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Soybean Seeding Rates: What's the number?

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Outline

- Seeding rates
 - Introduction
 - 2007 results
 - Seeding rate x row spacing interactions
 - Losses through emergence and attrition
 - Seed distribution
 - Populations and Iron Chlorosis
 - New recommendations



Interest is growing in reduced seeding rates. What's driving this?


Transitions

 Bin-run → conventional bagged seed

 Conventional → Roundup Ready

 Roundup Ready → Second generation RR

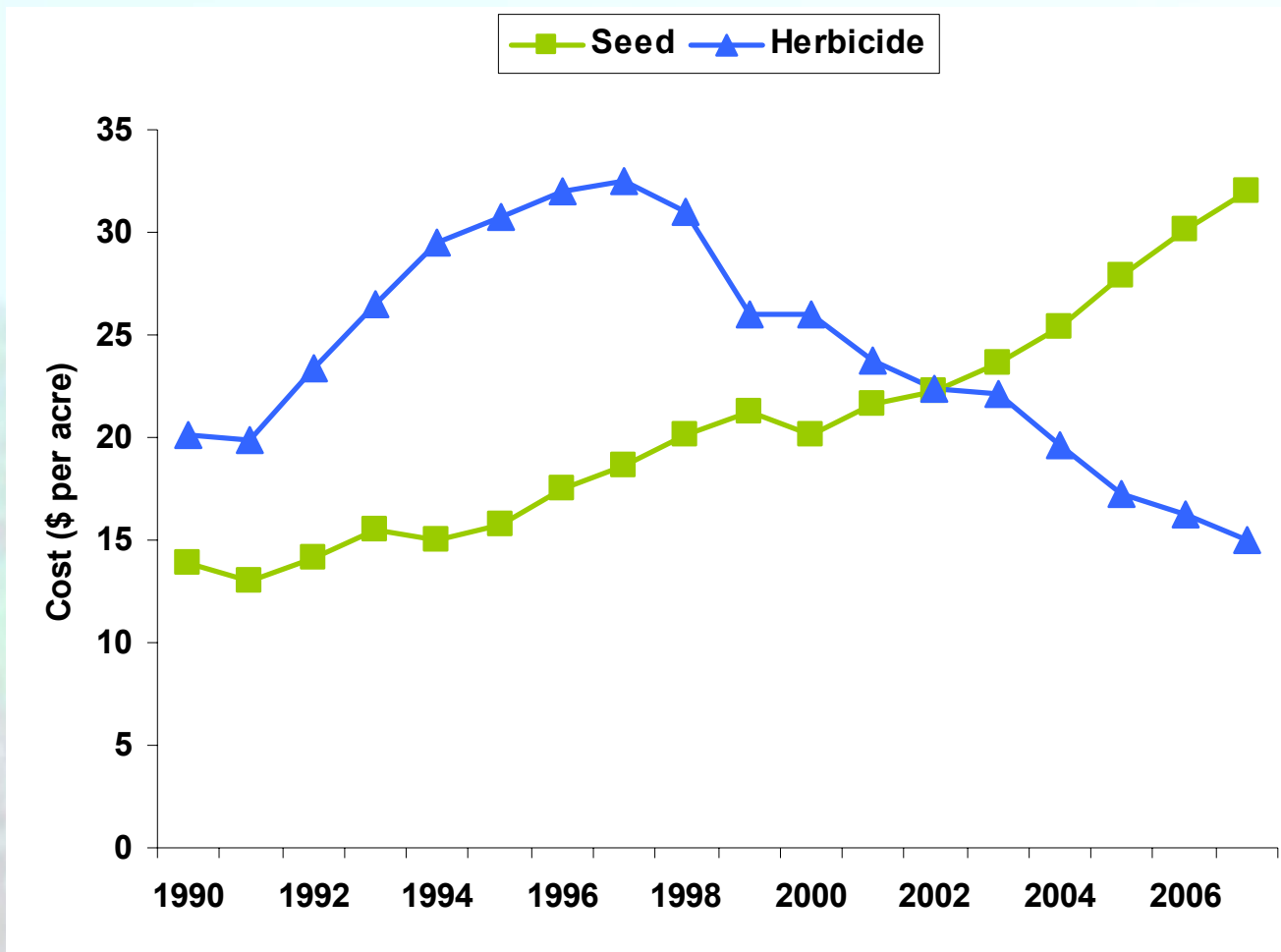
 Inflation

 Seed companies will charge what the market will bare. Currently, its quite a lot.



Soybean Seed and Herbicide Costs per Acre (1990-2007)

(Iowa Farm Business Association, 2007)



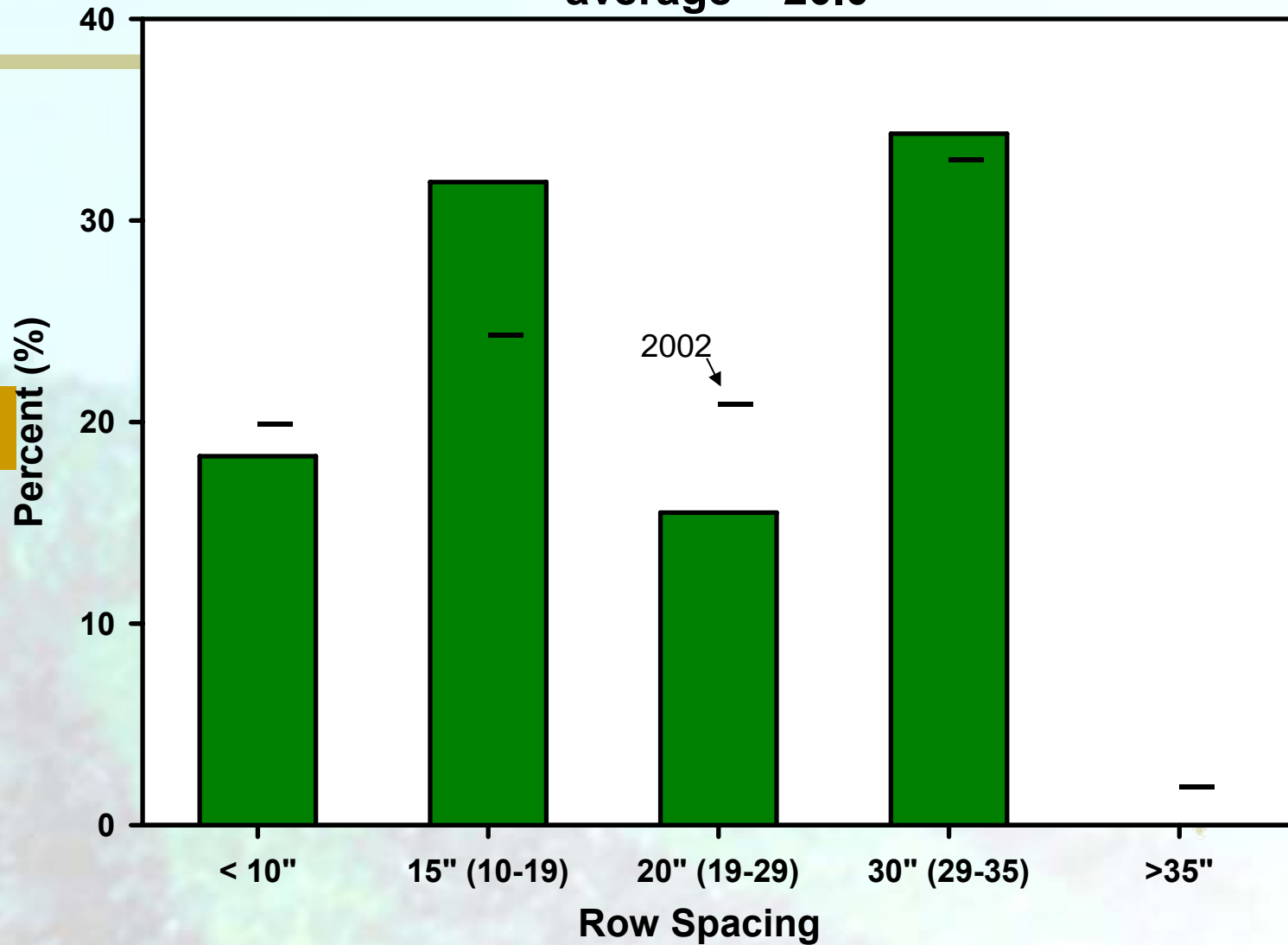
Overview – Soybean Populations

- Incremental yield improvement from increased seeding rates – *per se* – are very small
- Seeding rates serve primarily to establish a minimum stand
 - Higher populations yield better only when stand establishment is very poor.
 - Replanting can be averted by higher initial seeding rates, but often damage is too large
- Risk avoidance –or– “insurance”
 - Increasing rates – insurance against poor emergence and hail
 - A 30% increase in seeding rate requires a 1 Bu/A additional return.
 - -or- One needs 10 bu in 1 of 10 years to pay for a 30% increase.

Overview – Soybean Populations

- The seeding rate to obtain a required stand is dependant on
 - Abiotic –
 - Soil conditions, weather, and their interaction
 - temp, water, residue, compaction, crusting, and precipitation (including hail)
 - planting equipment (planter vs. air seeder)
 - Biotic - Seed quality, herbicide injury, insects, disease, or *operator error*.

2006 (2002) Soybean Row Width in Minnesota average = 20.0"

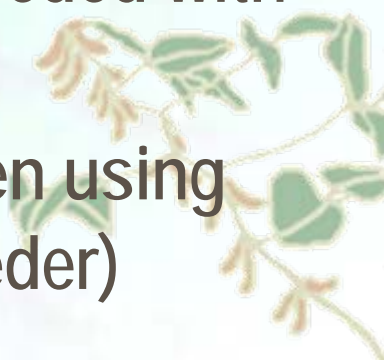


Current State Recommendations

	Germination	-----Recommended Seeding Rates -----		
State		30"	15"	7.5"
		-----Seeds or plants acre ⁻¹ -----		
Iowa-seeds	90%	125 to 140	125 to 140	125 to 140
Kentucky-plants	80%	111 to 139	139 to 167	119 to 179
Michigan-seeds	90%	122 to 157	139 to 174	175 to 280
Missouri-seeds	90%	140,000	175,000	200,000
Ohio-seeds	90%	129,000	160,000	196,000
Indiana-seeds	90%	129,000	160,000	196,000
Wisconsin		-	-	-

Seth's recommendations for Minnesota producers (through 2005)

- Seeding rates should be determined by soybean maturity group being planted (independent of latitude or row space)
 - Group II's – 170K live seeds per acre
 - Group I's – 180K live seeds per acre
 - Group 0's – 190K live seeds per acre
 - Group 00's – 200K live seeds per acre
- Seeding rate may be reduced by 10% when seeded with precision planters
- Seeding rate should be increased by 10% when using some sort of broadcast planter (drill or air seeder)

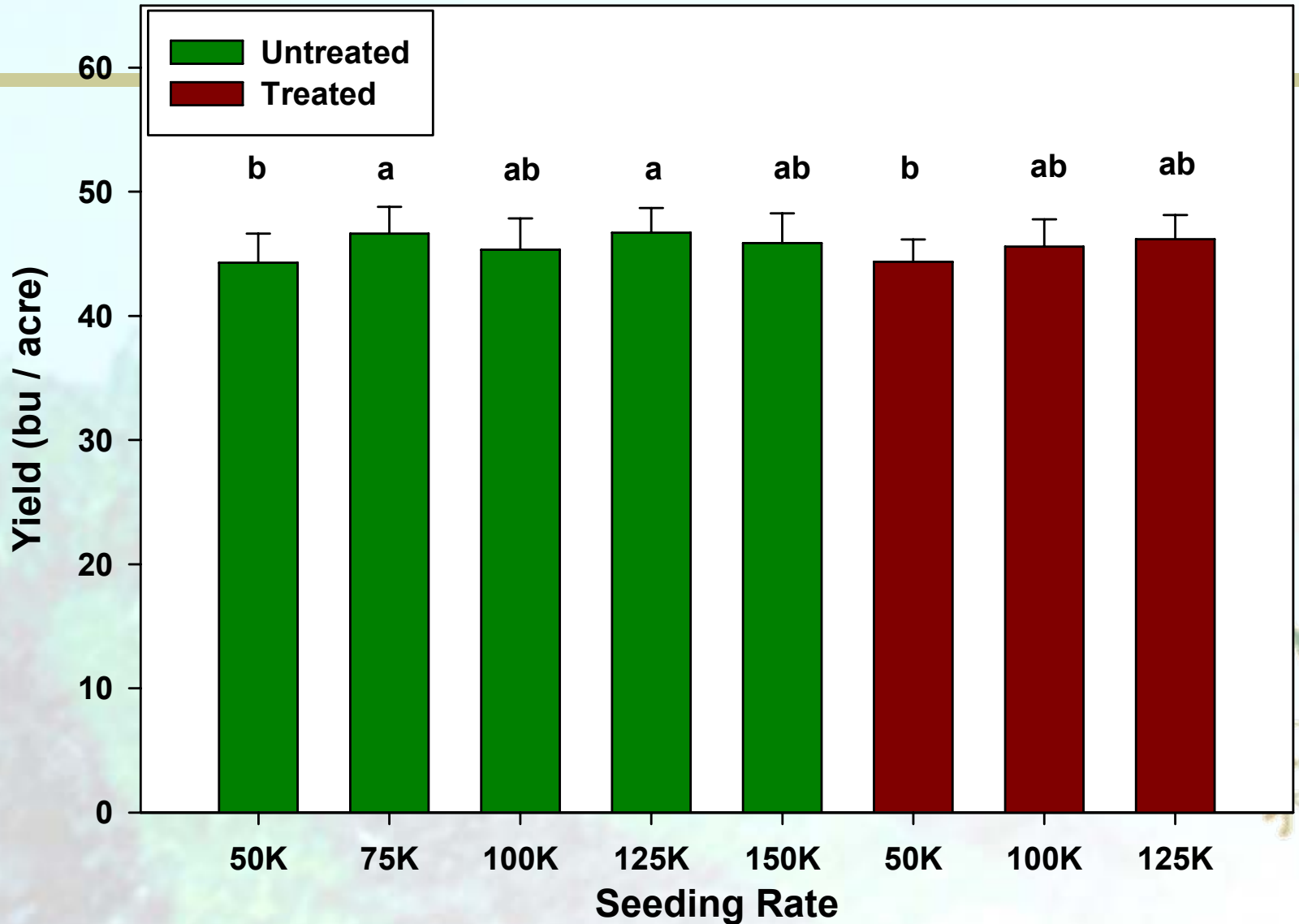


2007 Seeding rate trials

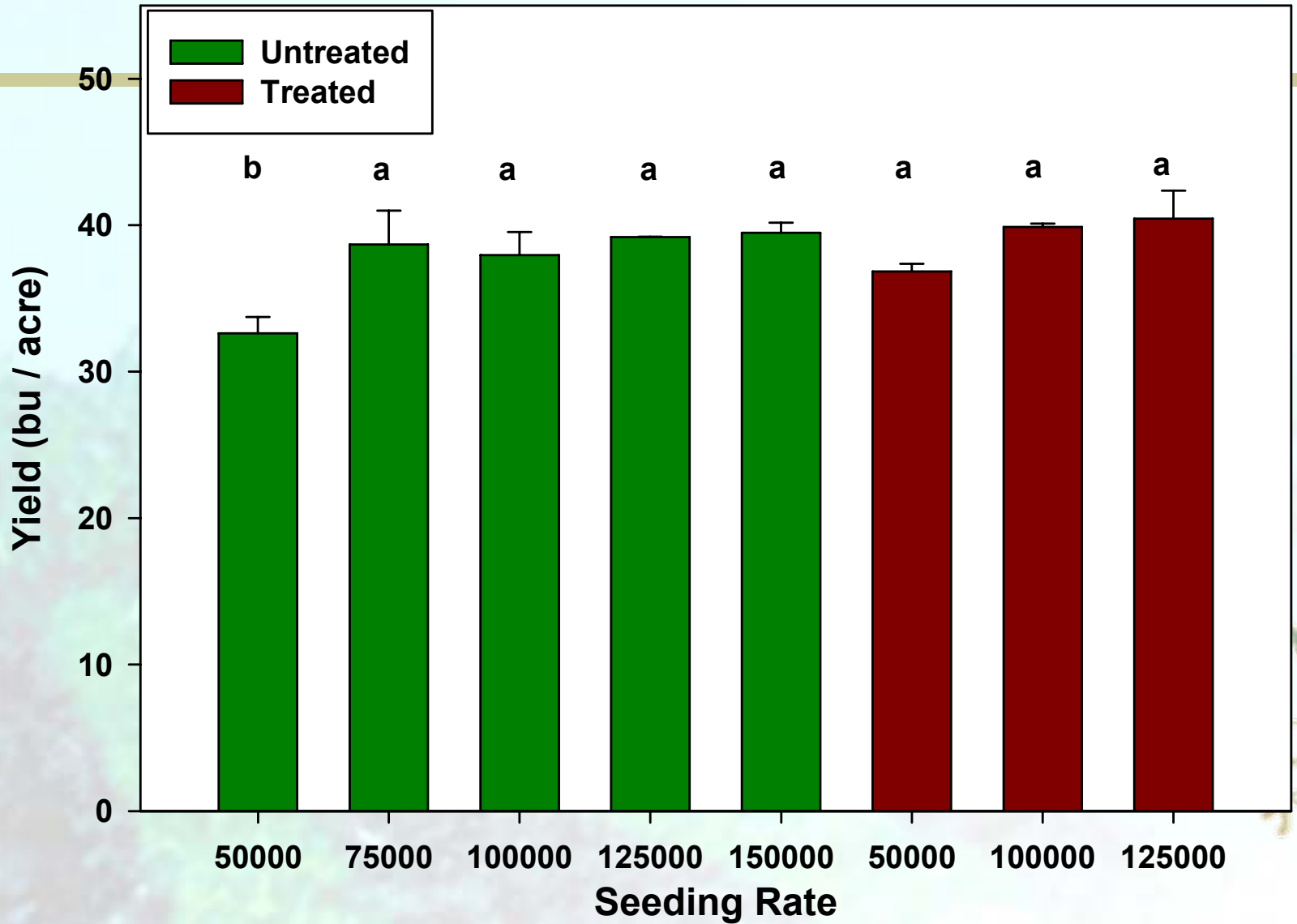
- Fritz Breitenbach, Lisa Behnken, Dave Nicolai, and Liz Stahl
- 5 seeding rates (50K-150K)
- 3 of the above rates also +/- CruiserMaxx
- 5 sites (south of Rosemount)



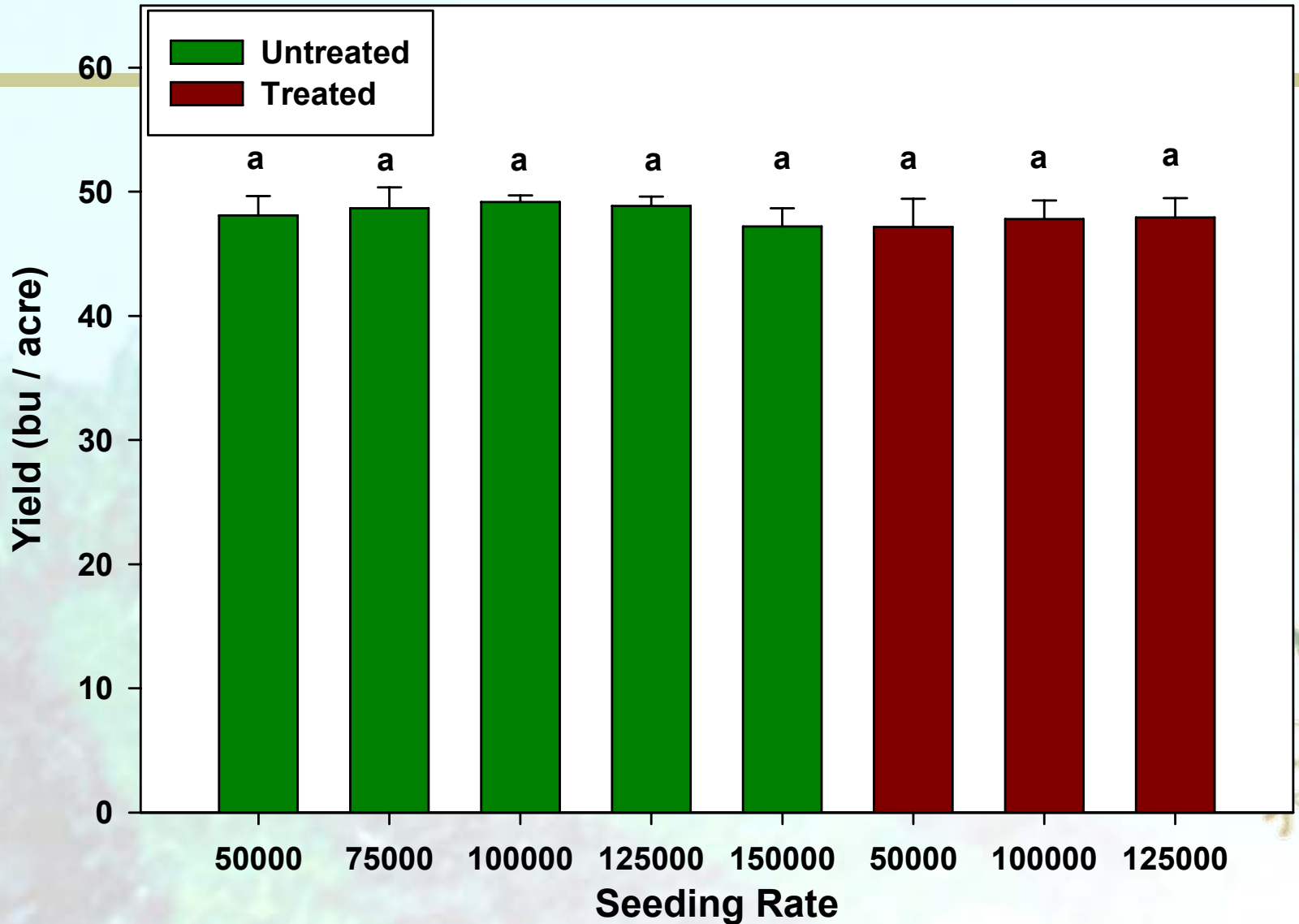
Yield vs Seeding Rate at 5 locations -- 2007



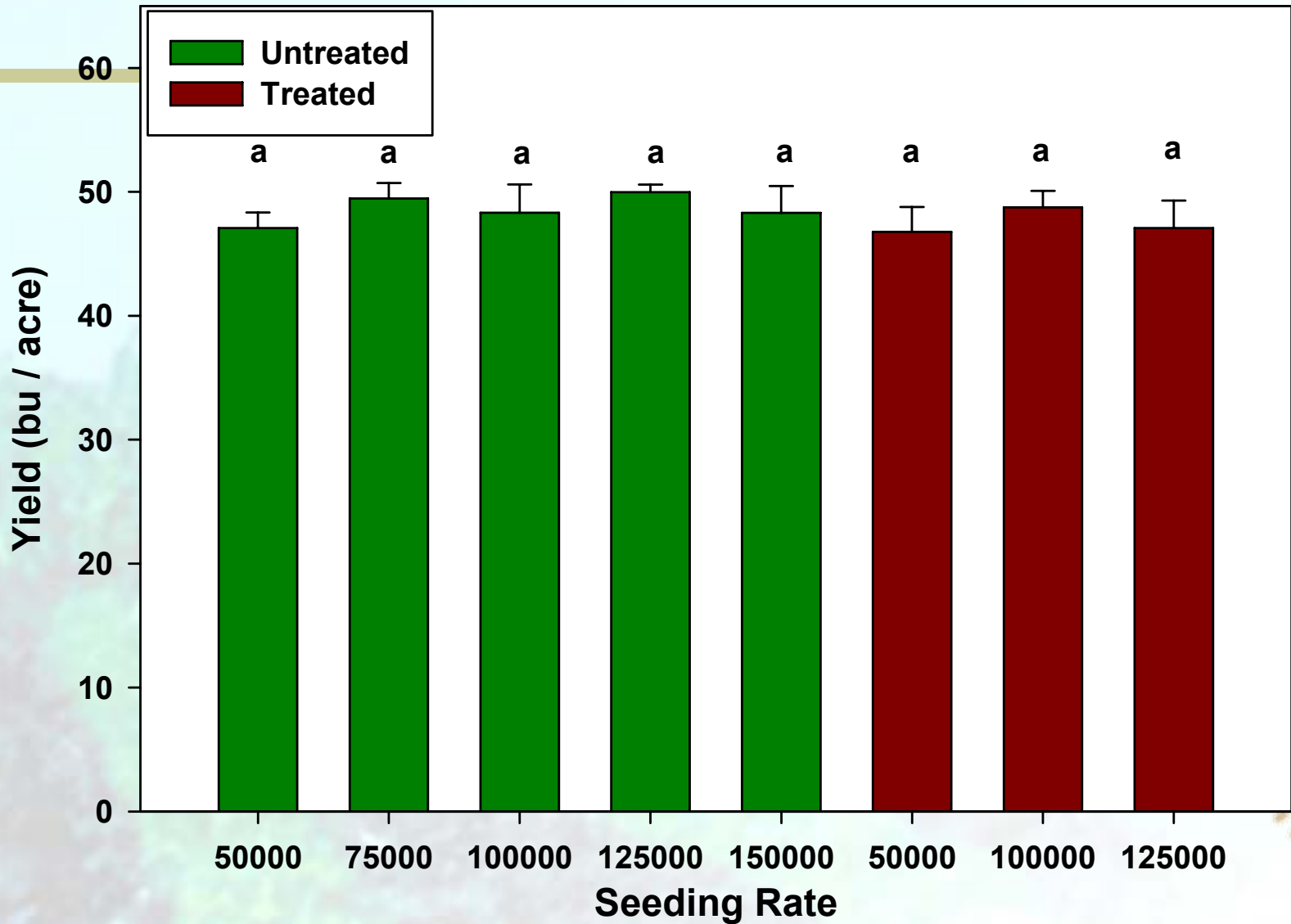
Yield vs Seeding Rate - Lamberton 2007



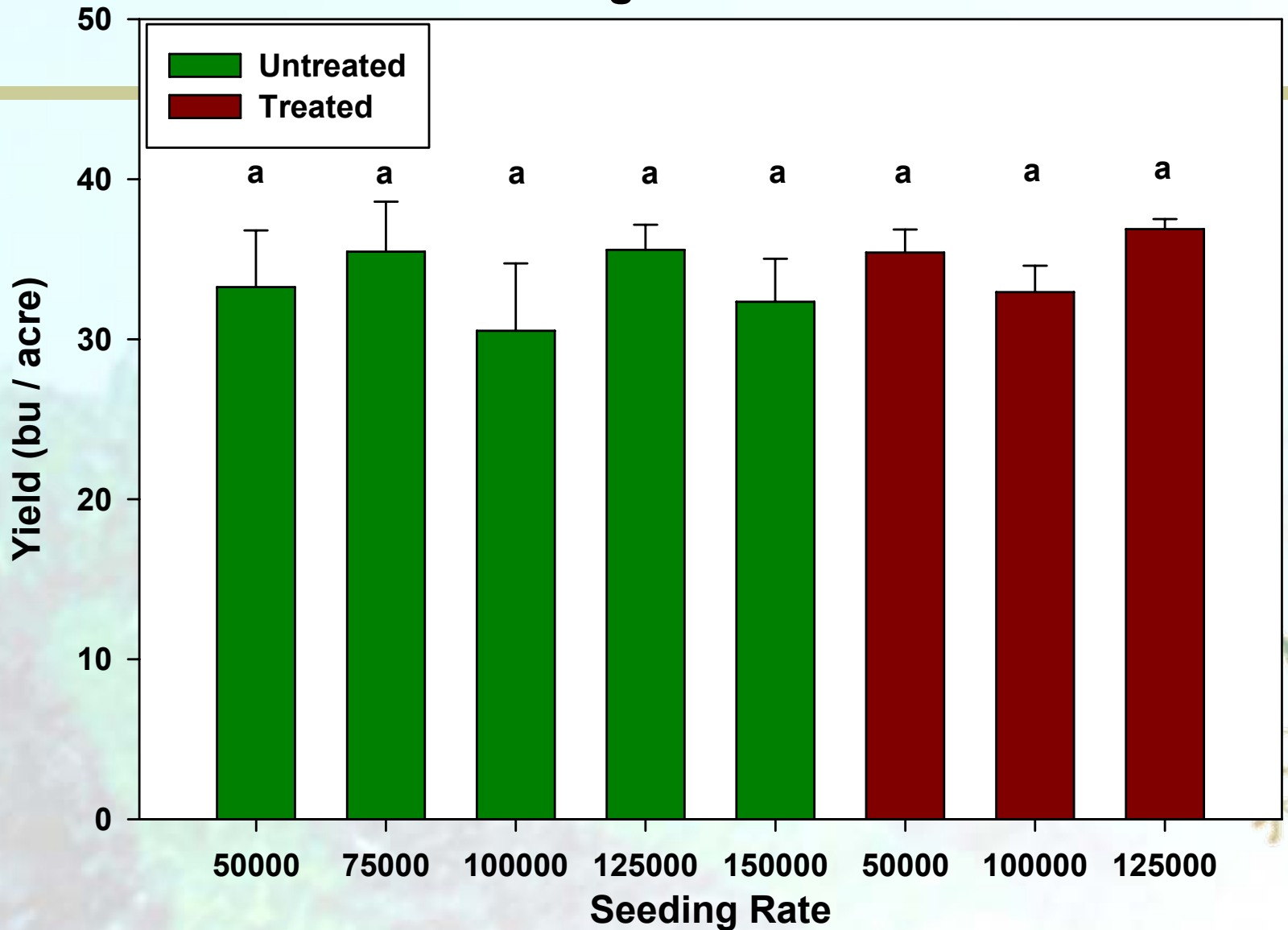
Yield vs Seeding Rate - Rochester 2007



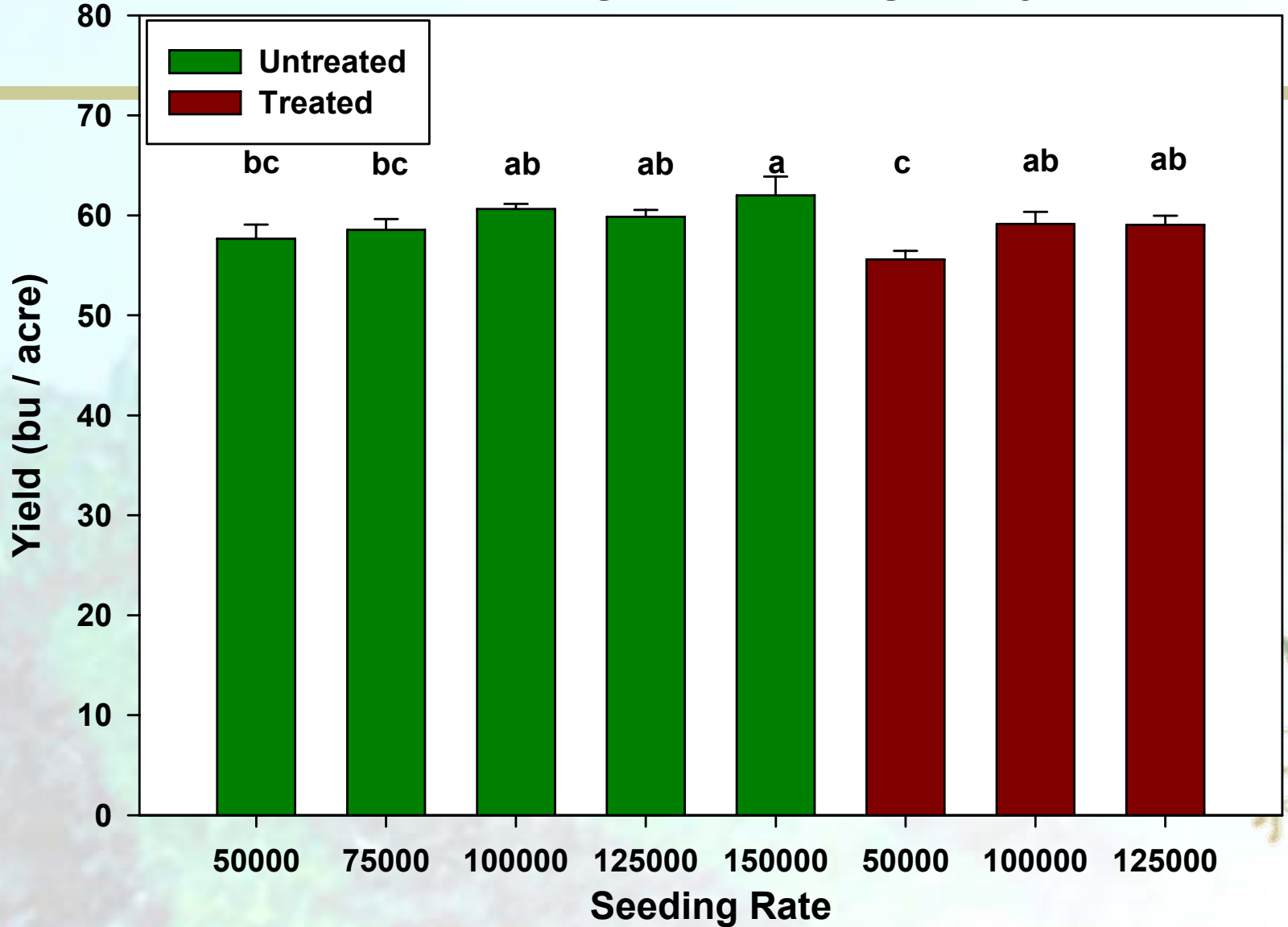
Yield vs Seeding Rate - Rock Dell 2007



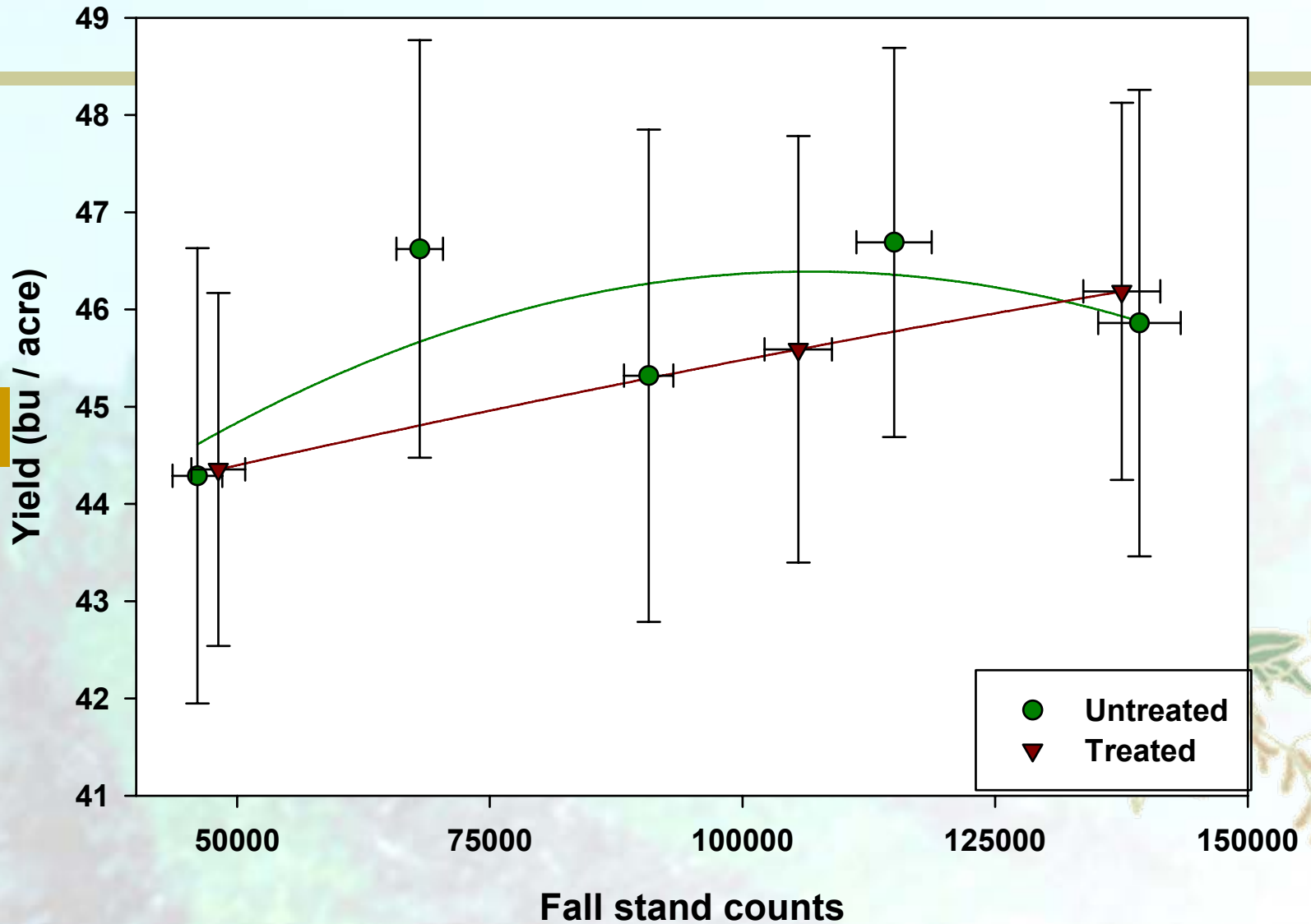
Yield vs Seeding Rate - Rosemount 2007



Yield vs Seeding Rate - Spring Valley 2007



Fall stand counts vs Yield at 5 locations in 2007



Soybean Population Strip Trials at the Dolan site in Sibley County -- Gold Country 2717 NRR

Planted population per acre	Yield adjusted for moisture
164,000	57.5
130,000	55.8
103,000	51.9
74,500	53.6

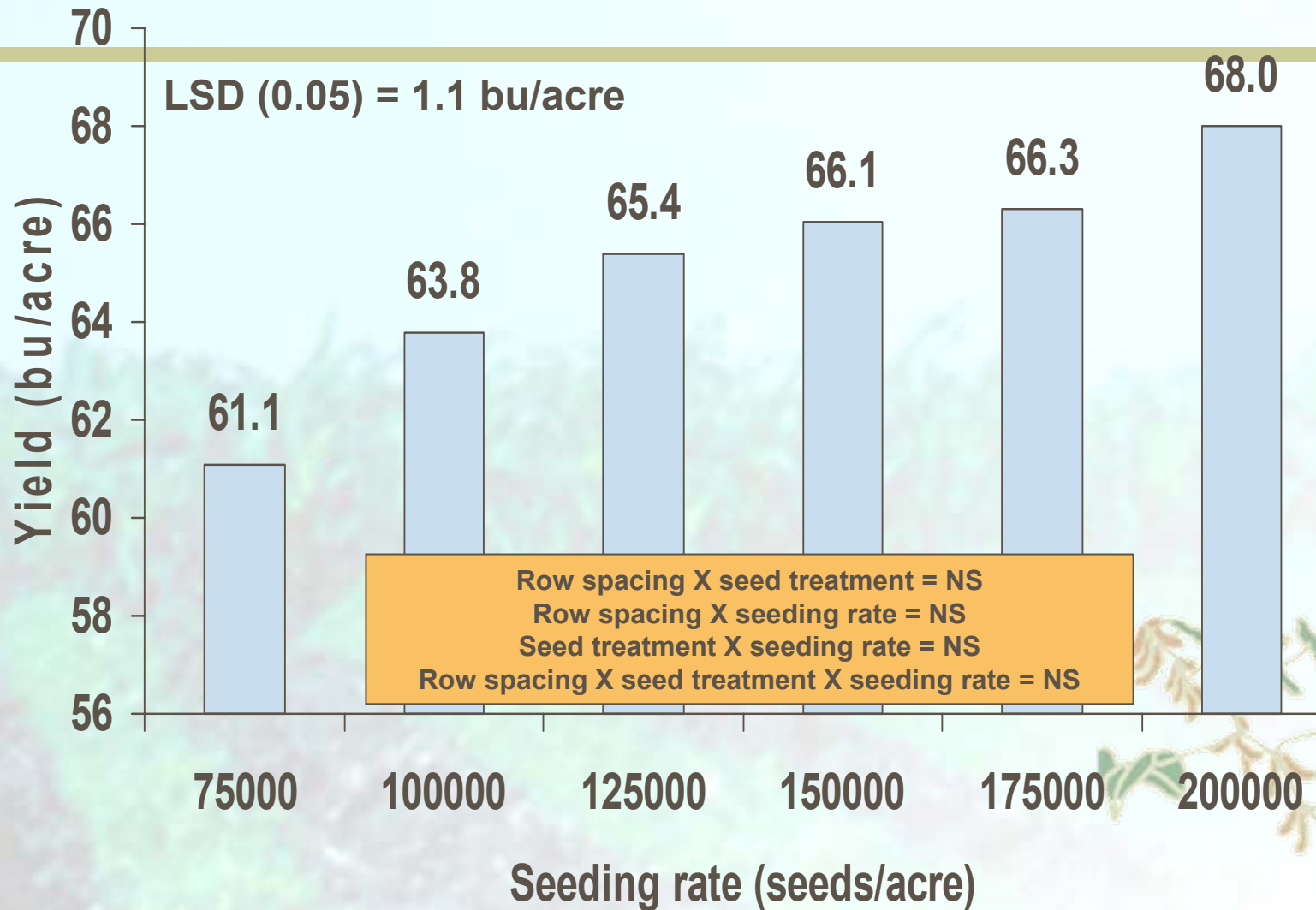
Soybean Population Strip Trials at the Doug Toreen site in Renville County -- Gold Country 2717 NRR

Planted population per acre	Yield adjusted for moisture
164,000	42.8
130,000	44.9
103,000	49.5
74,500	50.0

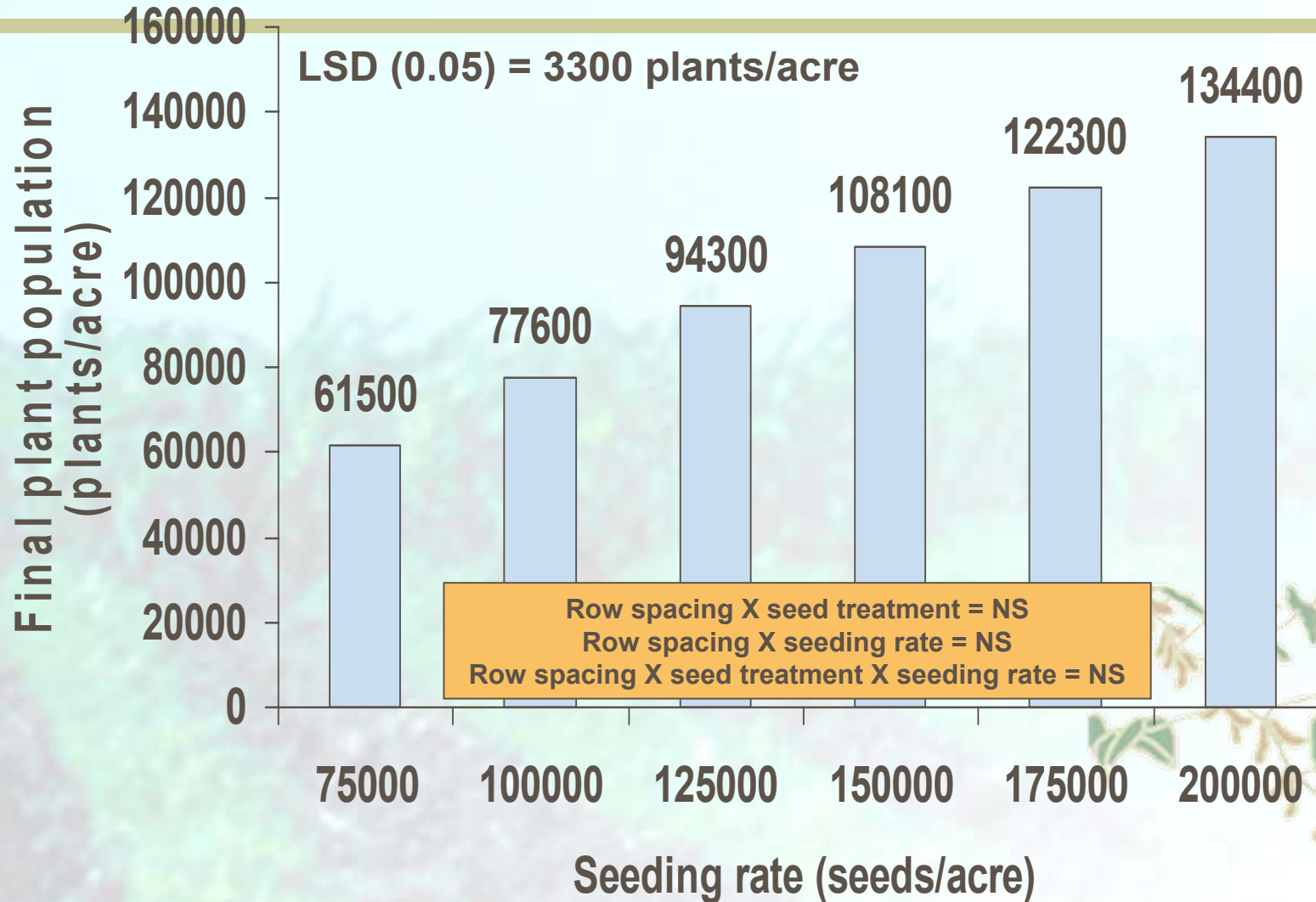
2007 Study conclusion

- ❖ This year's study re-emphasizes the ability of soybean to produce maximum yields at "low" populations
- ❖ Seeding rates above 100K were not needed to maximize yields
- ❖ Occasionally, reduced yields from higher seeding rates do show up.
- ❖ *CruiserMaxx had no impact on yield or yield response to populations*

Seeding Rate Effect on Yield Across 13 Iowa Environments (2005-2007)



Seeding Rate Effect on Final Plant Population Across 13 Environments (2005-2007)



Iowa Conclusions

- 100,000 plants at harvest is sufficient for maximizing yields.
- Plant at 125-140K under good conditions

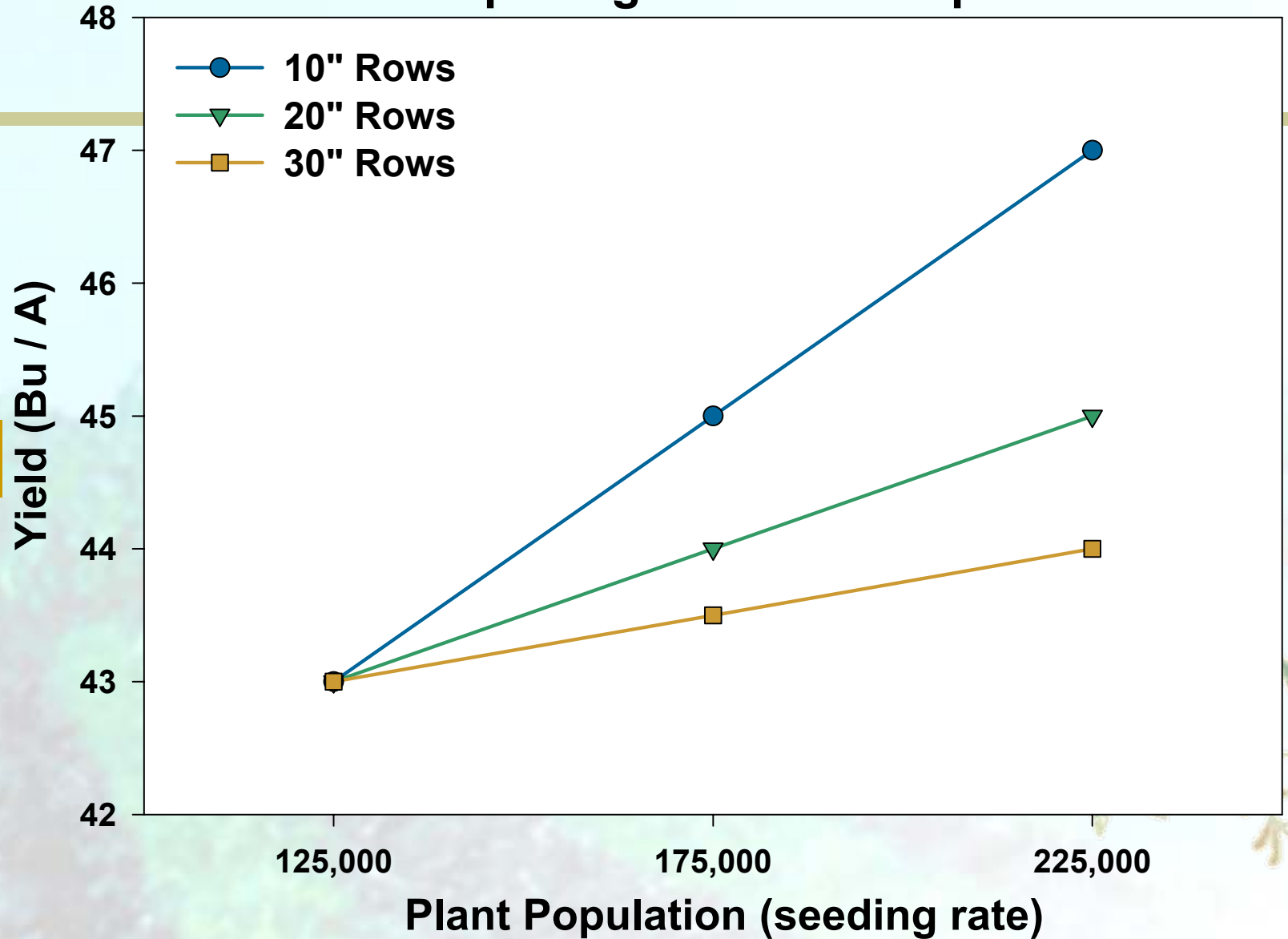


Row spacing effects

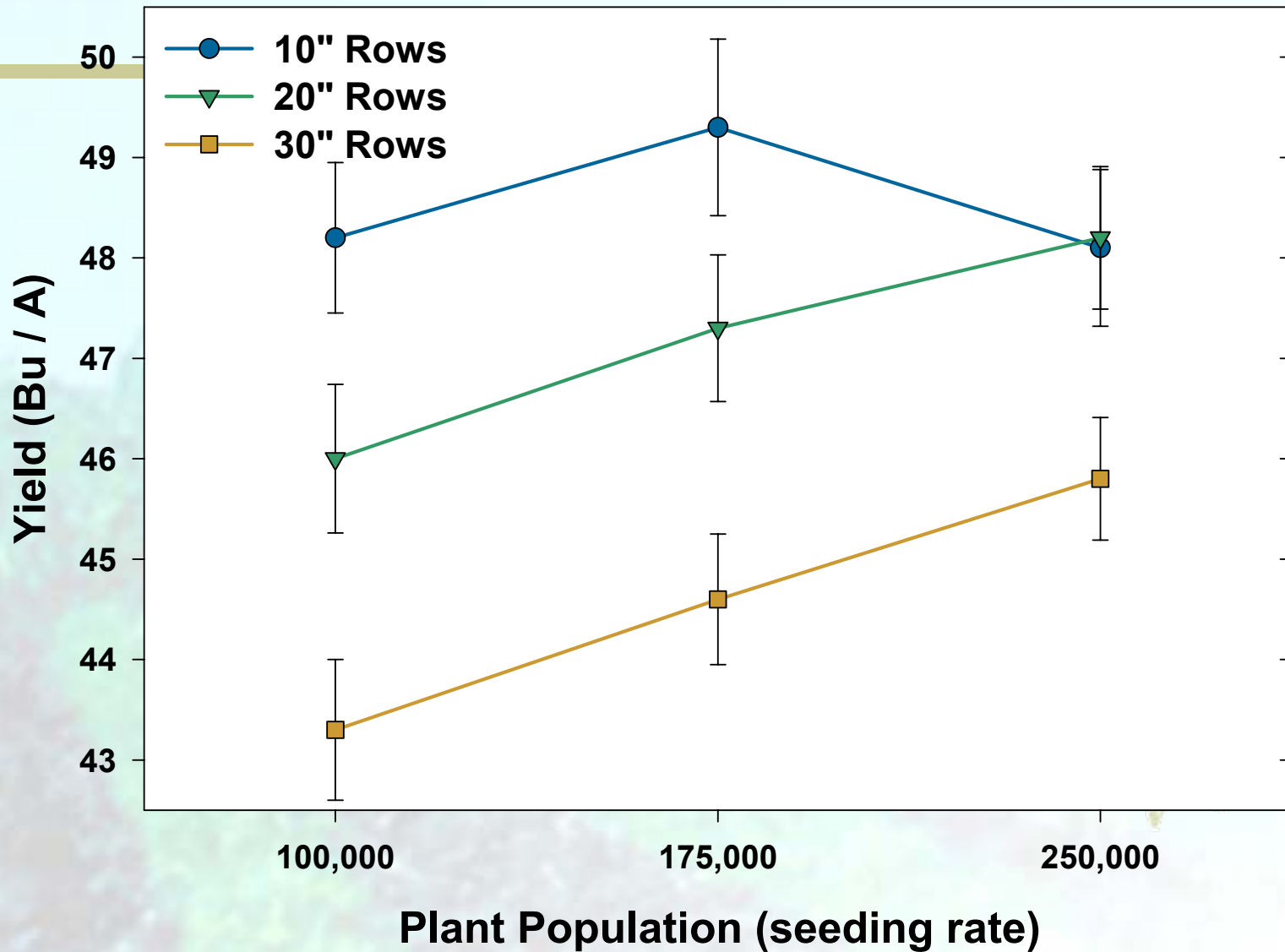
- Many states still recommend higher seeding rates for narrow rows



Classic Soybean Yield Response to Row spacing and Plant Population



Soybean Yield Response to Row Spacing and Plant Population 12 Environments in 1999-2000



Seth's recommendations for Minnesota producers (through 2005)

- ✦ Seeding rates should be determined by soybean maturity group being planted (independent of latitude or row space)
 - ✦ Group II's – 170K live seeds per acre
 - ✦ Group I's – 180K live seeds per acre
 - ✦ Group 0's – 190K live seeds per acre
 - ✦ Group 00's – 200K live seeds per acre
- ✦ Seeding rate may be reduced by 10% when seeded with precision planters
- ✦ Seeding rate should be increased by 10% when using some sort of broadcast planter (drill or air seeder)

Soybean emergence and attrition

- What effects do population, row spacing, and seed distribution have on emergence and attrition?
 - Seeds, seedlings, and plants compete with each other when they are very close to one another within a row
- Does planting machinery affect emergence?





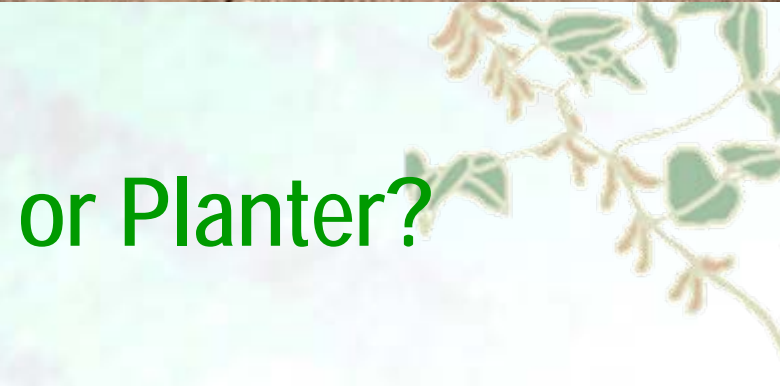
Air Seeder,



Drill,



or Planter?



Air Seeder,



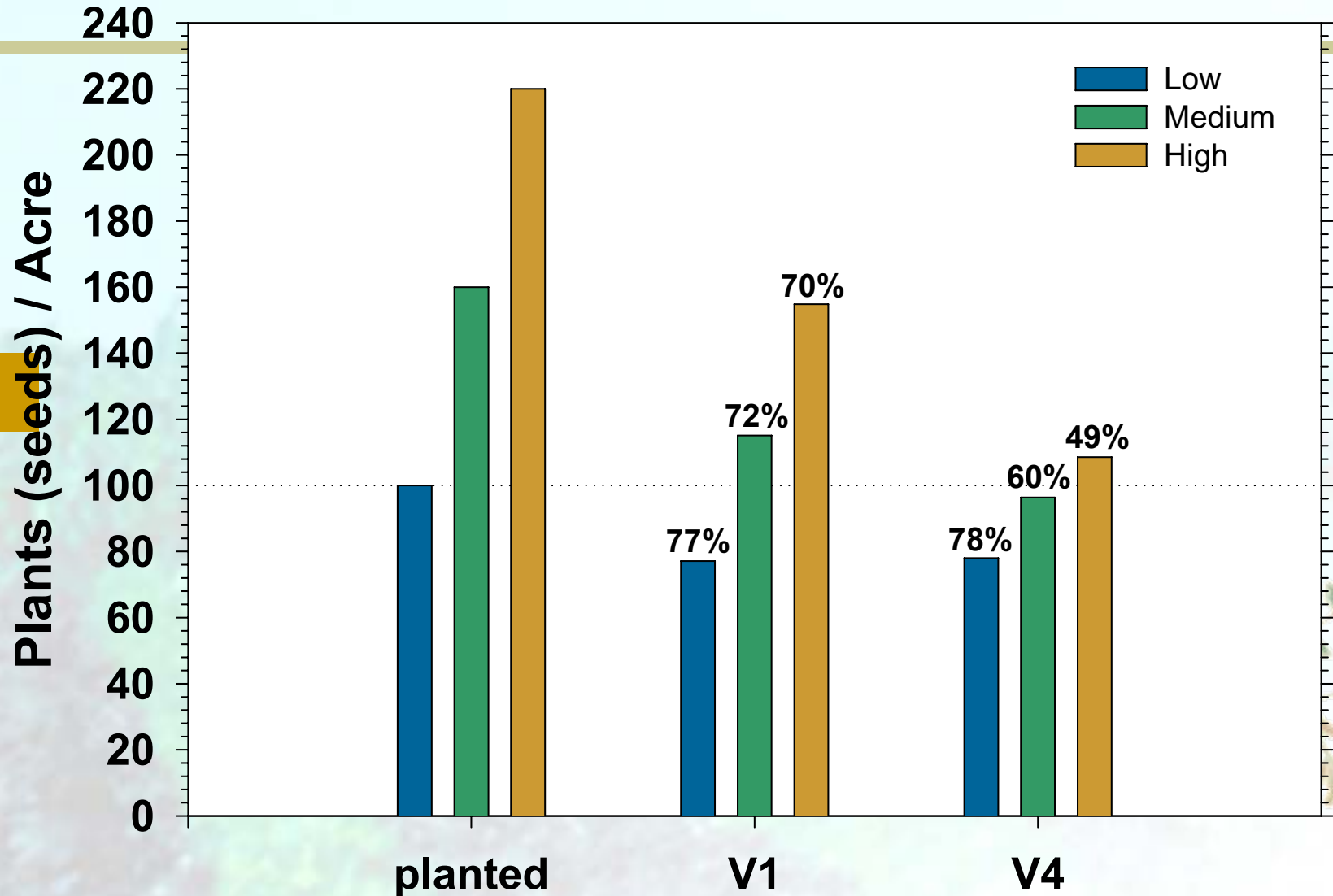
Drill,



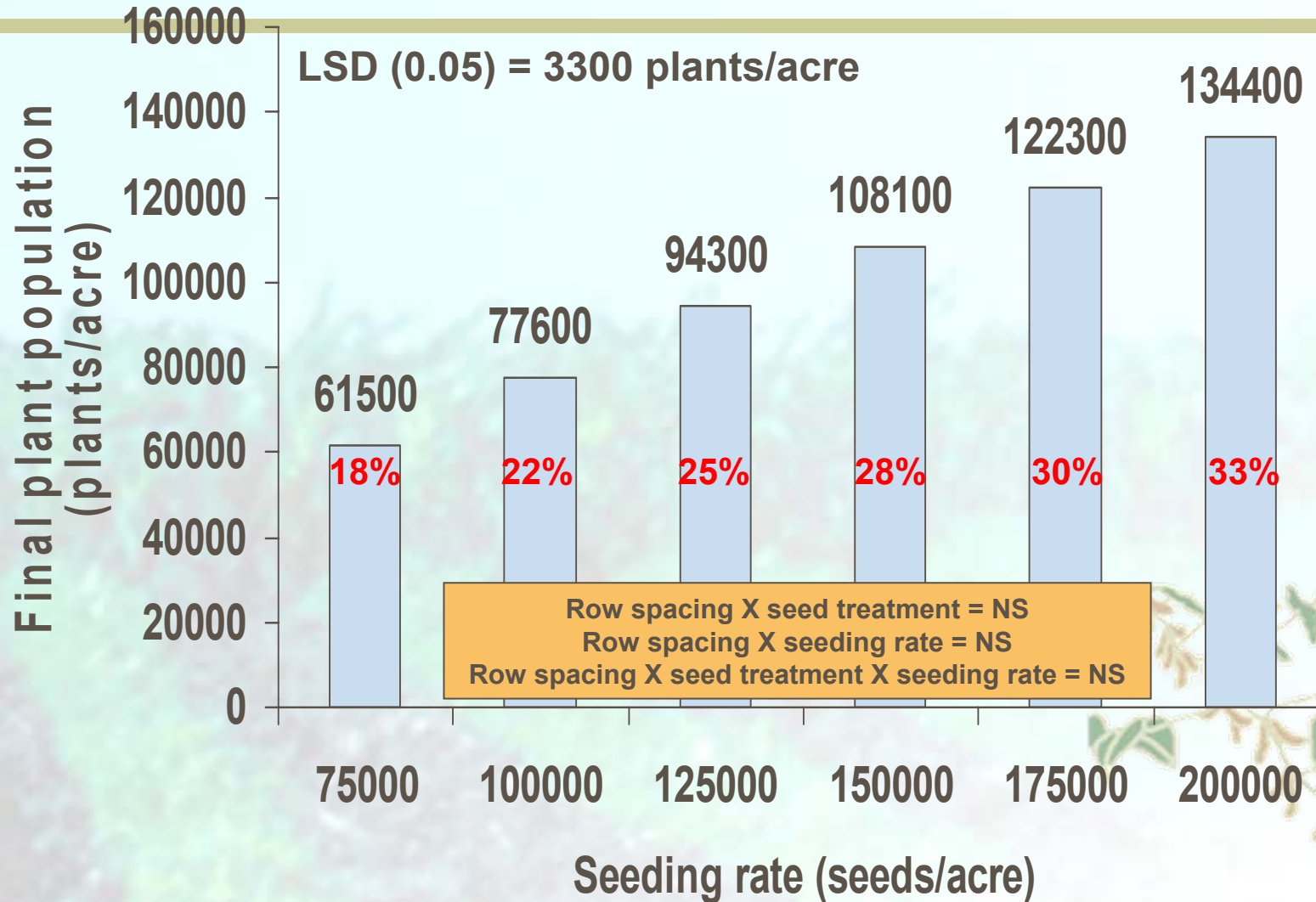
or Planter?



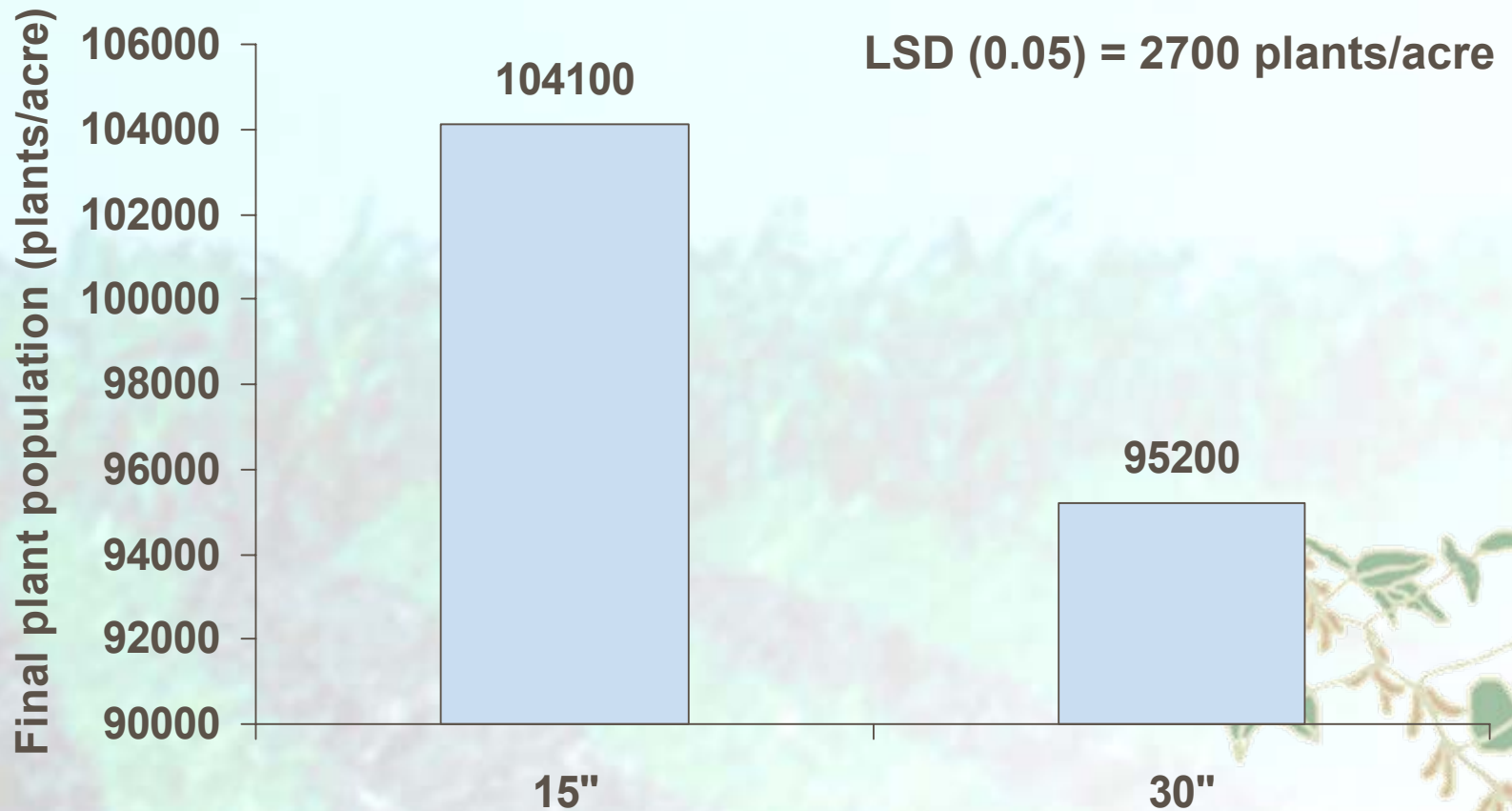
1999 Lamberton Seed Treatment Study -stand counts-



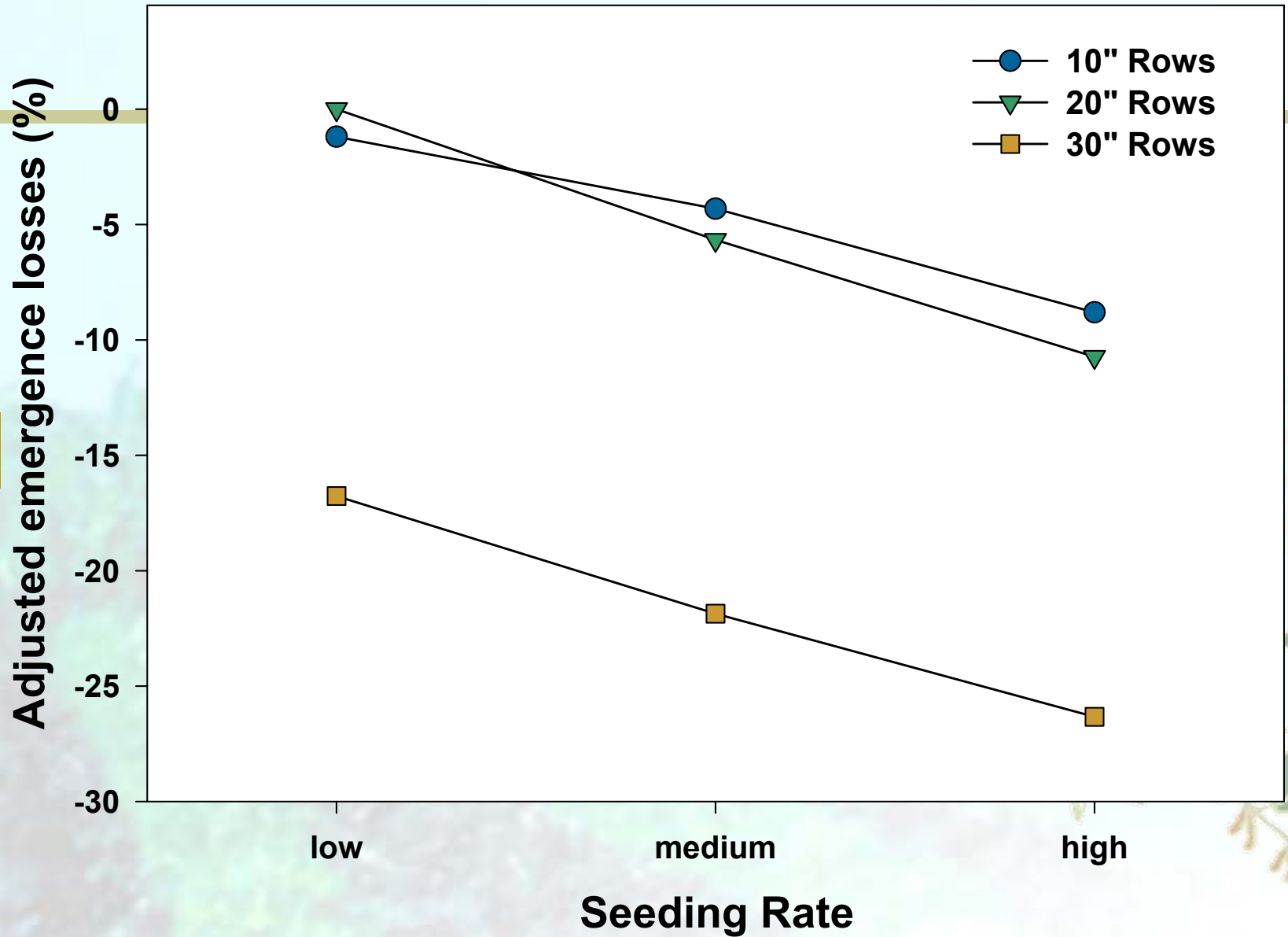
Seeding Rate Effect on Final Plant Population Across 13 Environments (2005-2007)



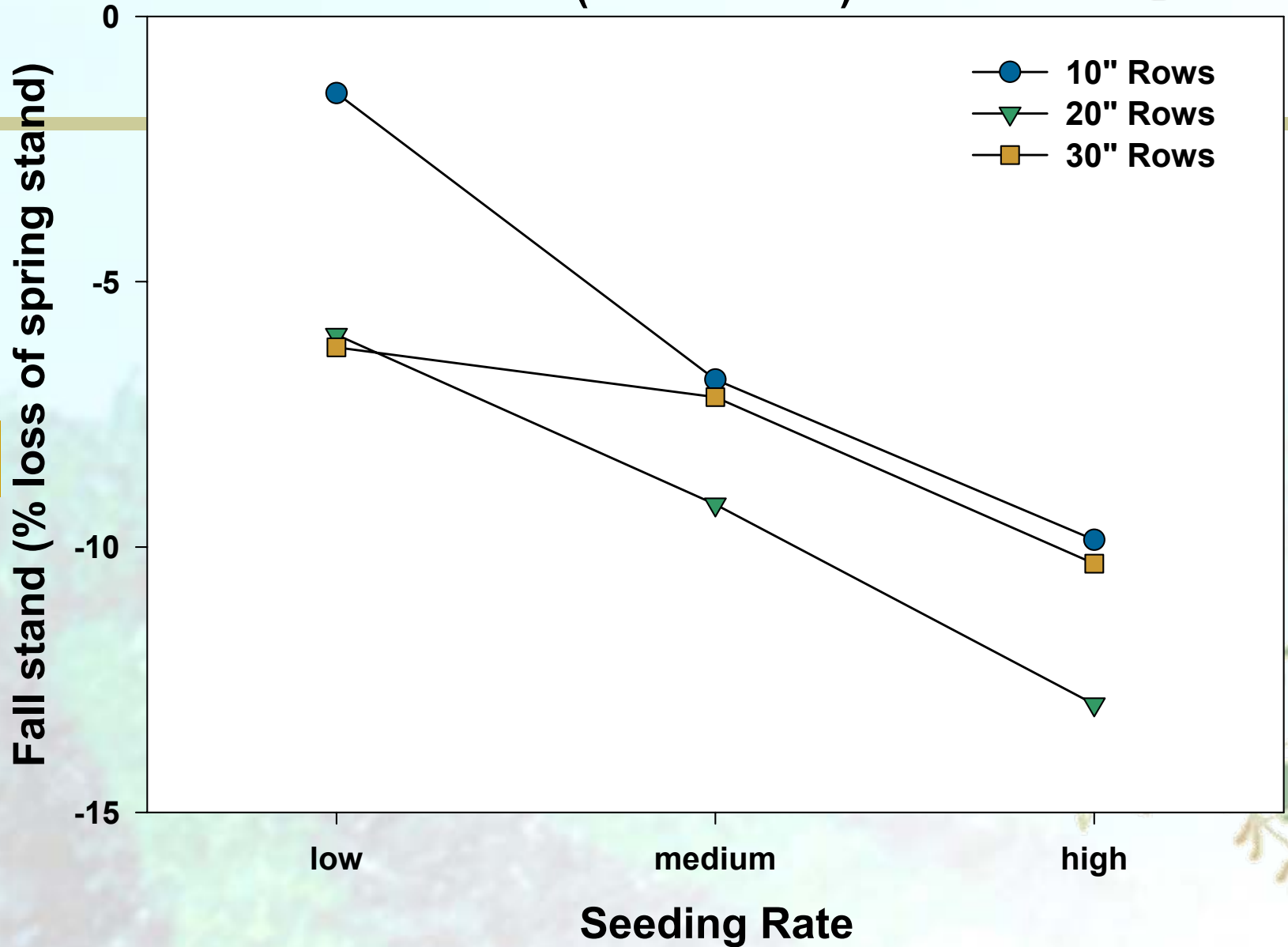
Row Spacing Effect on Final Plant Population Across 13 Iowa Environments (2005-2007)



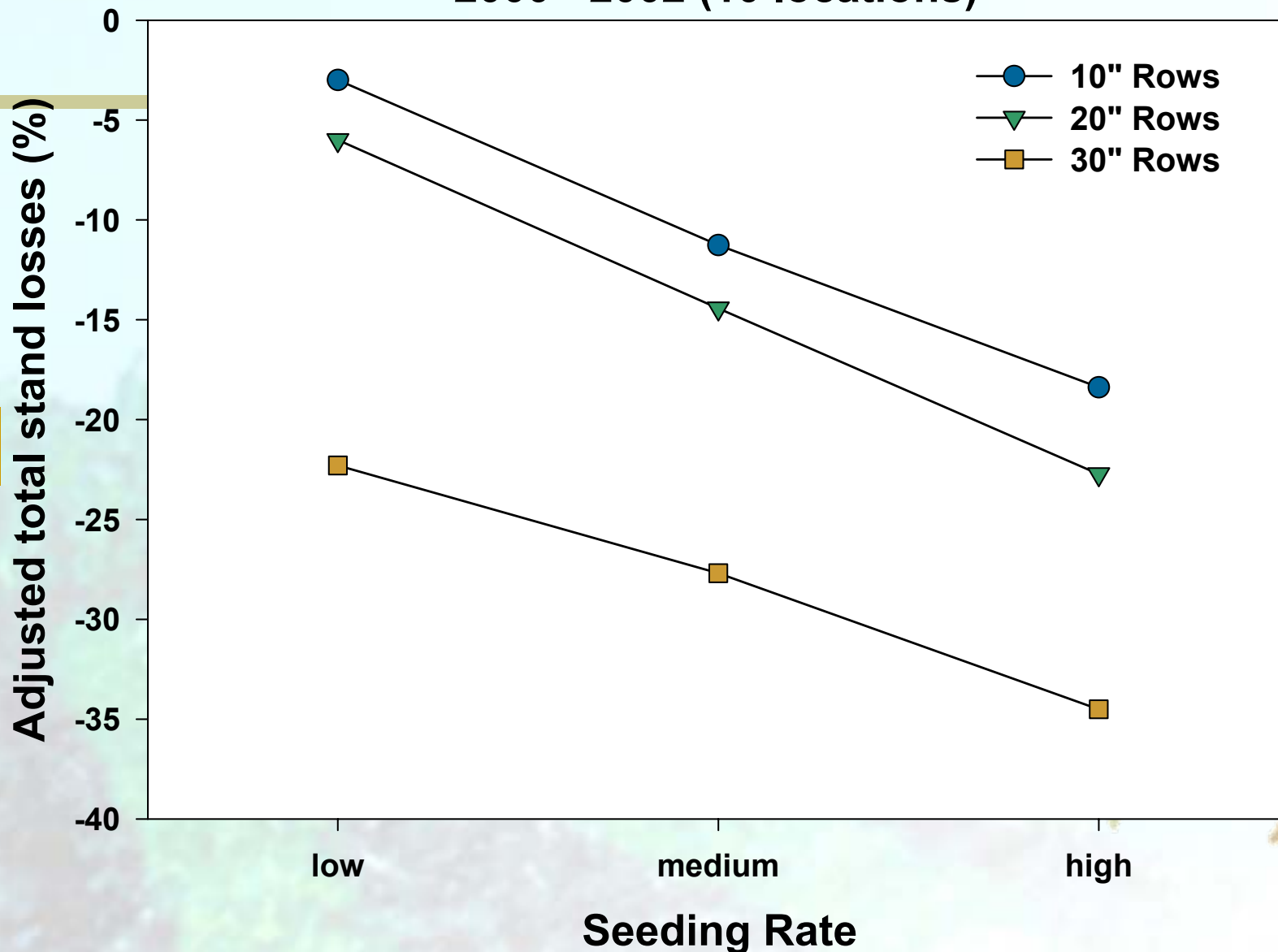
Adjusted soybean emergence 2000 - 2002 (10 locations)



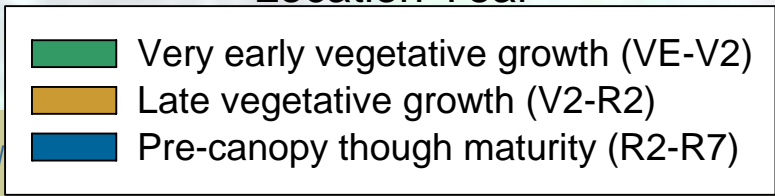
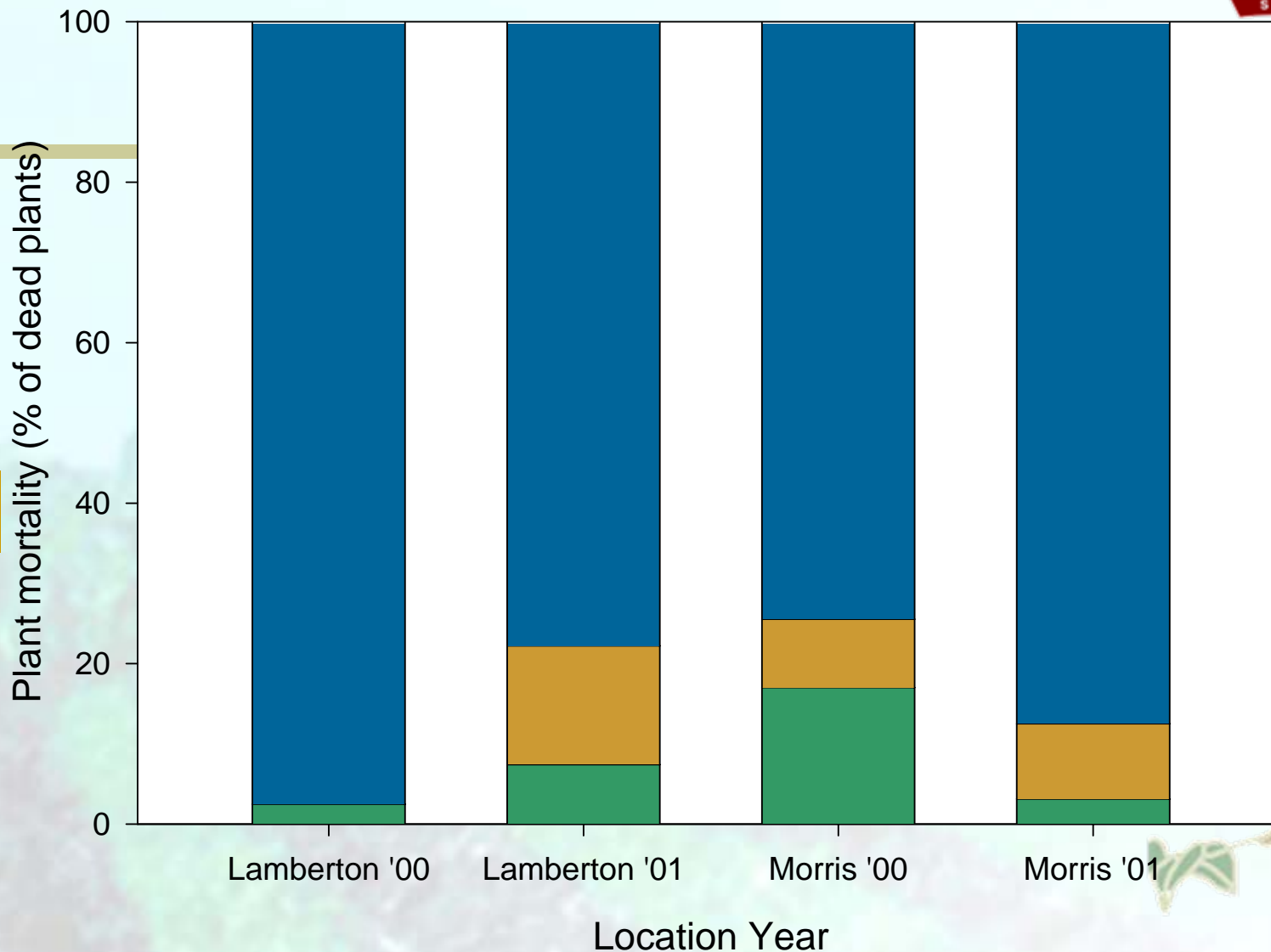
Soybean attrition 2000 - 2002 (10 locations)



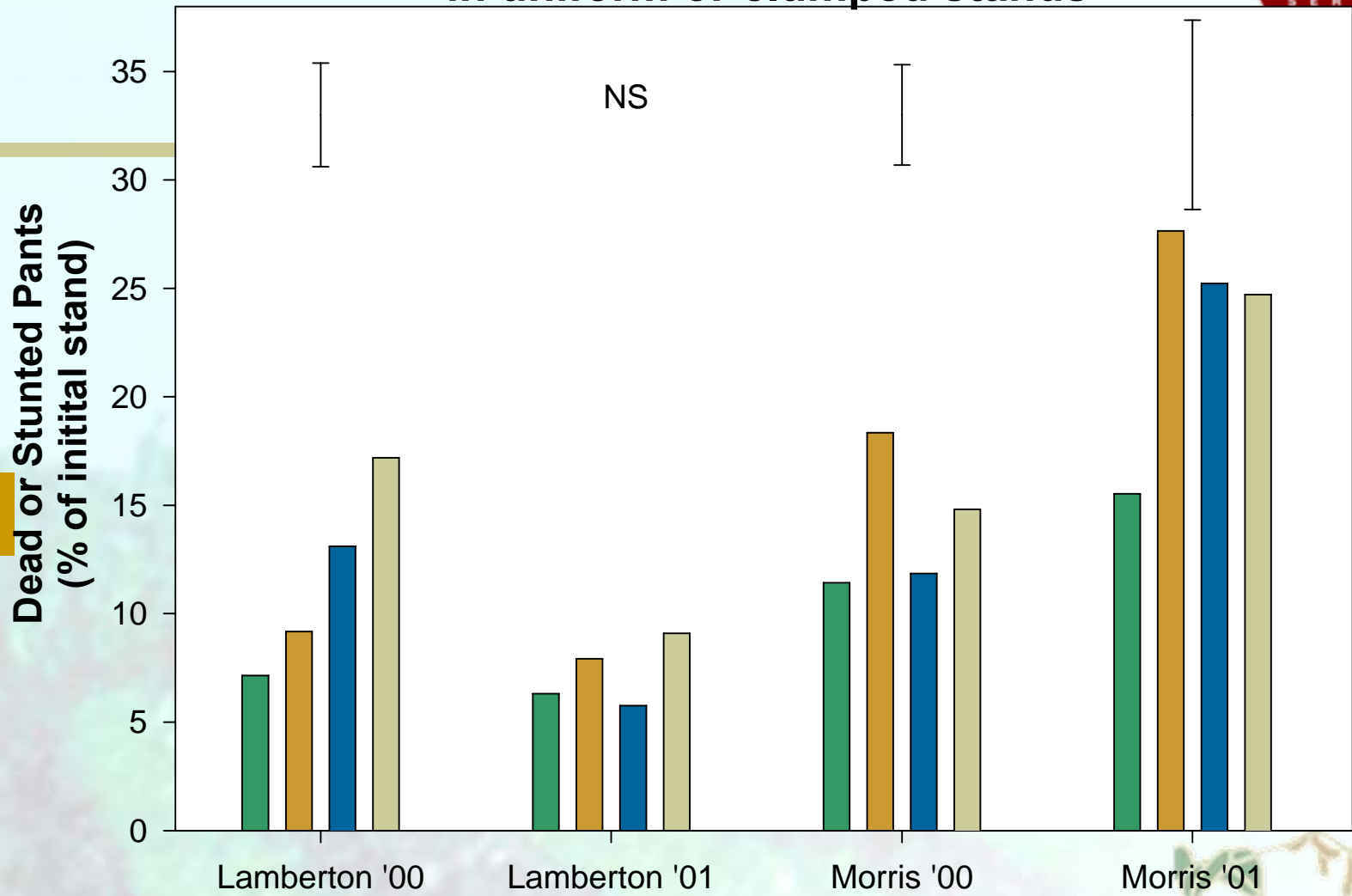
Adjusted total soybean stand losses emergence + attrition 2000 - 2002 (10 locations)



Soybean plant mortality by growth stage



Non-competitive plants in uniform or clumped stands



Uniform seed distribution
0% Clumped (random distribution)
25% Clumped
50% Clumped
LSD $P \leq 0.10$

Location Year

Seed distribution – conjecture

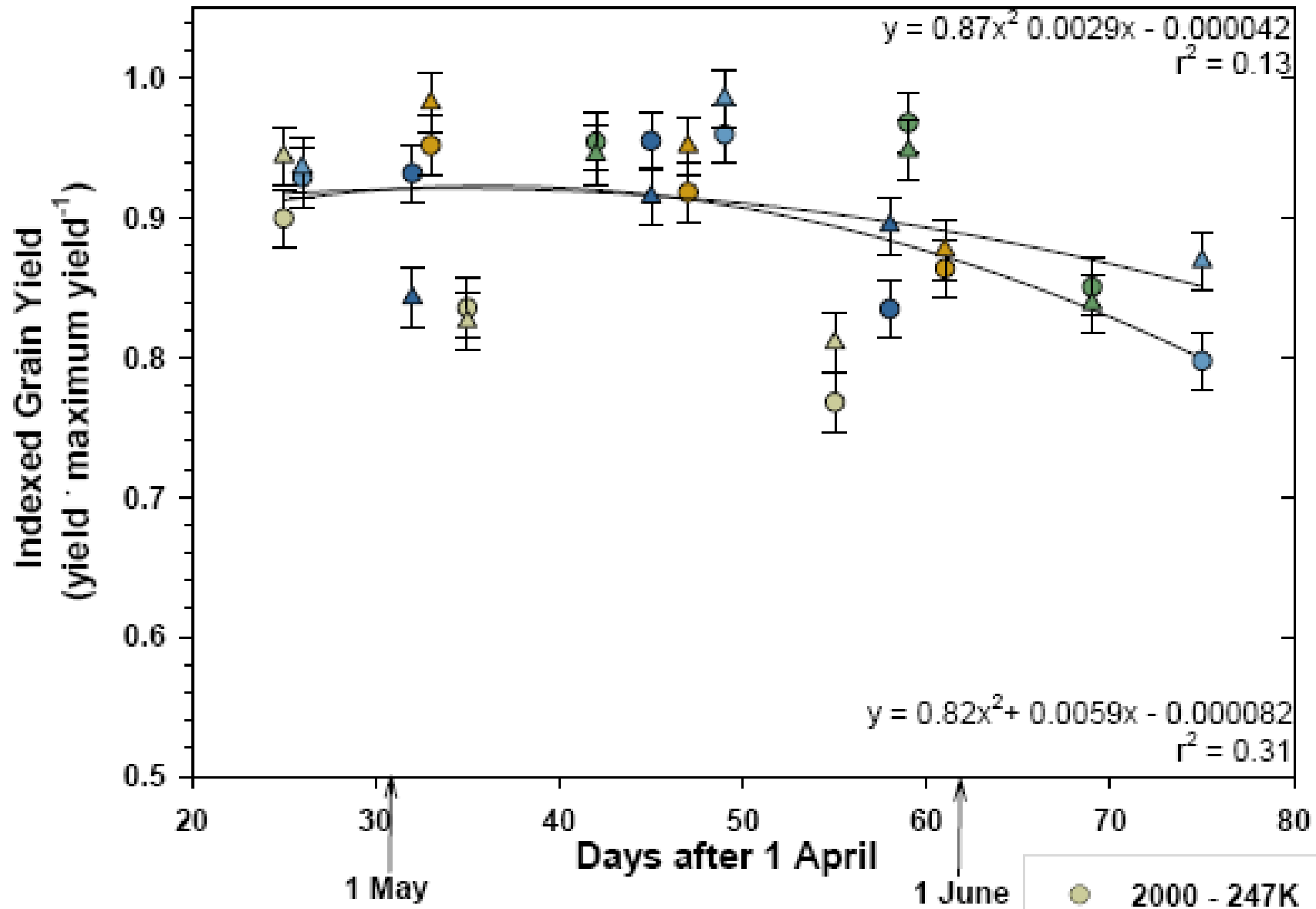
- ❏ Poor distribution will only effect yields when –
 - ❑ Seeding rather low rates (125-140K)
 - ❑ In poor growth environments (weather-disease-fertility)
- ❏ Double- and triple-drops do not cost yield, but those seeds may be wasted
- ❏ Wide rows amplify the effects of poor distribution
- ❏ Producers using older soybean planter units or drills cannot afford to be too conservative about seeding rates.
- ❏ One can still buy a lot of beans for the price of a new planter

Seeding rate and date of planting

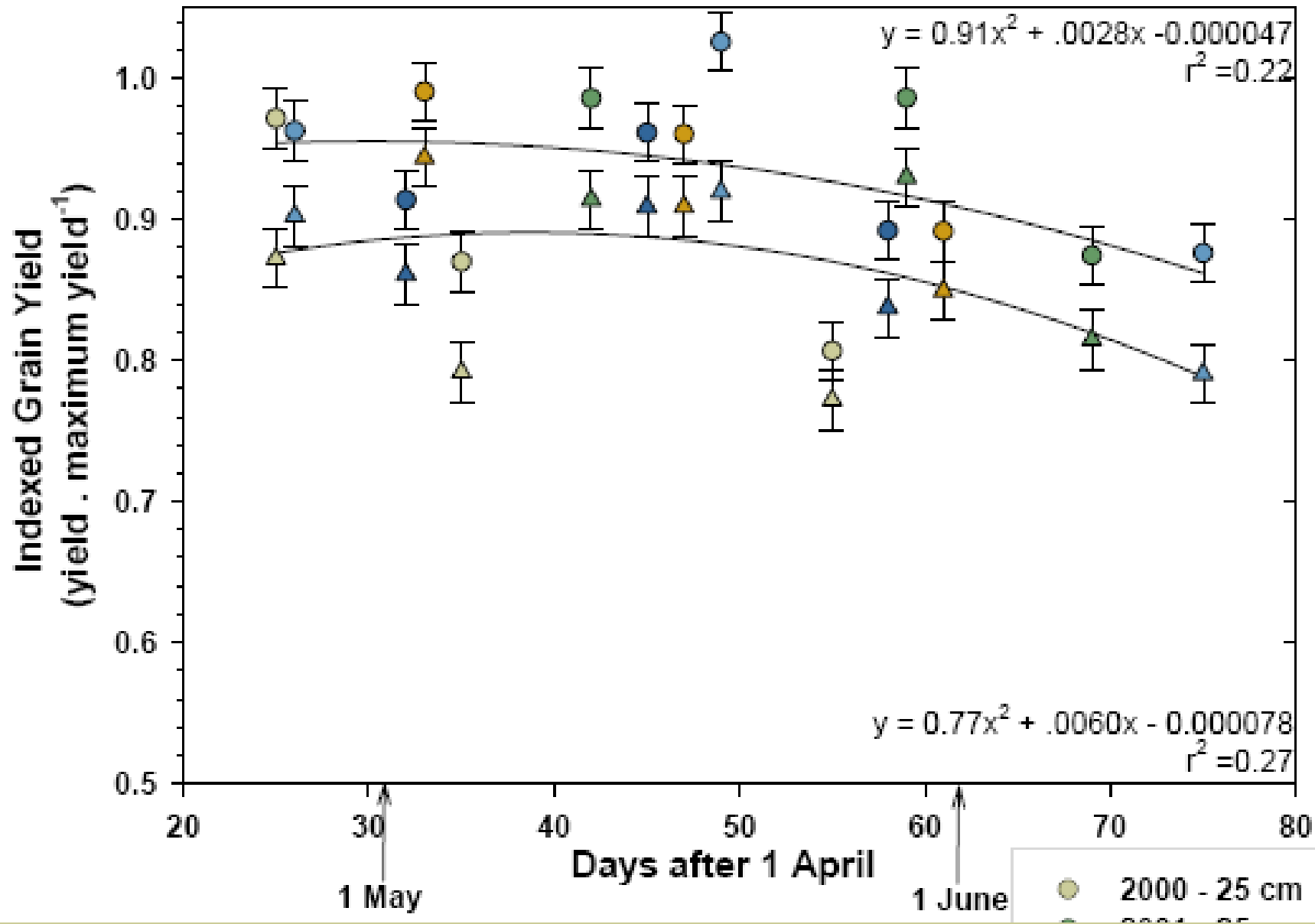
- Should early or late planted soybeans be planted at higher than normal rates?
- What about row spacing?



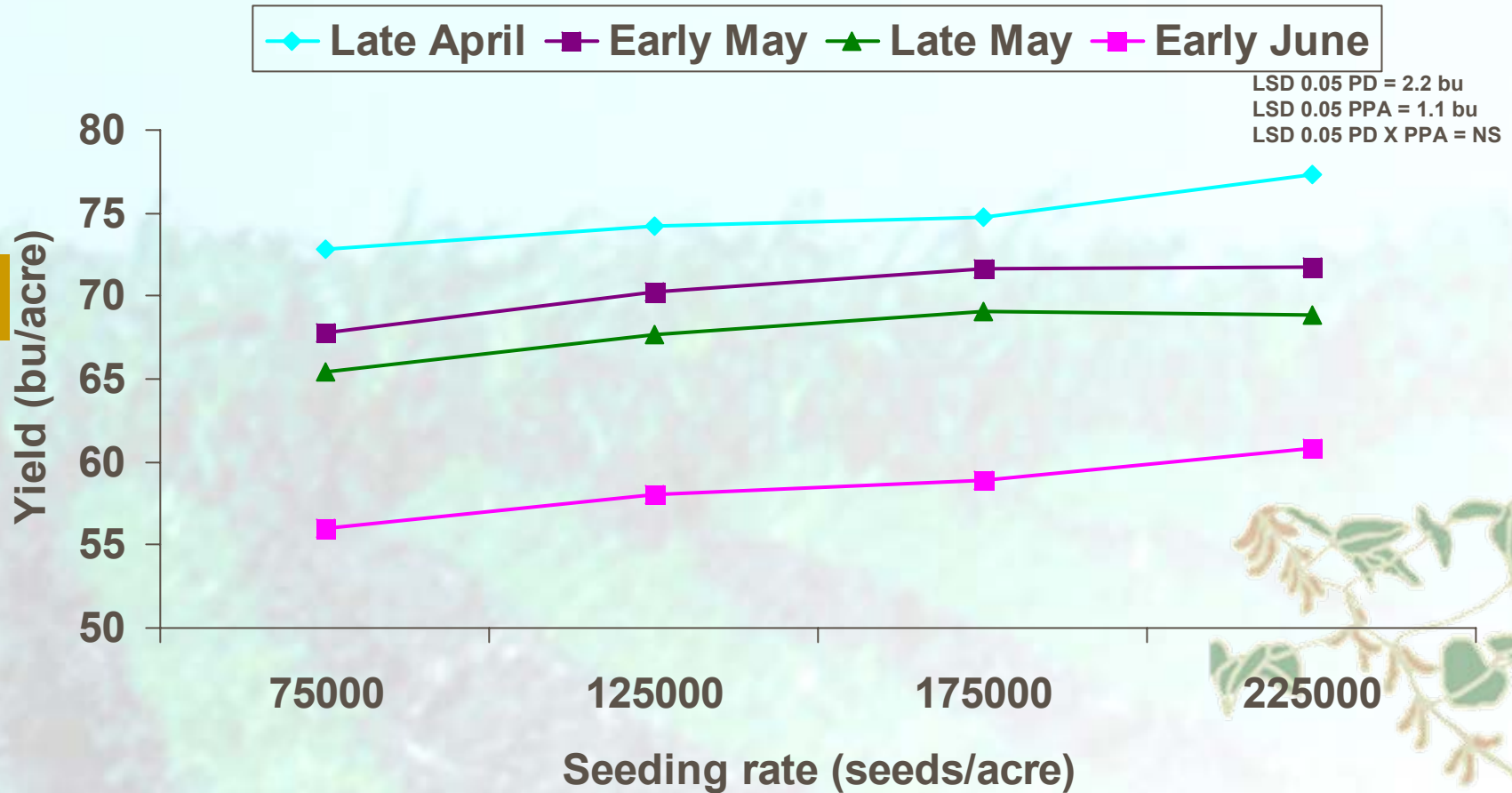
Population effects on soybean yield across planting dates and years



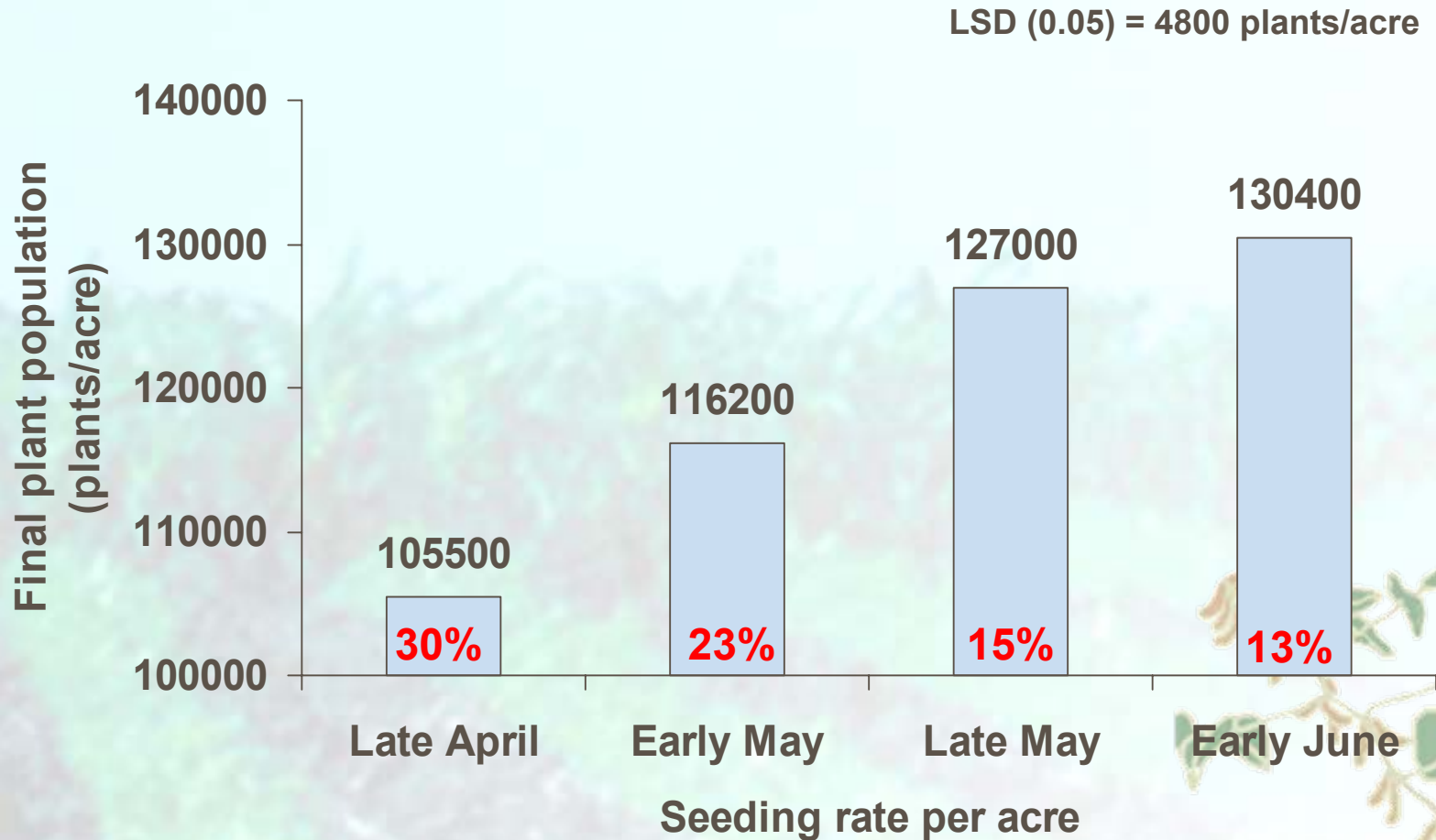
Row spacing effects on soybean yield across planting dates and years



Planting Date by Seeding Rate Interaction De Witt, Nevada, and Whiting (2004-2006)



Effect of Planting date on Final Plant Population at De Witt, Nevada, and Whiting, Iowa (2004-2006)

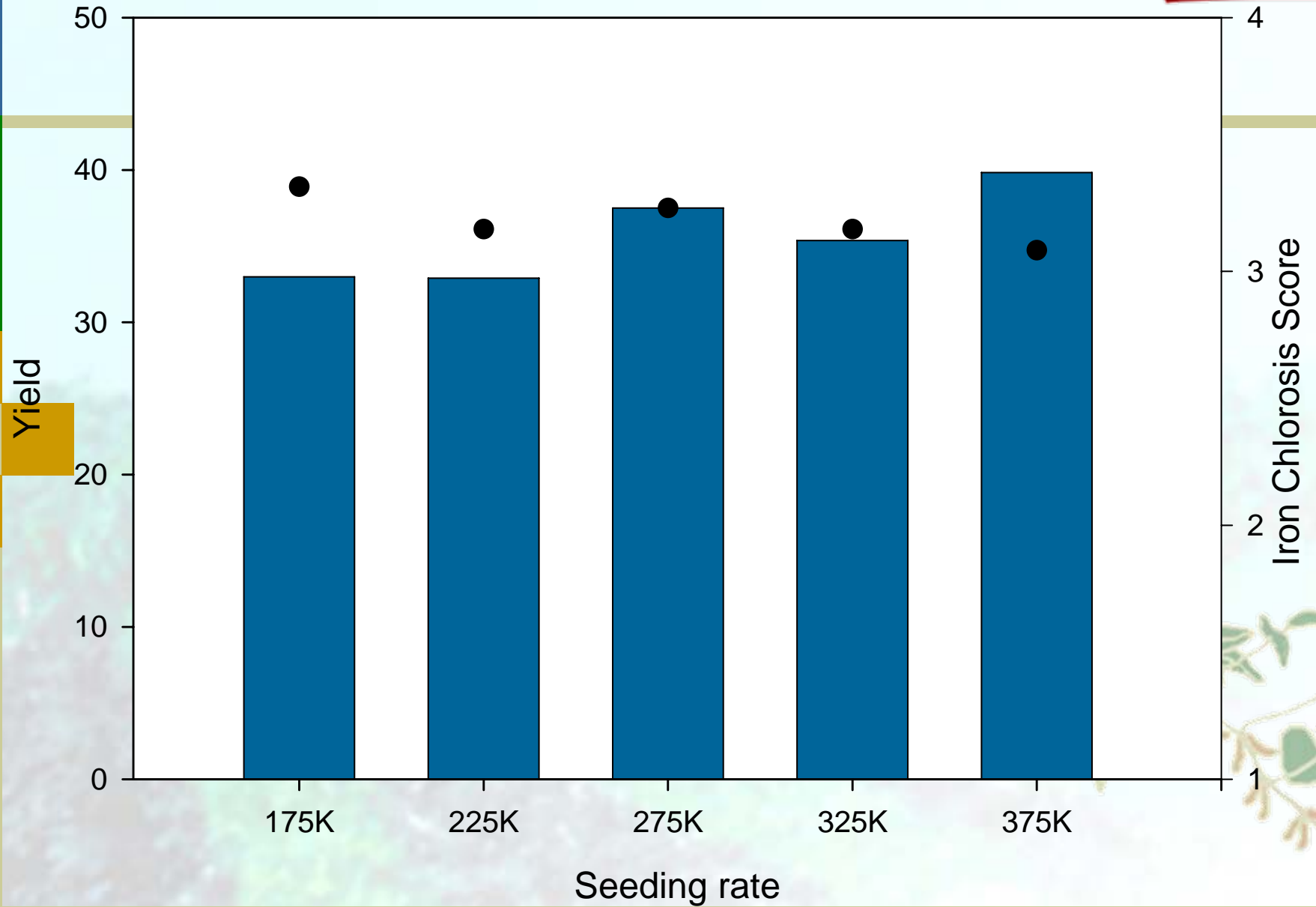


Populations and Iron Chlorosis

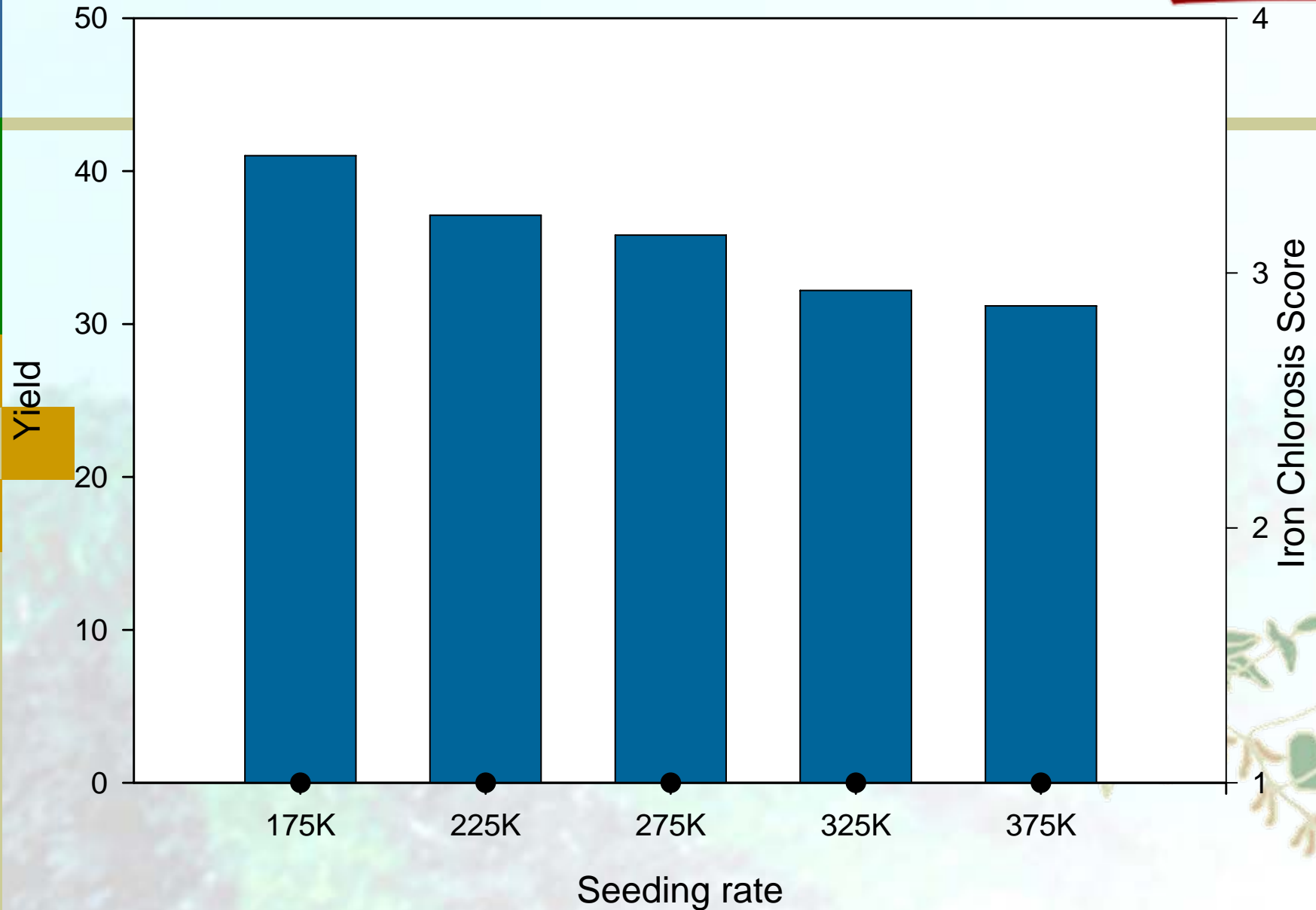
- Increased populations have been shown to “green soybeans up” during the season
- There is some evidence that this might translate to yield



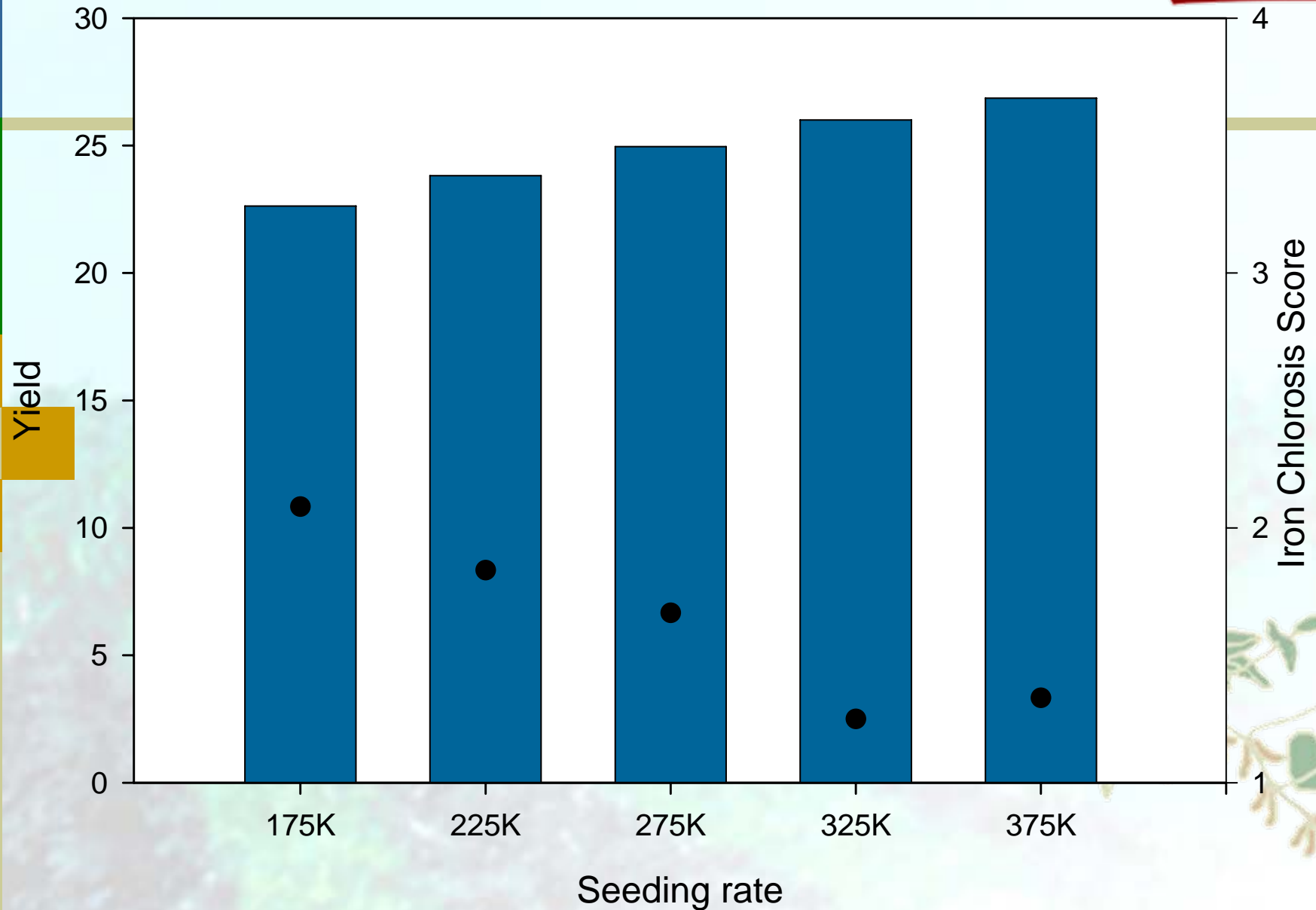
Foxhome 2002



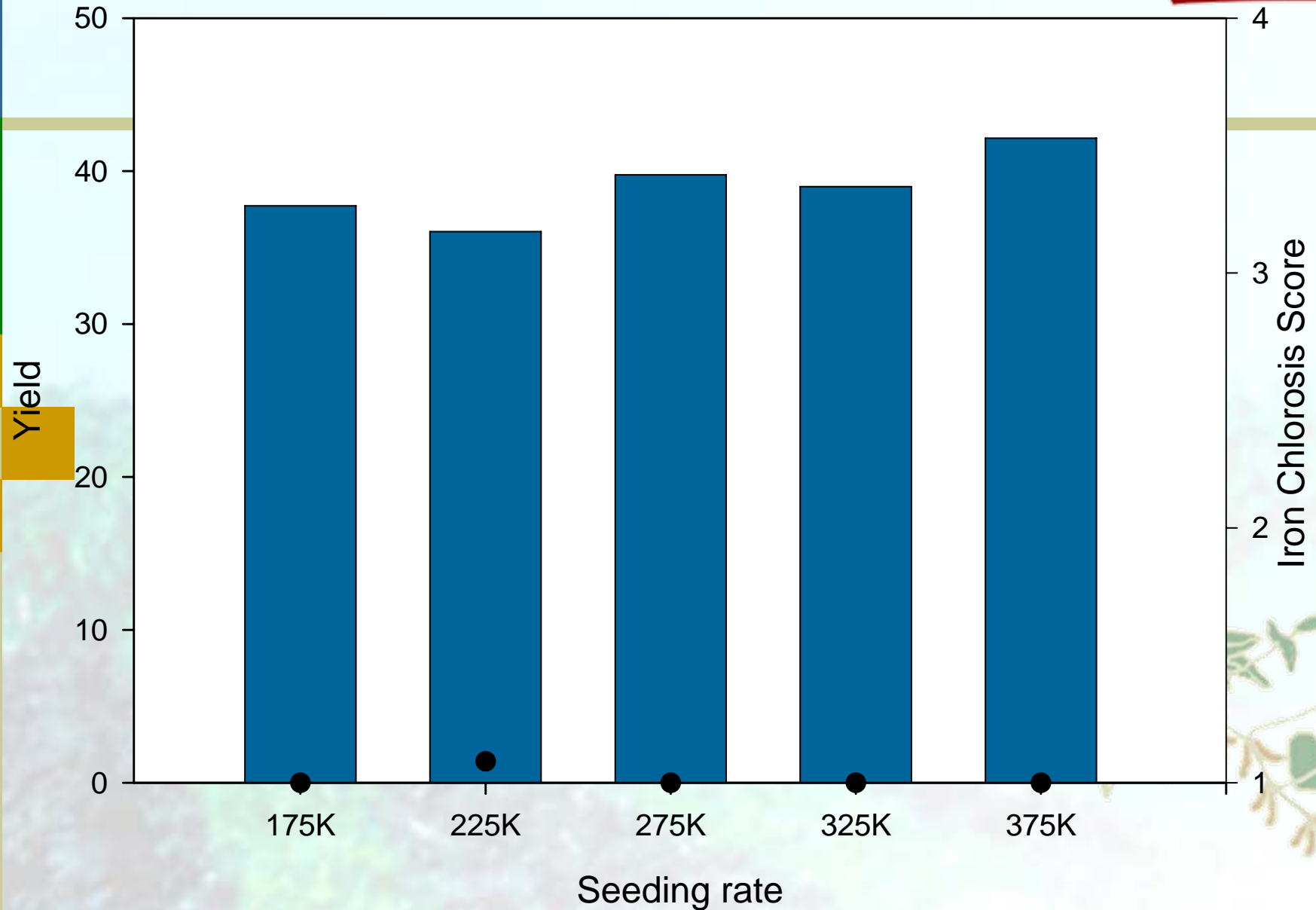
Wendell 2002



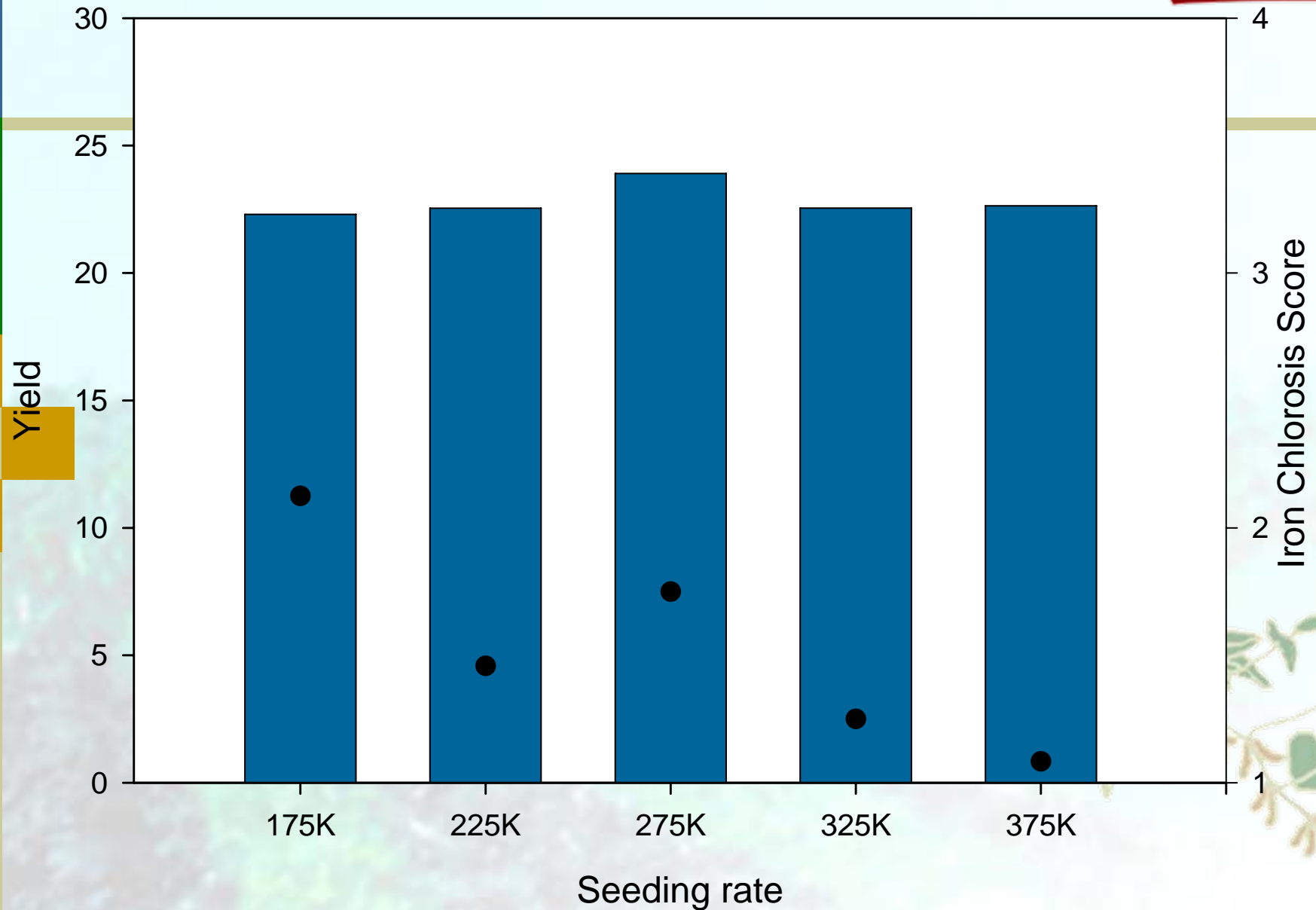
Foxhome 2003



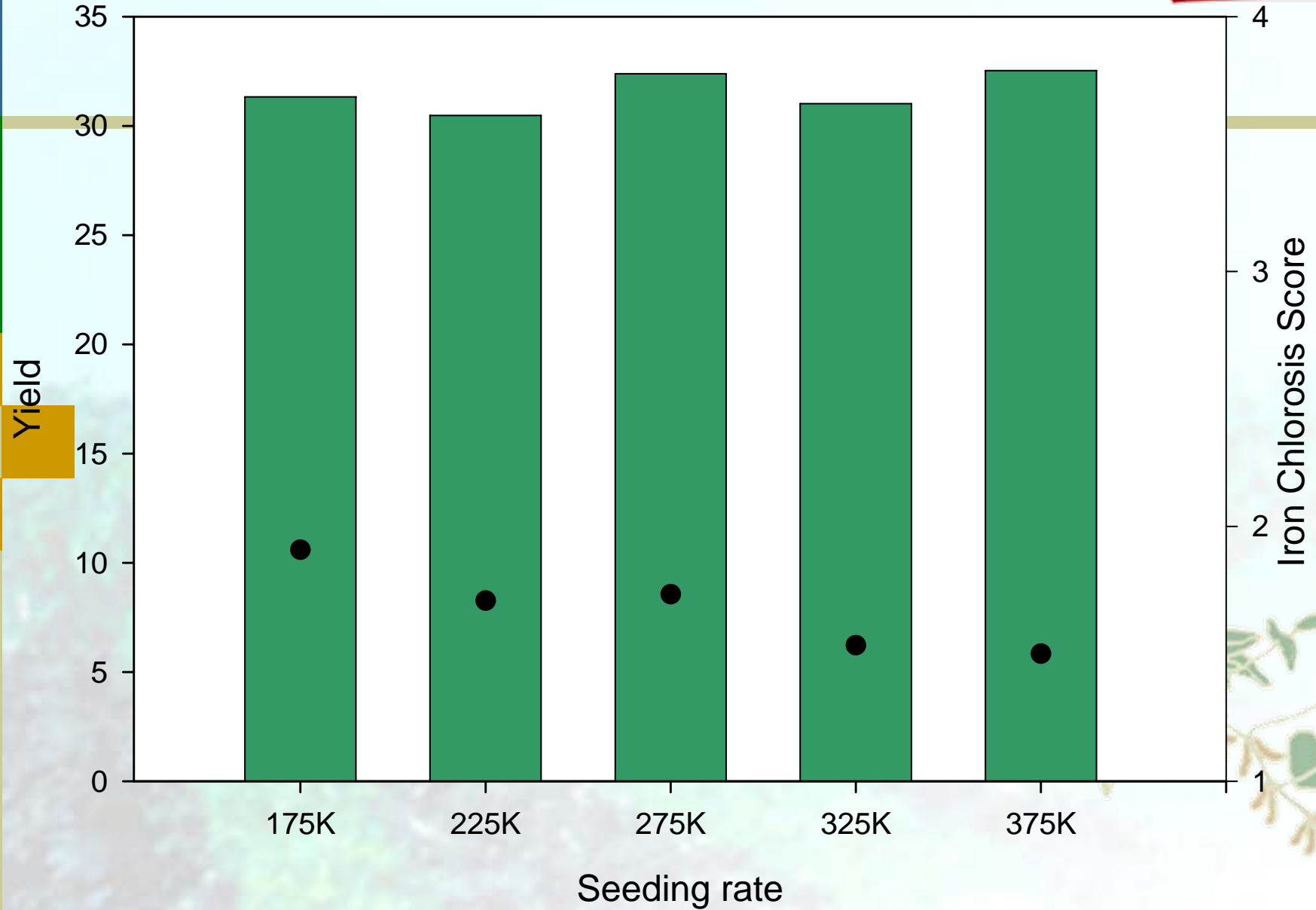
Herman 2003



Foxhome 2004



Average of 5 site years



Summary – Iron Chlorosis and population

- Smaller interplant distance does seem to reduce stresses from Iron Chlorosis (eg higher seeding rates in wide rows)
 - This may be NO_3^- related
- There are some unknown factors that can reduce yields with these narrow interplant distances that is probably independent of Iron Chlorosis
 - This is most likely water mediated
- Eventually – variable seeding rates may be useful



Overall Summary

- ❏ Soybean yields are determined final plant stands, not seeding rate
- ❏ Final stands are dependant on
 - ❑ Seeding rate
 - ❑ Row spacing
 - ❑ Date of planting
 - ❑ Environmental conditions – season long (but primarily directly after planting)
 - ❑ Biotic effects – pathogens and insects



Overall Summary (overall yield trends)

- Examination of MANY multi-site population studies from across the Midwest...
 - Under most conditions there appears to be a very small and linear yield advantage to increased seeding rates.
 - Usually 1 bu for 75-100K
 - Too small to pay for extra seed
- Occasionally, multi-site studies include rare instances of large yield decreases from increased seeding rates – due to late season drought. Results in flat yield response curves over site.

Overall Summary (attrition)

- ❏ Attrition sucks, but it does work in parallel with agronomic principles
 - ❏ Attrition is greatest in
 - ❏ Wide rows
 - ❏ Higher populations
 - ❏ Early planting
- ❏ Because wide rows, high seeding rates, and early planting benefit less from increased harvest populations, few interactions are noted in most studies

Overall Summary (recommendations)

- ✿ Harvest stands of 100,000 are required to maximize yields (in Southern Minnesota)
 - ✿ Greater final stands will be required in Central and Northern Minnesota, but the latitude effect hasn't been well modeled.
 - ✿ 125,000 in Central
 - ✿ 150,000 in Northern
- ✿ How you (or your customer) get(s) there is your business



Overall Summary (recommendations & caveats)

- ❏ Under ideal conditions seeding rates of 140,000 are sufficient
 - ❏ Independent of row spacing
 - ❏ Poor distribution caused by old planters/drills or excessive plating speed (<6 mph) requires higher seeding rates – 10%
 - ❏ Increased risk due to early planting or cold/rainy 10 day forecasts requires higher seeding rates – 10%

Overall Summary (recommendations & caveats)

- ❏ Under ideal conditions seeding rates of 140,000 are sufficient
 - ❏ Production in Central and Northern MN requires higher seeding rates
 - ❏ Group II's – 140K live seeds / acre
 - ❏ Group I's – 150K live seeds / acre
 - ❏ Group 0's – 160K live seeds / acre
 - ❏ Group 00's – 170K live seeds / acre



Overall Summary (recommendations & caveats)

- ❏ Under ideal conditions seeding rates of 140,000 are sufficient
 - ❏ Production on IDC prone soils requires higher seeding rates
 - ❏ All recommendations based on viable seeds, so reduced germ will require increased rates



Overall Summary (recommendations)

- ❖ Since yield is determined by fall stand
 - ❖ Be liberal with seeding rates until you know what you have.
 - ❖ Take spring and fall stand counts in every field.
 - ❖ Note differences in risk factors (planting date, soil type, weather after planting).
 - ❖ Adjust seeding rates downward slowly over years.



Economic Analysis Assuming 140,000 seeds per bag

	\$8 per bushel			\$9 per bushel			\$10 per bushel		
	28	32	36	28	32	36	28	32	36
	\$ per acre			\$ per acre			\$ per acre		
75000	474c	472c	469b	535c	533c	531c	596d	594c	592c
100000	490b	488b	485a	554b	551b	548b	618c	615b	612b
125000	498ab	494ab	491a	563ab	560ab	556ab	629b	625ab	622ab
150000	498ab	494ab	490a	564ab	560ab	556ab	630ab	626ab	622ab
175000	495b	490b	485a	562ab	557ab	552ab	628bc	623a	618ab
200000	504a	498a	492a	572a	566a	560a	640a	634a	628a

† Values within a column followed by the same letter are not significant at $P \leq 0.05$

Economic Analysis (\$32 per bag)

	\$8 per bushel			\$9 per bushel			\$10 per bushel		
	2600	2800	3000	2600	2800	3000	2600	2800	3000
	Seeds per lbs			Seeds per lbs			Seeds per lbs		
75000	473c	474c	475c	534d	535c	536d	595c	596d	597d
100000	489b	491b	492b	553c	555b	556c	617b	618c	620c
125000	497ab	498ab	500ab	562abc	564ab	566abc	627ab	629bc	631bc
150000	497ab	499ab	501ab	563abc	565ab	567abc	629a	631ab	633ab
175000	493b	496b	498ab	560ab	562ab	565bc	626ab	629bc	631bc
200000	502a	505a	507a	569a	573a	575a	637a	641a	643a

† Values within a column followed by the same letter are not significant at $P \leq 0.05$

Thank you

Seth Naeve

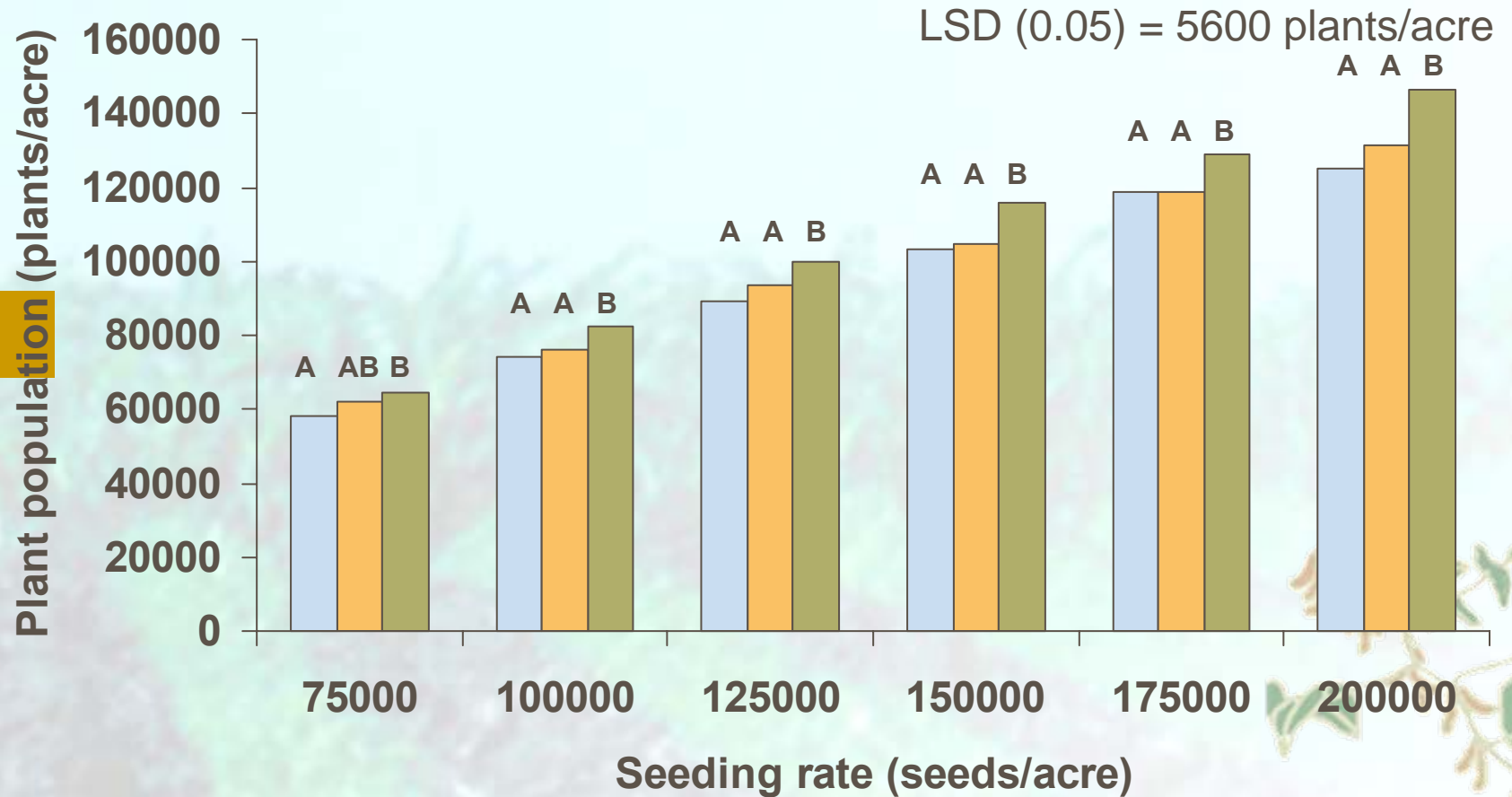
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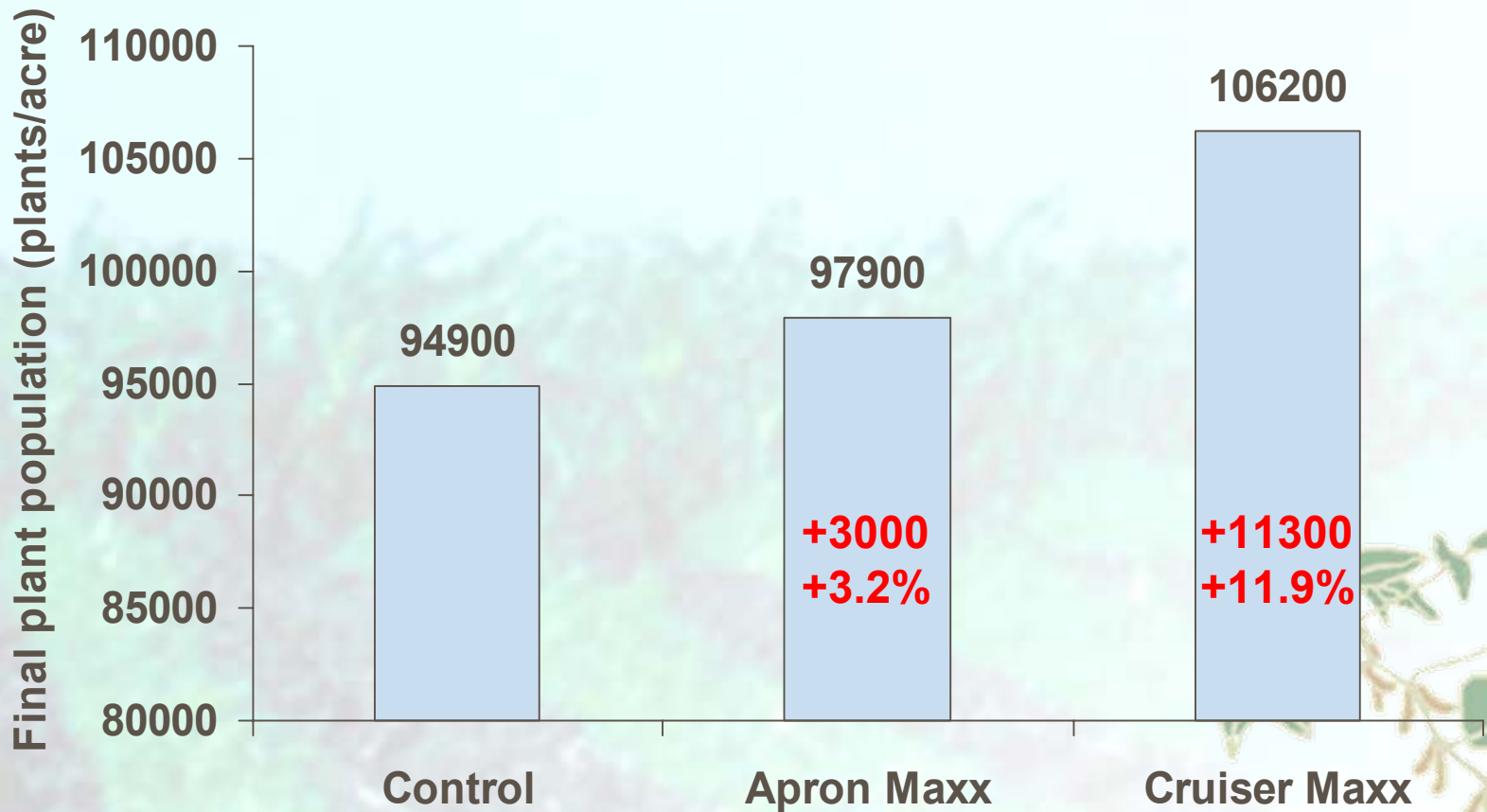
Seed Treatment and Seeding Rate Effect on Final Plant Population Across 13 Environments (2005-2007)

Control Apron Maxx Cruiser Maxx



Treatment Effect on Final Plant Population Across 13 Environments (2005-2007)

LSD (0.05) = 2300 plants/acre

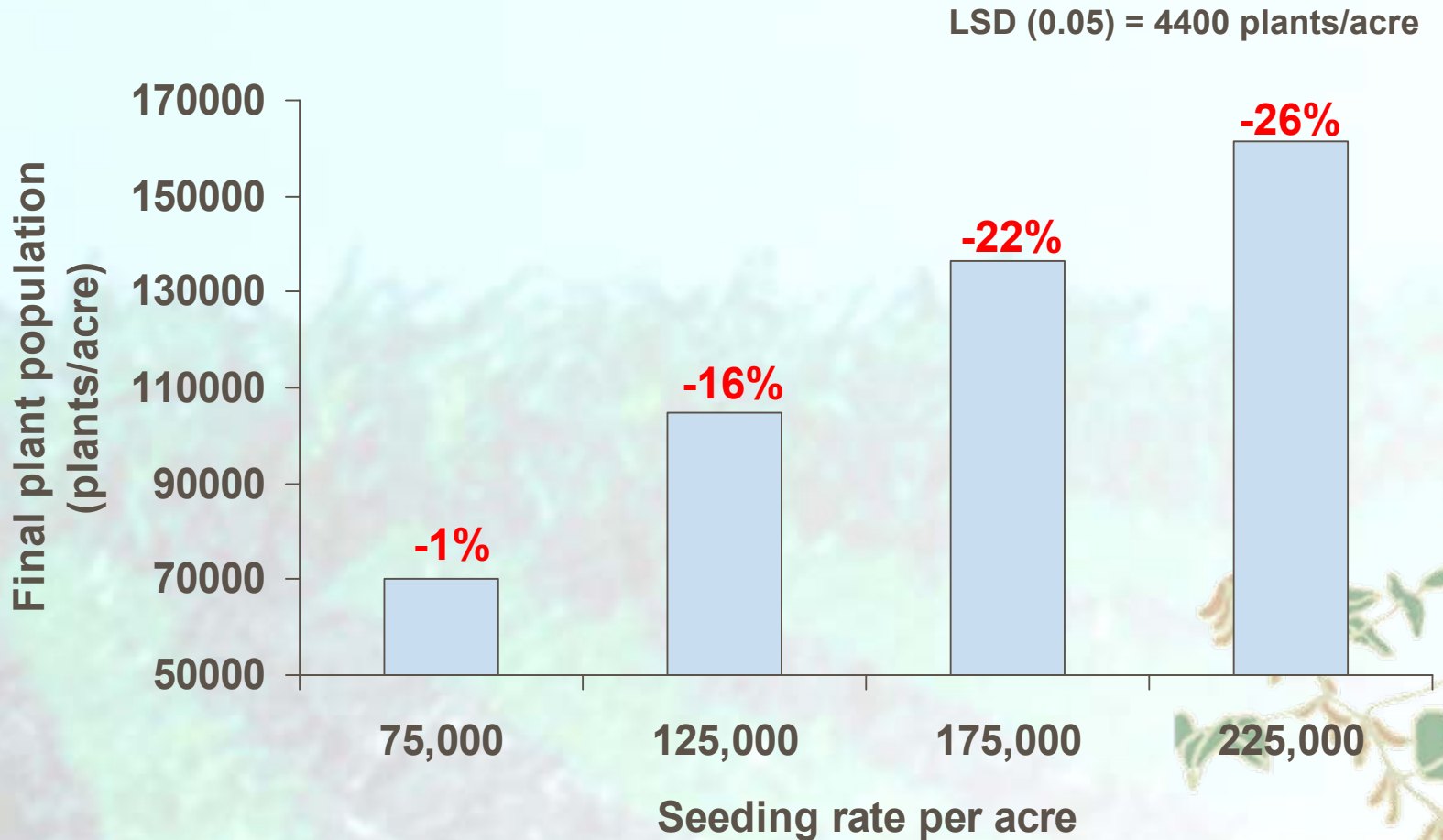


Summary – Soybean Seed Treatment

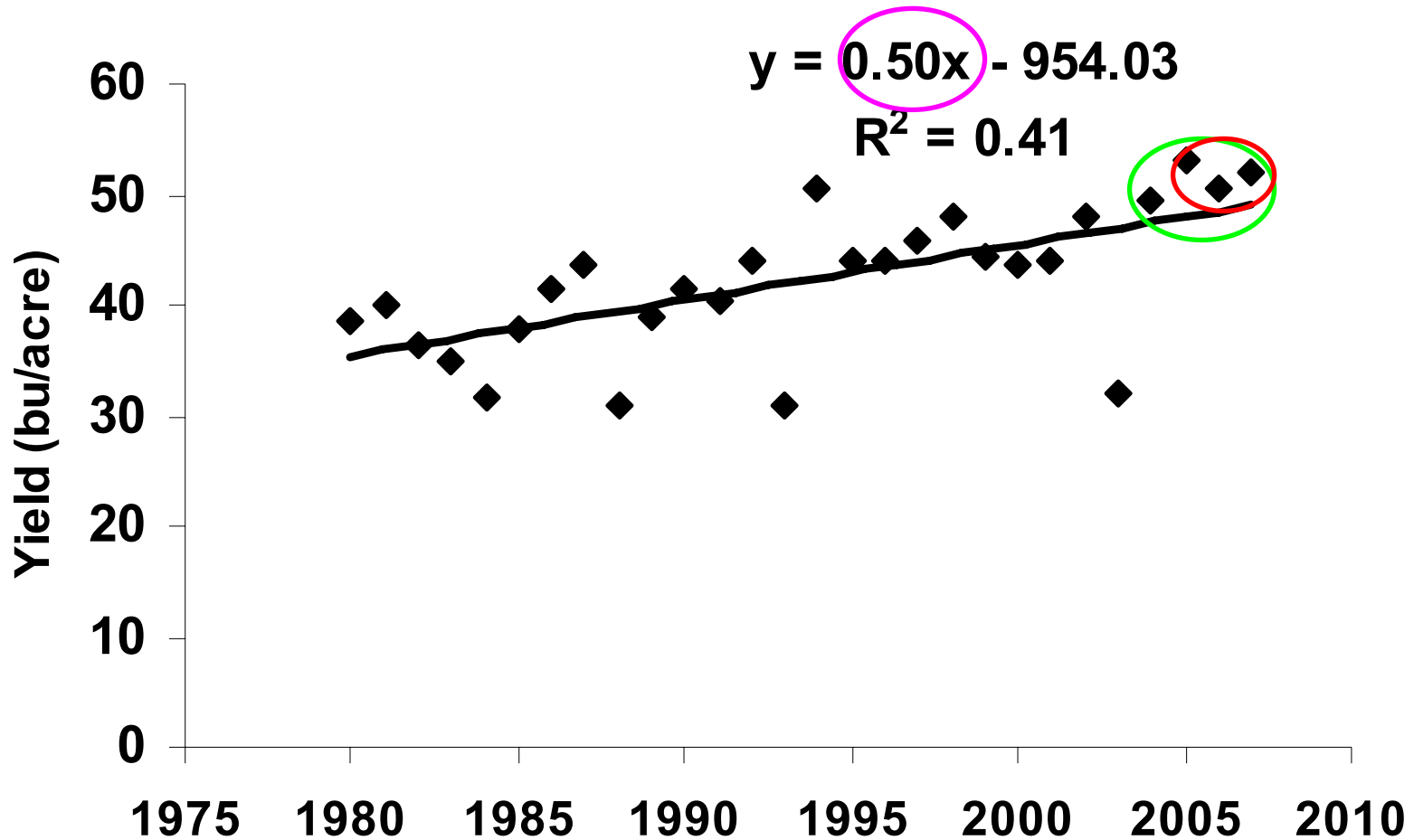
- Apron Maxx (mefenoxam + fludioxonil) did have an effect on stand but not on yield
- Soybean yield and final plant population was increased with Cruiser Maxx (mefenoxam + fludioxonil + thiamethoxam)
 - Improved stand was quite consistent across all locations
 - Yield response was driven by bean leaf beetles



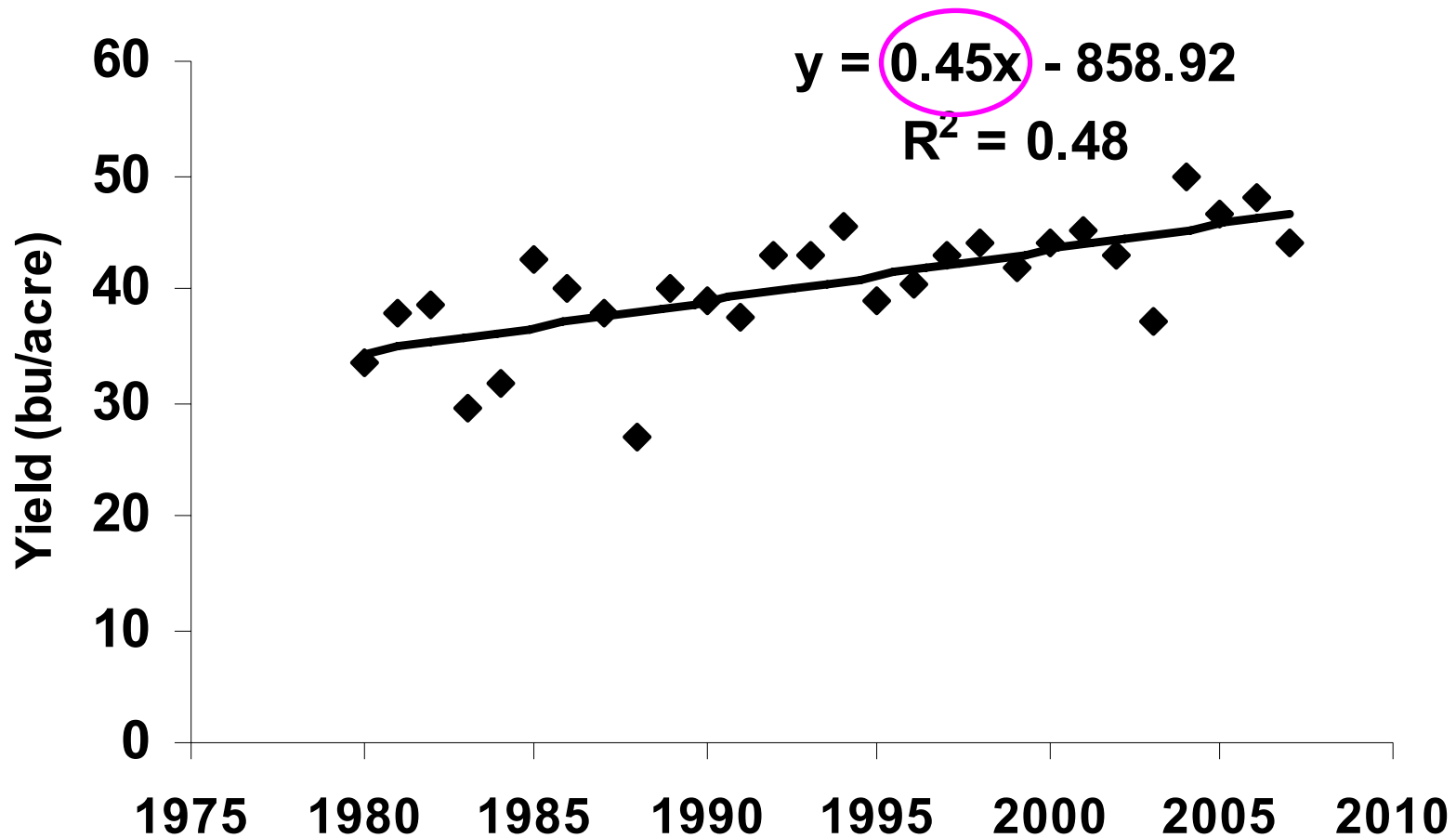
Planting date by seeding rate interaction at De Witt, Nevada, and Whiting (2004-2006)



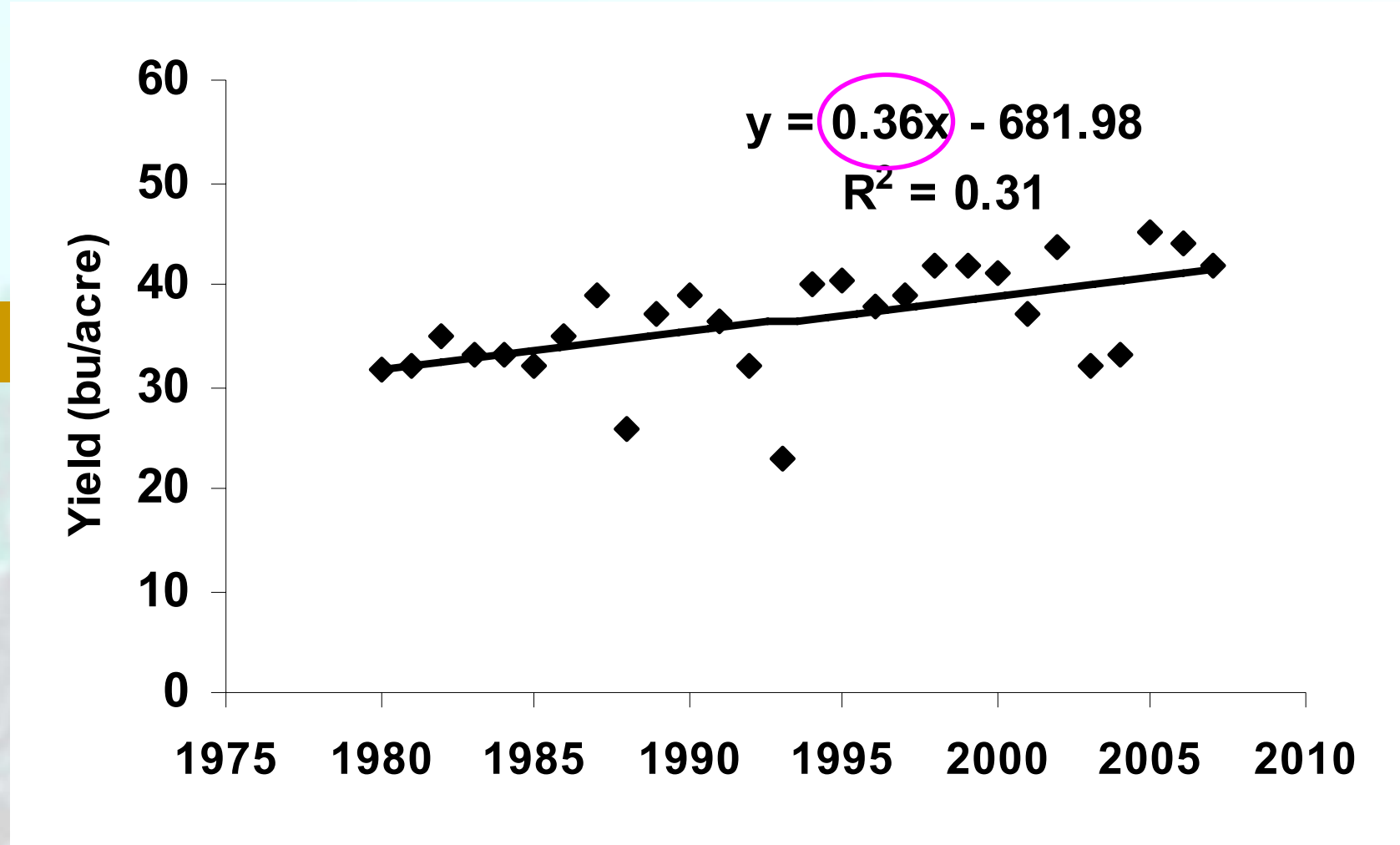
Iowa Soybean Yield, 1980-2007



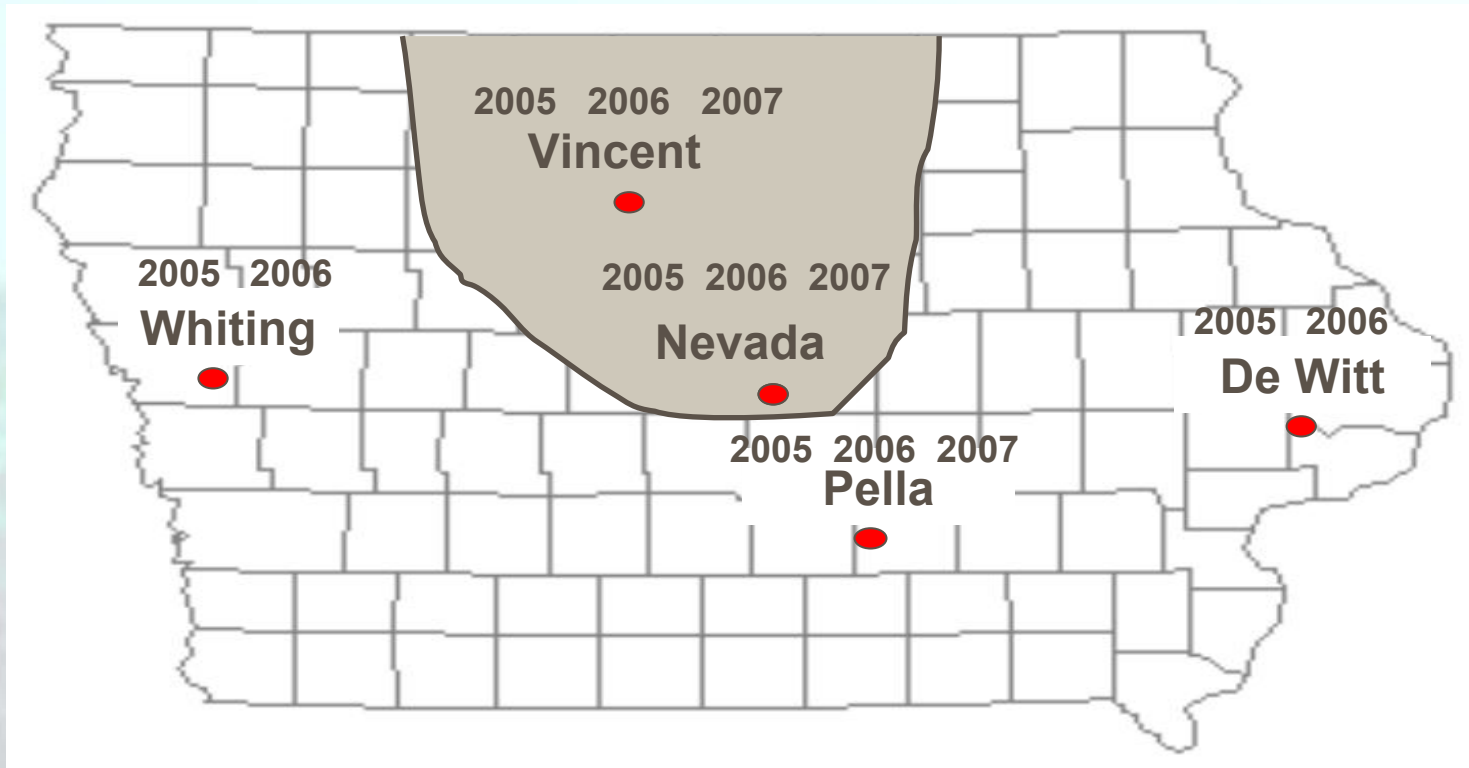
Illinois Soybean Yield, 1980-2007



Minnesota Soybean Yield, 1980-2007



Locations



Decision Tree



How to get to a final stand of 100,000 plants per acre using a planter?

- + Good seedbed ("tillage")
- + 1-1.5 inch planting depth
- + Relatively new planter (< 5 yr old)
- + Moderate planting speed (< 6 mph)
- + Excellent seed quality

IF you have 5 "+" ~ 125,000 seeds/acre

IF you have 4 "+" ~ 140,000 seeds/acre

etc.



Conclusion

- IF you have PERFECT seedbed condition, perfect planter settings, good seed quality, and use a modern planter a seeding rate of 125,000 – 140,000 seeds per acre should be enough for 15, 20, 22, 30, and 36 inch row spacing.

We just need 100,000 plants per acre at harvest