of Planting
Radium, Kansas

Table 1. Cotton growth and development characteristics for three different planting dates.

Planting Date	Plant Population	First Flower	First Fruiting Branch	Nodes Above Uppermost 1st White Flower				Cutout	First Cracked Boll	Total Fruiting Branches
	acre^{-1}		node	1st Flower	Aug 5	Aug 13	Aug 26			
May 20	37,897 a†	July 18	6	7	6	5	2	Aug 14	Aug 16	7.4
June 2	40,511 a	July 31	6	8	7	6	3	Aug 26	Sept 4	6.3
June 15	31,799 a	Aug 10	5	12	12‡	12	5	Aug 25	Oct 10	6.1

† Means within a column followed by the same letter are not significantly different P≤0.05.

‡ The June 15 planting date had reached Match Head Square stage of development

DeltaPine DP 1908 B3XF

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2020 Cotton Date of Planting
Radium, Kansas

Planting Date	Plant Population	Total Harvestable Bolls			First Position Bolls			Second Position Bolls			Third Position Bolls			Vegetative Bolls		
	acre^{-1}	acre^{-1}	seed	lint	no. acre^{-1}	seed	lint	no. acre^{-1}	seed	lint	no. acre^{-1}	seed	lint	no. acre^{-1}	seed	lint
			- lb acre^{-1} -			- - lb acre^{-1} - -			- - lb acre^{-1} - -			- lb acre^{-1} -			- lb acre^{-1} -	
May 20	37,897 a†	212,137 a	1149 a	865 a	144,184 a	797 a	610 a	42,689 a	228	171	7841	44	30	71,003	80	55
June 2	40,511 a	152,024 ab	834 b	567 b	106,722 a	586 a	405 ab	26,572 b	141	93	2614	18	10	67,082	88	59
June 15	31,799 a	67,082 b	80 c	220 c	36,590 b	80 b	220 b									
Mean	36,736	131,841	688	551	95,832	488	412	34,631	185	132	5,228	31	20	69,043	84	57

† Means within a column followed by the same letter are not significantly different P≤0.05.

Variety: DeltaPine DP 1908 B3XF

38.120794, -98.895808

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2020 Cotton Date of Planting - Radium, Kansas

		Total		
Planting Date	Plant Population	Harvestable Bolls	Seed	Lint
	acre^{-1}	acre^{-1}	- - lb acre^{-1} - -	
May 20	37,897 a†	212,137 a	1149 a	865 a
June 2	40,511 a	152,024 ab	834 b	567 b
June 15	31,799 a	67,082 b	80 c	220 c
Mean	36,736	131,841	688	551

† Means within a column followed by the same letter are not significantly different P≤0.05.

Variety: DeltaPine DP 1908 B3XF

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