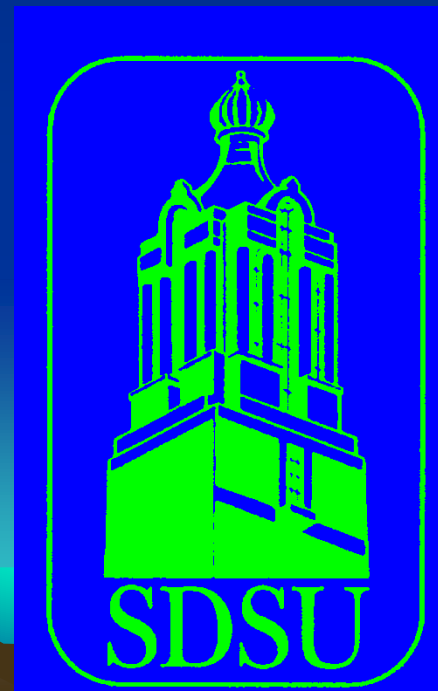


Seed Banding Fertilizer – What are the Limits ?

Ron Gelderman
South Dakota State University



Nutrient Efficiency and Management Conference, Feb. 15, Morton MN.

Fertilizer with Seed

- Introduction
 - Higher P prices, greater efficiency band
 - More banding with seed
 - Factors influencing limits with seed
 - Management to limit seed damage

Excel decision tool we can use



Fertilizer with Seed

- Terms
 - Seed-placed
 - Seed band
 - Pop up
 - In-furrow
 - Row placed starters



Fertilizer with Seed

- Row crops - liquids



Fertilizer with Seed

- Small grains – dry materials



Fertilizer with Seed

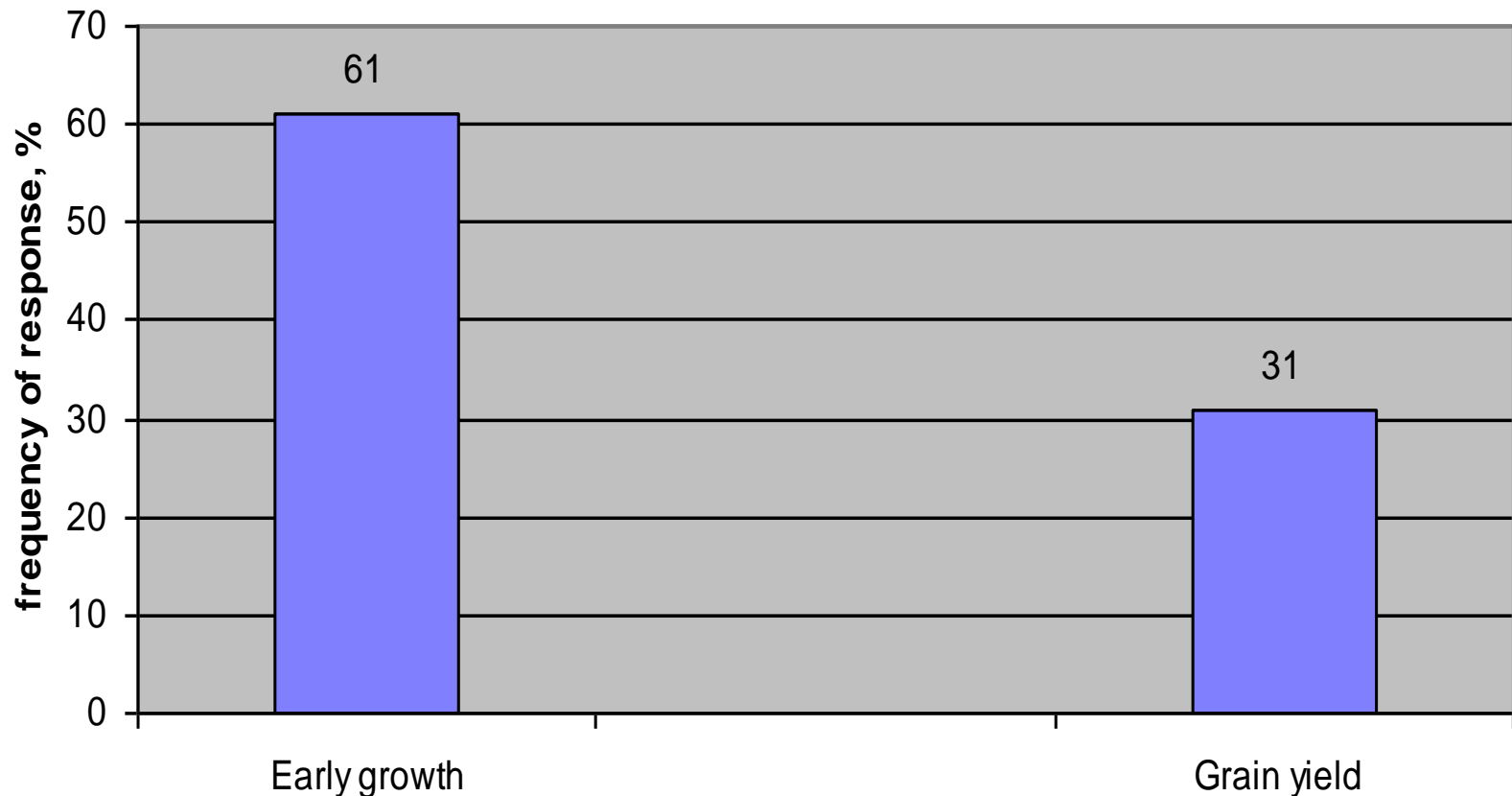
Why apply a band?

- 1) Starter effect – early growth response
- 2) More efficient uptake P and K
- 3) Small amounts of Zn and S
- 4) Small grain apply much of N,P,K



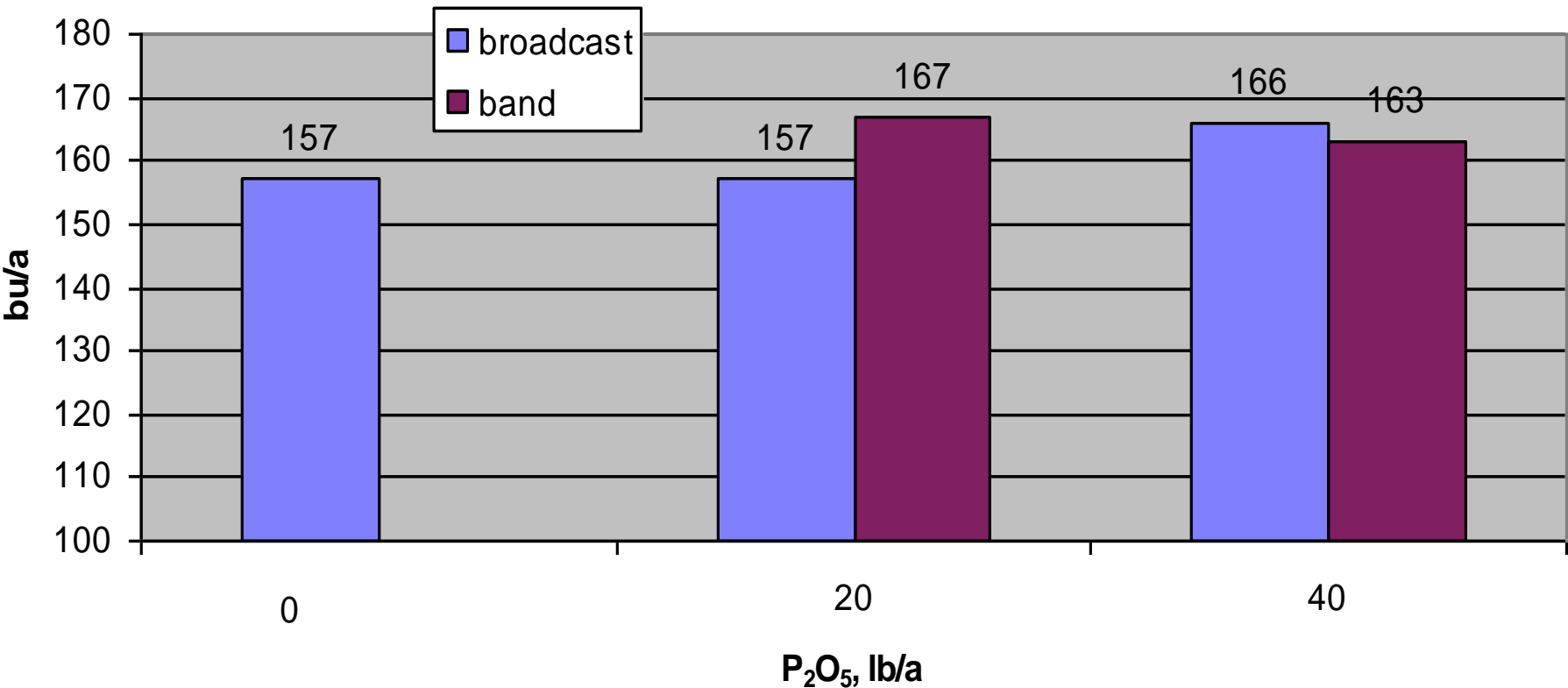
Starter – early growth response

Corn response to starter, 61 sites, 1987 - 1997, South Dakota.



Band - more efficient

Placement and rate of phosphorus (MAP) on no-till corn yield, two year mean, Watertown, SD.



Band vs. Broadcast P on corn

- Lit review of 38 sites/studies (upper midwest) yields
- All responsive to phosphorus
- 60% of the time band > broadcast



Fertilizer with Seed

- Separate Fertilizer openers
 - weight
 - expense
 - seed row disturbance
 - in-furrow similar to 2x2



Influence of phosphorus placement on P uptake at tassel and grain yield of irrigated corn, Pierre, SD. Ave. 3 years.

P ₂ O ₅ *	P uptake	Yield
Placement		
	g/shoot	bu/a
with seed	0.26 a	197 a
2 x 2	0.23 bc	197 a
surface band- over row	0.22 c	189 b

After Riedell et al. (2000)

* 20 lbs/a P₂O₅/a as 10-34-0. P soil test = 6 (Low),



Fertilizer with Seed

- Major problems
 - 1) Salt concentration around seed prevents water uptake into seed
 - 2) Ammonia from urea, 28%, DAP inactivates seed enzymes.
 - 3) Thiosulfate also very toxic to seed











Poor Stands



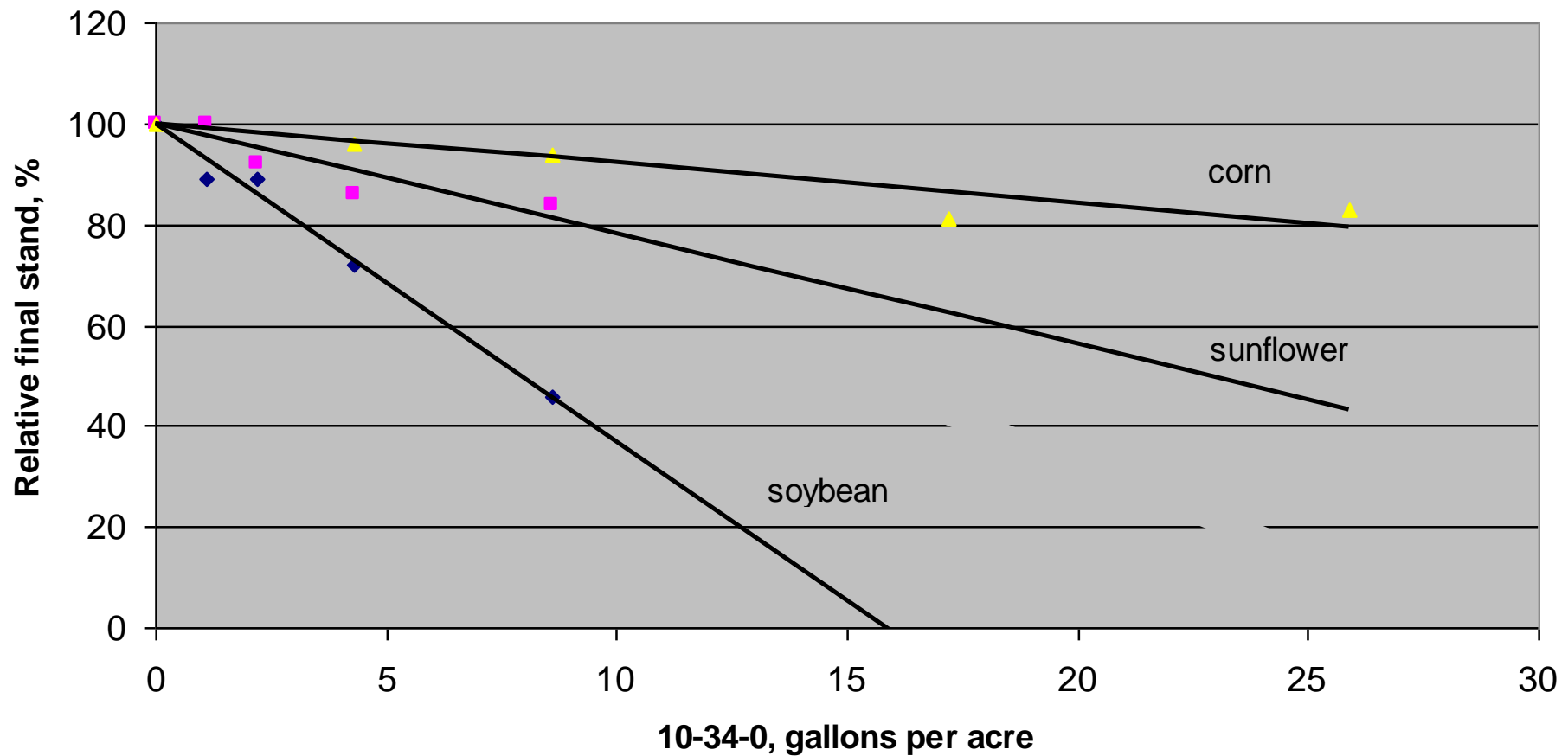
Kaiser UMN

Fertilizer with Seed

- Factor affecting emergence
 - crop sensitivity



Crop sensitivity to 10-34-0 applied with seed (30" rows), Brookings, 1997.



Fertilizer with Seed

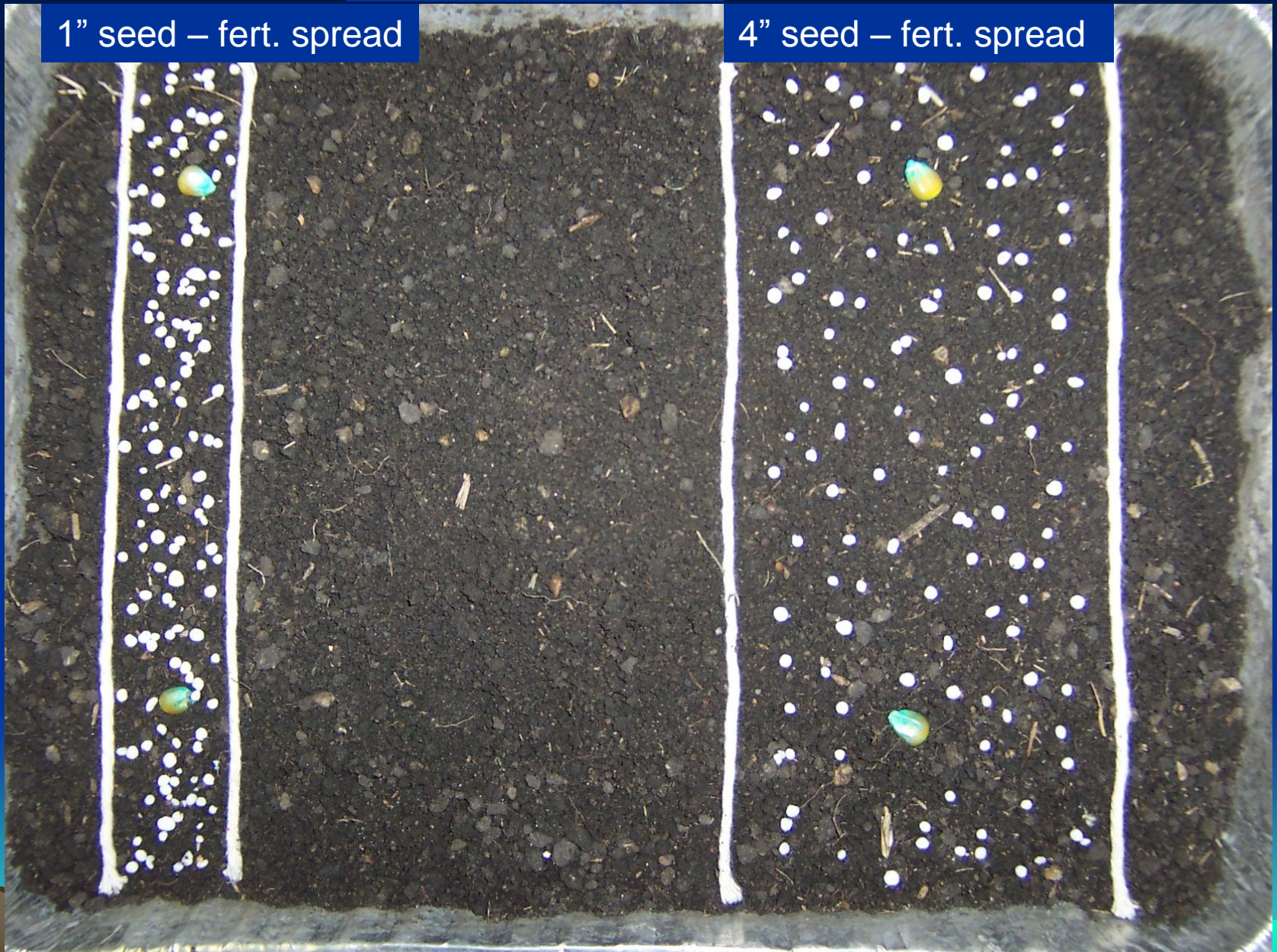
- Factor affecting emergence
 - crop sensitivity
 - planter furrow width (seed-fert spread width)



100 lb/a of Material

1" seed – fert. spread

4" seed – fert. spread



Fertilizer with Seed

- Factor affecting emergence
 - crop sensitivity
 - planter furrow width (seed-fert spread width)
 - row width (dilution effect)

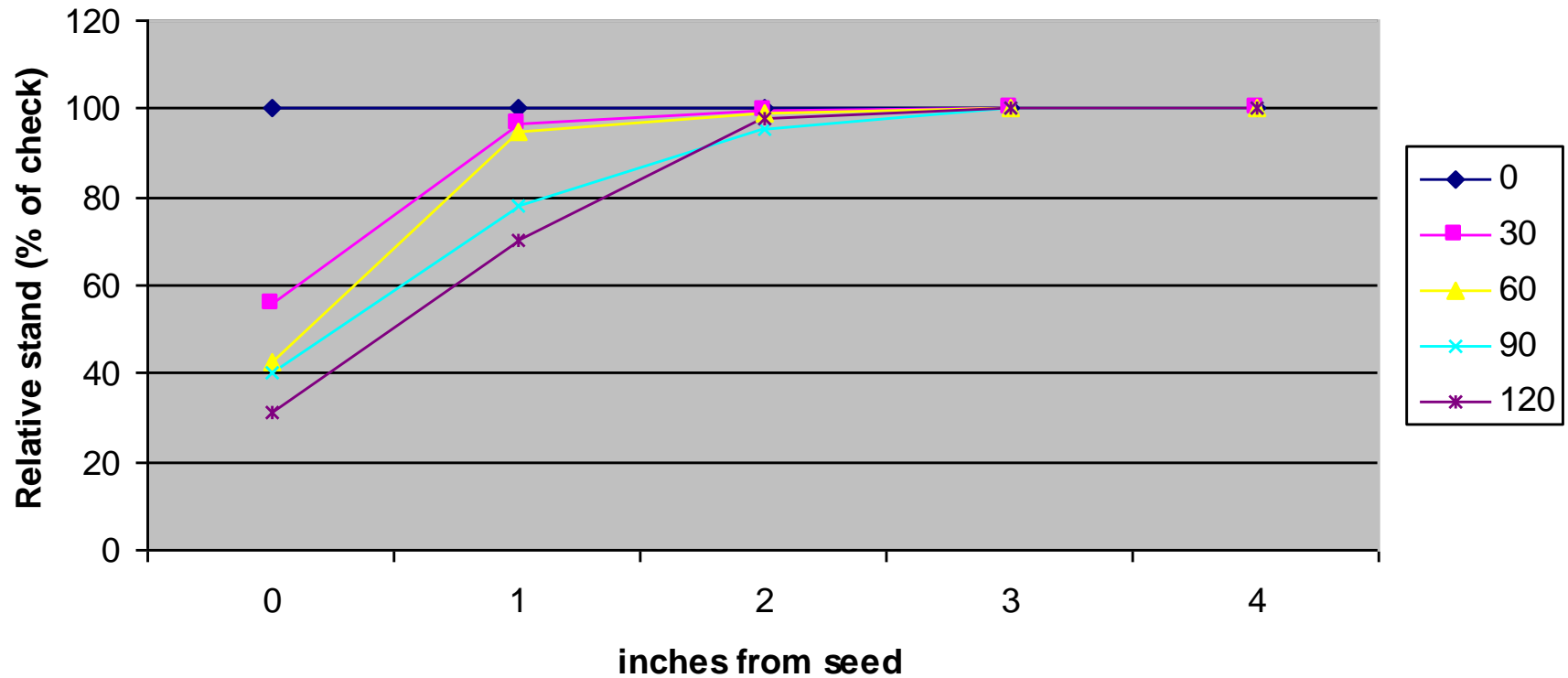


Fertilizer with Seed

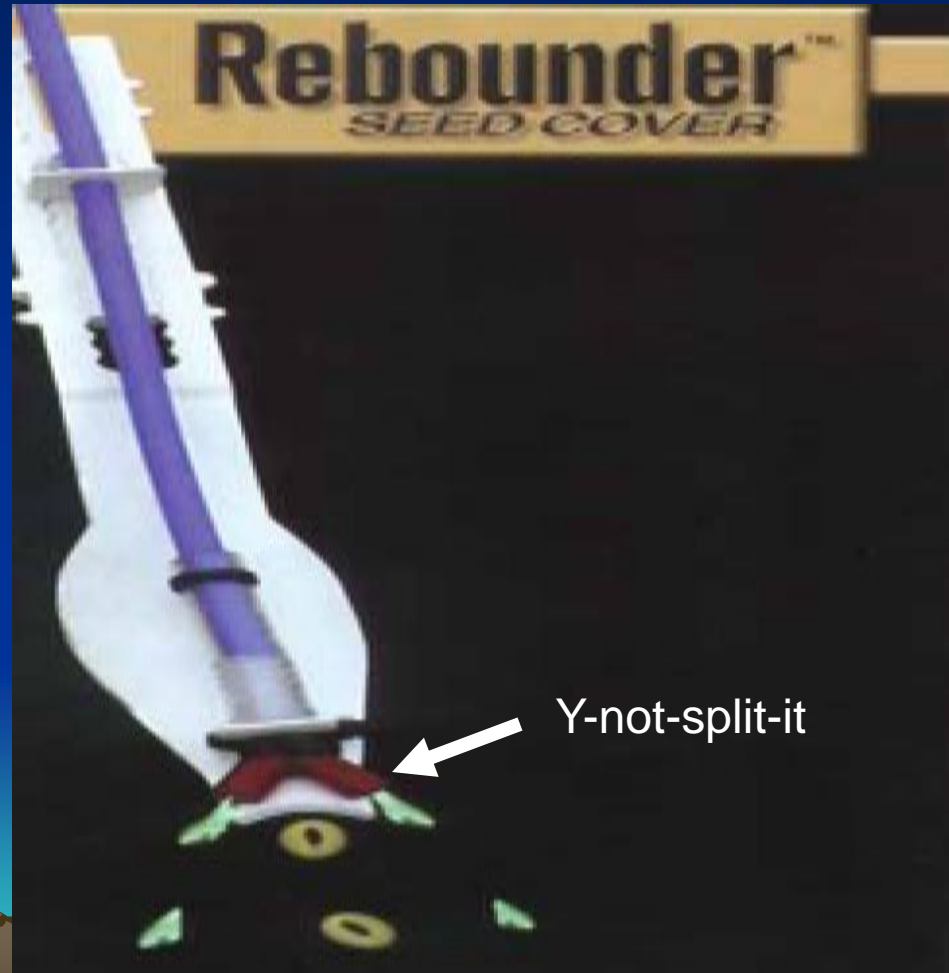
- Factor affecting emergence
 - crop sensitivity
 - planter furrow width (seed-fert spread width)
 - row width
 - distance of fertilizer from seed



Influence of Urea rate and distance from seed on final corn plant stand, mean four site years.



Fertilizer with Seed



Fertilizer with Seed

- Factor affecting emergence
 - crop sensitivity
 - planter furrow width (seed-fert spread width)
 - row width
 - distance of fertilizer from seed
 - rainfall after planting



Fertilizer with Seed

- Factor affecting emergence

Soil Factors

- pH
- soil moisture
- soil texture (CEC)
- organic matter (CEC)



Fertilizer with Seed

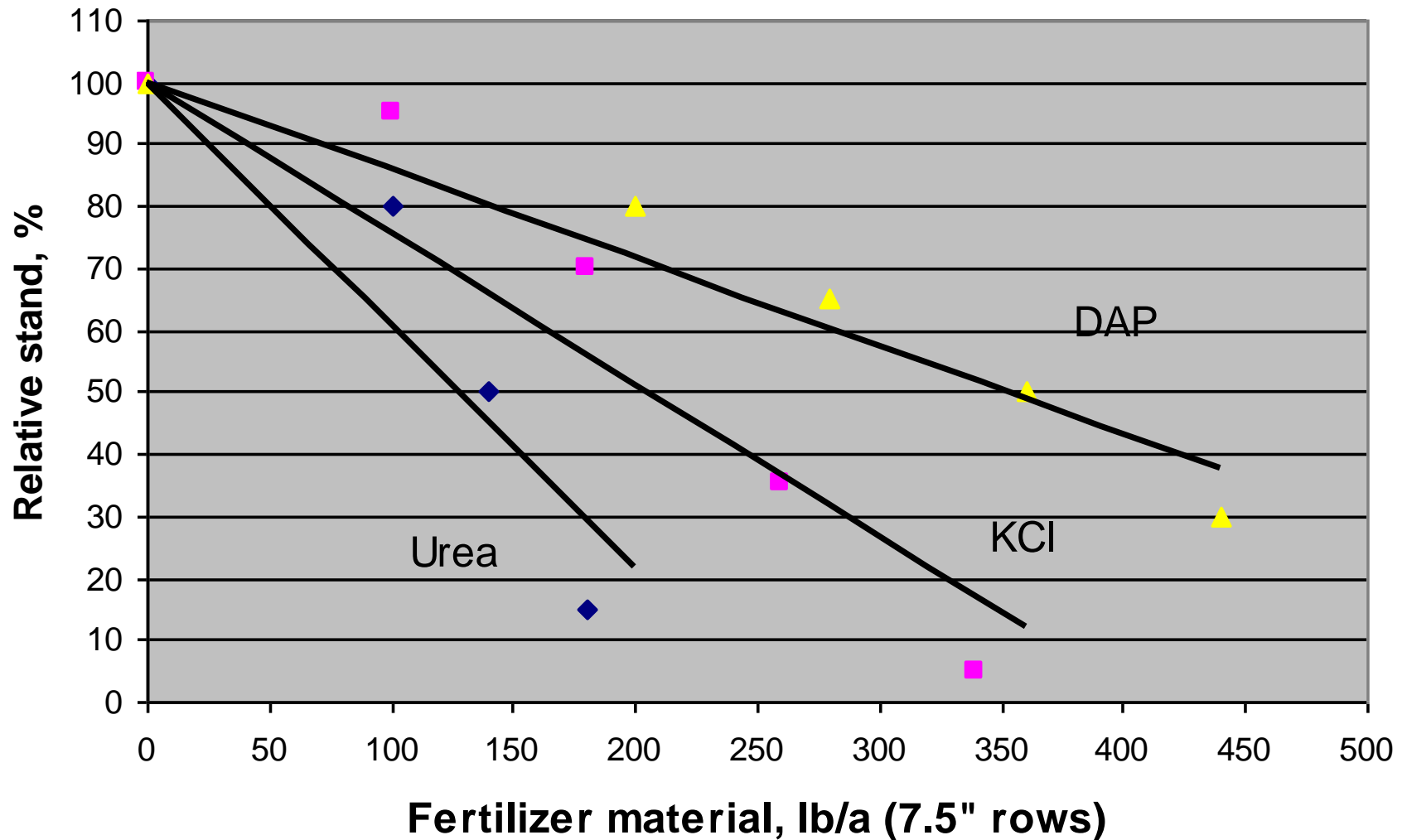
- Factor affecting emergence

Fertilizer Factors

- Fertilizer (nutrient/source/analysis)



Influence of fertilizer on wheat stand, laboratory study, spring 2008, SDSU



Fertilizer with Seed

- Factor affecting emergence

Fertilizer Factors

- Fertilizer (nutrient/source/analysis)
- Fertilizer rate



Fertilizer with Seed

- Many crop advisors have some “rule of thumb” guidelines. (i.e. 10 lbs of N + K₂O)

Limited to:

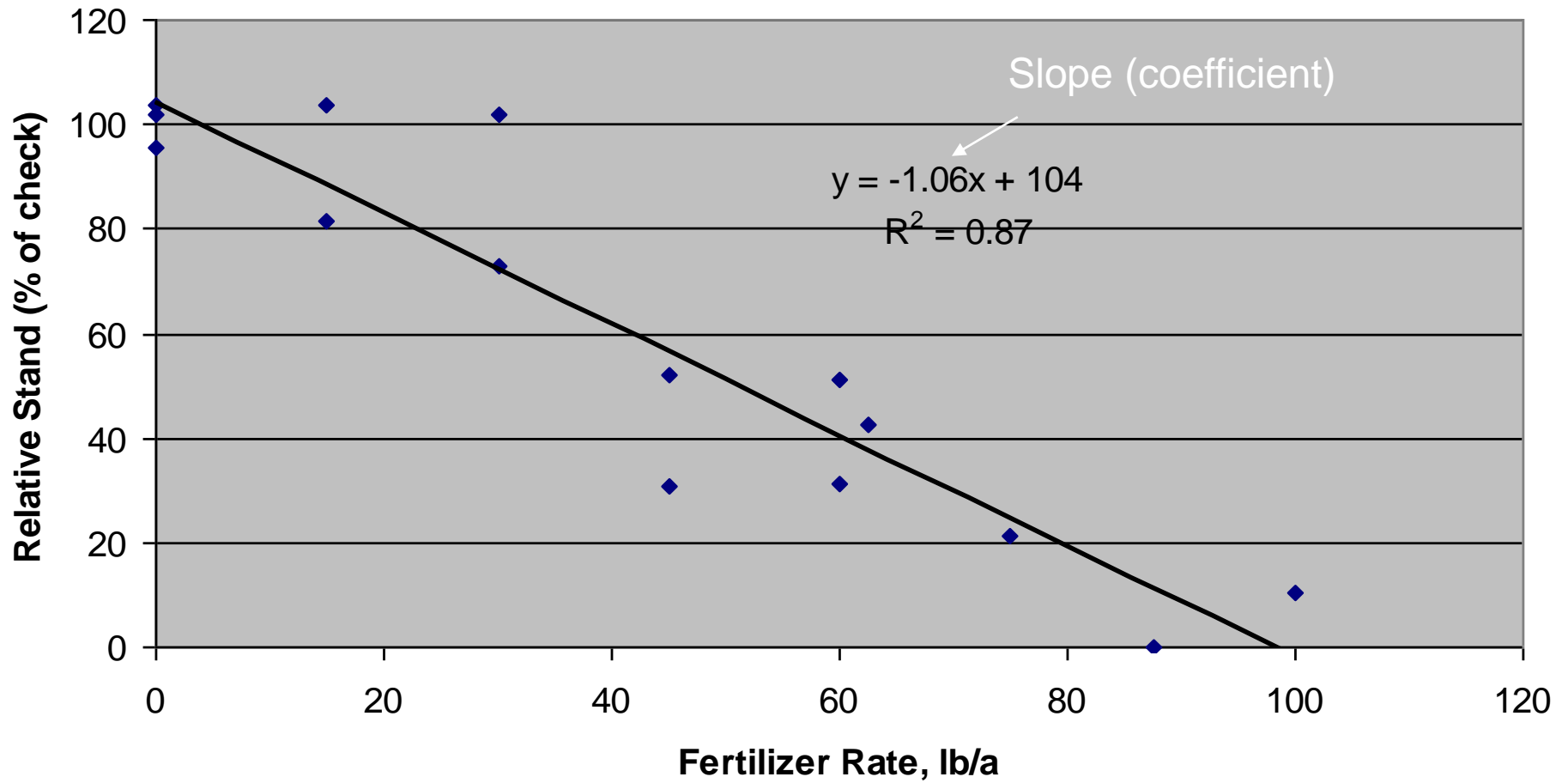
- very few crops and fertilizer materials
- specific row widths and seed spread widths

Need to remember other factors

Soil moisture, opener width, row width, texture, fertilizer analysis etc.



Soybean MAP



Fertilizer (F)

MAP(11-55-0) ▼

132 lbs/a with the seed

Fert. Analysis (A)

0.55

gal/acre

Salt Index (I)

0.485

14.5 lbs/a of Nitrogen

Crop (C)

Corn ▼

C

0.019

Seed Spread (S)

inches

1

%Stand (T)

%

95

Row spacing (R)

inches

7.5

Soil moisture (M)

1.0

soil moisture at planting



moist



borderline



dry

Common Crops of Region

Corn

Soybean

Wheat, hard red spring

Wheat, hard red winter

Wheat, durum

Oats

Barley

Flax

Millet

Sunflower

Safflower

Sorghum

Lentil

Pea

Mustard

Canola

Alfalfa

Edible beans



Common Fertilizers of Region

Urea

7-21-7

28% (UAN)

9-18-9

DAP

3-18-18

MAP

4-10-10

TSP

KCl

10-34-0

Amm. Thiosulfate

12 fert x 18 crops = 216 studies x 20 plots/site = 4320 field plots



Fertilizer with Seed

Literature review, US and Canada

- 36 references,
- 13 common crops, 13 common fertilizers
- 219 separate crop by fertilizer studies



Fertilizer with Seed

Results - References

- Of possible 139 combinations (13 x 13) 45 had at least two studies for a mean

Lots of variability in results

due to soils? Soil moisture? Rainfall?

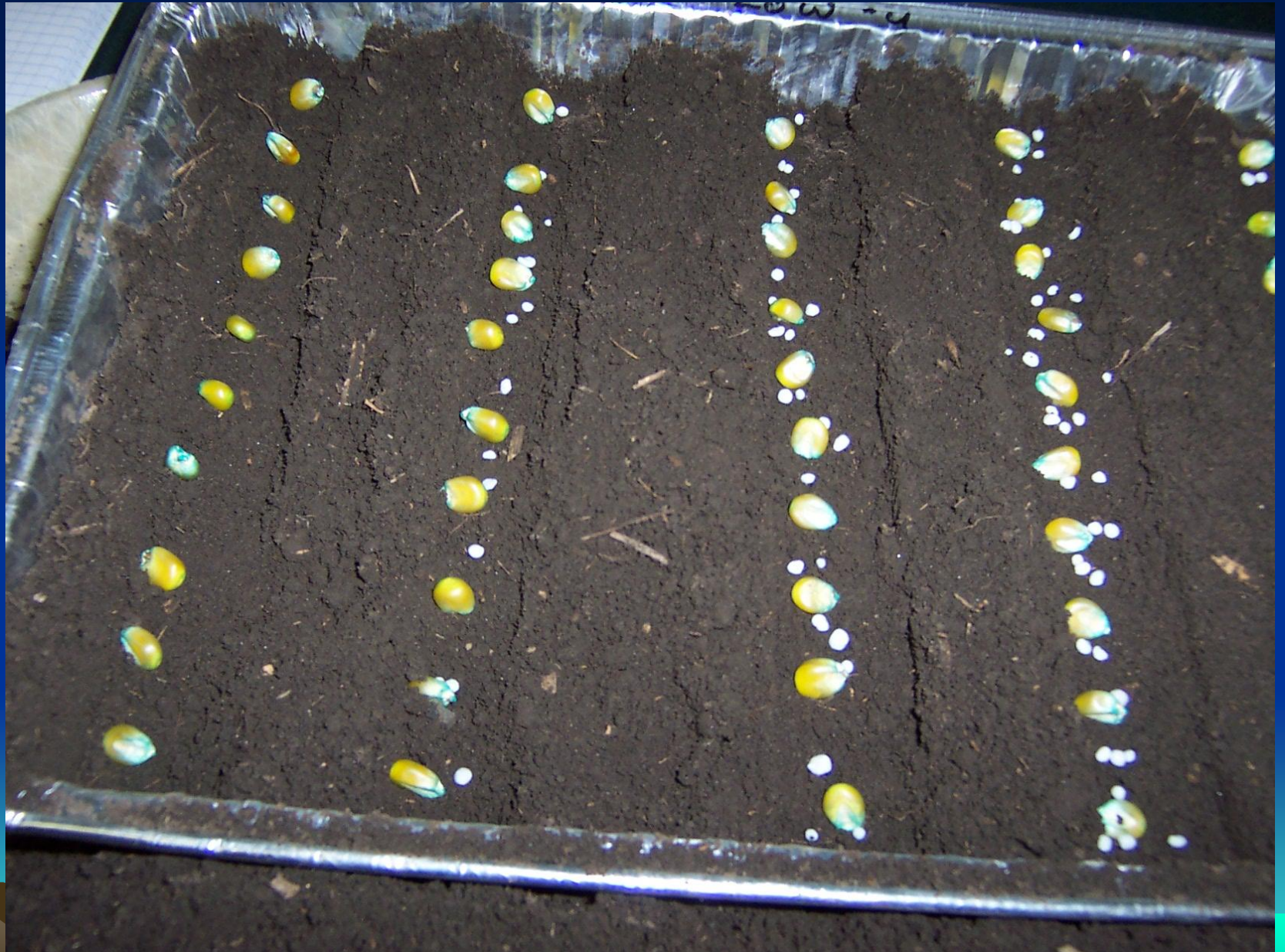
Most references did not note these details

- So this data not complete either



Fertilizer with Seed – Lab study

- Using 16 crops x 16 fertilizers x 3 reps
- Using soil and 8 inch row with 10 seeds and 5 rates of fertilizer material.
- Rates adjusted for 30 inch rows 1 inch furrow opening (seed-fertilizer spread)
- Final emergence is taken 11 days after planting
- Soil texture = Clay Loam (38% Sand, 30% Silt, 32% Clay)
- OM = 4.3%, pH = 7.3, Moist Bulk Density = 0.80 g/cc. Moist content = 15% Vol, 18% grav.





Lab study – fertilizer with seed

- Looked at how final stand was influenced by fertilizer rate

From those slopes predict stand loss from added fertilizer.



Lab study – fertilizer with seed

- Results

Compared Lab to field results and 2005
SDSU recommendation



Comparison of current SDSU fertilizer-seed guidelines with Literature review and Lab Study values.

	Corn		
	30" rows at 95% stand, fine texture, moist soil at planting		
Fertilizer	2005 rec ¹	Field Results	Decision Aid
	----- lb material/acre -----		
10-34-0	100	83	135
7-21-7	71	45	94
9-18-9	56	63	33
ATS	0		17
0-0-60	17	--	11
MAP	91	63	31
DAP	56	24	21

¹ Gerwing and Gelderman, Fertilizer Recommendations Guide, 2005

² Literature Review in Gelderman, 2007, Fertilizer with Seed Decision Aid

Comparison of current SDSU fertilizer-seed guidelines with Literature review and Lab Study values.

	Wheat 7.5" rows at 85% stand, fine texture, moist		
Fertilizer	2005 rec ¹	Field Results	Decision Aid
	----- lb material/acre -----		
Urea	54	28	42
UAN	89	--	233
MAP	227	130	148
DAP	139	92	111
0-0-60	42	92	67

¹ Gerwing and Gelderman, Fertilizer Recommendations Guide, 2005

² Literature Review in Gelderman, 2007, Fertilizer with Seed Decision Aid



Comparison of current SDSU fertilizer-seed guidelines with Literature review and Lab Study values.

	Soybean 15" rows at 85% stand, fine texture, moist		
Fertilizer	2005 rec ¹	Field Results	Decision Aid
	----- lb material/acre -----		
MAP	45	30	27
DAP	28	32	28
10-34-0	50	75	63
7-21-7	35	107	50
9-18-9	28	116	44
4-10-10	35	107	59
0-0-60	8	17	14

¹ Gerwing and Gelderman, Fertilizer Recommendations Guide, 2005

² Literature Review in Gelderman, 2007, Fertilizer with Seed Decision Aid

Relative injury potential of fertilizers

4-10-10	1.0
7-21-7	1.4
3-18-18	1.7
10-34-0	1.9
TSP	2.5
9-18-9	2.5
KSMg	3.3
K Sulfate	3.6
MAP	3.8
DAP	4.3
28-0-0	6.0
KCL	6.7
Am.Nit.	8.1
Urea +NBPT	8.4
ATS	12.9
Urea	15.2

Relative sensitivity of crops to seed-placed fertilizer

Corn	1.0
Barley	1.7
Wheat	2.2
Durum	2.5
Sunflower	2.5
Oats	2.7
Sorghum	3.4
Pea	3.6
Cotton	3.7
Lentil	4.8
Safflower	5.1
Soybean	6.2
Mustard	6.3
Flax	6.4
Canola	6.4
Alfalfa	7.3

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Maximum Fertilizer Material to Apply with Seed

Select Crop

Corn
Soybean
Wheat
Alfalfa
Barley
Canola
Flax
Lentil
Mustard
Oat
Pea
Sorghum
Sunflower

Select Fertilizer

Urea(46-0-0)
UAN (28-0-0)
--
MAP (11-55-0)
DAP (18-46-0)
TSP (0-46-0)
APP (10-34-0)
7-21-7
9-18-9
4-10-10
--
ATS (12-0-26)

Fertilizer Rate (F)

38.5 lbs/a with the seed

3.3 gal/acre

Yellow Boxes are Calculated

This rate will have:

3.8 lbs/a of Nitrogen (N)

13.1 lbs/a of Phosphorus (P₂O₅)

lbs/a of Potassium (K₂O)

lbs/a of Sulfur (S)

Parameters

1.0 Soil Moisture & Texture (MX)

-0.13 Coefficient (C)

Enter Values in Boxes

Seed Spread (S) inches 1

Row spacing (R) inches 30

Target Stand (T) % 95

Select: Soil Texture

Texture_Fine-Medium
Texture_Coarse

Planting- Soil Moisture

Soil_Moist
Soil_Borderline
Soil_Dry



$$\text{Equation: } F = 30S(T-100)/CRMX$$

Where:

F=fertilizer material in lb/a

S=seed spread in inches

T=Target Stand, as % when no fertilizer is applied (100%= no fertilizer applied with seed)

C= negative regression coefficient for the selected crop x fertilizer: (% / lb a⁻¹)

R=row spacing in inches

MX = planting soil moisture and soil texture coefficient.

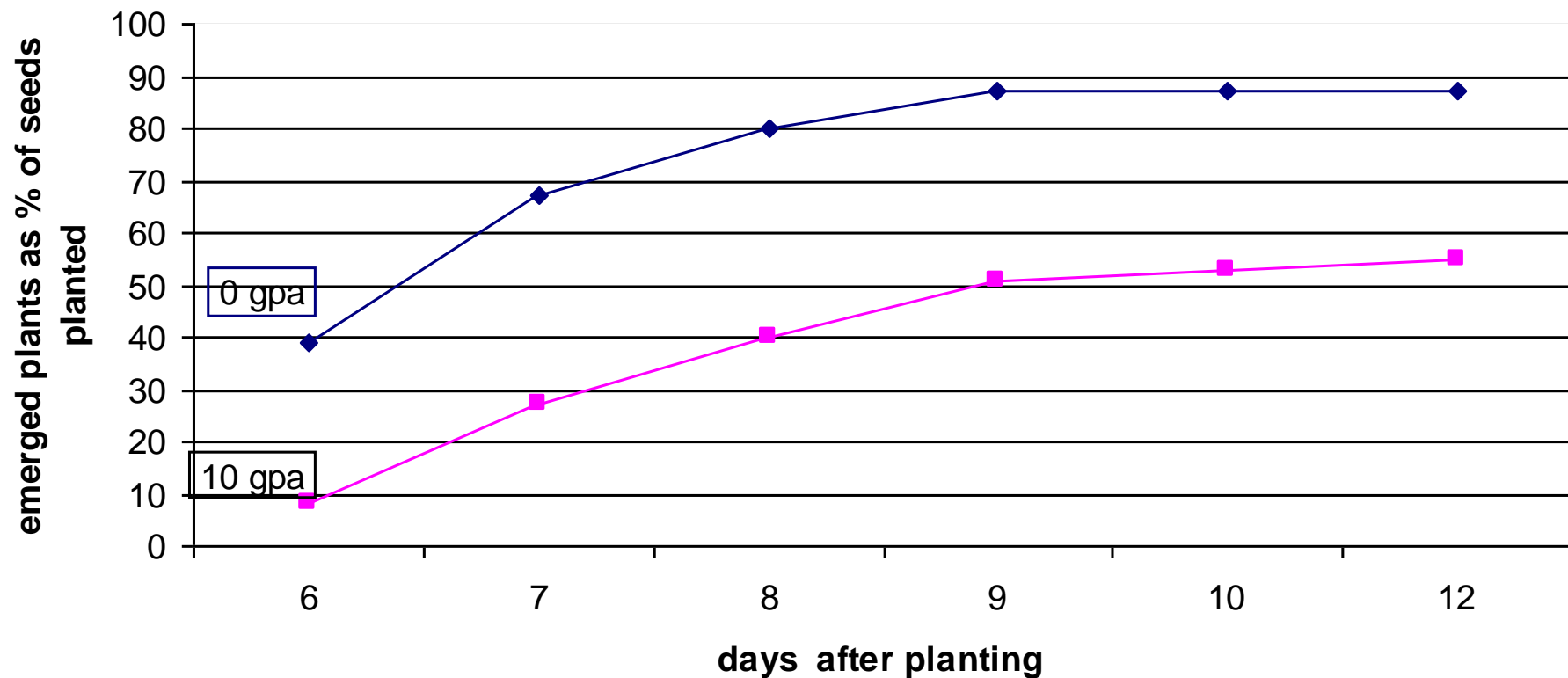
Values should match Blue Box entries

1 30 95 Verify

Press: Seed Spread & Stand Definitions

Press: Fit Program to Screen

Soybean (30" rows) emergence as influenced by rate of 10-34-0 with seed, Brookings, 2008



Fertilizer with Seed

Summary/Conclusions

1. Laboratory data was used to develop aid, field data to verify.
2. The user friendly decision aid was developed to estimate safe rates of seed-placed fertilizer.



Fertilizer with Seed

Summary/Conclusions

3. The aid reminds the producer/crop advisor of factors that are important and gives information now known
4. The decision aid appears to produce safe rate estimates similar to field data.



Current Work

- Sandy Loam soil
- Additional fertilizers
 - Ammonium Sulfate
 - poly coated urea

Difference in varieties or cultivars?



Fertilizer with Seed

Program available on Websites:

Google SDSU Soil Fertility

Click on Fertilizer Seed Decision Aid

IPNI:

<http://www.ipni.net/toolbox>



SPONSORS

- International Plant Nutrient Institute (IPNI)
- SDSU Soil Testing Laboratory
- South Dakota Ag. Expt. Station
- South Dakota Cooperative Extension Ser.



Questions

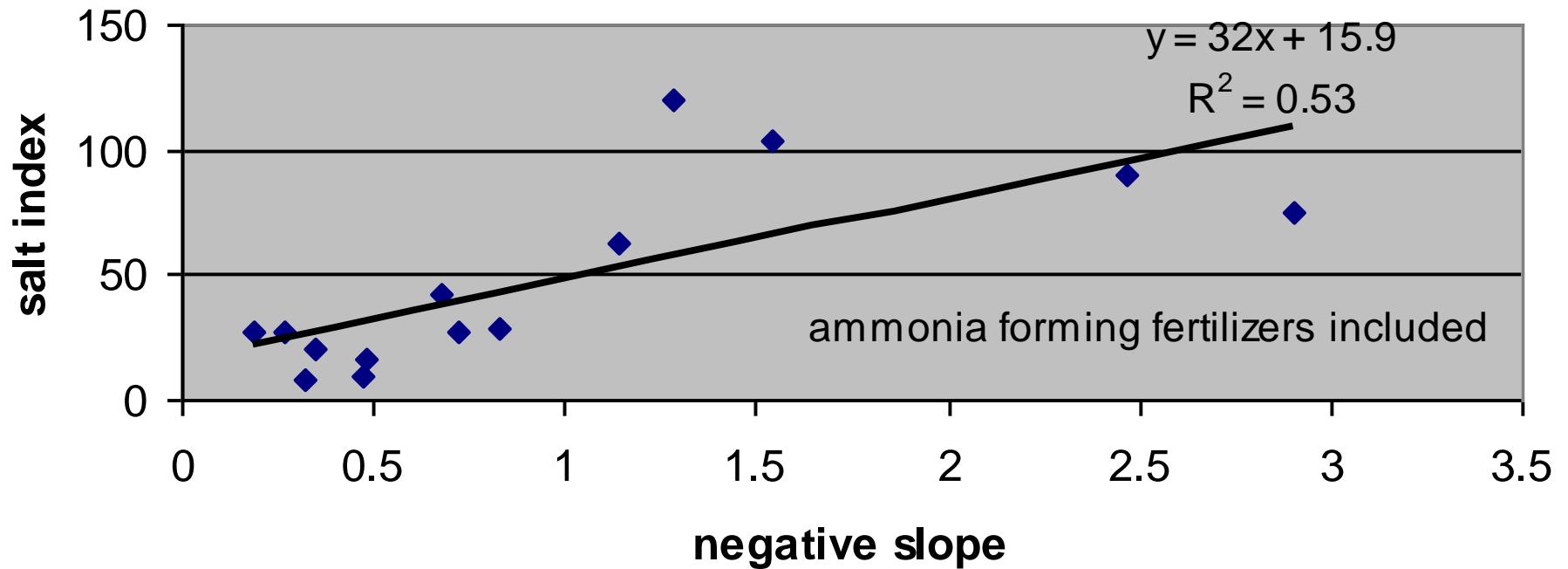
Comments

Suggestions

Ronald.Gelderman@sdstate.edu



**Relationship of fertilizer salt index and average regression slope
(rel. stand regressed on rate) from laboratory study.**



Relationship of fertilizer salt index and average regression slope (rel. stand regressed on rate) from laboratory study.

