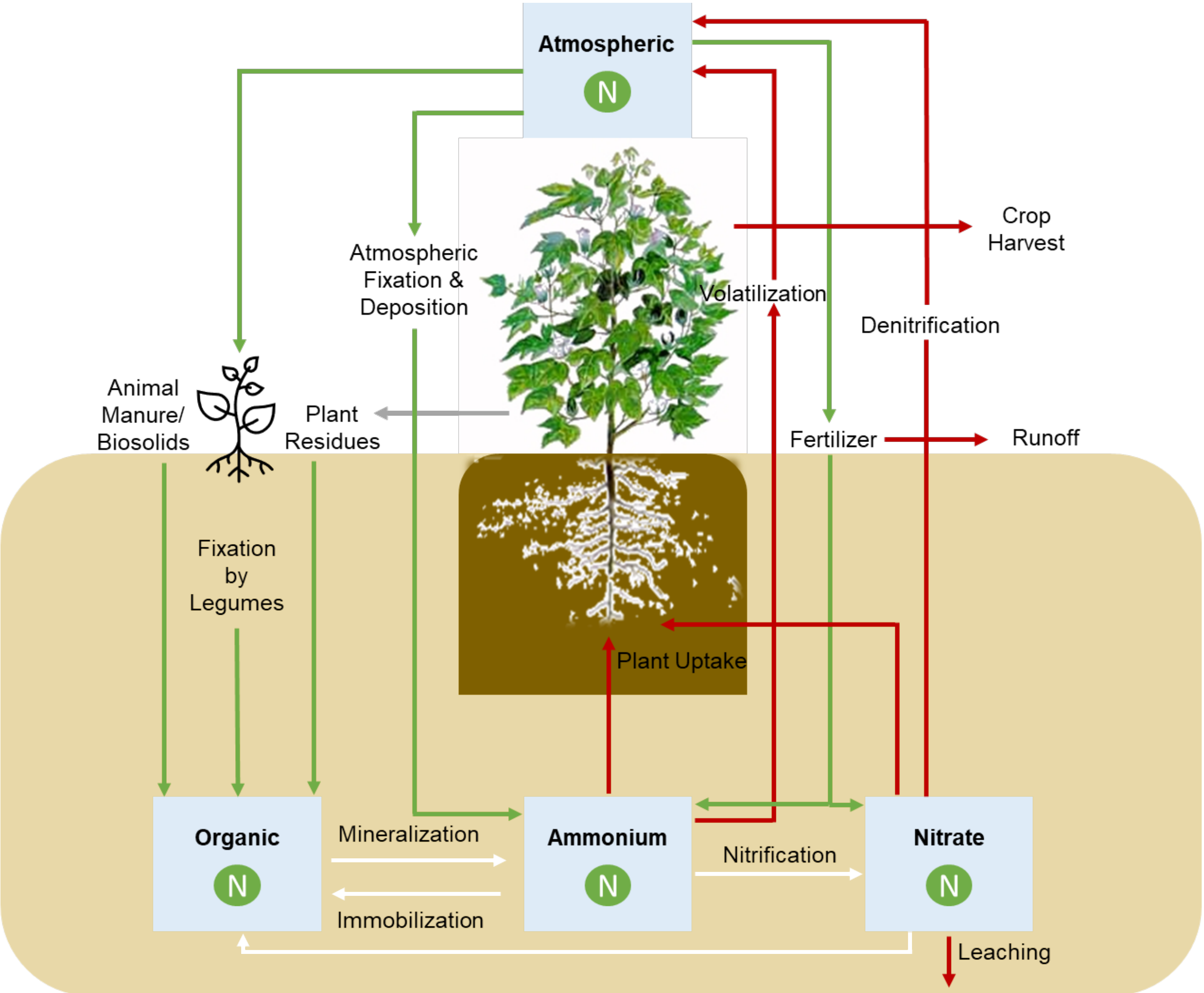
Prioritizing Nutrient Inputs to Maximize Use Efficiency

2nd Annual
Great Plains Cotton Conference

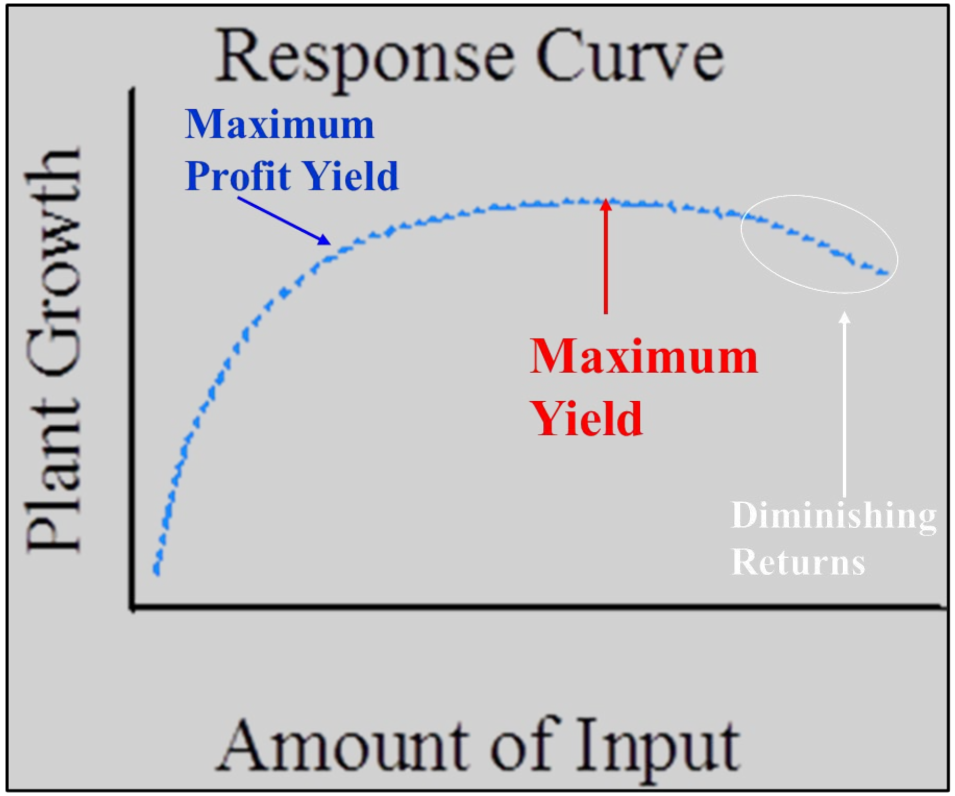
February 23, 2021

Efficient Nutrient Management

Environment



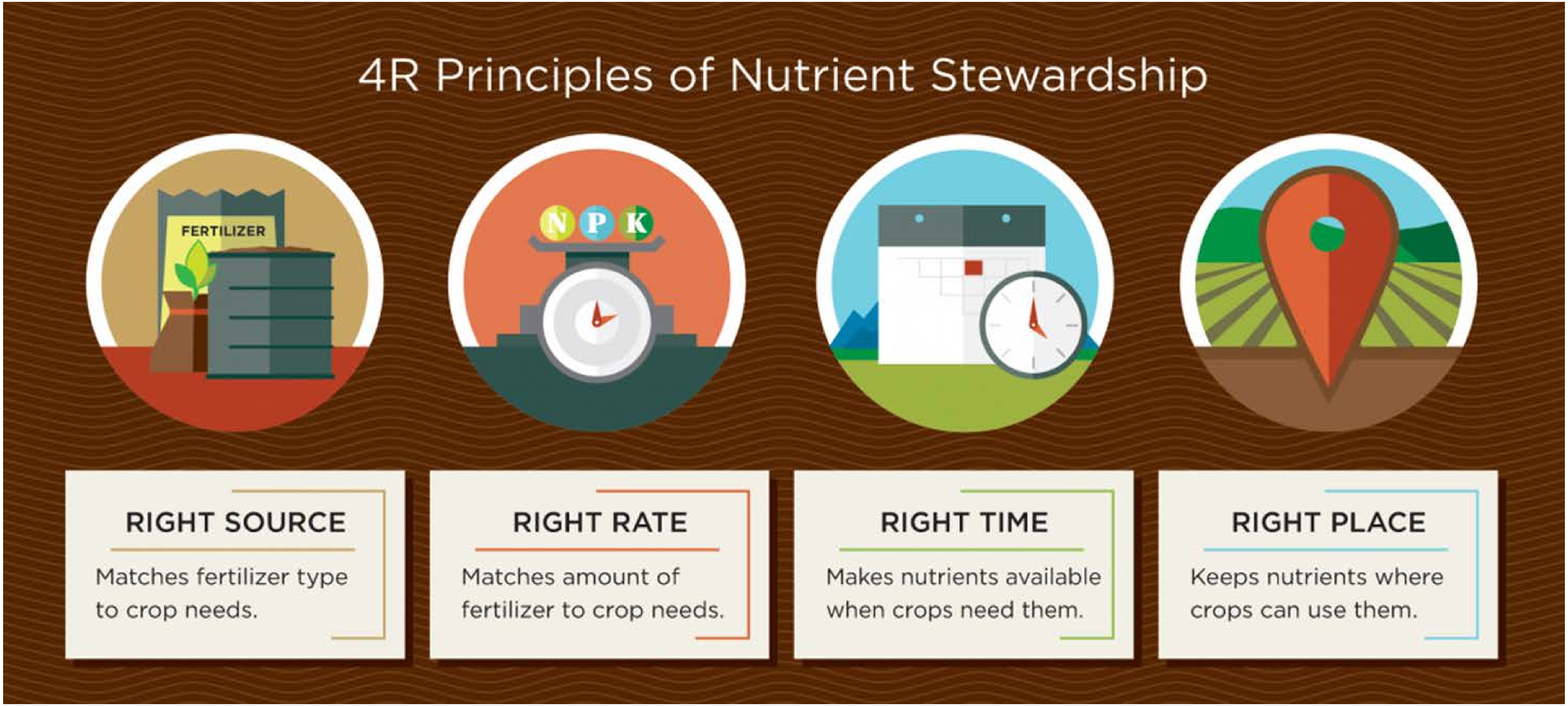
Economics



Urea: $453/ton
UAN32: $285/ton
UAN28: $243/ton
Anhydrous: $524/ton

10-34-0: $512/ton
MAP: $642/ton
DAP: $588/ton
60-0-0:$398/ton

Efficient Nutrient Management



Increased Cotton Productivity

Genetics × Environment × Management

1990 → 2020

Selective breeding for increased number of fibers per ovule, increased number of seeds per boll, increased number of bolls per plant, increased boll weight

Increased resistance to biotic/abiotic stresses

Optimized plant architecture (compact, foliage angle)

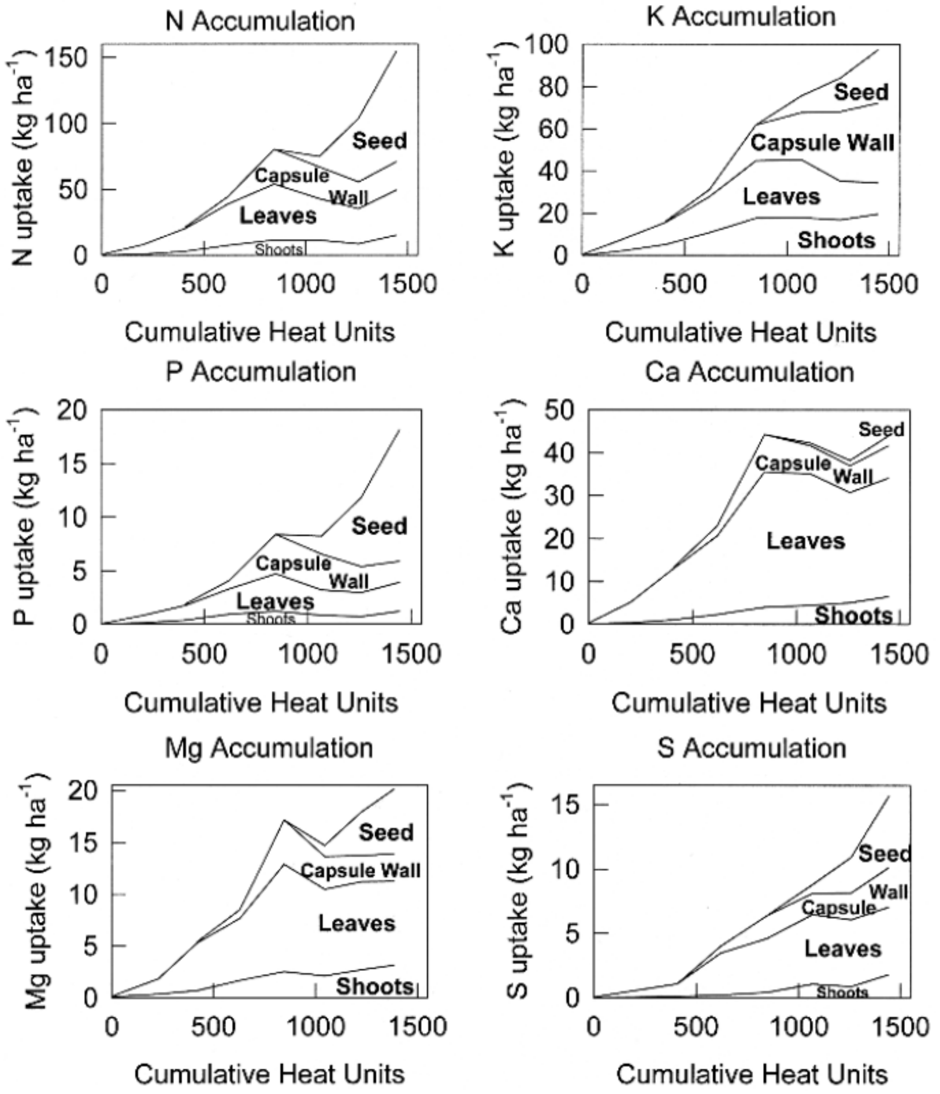
Adaptability to wide range of of environmental conditions

Adoption of new technology/management strategies

Change in the patterns of dry matter and nutrient allocation

Early Research on Cotton Nutrient Allocation

Year	Authors	Lint yield (lb/acre)
1919	*Fraps*	55-385
1926	*McHargue*	300
1942	*Olson and Bledsoe*	163-660
1970	*Bassett et al.*	1051-1452
1990 1992 1993	*Mullins and Burmester*	749
2020	*Pabuayon, Lewis, and Ritchie*	**865-1525**



Uptake and partitioning of macronutrients of older cotton cultivars **(Mullins and Burmester, 1990, 1992, 1993)**

Early Research on Cotton Nutrient Allocation

		Lint yield
1992 1993	*Mullins and Burmester*	749
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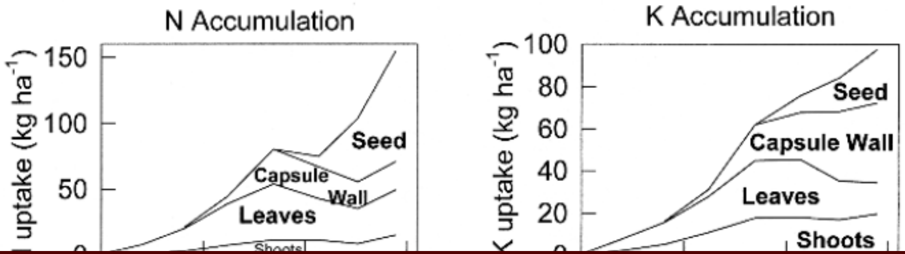
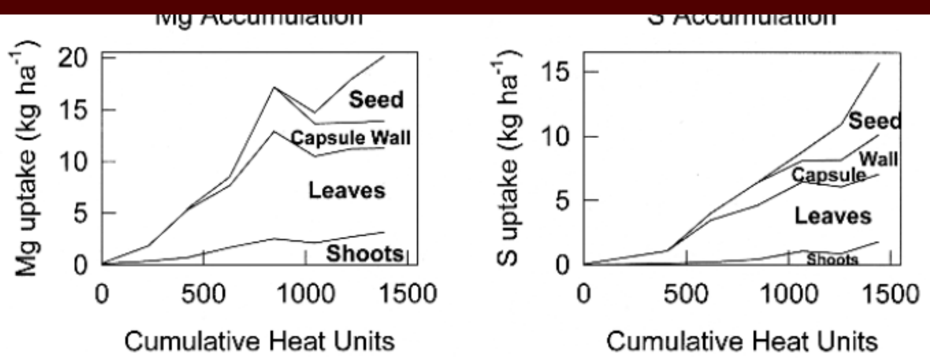
Dry matter and nutrient partitioning, uptake, and removal have significantly changed from previous reports (Mullins and Burmester, 1990) due in part to physiological changes which has increased yields of modern cotton cultivars.





Uptake and partitioning of macronutrients of older cotton cultivars **(Mullins and Burmester, 1990, 1992, 1993)**

Study Details

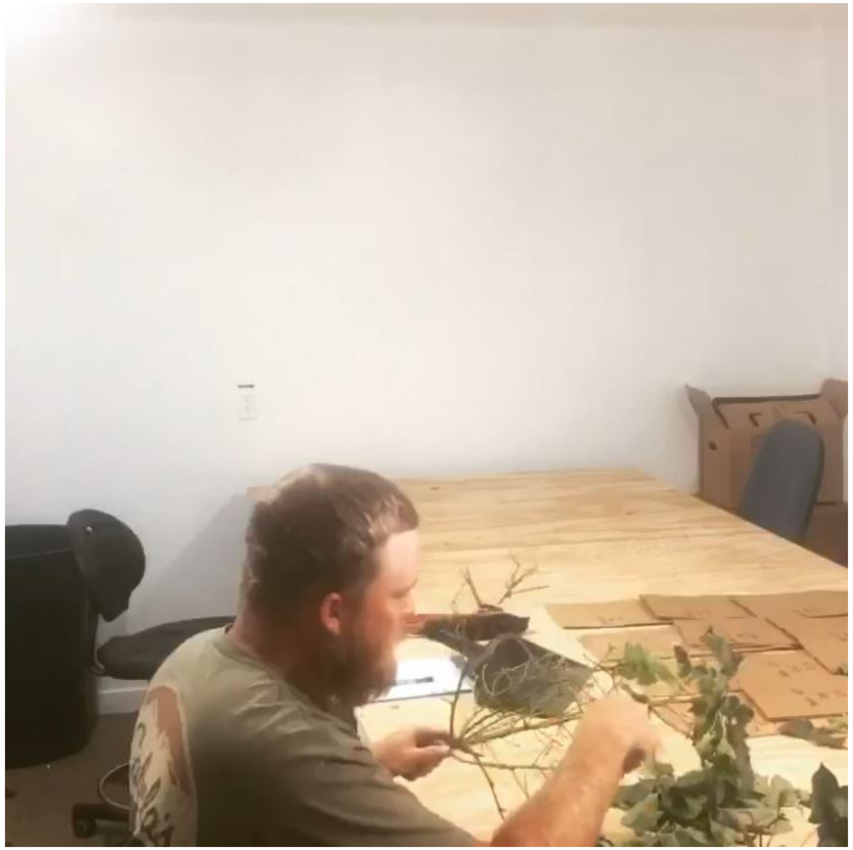
- 2018-2020 at New Deal, TX (Chillicothe, Brownfield, and San Angelo)
- Cultivars: *PM HS26, FM 958, and DP 1646 B2XF*
- Fertilizers:

  100 lb N/acre (40% pre-plant, 60% at 50 DAP)

  80 lb P_2O_5 /acre; **27 lb K_2O /acre** (pre-plant)
- Irrigation: 12 inches (subsurface drip irrigation)
- Measurements:

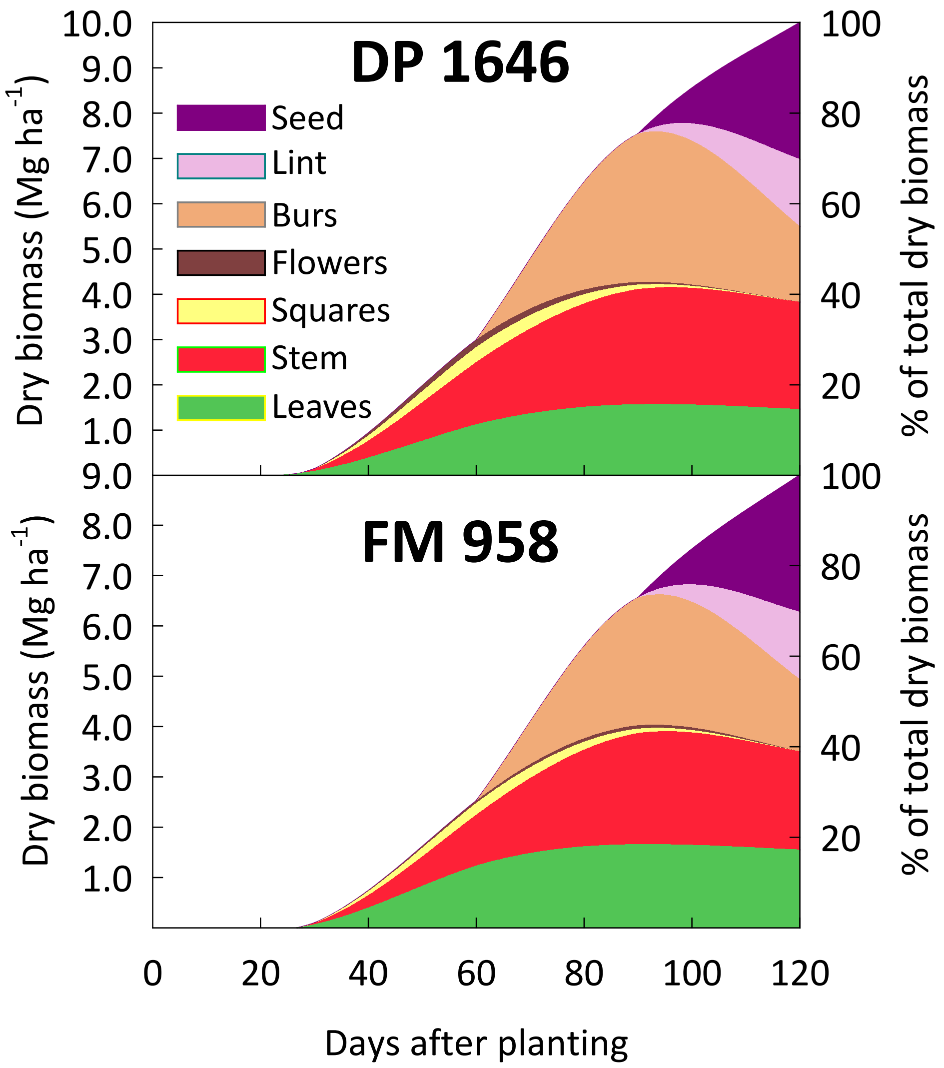
  Yield and biomass production

  Uptake and partitioning of macro and micronutrients to different plant organs



Key Findings

Bigger resource pool and greater efficiency in partitioning of dry matter towards fruit development



Key Findings

Efficient resource partitioning was reflected in greater lint yield of FM 958 and DP 1646 than older cultivars

Lint yield (lb/acre)				
Previous report		Current report		
1990		*2018*	*2019*	*2020*
749	*PM HS26*	**1300 b**	**676 b**	**791 b**
	FM 958	**1556 a**	**699 ab**	**975 a**
	DP 1646	**1525 a**	**865 a**	**956 ab**

Key Findings

Newer cultivars have better efficiency in using and remobilizing macronutrients to produce more lint yield

Nutrient	% increase (from the 1990s report to current report)	
	Total uptake	*Lint yield/unit of nutrient taken up*
N	**36%**	**66%**
P	**12%**	**88%**
K	**26%**	**64%**
S	**48%**	**30%**
Ca	**44%**	**44%**
Mg	**47%**	**40%**

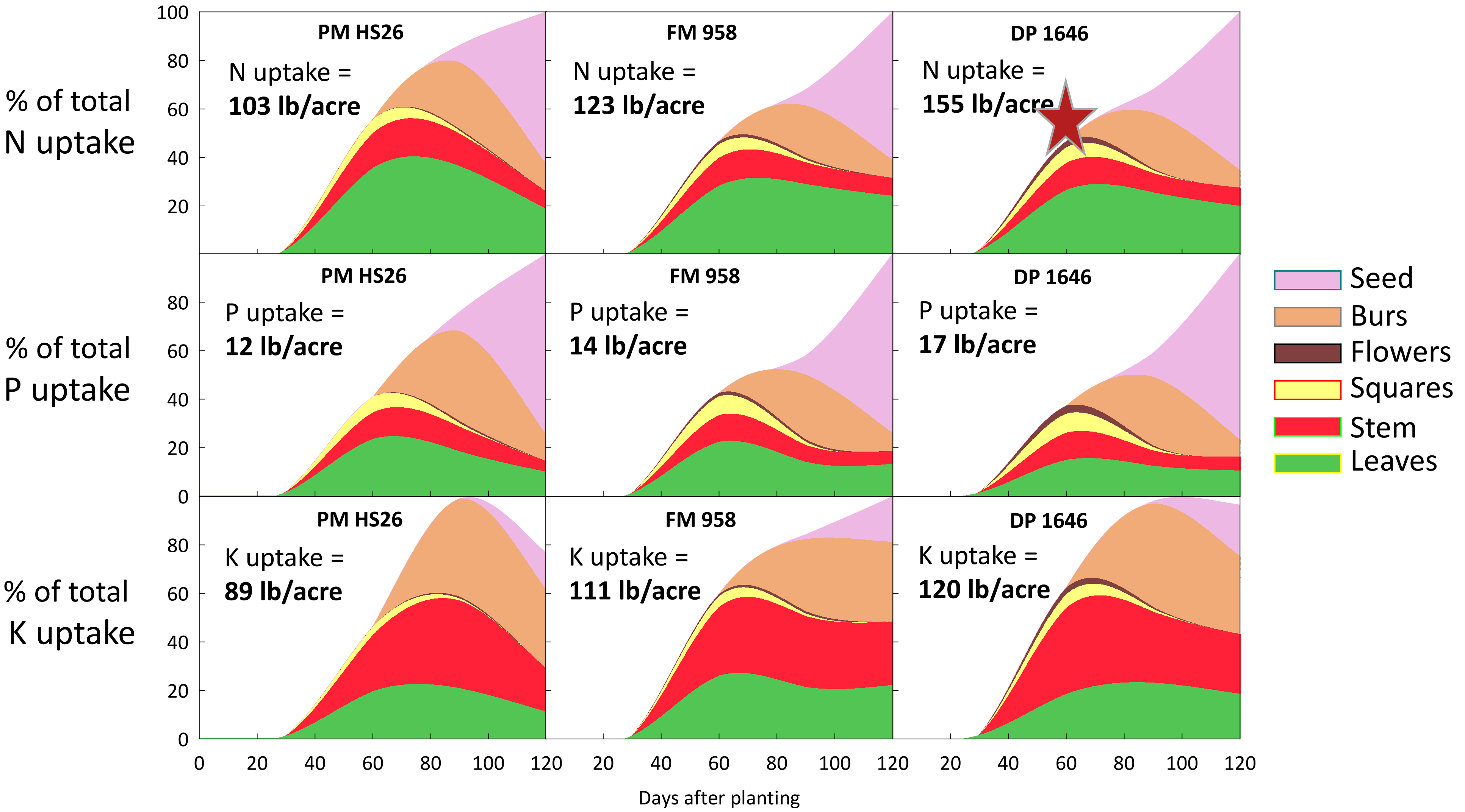
Note: current report based on the performance of DP 1646 under favorable growing environment

Key Findings

Fruit of modern cultivars are more nutrient-dense than previously reported

2018

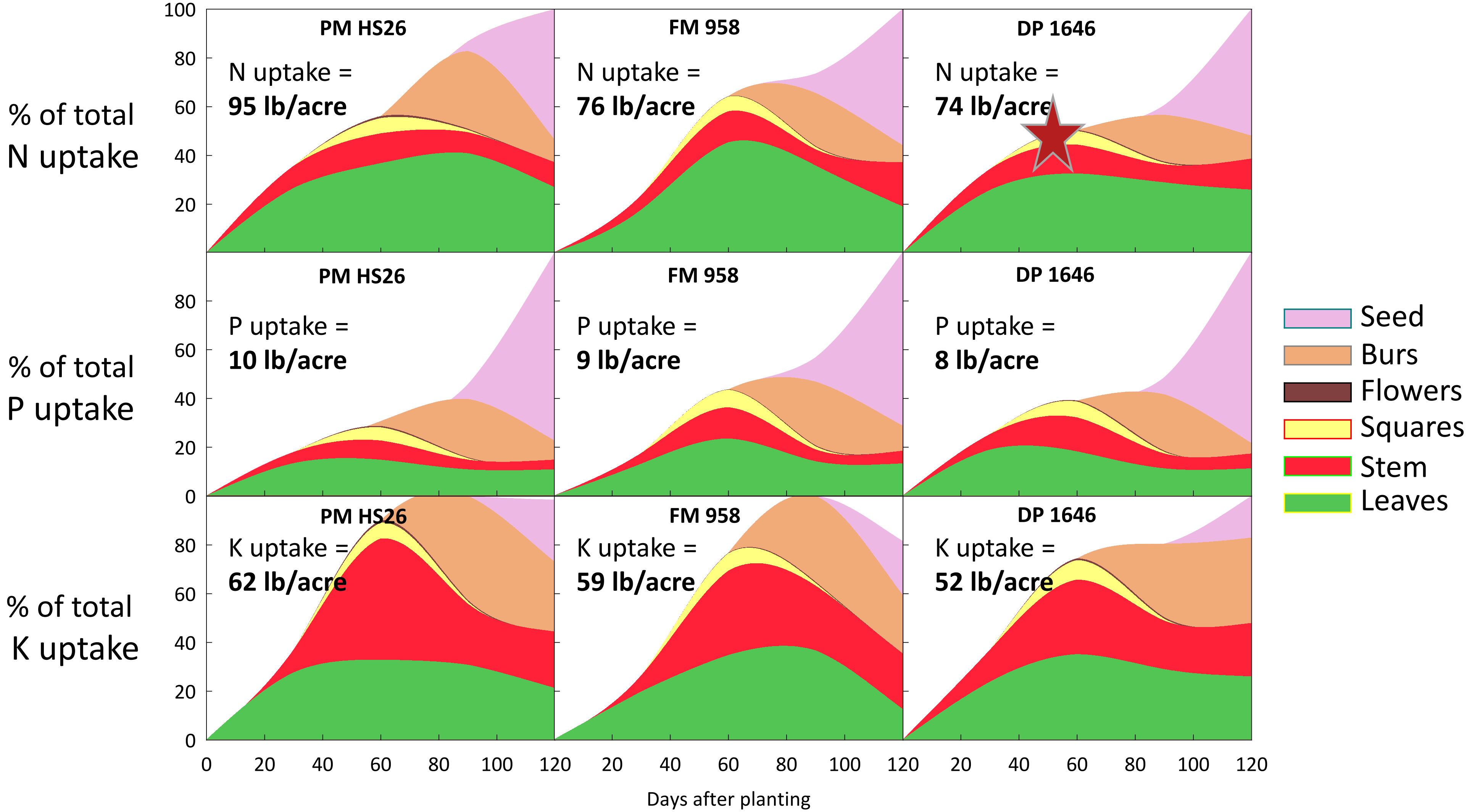
Primary Macronutrients



Key Findings

Fruit of modern cultivars are more nutrient-dense than previously reported

2019
Primary Macronutrients



Key Findings

Higher uptake of Zn and Cu and lower uptake of Fe and Mn in newer cultivars compared to older cultivars

Micronutrient	1993 (Mullins-Burmester report)			2018 (current report)			2019 (current report)		
	Uptake	Removal	Uptake Index	Uptake	Removal	Uptake Index	Uptake	Removal	Uptake Index
	—— lb/acre ——		lb per 480 lb lint	—— lb/acre ——		lb per 480 lb lint	—— lb/acre ——		lb per 480 lb lint
Zn	**0.092**	0.044	0.072	**0.119**	0.088	0.053	**0.105**	0.079	0.086
Cu	**0.025**	0.004	0.019	**0.042**	0.022	0.019	**0.025**	0.012	0.019
Fe	**0.559**	0.079	0.432	**0.252**	0.046	0.110	**0.161**	0.036	0.139
Mn	**0.346**	0.023	0.072	**0.140**	0.028	0.062	**0.110**	0.016	0.096
B	---	---	---	0.278	0.037	0.125	0.155	0.021	0.134
Na	---	---	---	2.205	1.221	0.970	1.004	0.181	0.888

Conclusions

1. Macronutrient uptake has increased along with yield
2. Improvement in nutrient uptake efficiency after 30 years of cotton production (40 lb N/acre/bale)
3. Greater removal rates (seed) of modern cultivars
4. Updated information can be used for optimizing nutrient application – more site years coming.
5. Nutrient recommendation adjustments to the shift in cultivar growth characteristics with future rate and timing studies

Published article:

Pabuayon, I. L. B., Lewis, K. L., & Ritchie, G. L. (2020). Dry matter and nutrient partitioning changes for the past 30 years of cotton production. *Agronomy Journal*. 112 (5): 4373-4385

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