Manganese for Soybeans in Kansas

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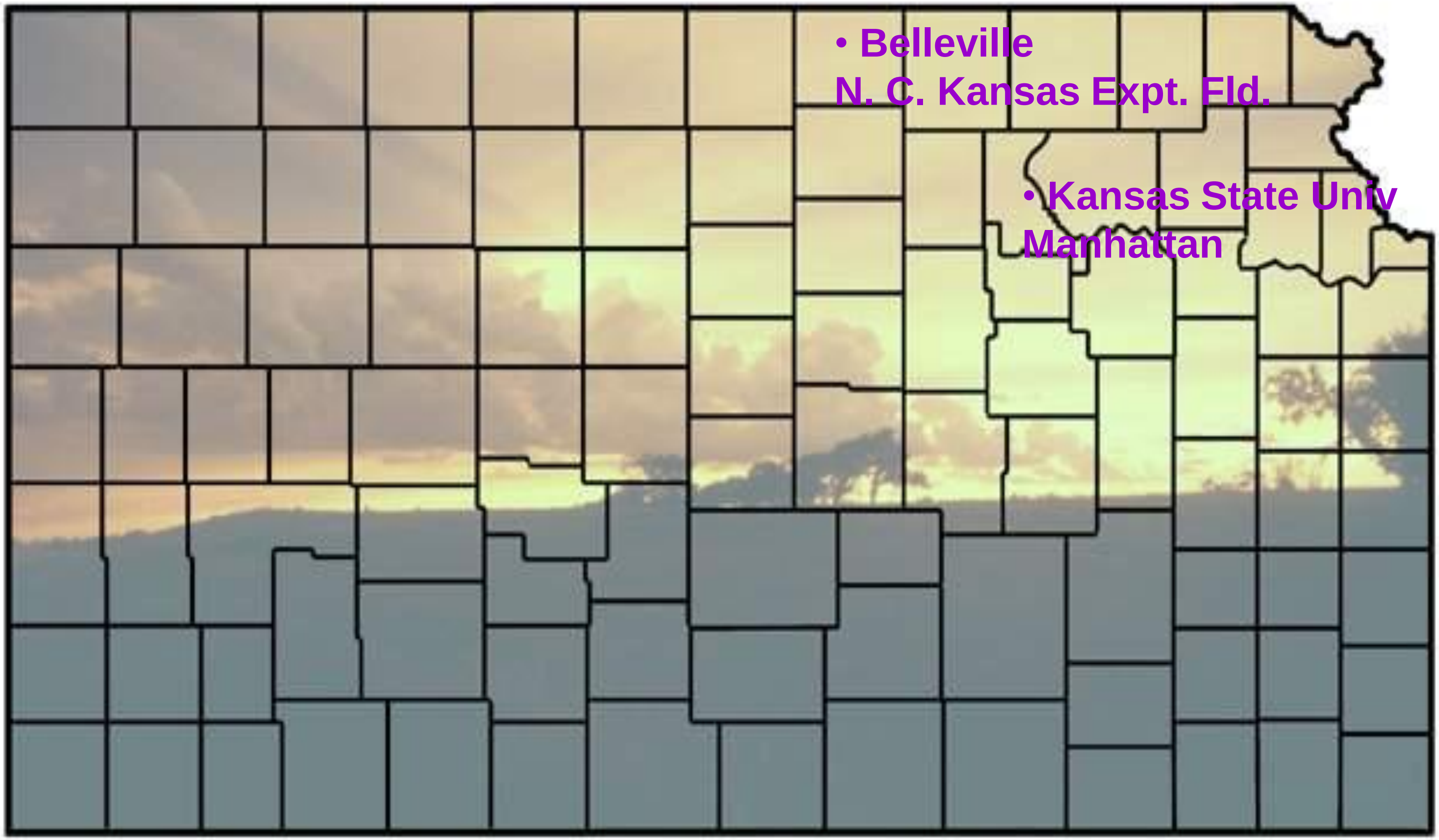

• Belleville
N. C. Kansas Expt. Fld.
• Kansas State Univ
Manhattan

PURDUE UNIVERSITY HAD BEEN WORKING ON THIS PROBLEM FOR YEARS

Dr. Don Huber

Conclusions:

Glyphosate resistant beans have a problem with Mn uptake

May be related to changes in rhizosphere

Mn crucial in N utilization by plant

Function of Manganese

- Important in photosynthesis (splitting of water molecule and evolution of oxygen).
- Activates enzymes leading to the biosynthesis of lignin and flavonoids. Flavonoids in legumes stimulate nodulation gene expression.
- Responsible for degradation of fixed N transported from roots to shoots.

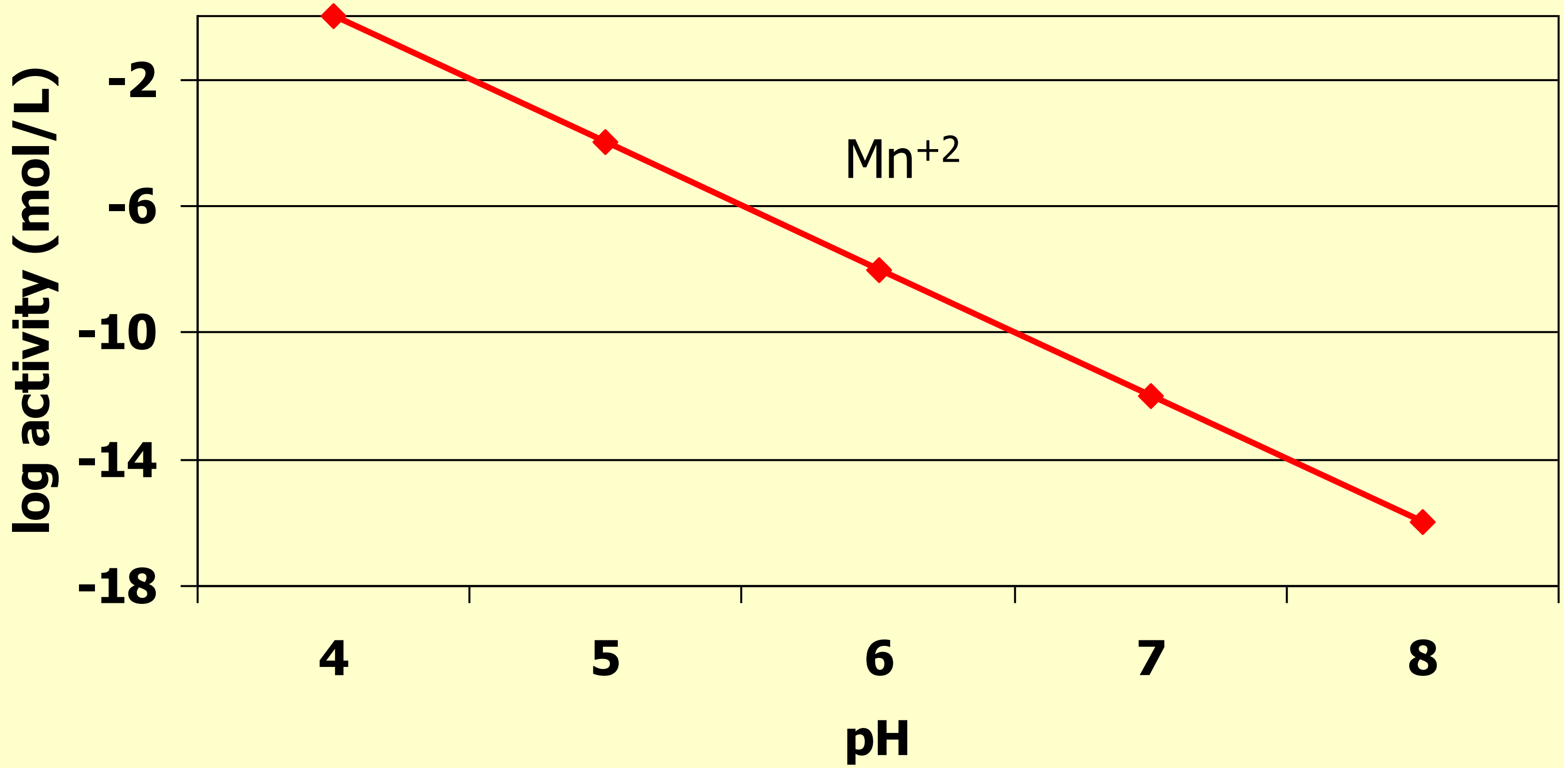
Glyphosate

- Glyphosate inhibits the shikimate pathway, responsible for the biosynthesis of phenolics, flavonoids and lignin.
- Mn reducing soil microorganisms also posses the shikimate pathway.
- Glyphosate is an organic compound and can persist in the rhizosphere and can interfere with with MN-reducing microorganisms.

Mn nutrition problems with herbicide resistant soybeans

- Insertion of gene giving herbicide resistance changed soybean root exudates. Plants solublize less Mn than conventional soybeans.
- Glyphosate application may interfere with Mn metabolism within the plant.

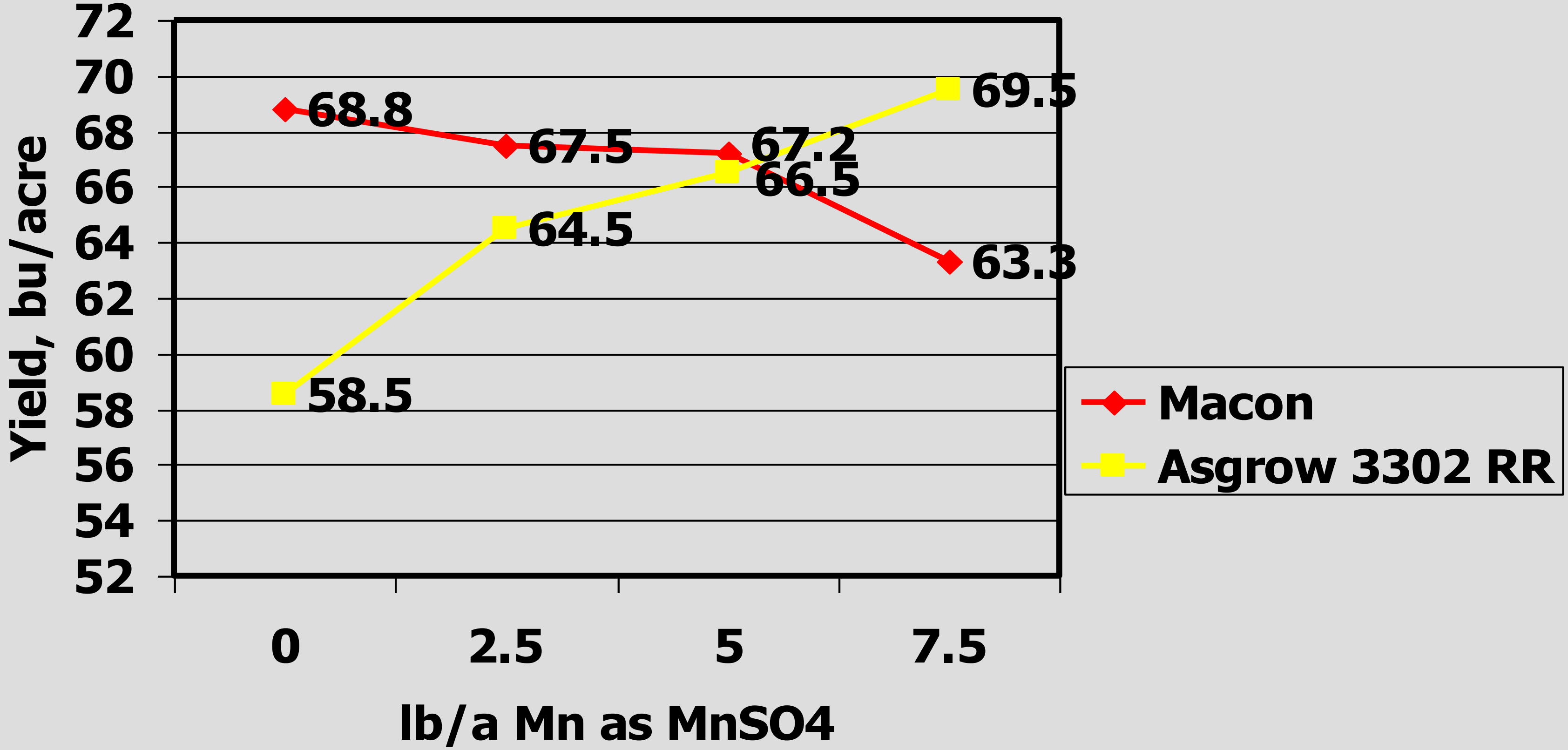
Availability of Mn^{+2} in Soil Solution



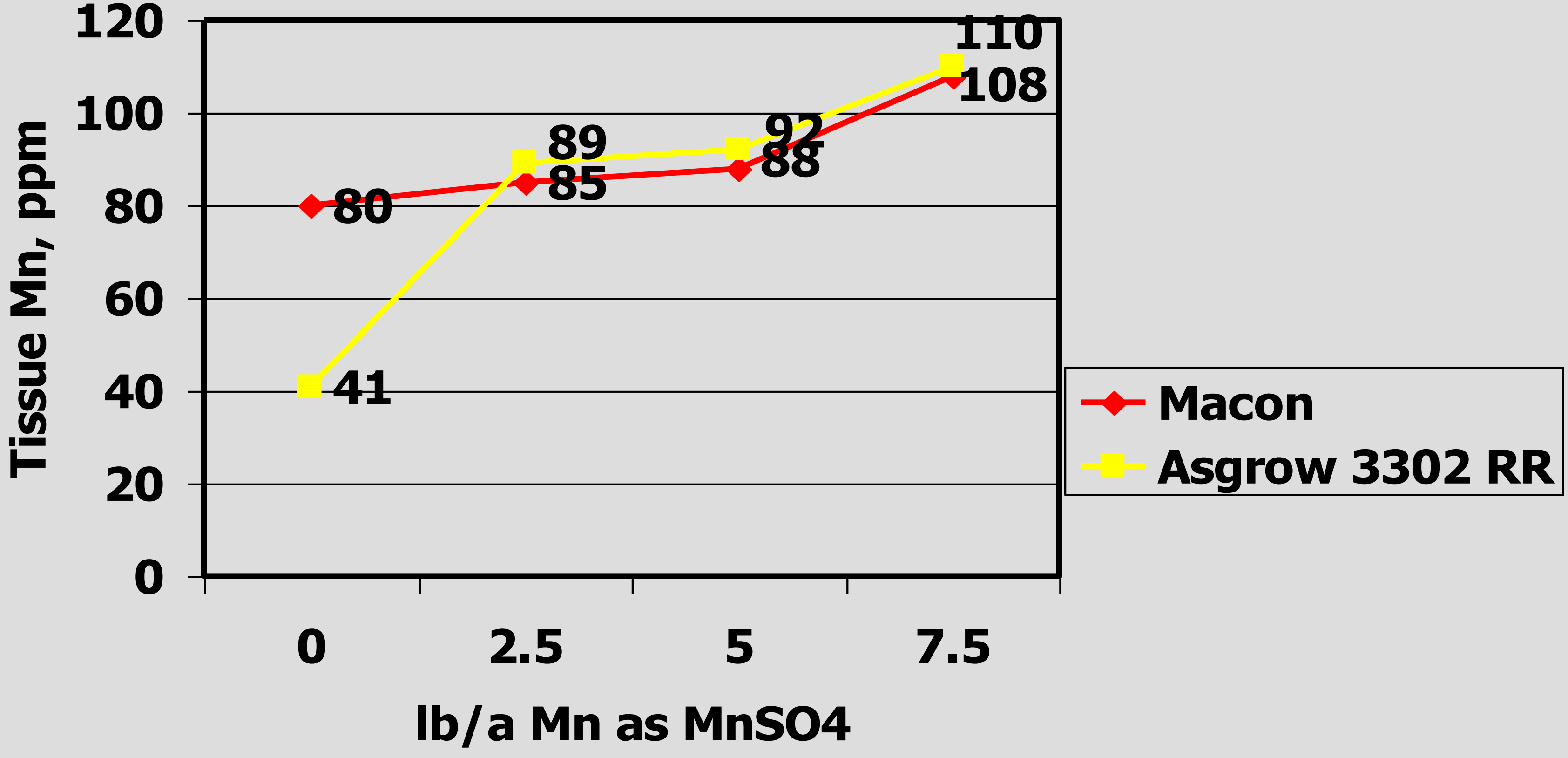
Manganese Deficiency

Manganese Deficiency

Manganese Application Effects on Soybean Yield Kansas--2004

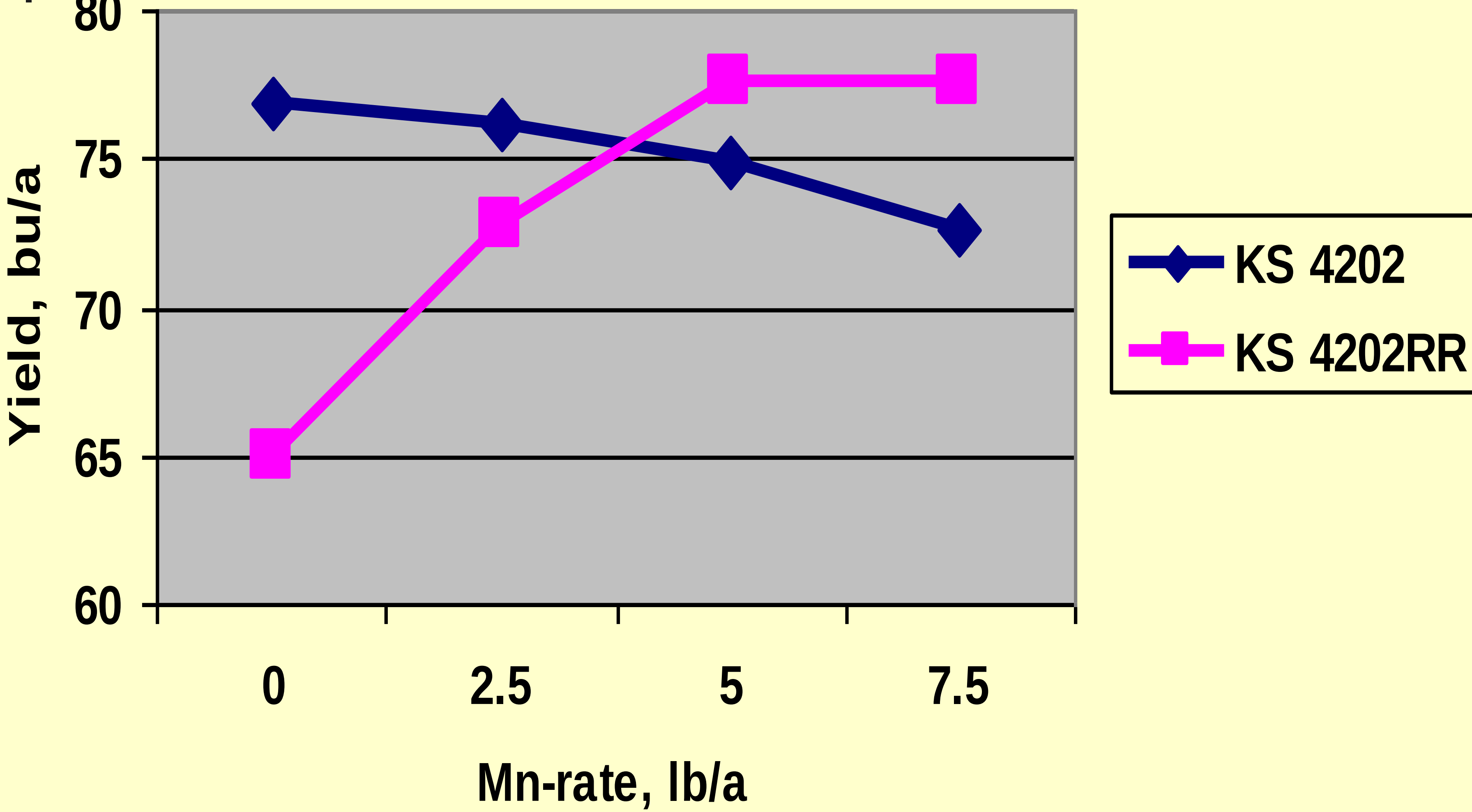


Manganese Application Effects on Leaf Tissue Mn Concentration at Full Bloom Kansas-2004

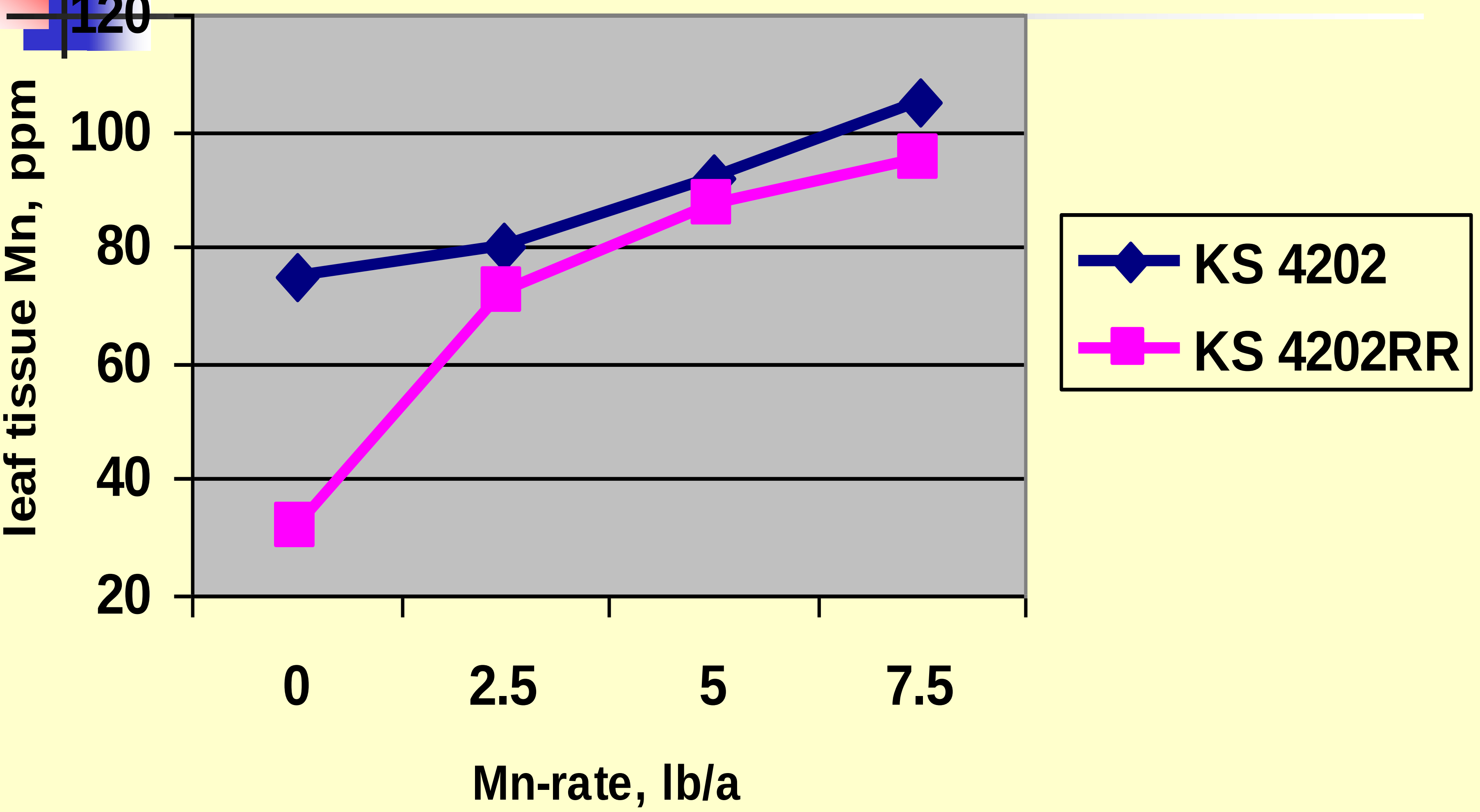


Early Season Mn Response

Mn Response in Glyphosate Resistant Soybeans---Kansas 2005



Mn Concentrations in Glyphosate Resistant Soybeans---Kansas 2005



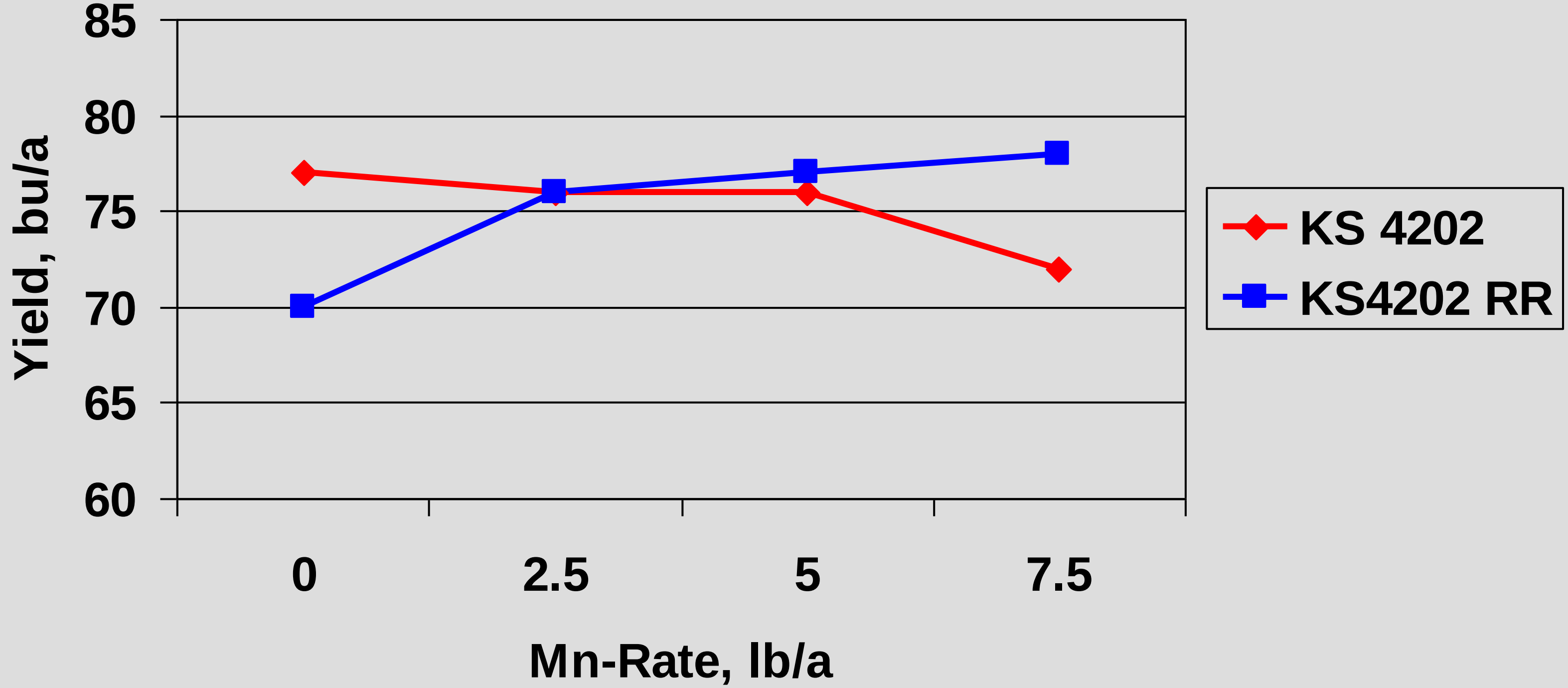
FOLIAR Mn FOR GLYLPHOSATE RESISTANT BEANS

Stage of Growth	Yield bu/A
Control	62
V-4	68
V-4 + V-8	72
V-4 + V-8 + R-2	80
$LSD_{.05}$	3

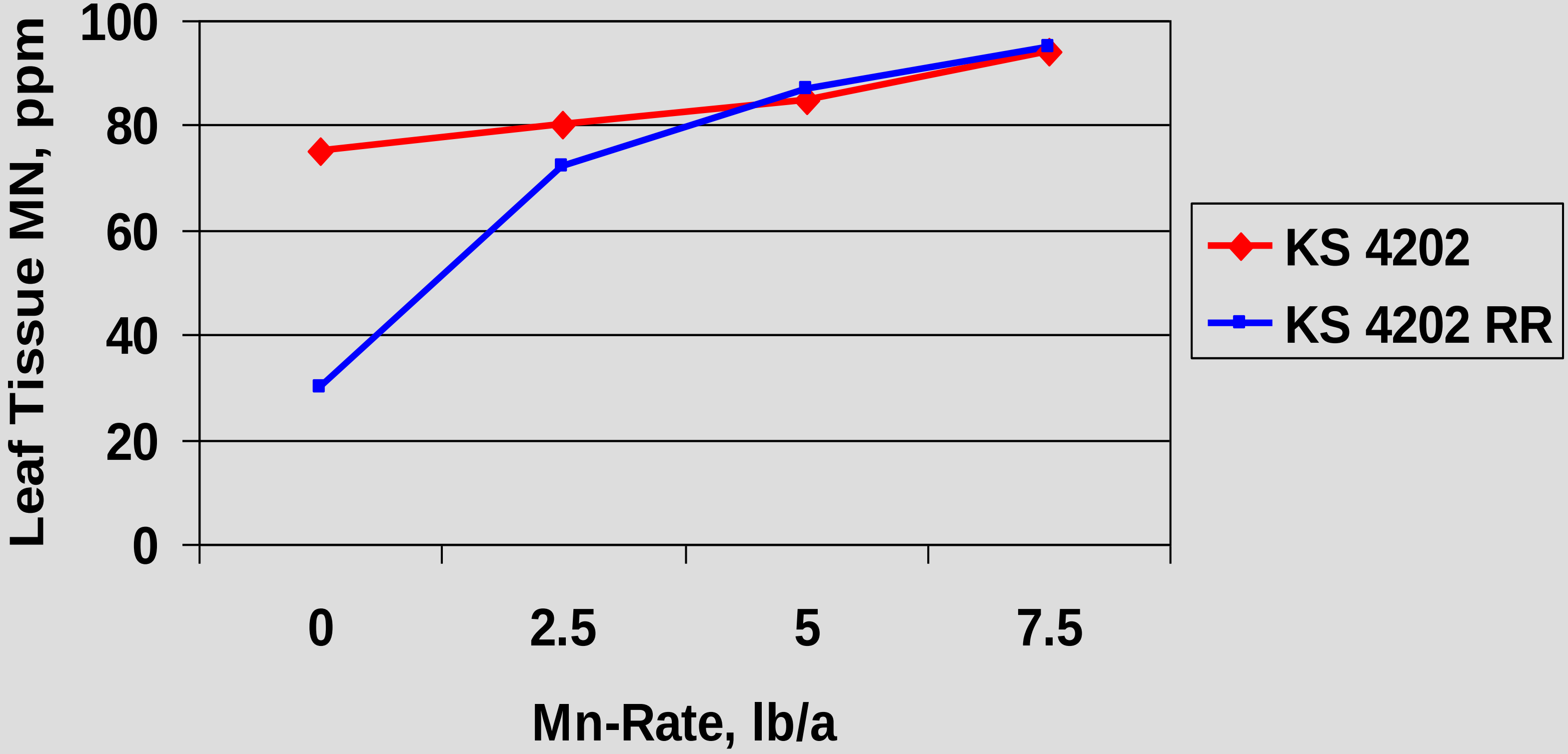
0.3 lb Mn/appln

Gordon, KSU

Mn Application Effects on Soybean Yield, 2005-2006.



Mn Application Effects on Leaf Tissue Mn Concentration, 2005-2006



Liquid Applied Manganese Effects on Soybean Yield, 2006

Stage of Growth	Yield, bu/acre
Untreated check	**66**
Starter (.3 lb)	**66**
Starter (.6 lb)	**70**
Starter (.3 lb) + V4	**74**
V4	**66**
V4+V8	**72**
V4+V8+R2	**74**
LSD (0.05)	3

Research continuing with support from the Kansas Soybean Commission and the Fluid Fertilizer Foundation

Maximizing Corn Yields in the Central Great Plains

Barney Gordon

K-STATE Research and Extension
Kansas State University

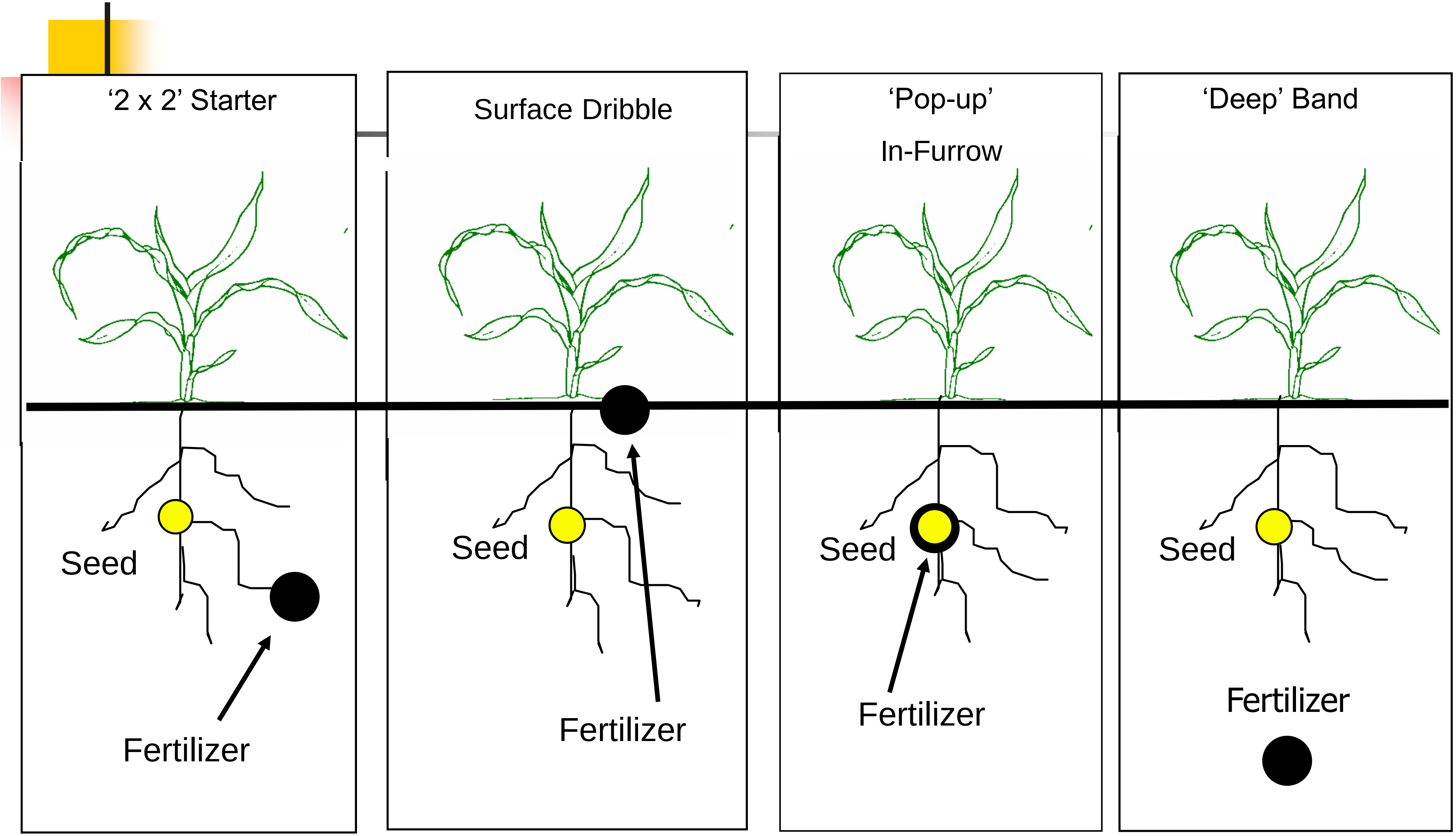
Application Method and Composition Of Starter Fertilizer for Irrigated Corn

Treatments

- ***Application methods:***

1) In-Furrow
2) 2 X 2
3) Dribble on soil surface 2” to the side
4) 8” band centered on row

Band Applications



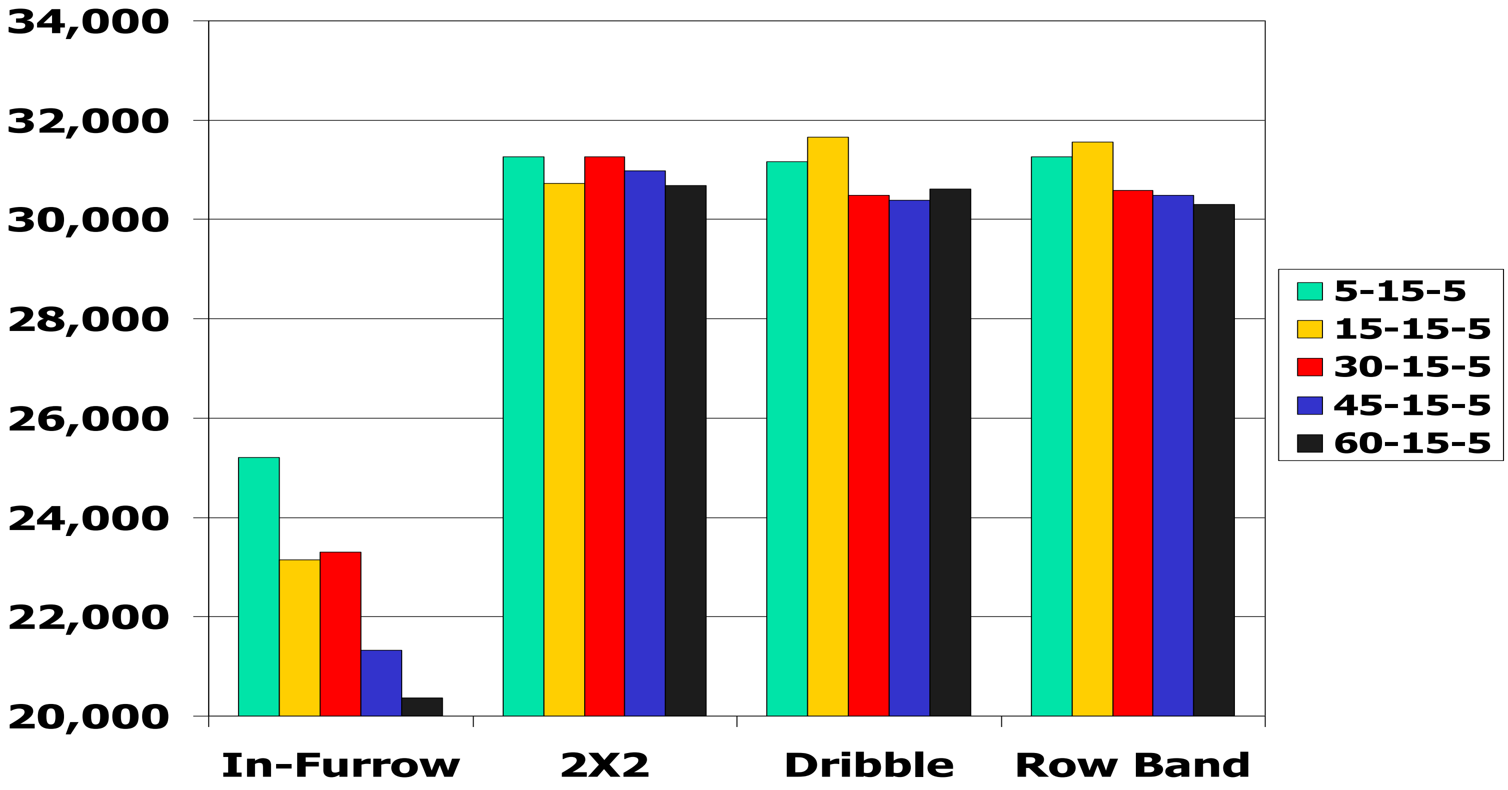
Treatments

- ***Liquid Starter Fertilizer***

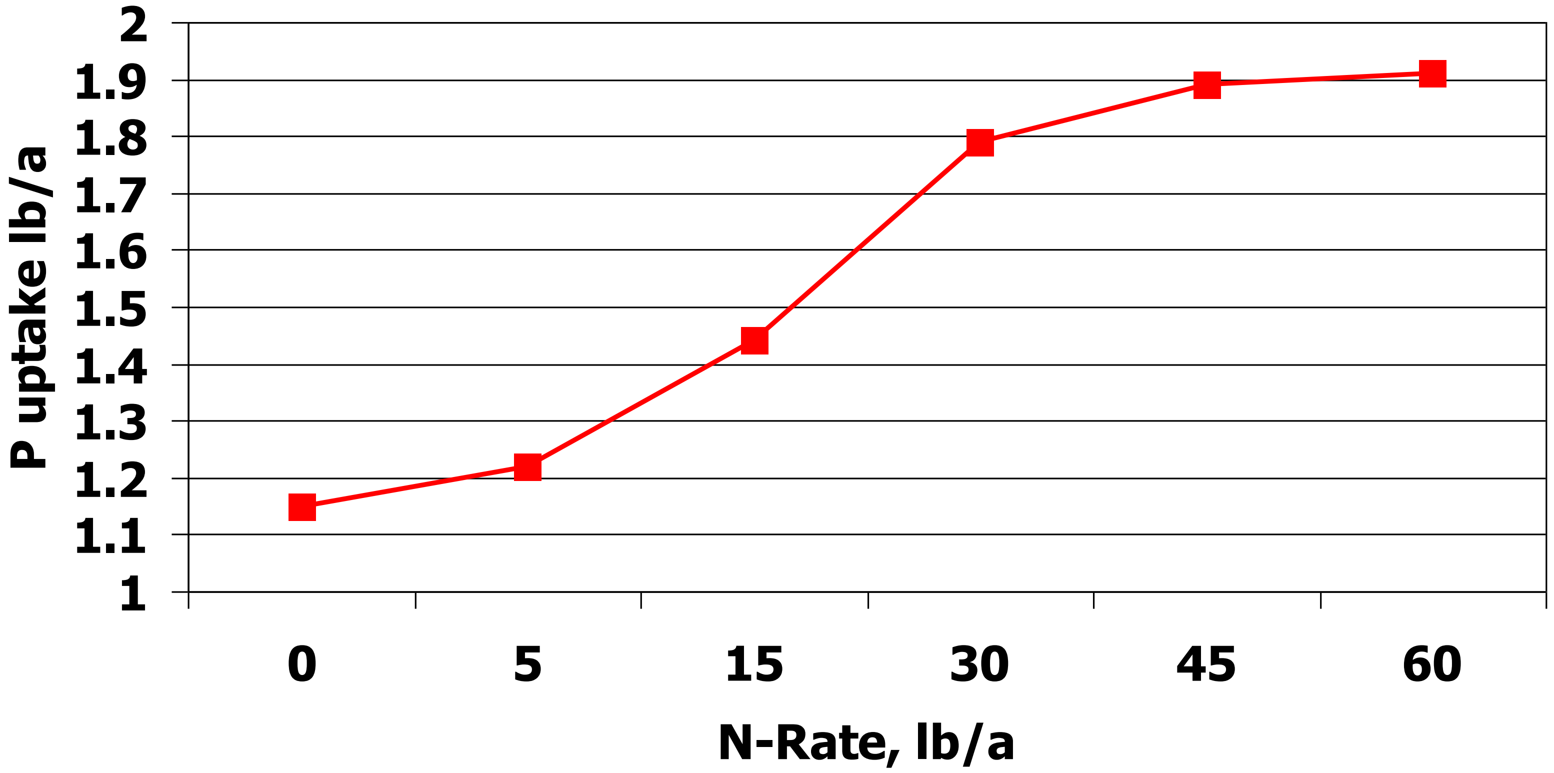
1) 5-15-5
2) 15-15-5
3) 30-15-5
4) 45-15-5
5) 60-15-5

Total N applied=200 lb/a

Plant Population



Starter N-Rate Effects on V-6 Stage Whole Plant P Uptake



N Stimulation of P Absorption by Plants

- Decrease in the rhizosphere pH and increased solubility of soil phosphates.
- Increased root length.
- Increased physiological capacity of the root to adsorb P. N treatment of corn roots resulted in higher P uptake than a 10-fold increase in P concentration.

(Kamprath, 1987)

Starter Effects on Corn Yield (bu/a) 3-year avg

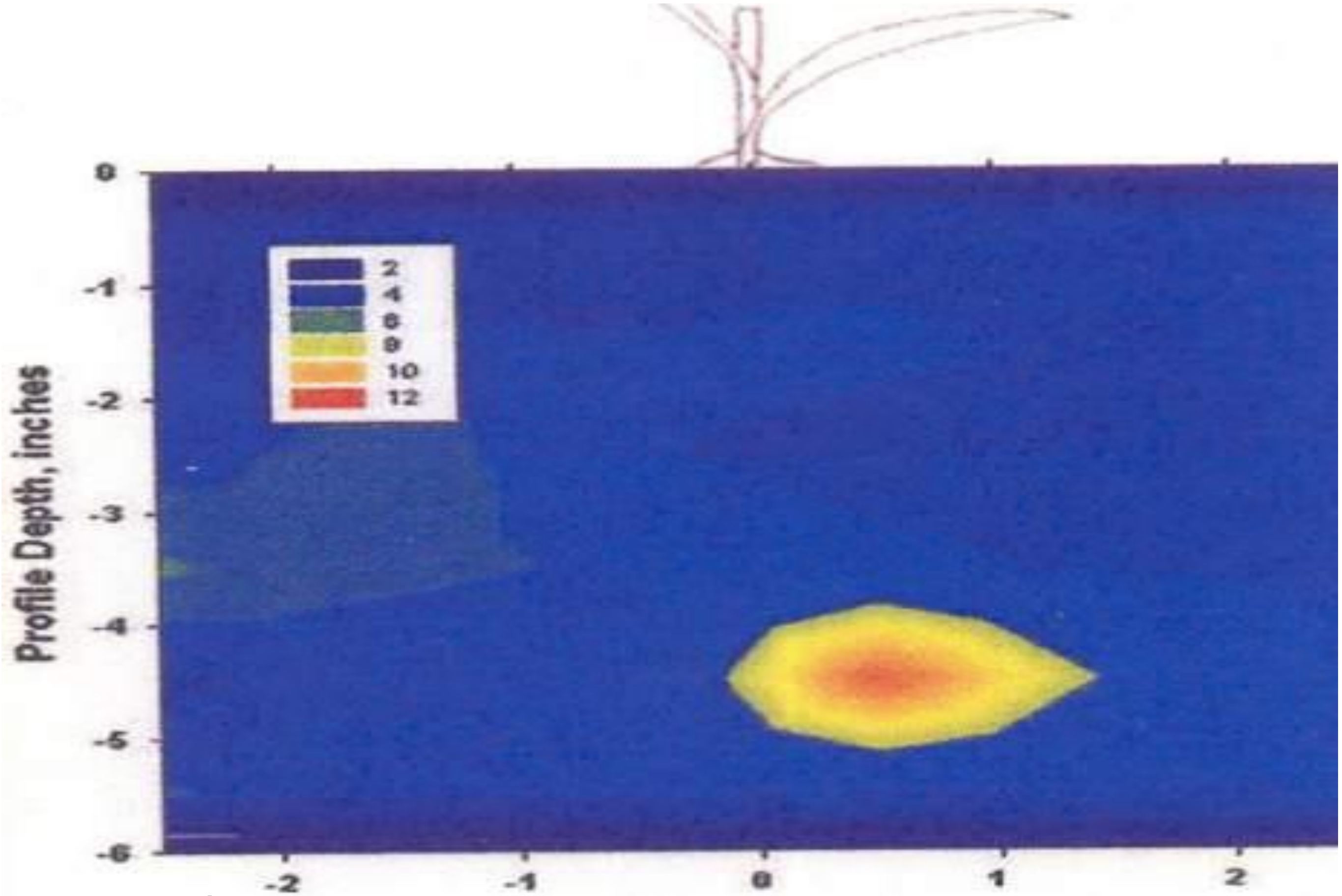
Starter	In-furrow	2x2	Dribble	Row Band
5-15-5	172	*194*	*190*	*179*
15-15-5	177	197	198	180
30-15-5	174	*216*	*212*	*192*
45-15-5	171	215	213	195
60-15-5	163	214	213	201
Average	***171***	***207***	***205***	***189***

Corn Yield response to starter fertilizer, 3-year average

Starter	Placement	Yield, bu/a
No starter check	--------	**105**
10-15-5	Dribble	**122**
40-15-5	Dribble	**133**
40-15-5	In-furrow	**120**
40-15-5	2 x 2	**132**
LSD (0.05)		6

Lamond, KSU Manhattan

Profile Distribution of bio-available P, 40 days after application
Dribble applied 15-30-10 liquid starter fertilizer.



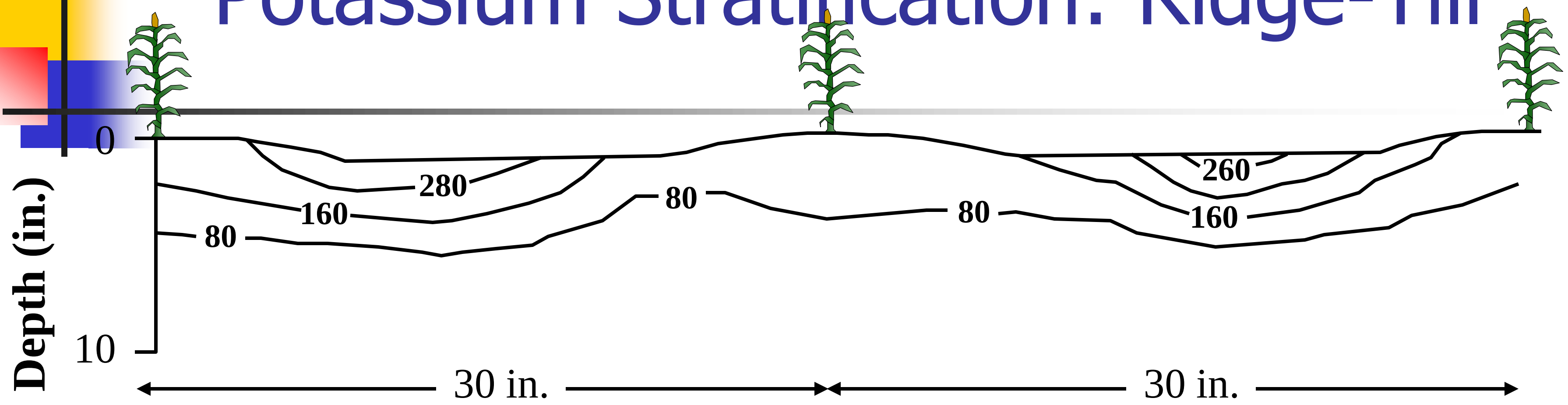
Kovar, USDA/ARS Ames, IA

Conclusions

- Dribble applied starter fertilizer as effective as 2x2. In-furrow applied starter reduced plant populations and yields.
- Higher N analysis starters maximized grain yields.
- In reduced tillage systems, addition of K can be beneficial, even on high K soils.


Potassium Deficiency Symptoms
Early Season

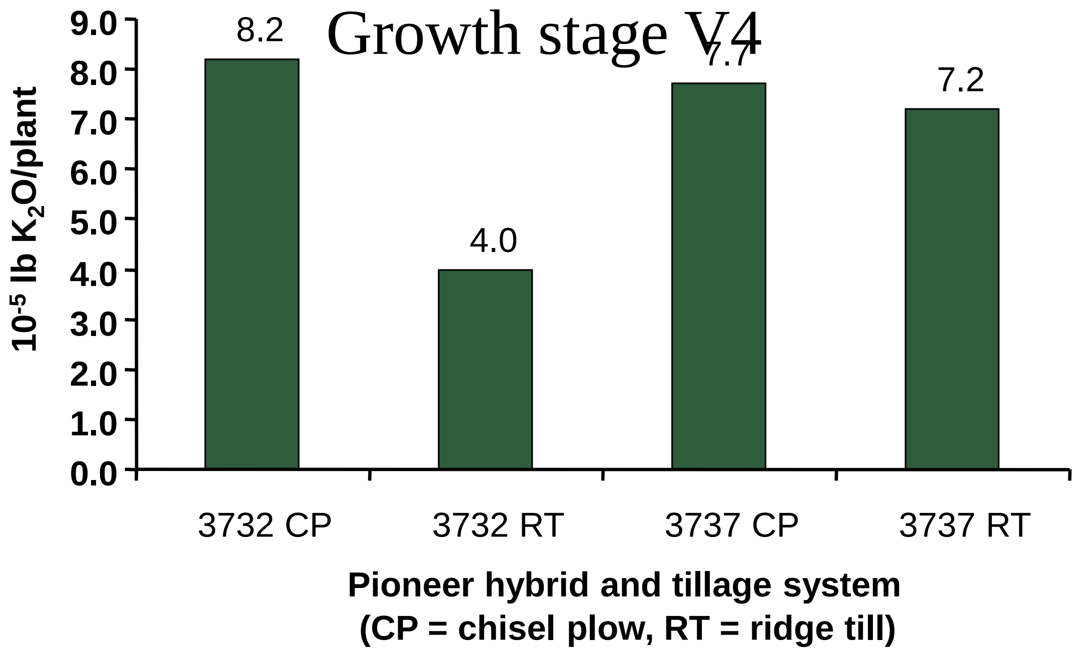
Potassium Stratification: Ridge-Till



- 24 consecutive years in ridge-till.
- Localized high concentrations of K in inter-rows of ridges.

K Uptake Varies with Hybrid

- Pioneer 3737
  - Greater uptake in ridge-till
  - More roots with greater activity located near the surface
- Pioneer 3732
  - Less uptake in ridge-till
  - Fewer roots and lower activity near the surface



Allan et al., 1997 (MN)

Starter fertilizer effects on ridge-tilled corn, 2002-2005 (Soil Test K=220 ppm)

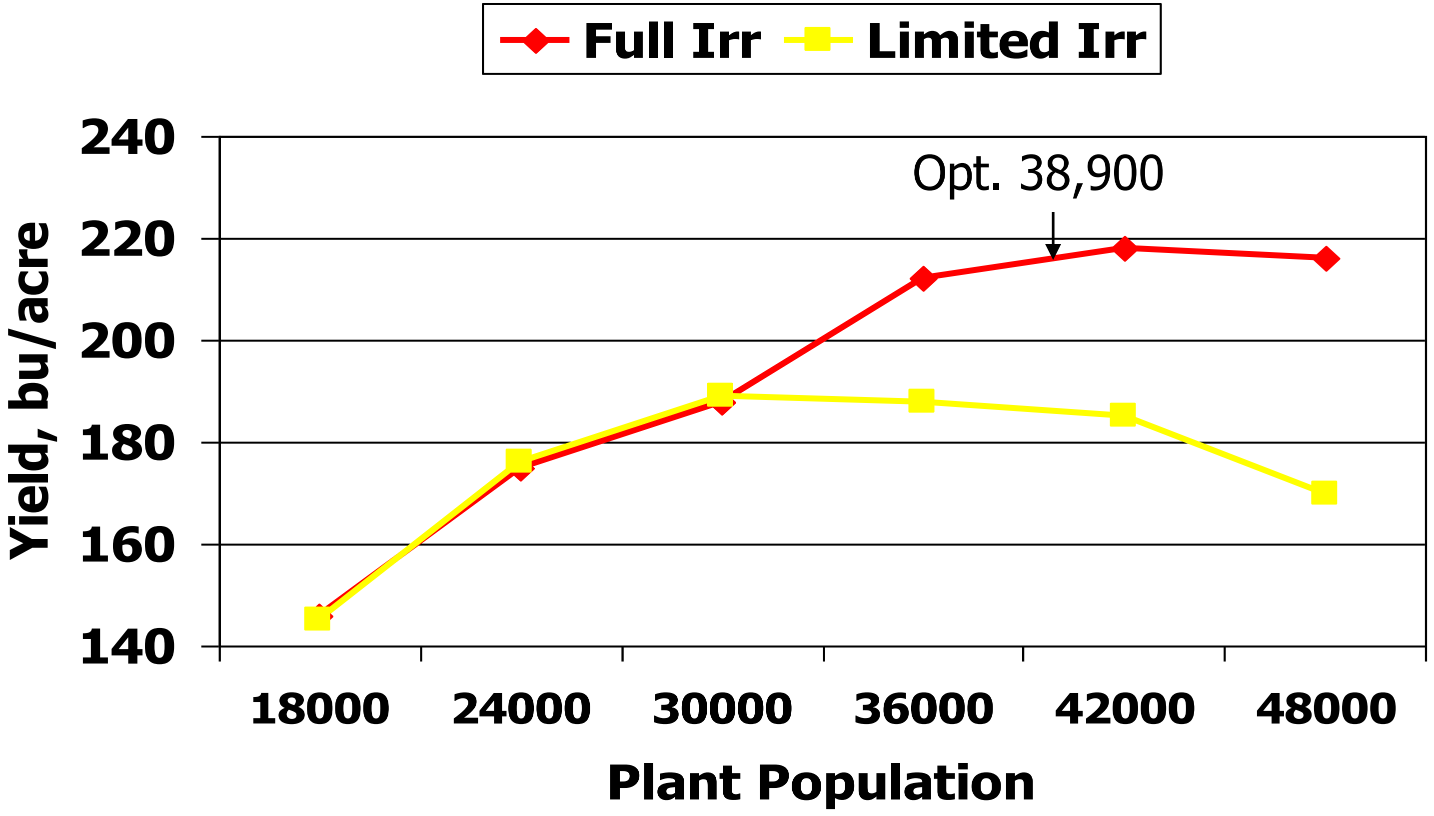
Treatment	V-6 Dry Weight	V-6 K	Days from Emergence	Yield
---------------- lb/acre-----------			Days	bu/acre
0-0-0-0	**215**	**6.2**	**80**	**165**
15-30-5	**388**	**10.8**	**71**	**184**
30-15-5	**361**	**15.6**	**71**	**179**
30-30-0	**399**	**11.9**	**72**	**185**
30-30-5	**469**	**15.9**	**69**	**196**
LSD(0.05)	26	1.5	2	9

K-Application

- Temperature, soil moisture content, and compaction can limit K uptake and result in K deficiency on soils not low in available K.
- K stratification can occur in soils managed with reduced tillage systems.
- Hybrids may differ in ability to take up K from the soil.

Interactions Among Water, Fertility and Plant Population

Irrigation and Population Effects on Corn Yield (8 year avg)



Maximizing Irrigated Corn Yields Carr sandy loam soil, 3-year avg.

Population plants/a	P_2O_5 +K_2O + S (lb/acre) 30+0+0	100+80+40	Response
	grain yield (bu/acre)		bu/a
28,000	**162**	**205**	**43**
42,000	**159**	**223**	**64**
Response	**-3**	**18**	

Maximizing Irrigated Corn Yields
Crete silt loam soil, 3-year avg.

Population plants/a	P_2O_5 +K_2O + S (lb/acre) 30+0+0	100+80+40	Response
	grain yield (bu/acre)		bu/a
28,000	**201**	**224**	**23**
42,000	**195**	**258**	**63**
Response	**-6**	**34**	

Strip-Tillage for Crop Production

No-Till

- Advantages of No-tillage include: reduction of soil erosion, increased soil water use efficiency, improved soil quality, and time and labor savings.
- Disadvantages: High residue production systems can depress early-season plant growth and reduce nutrient uptake.

Strip-tillage

- Strip-tillage can provide an environment that conserves soil and water while establishing a seed-bed that is similar to conventional tillage.

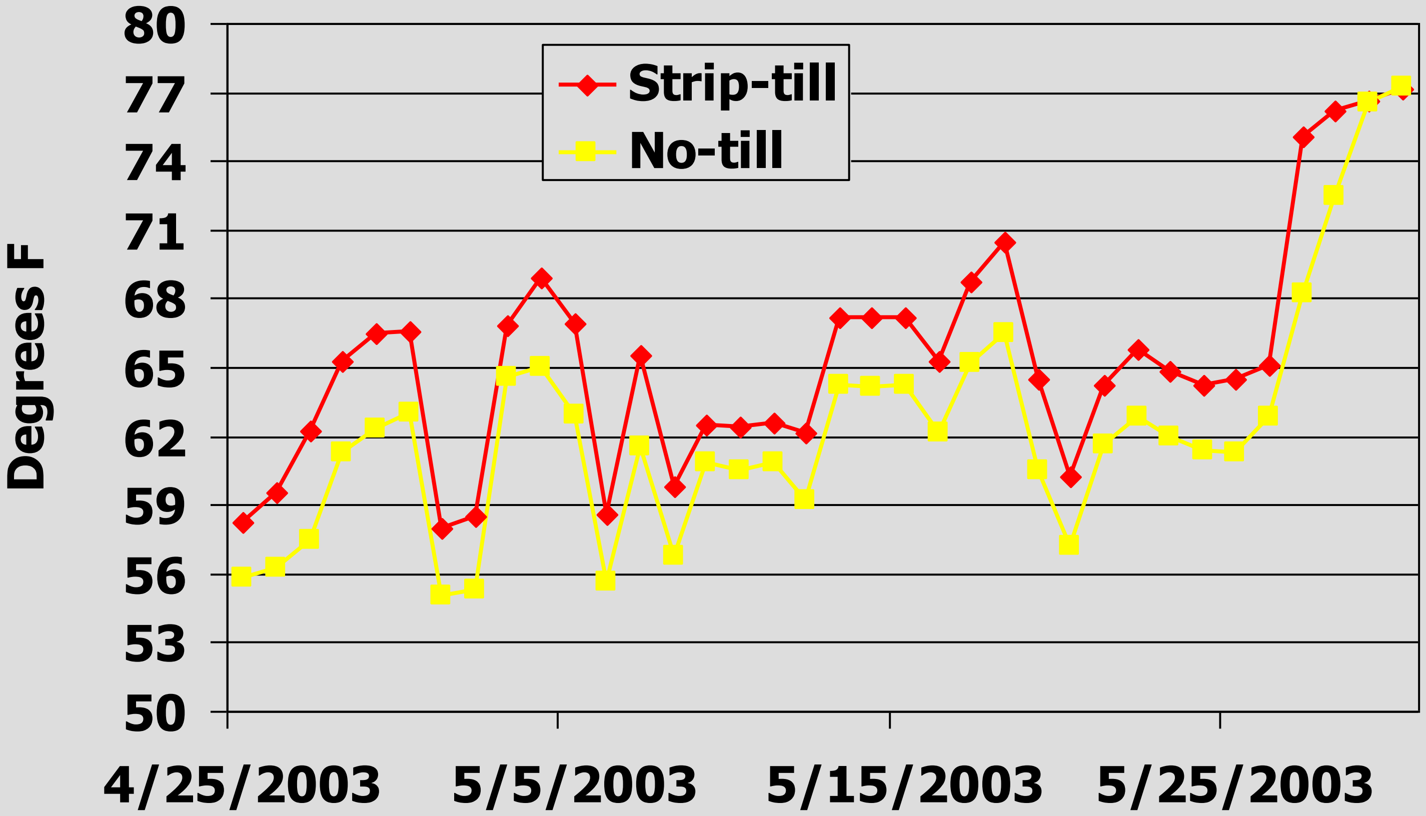
Fall Strip-Tillage

Strip-Tillage

No-Till Vs Strip-Till Early Season Growth

Strip-till vs No-till

Soil Temperature at Planting Depth Belleville



Early Season Growth and Nutrient Uptake, 3-year avg.

Treatment	V-6 Dry Wt.	V-6 N Uptake	V-6 P Uptake
	lb/acre		
Strip-Till	**347**	**16.1**	**2.9**
No-Till	**205**	**9.2**	**1.3**

Belleville, 3-year avg.

Treat.	Day to Mid-Silk	Moist, %	Yield,* bu/a
Strip-Till	**53**	**14.5**	**114**
No-Till	**65**	**17.1**	**100**

*Includes unfertilized check

Tillage and Fertilizer Timing Effects on Irrigated Corn Yield (Soybean Rotation) 2004-2006.

Tillage	Fertilizer	Timing*	Avg.
Strip	180-30-0	Fall	**208**
Strip	180-0-0	Fall	**197**
Strip	180-30-0	Planting	**208**
No-Till	180-30-0	Planting	**200**
No-till	180-0-0	Planting	**192**

***Timing of fertilizer application. All Strip-Tillage was done in the fall.**
•Planting time fertilizer was applied 2 x 2

Tillage and Fertilizer Timing Effects on Irrigated Corn Yield (Continuous Corn) 2004-2006.

Tillage	Fertilizer	Timing*	Avg.
Strip	180-30-0	Fall	**215**
Strip	180-30-0	Planting	**213**
No-Till	180-30-0	Planting	**202**

***Timing of fertilizer application. All Strip-Tillage was done in the fall.**
•Planting time fertilizer was applied 2 x 2

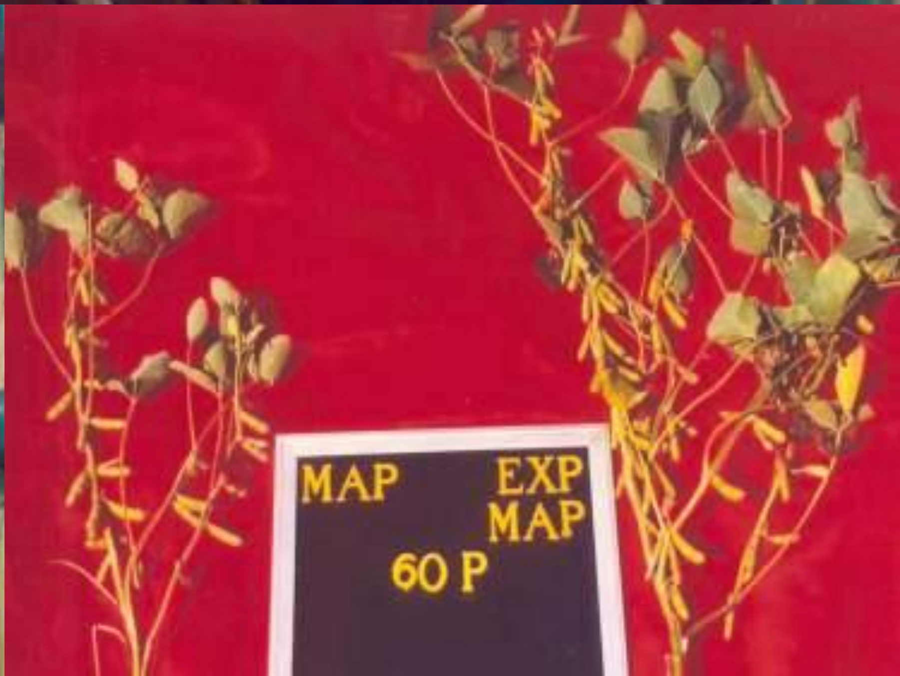
Strip-Till Corn Yield Compared to No-Till

Previous Crop	Strip-till Yield Advantage over No-Till
Wheat	**14**
Soybeans	**8**
Corn	**12**

Conclusion


Strip-Till
Strip-Till has proven to improve early season growth, nutrient uptake and yield of crops grown in high-residue production systems
No-Till

Use of AVAIL with Phosphorus Fertilizer



Phosphorus Fertilizers

- Crop recovery of applied P fertilizer is often low- can be as little as 25% during season of application (Mortvet, 1994).
- At high pH, P is fixed by Ca and Mg.
- At low pH, P is fixed by Fe and Al.

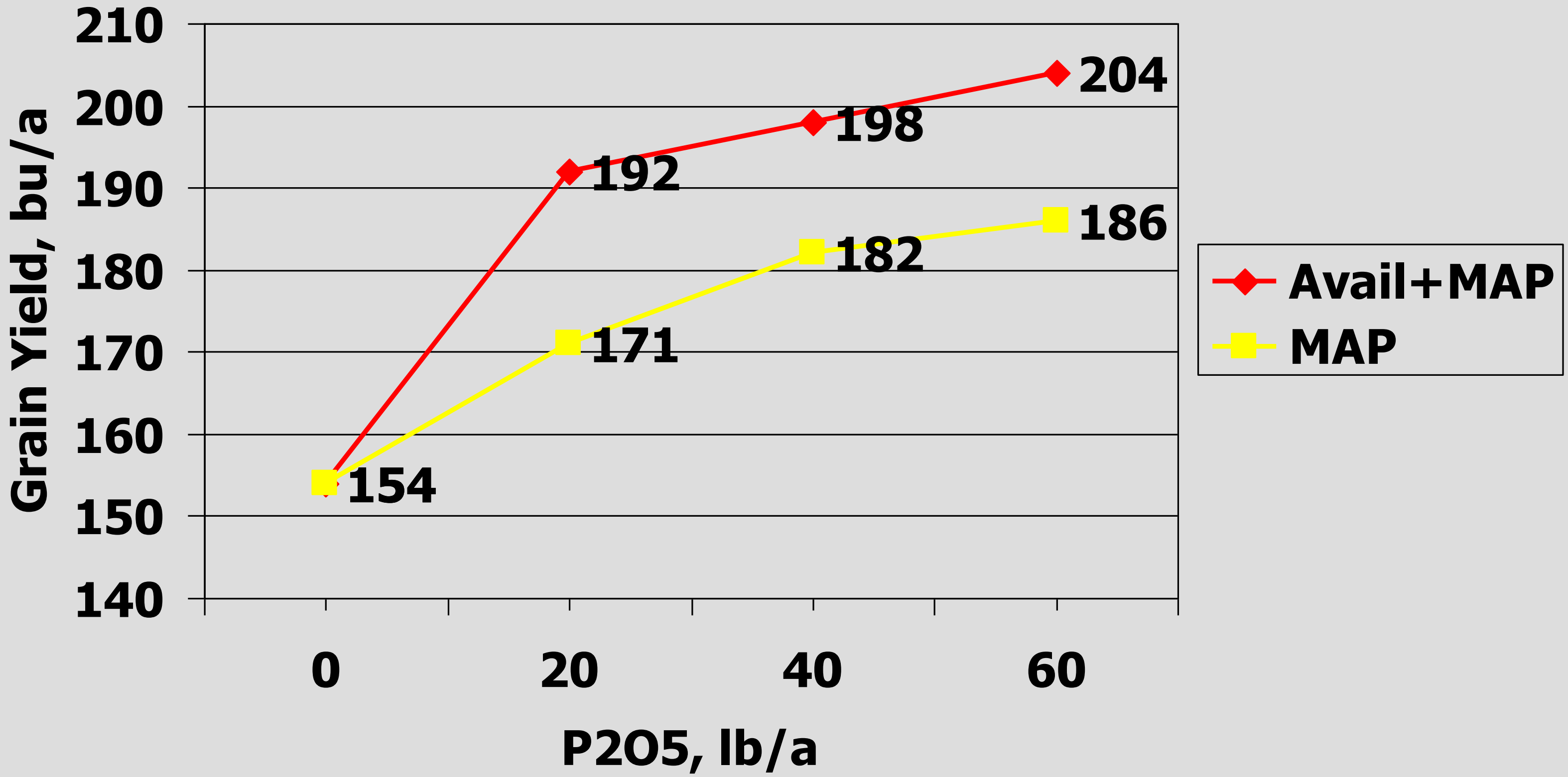
AVAIL

- Specialty Fertilizer Products has developed and patented a family of di-carboxylic co-polymers.
- Can be used as a coating on granular phosphate fertilizers or mixed into liquid phosphate fertilizers.

AVAIL- Mode of Action

- Polymer sequesters antagonistic cations out of the soil solution.
- P remains unfixed and available for plant uptake.
- Results in highly concentrated zones of available P for the plants.

Corn Grain Yield Scandia, 2001-2003



Summary

- Influencing or controlling reactions in the microenvironment around the fertilizer granule has proven to have a significant benefit to the availability of applied nutrient P.
- Use of AVAIL increased P uptake and yield of corn.

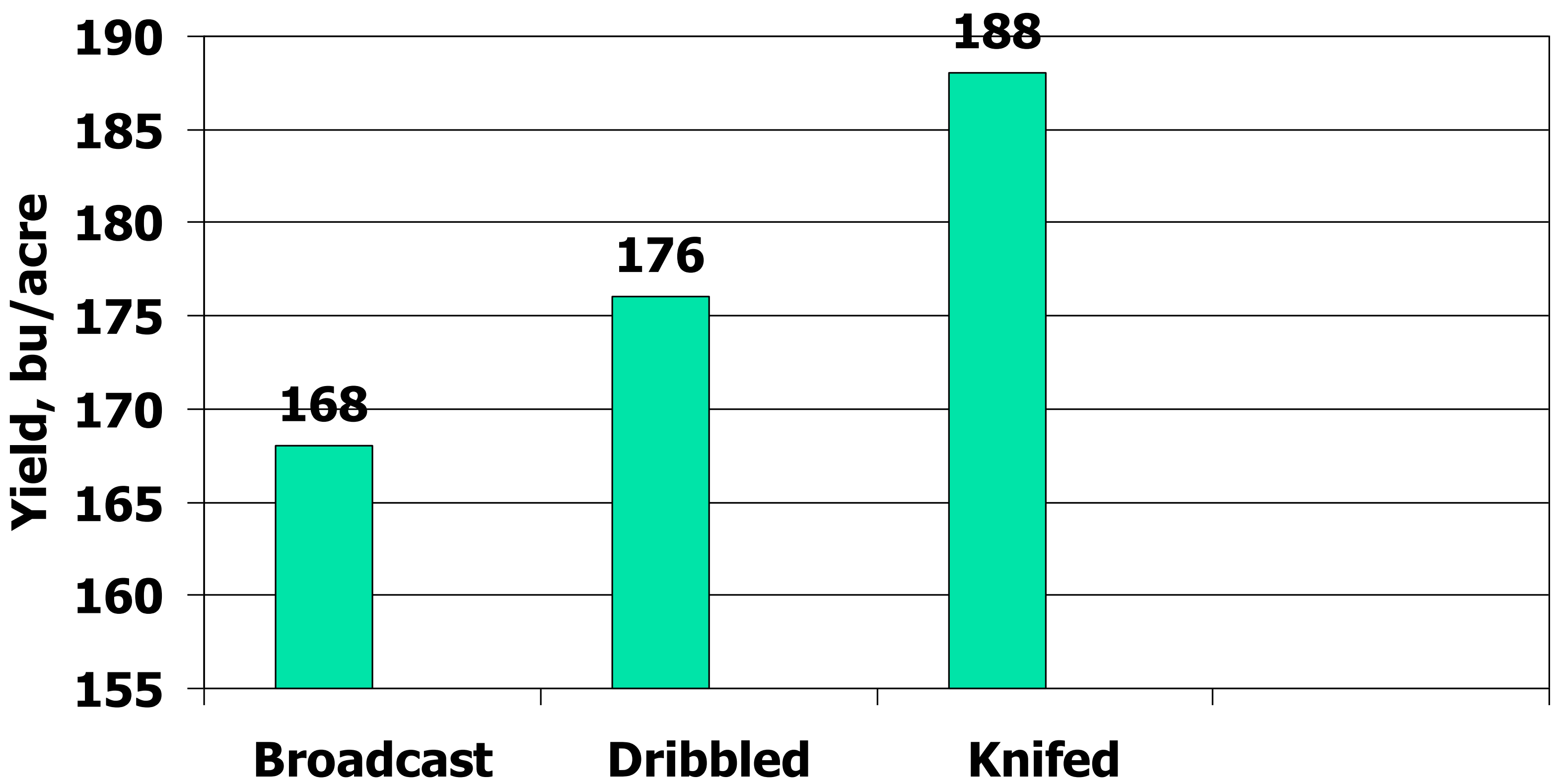
Nitrogen Fertilization Problems in Reduced-Tillage Corn Production

- N immobilization can be a problem when N fertilizers are surface applied in high-residue production systems.
- Surface applications of urea-containing fertilizers are subject to volatilization losses.
- Leaching losses.

N Volatilization Losses

- N losses due to volatilization from broadcast urea-containing fertilizers in no-tillage productions system can be significant. Depending on conditions, losses can be 10-20% of applied N.
- In a study at Purdue (Keller and Mengel, 1985) broadcasting urea in corn stubble resulted in a 29% N loss. Peak loss was nearly 3 lb N/acre/hour. Nearly all losses occurred within 50 hours of application.

Corn Yield as affected by Method of UAN Application

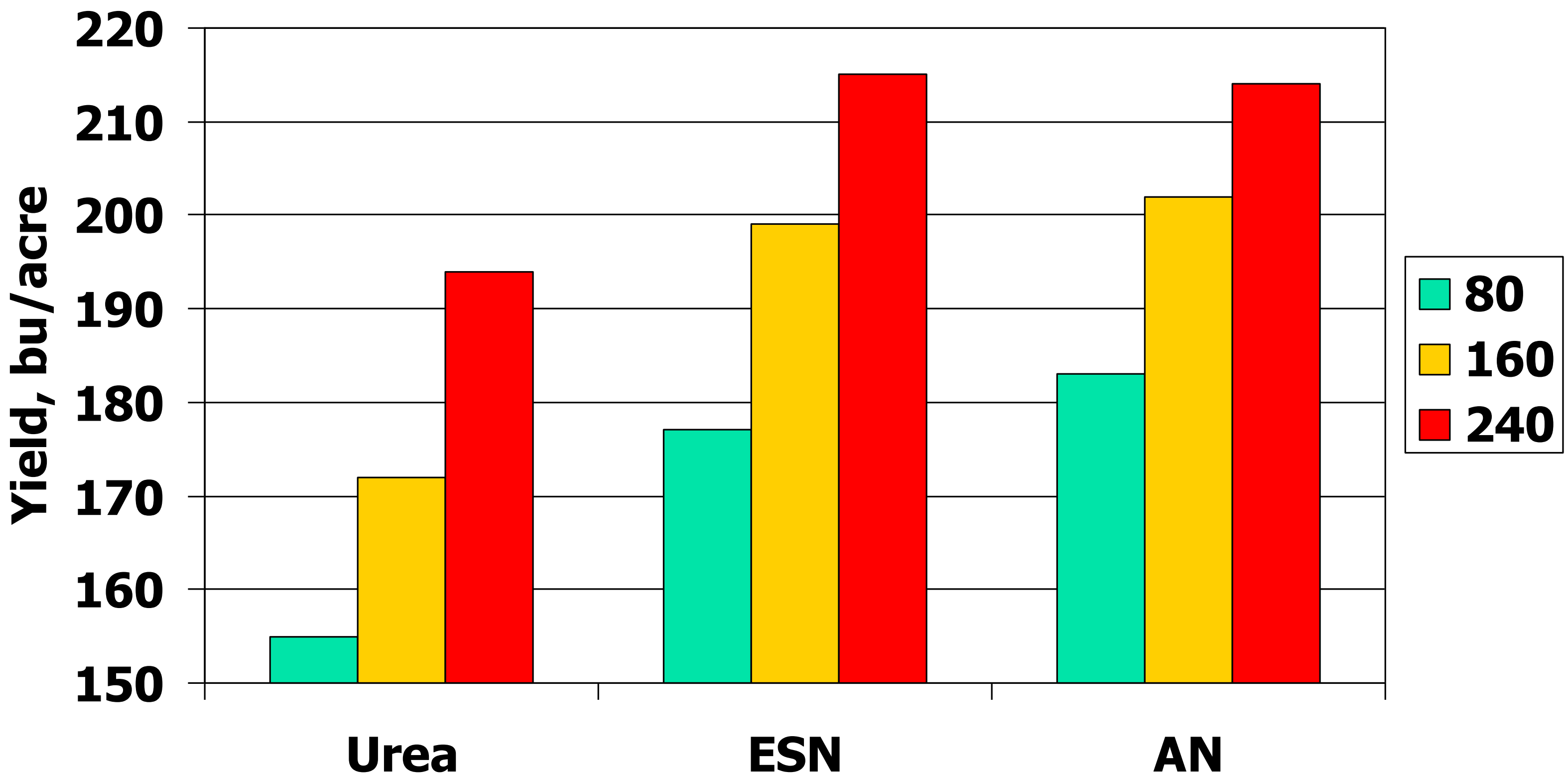


Scandia, 5-year average

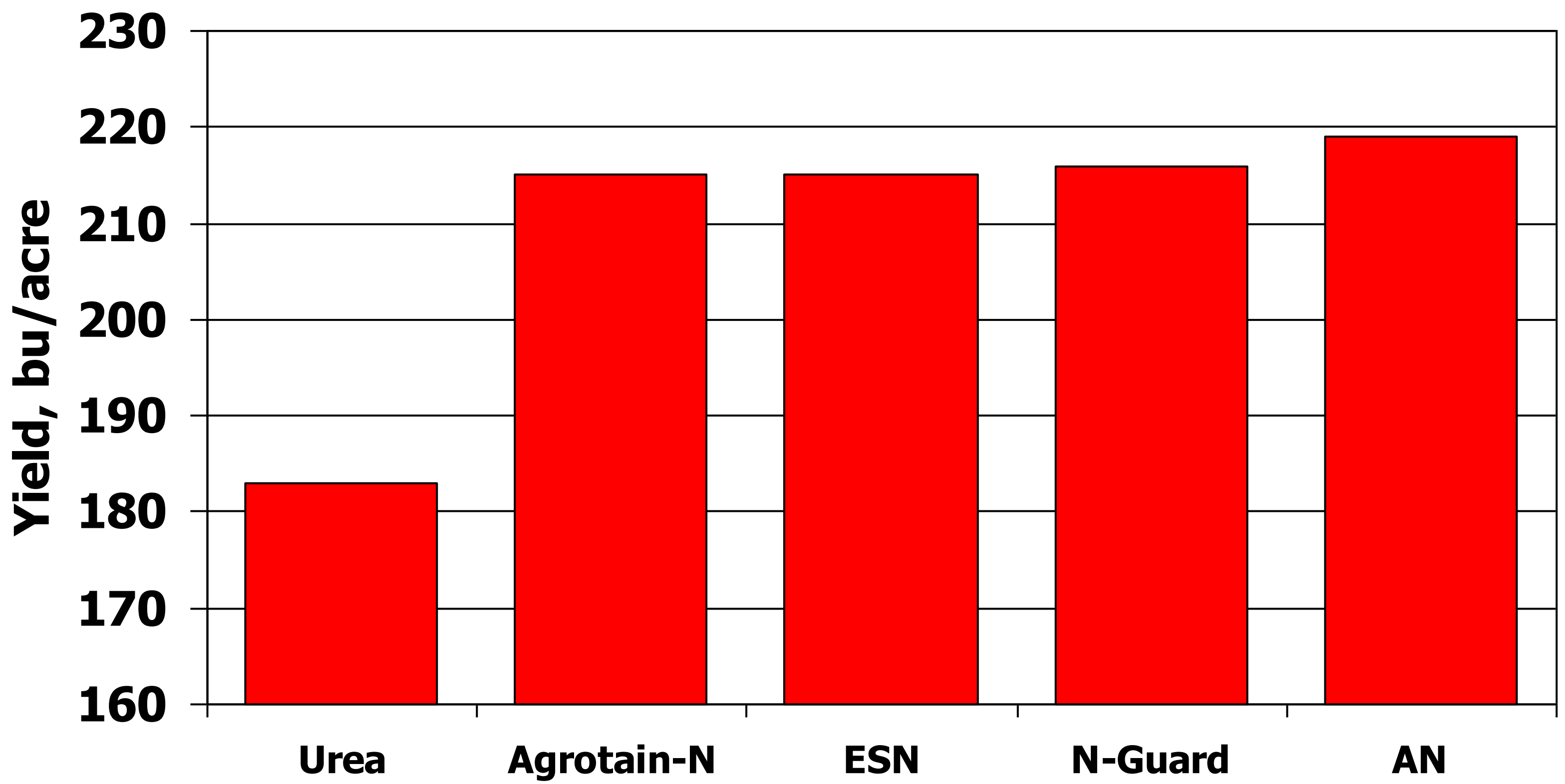
Tools to Manage N-Losses with Surface Applied N.

- Urease-Inhibitors (Agrotain)
- Controlled Release N. Urea granule is coated, but allows water to diffuse across membrane. N-release is then temperature controlled. (ESN).
- Long-Chain liquid Polymer coating of Urea (Nutrisphere-N, formerly N-Guard).

Corn Yield as Affected by N-Source and Rate (3-year average)



Corn Yield as Affected by N Source (2-year Average)



N-Rate= 160 lb/acre

Summary

- Subsurface application of N is the most efficient application method.
- If surfacing applying, banding is more efficient than broadcasting.
- If broadcasting on the soil surface there are products available that can minimize N losses and improve efficiency.

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