Dry Bean Research in Northwest Kansas

Lucas Haag, Ph.D., Northwest Area Agronomist
Jeanne Falk Jones, Multi-County Agronomist, Sunflower District

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Dry Beans

- Introduction of upright/bush type varieties the biggest game changer (direct harvest)
- Traditionally an irrigated crop, but some success into dryland wheat stubble
- Provides a broadleaf crop for rotation
- Established markets available

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Rationale

- Most management recommendations are based on vine-type varieties and production system
- Little research data from the Tri-State Region exists

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Objectives

- Evaluate Variety x Row Spacing x Seeding Rate dynamics for yield, harvestability, weed control, and disease susceptibility
- Investigate new fertility practices possible through narrow row seeding (in-furrow placement)
- Initiate a variety testing program

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Dry Bean Research – 2019 Pintos
Sherman County - Irrigated

- 4 Varieties
  - Cowboy, Lariat, Torreon, Windbreaker
- 3 Seeding Rates
  - 60k, 100k, and 130k
- 2 Row Spacings
  - 10” and 30”
- 24 total treatments x 5 reps = 120 plots

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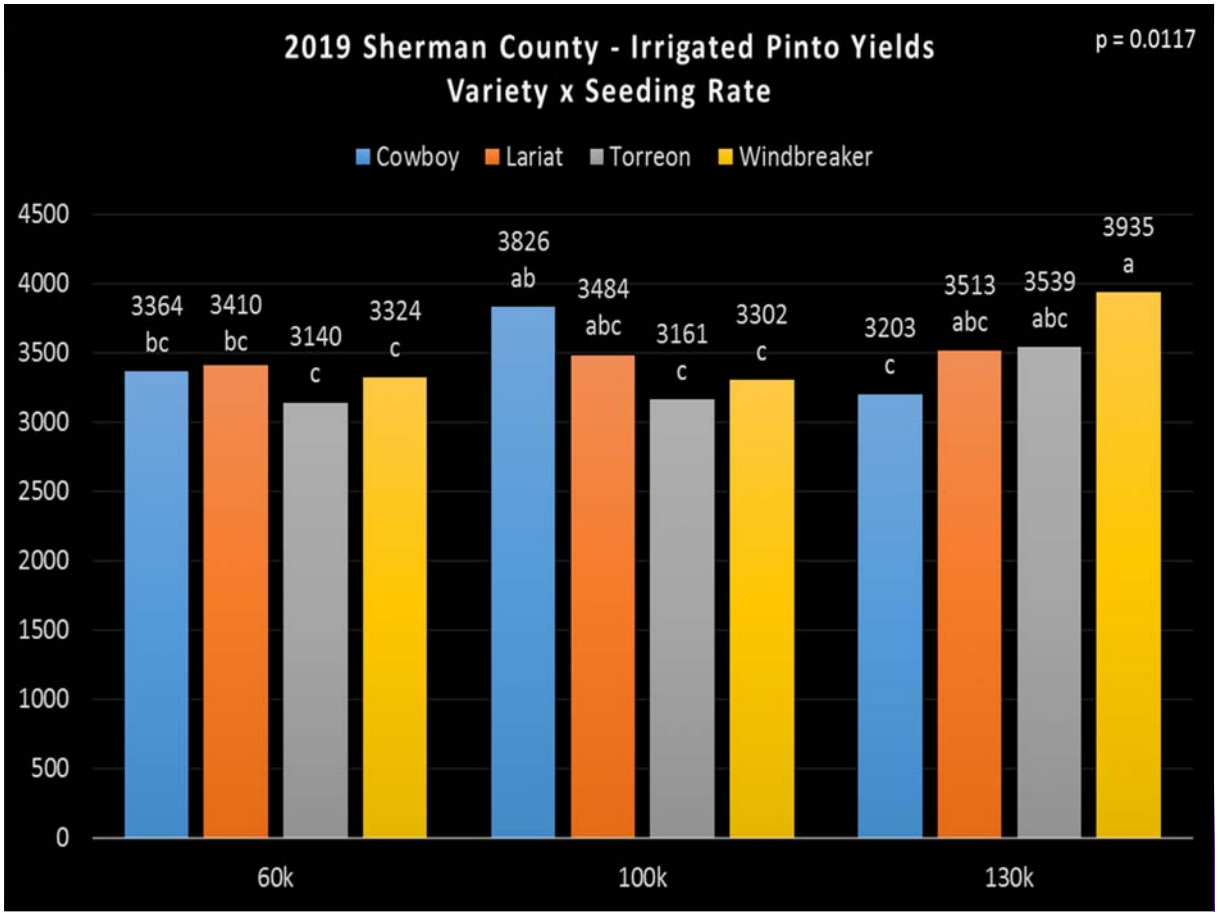

Moving Forward into 2020

- We have secured a USDA SCBDG to partially fund this project through the 2021 season
- Variety x Row Spacing x Seeding Rate trial will continue
- Plan to have a variety performance test
- Fertility trials will continue
- Regular monitoring with sUAV's to monitor canopy closure
- Summer field day event

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Dry Bean Fertility Management

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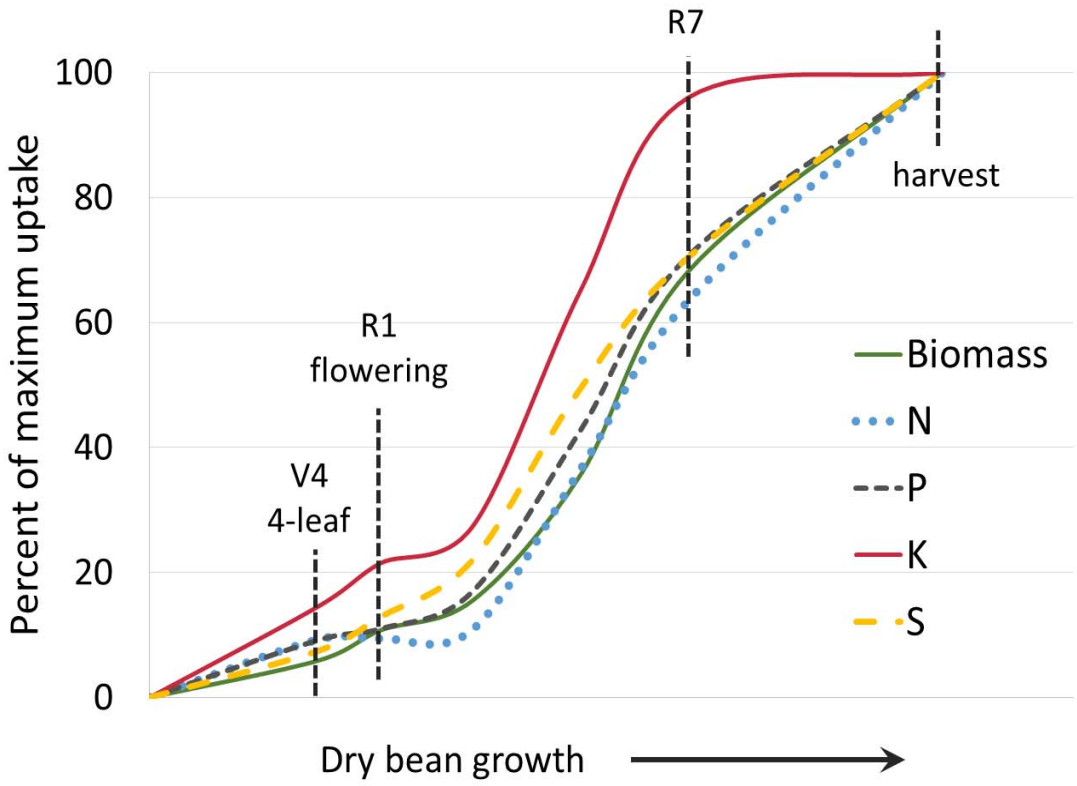

Source: Heard, J., and B. Brolley. 2008. *Nutrient uptake and partitioning by dry beans in Manitoba*. In Proc. of 2008 Manitoba Agronomist Conf.

Dry Bean Nutrient Removal

lb of Nutrient / cwt	
N	5.00
P2O5	1.32
K2O	1.53
Ca	0.30
Mg	0.10
S	0.87
Fe	0.05
Zn	0.01
Mn	0.00
Cu	0.00
B	0.01

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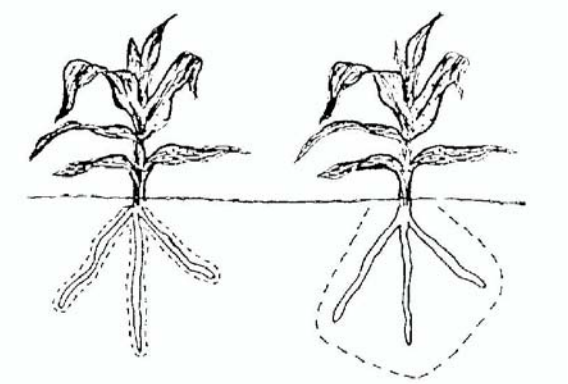
Meeting the bean's needs

Soil sample

- 0-6" Immobile nutrients
- 0-24" Mobile nutrients



Nutrient mobility effect on root uptake zones

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Soil Nutrients

Primary Nutrients	Secondary Nutrients
Nitrogen (N)	Calcium (C)
Phosphorus (P)	Magnesium (Mg)
Potassium (K)	Sulfur (S)

Micronutrients

Boron (B)	Chlorine (Cl)
Manganese (Mn)	Iron (Fe)
Copper (Cu)	Molybedenum (Mo)
Zinc (Zn)	Nickel (Ni)

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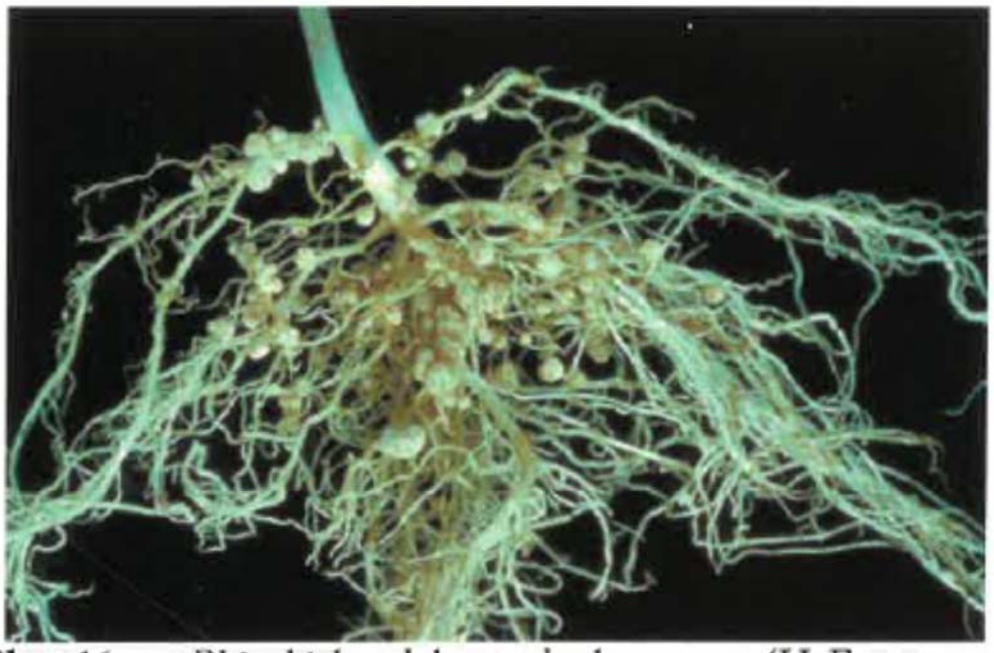

Plate 16. Rhizobial nodules on dry bean roots (H. F. Schwartz)

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Nitrogen

- Dry beans are a legume capable of forming a symbiotic relationship with N-fixing bacteria
- Research in the Central High Plains has not shown that inoculation improves yield in fields where dry beans have been grown
- However, inoculation is recommended for fields that have never grown dry beans

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Nitrogen

lb/ac profile N	Nitrogen Recommendation, lb/ac
0-20	75
21-40	60
41-60	45
61-80	30
81-100	15
>100	0

Based on 2500 lb/ac yield goal
Adjust +/- 3 lb of N per 100 lb of yield goal
e.g. add 15 lb/ac N for a 3000 lb yield goal
e.g. subtract 30 lb/ac N for a 1500 lb yield goal

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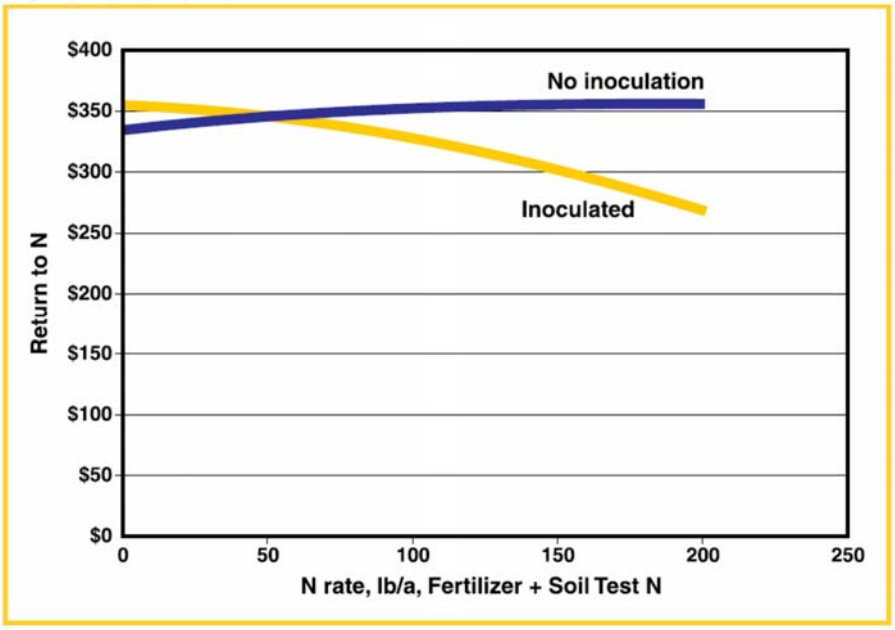
Inoculation vs. Applied N



D.W. Franzen, NDSU. Average of 30 site-years

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Phosphorus

Phosphorus soil test method and critical levels

Lbs P_2O_5/ac

Olsen-P	Bray P-1	Mehlich 3	Banded	Broadcast
0-3	0-5	0-6	30	60
4-6	6-10	7-12	20	40
7-9	11-15	13-18	10	20
>10	>16	>19	0	0

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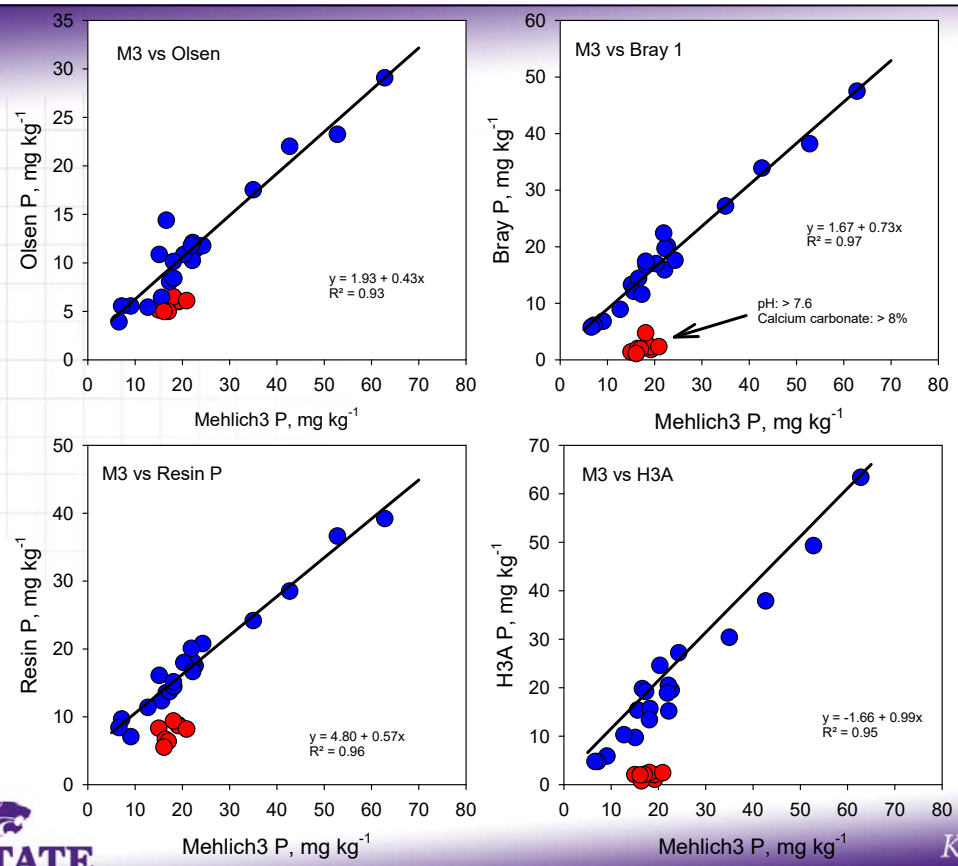

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Zinc

DTPA Soil Test	pH less than 7.5		pH more than 7.5	
ppm	Lbs Banded	Lbs Broadcast	Lbs Banded	Lbs Broadcast
0-0.50	3	6	5	10
0.51-1.0	2	4	4	8
1.01-1.5	1	2	2	4
>1.5	0	0	0	0

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Fe

- Typically small seeded types such as black and navy are more sensitive than medium sized types like pinto, great northern, small red, or pink.
- Work with soybeans in Northwest Kansas has shown Ortho-Ortho EDDHA chelated Fe to be very effective when applied in-furrow or as a seed treatment

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What About Starter

- Beans are very sensitive to salts
- The total lbs of N and KO applied as an in-furrow starter should not exceed 20 lbs/ac
- Quite possible to see responses to starter P, especially in soils with low STP
- Zinc and/or Iron, likely most effective when applied as a starter

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Dry Bean Water Use

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Seasonal Water Use of Crops

Total ET = Precipitation + Irrigation + Soil Water Depletion

Alfalfa	31-33 in
Corn	23-26 in
Dry Bean	15-16 in
Soybean	18-22 in
Sunflower	18-26 in
Winter Wheat	16-18 in

Yonts. U of Neb. 2006

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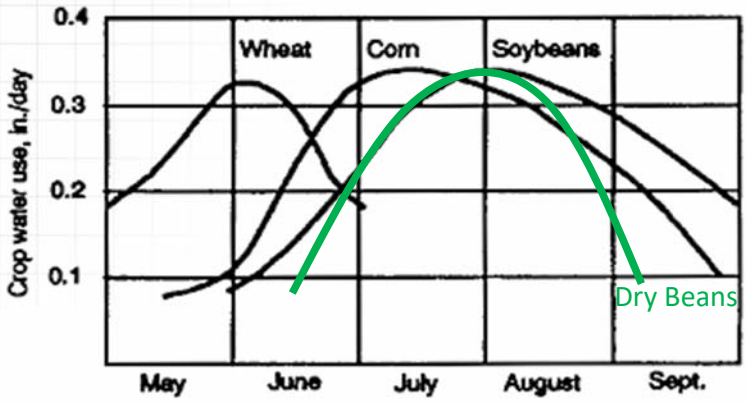
Water Use Timing



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Effect of VPD on Water Use Efficiency

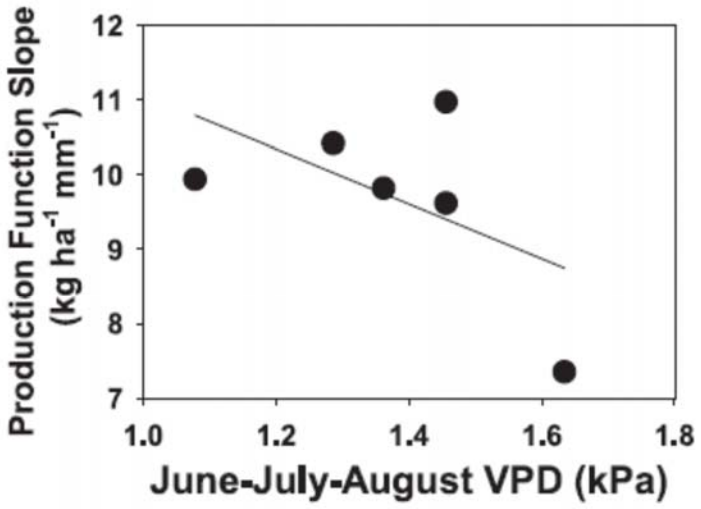

Fig. 2. Relationship between dry bean production function slope and average June, July, and August vapor pressure deficit at Akron, CO.

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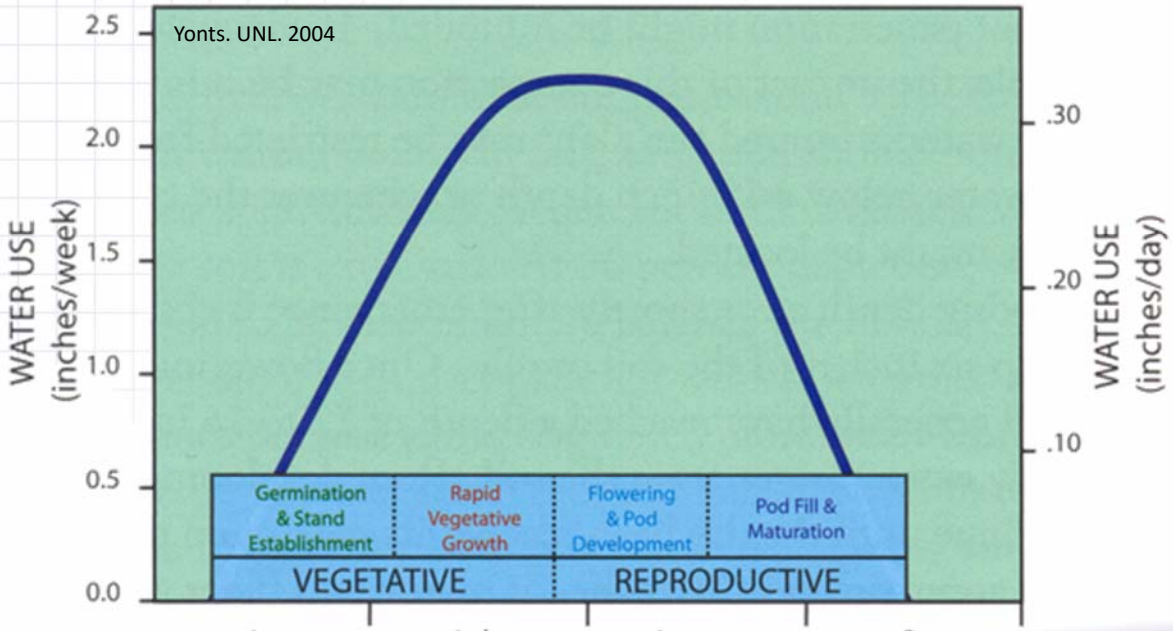
Water Use for Dry Beans



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Timing of Stress

Early Season

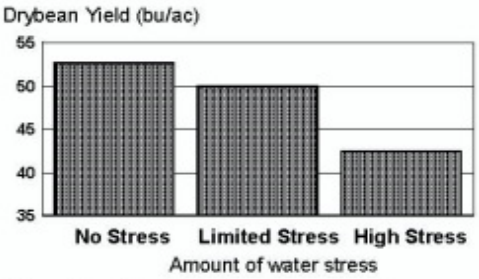

Figure 1a. Effect of early season water stress on dry bean yield using sprinkler irrigation.

Limited stress: initial irrigation delayed by 1 week
High stress: initial irrigation delayed by 2 weeks

Late Season

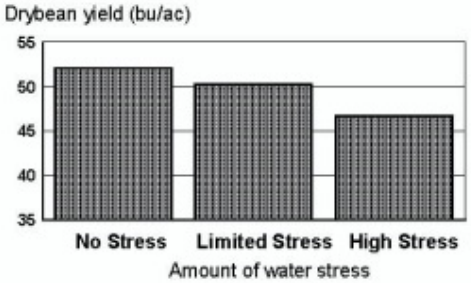

Figure 2a. Effect of late season water stress on dry bean yield using sprinkler irrigation.

Limited stress: After Aug 10, beans received every other irrigation that was scheduled
High stress: After Aug 10, water was no longer applied after

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CMX Tools 2008

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Rooting Structure

Majority of roots are in top 18”

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Predicting the Last Irrigation

	Stage of Growth	Description	Approximate Days to Maturity	Water Use to Maturity (inches)
R5	Early seed fill	One pod with fully developed seeds	35	7.0
R6	Mid-seed fill	50% of pods with fully developed seeds	25	4.2
R7	Beginning maturity	One pod has changed to mature color	15	2.0
R8	Harvest maturity	80% of pods have changed to mature color	0	0

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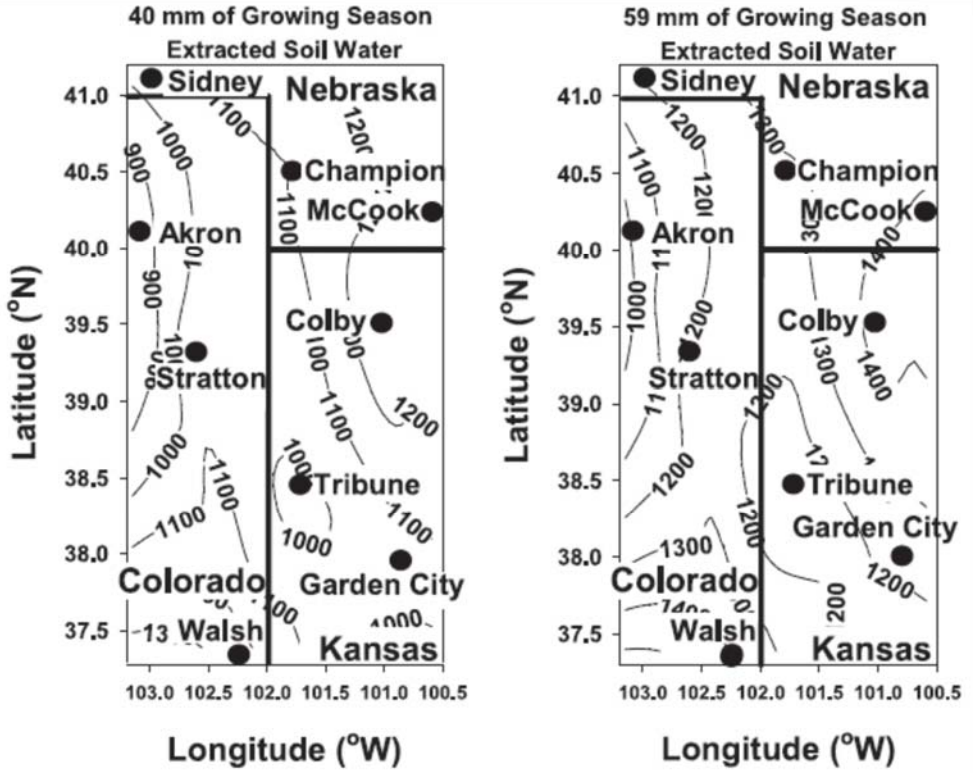
Precision Irrigation. UNL. Yonts et al



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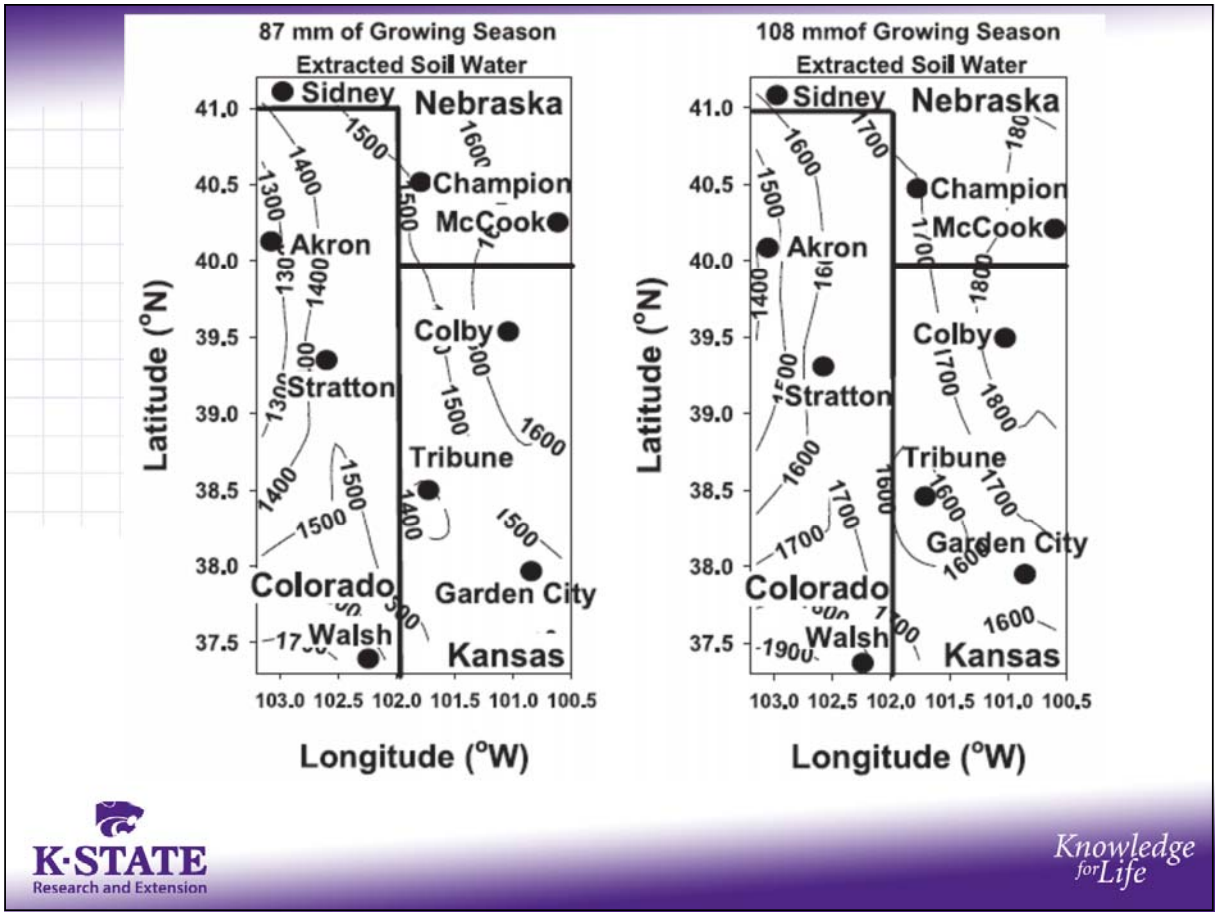

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Questions / Discussion