Sorghum Production For Maximum Yields

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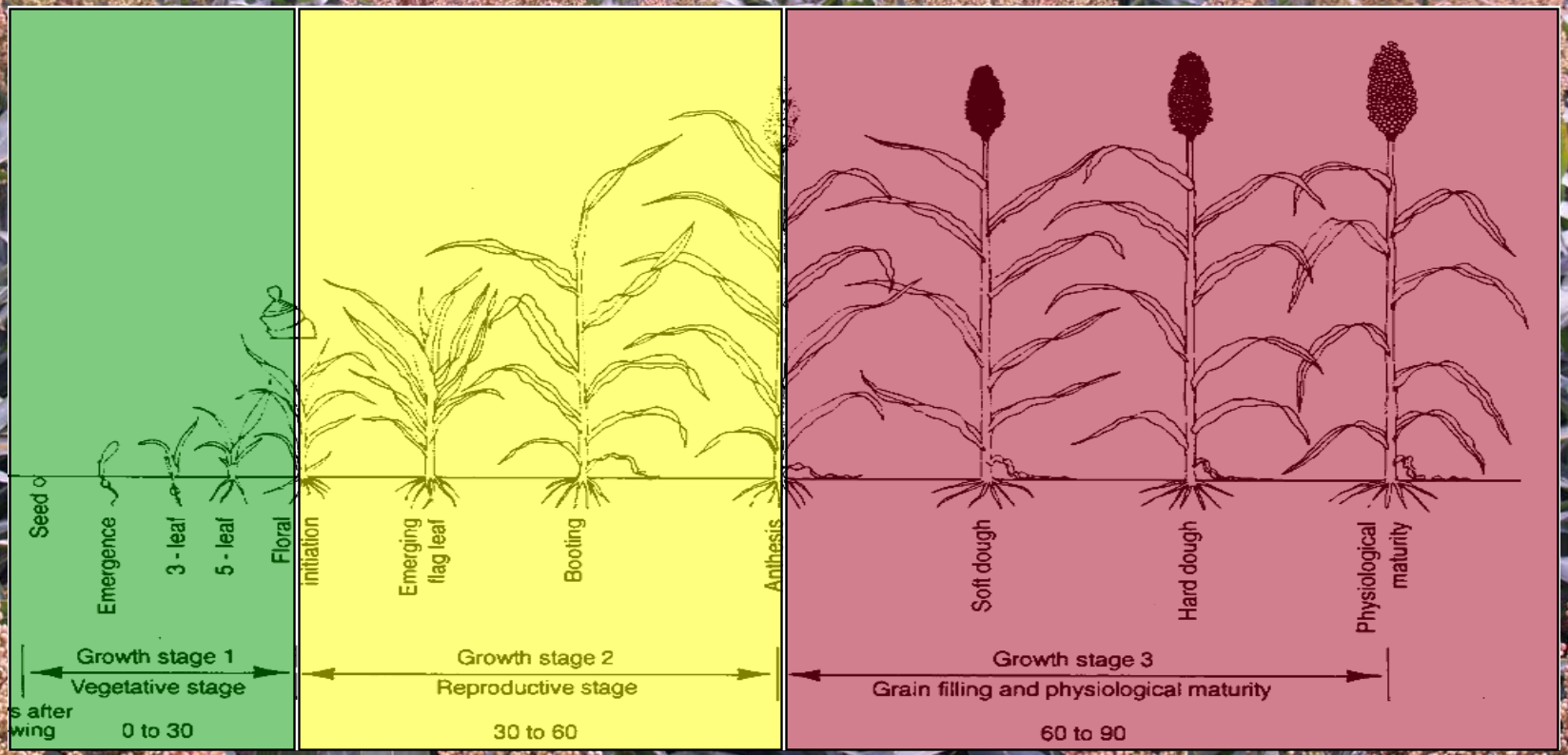
Agronomy Extension

Crop Production/Cropping Systems

Outline

- Yield formation
- Hybrid selection
  - Maturity vs. growing season
  - Seed and plant color
  - Resources/tools
- Planting
  - Populations
  - Row spacing
- Tillage and rotation

Sorghum Yield Formation



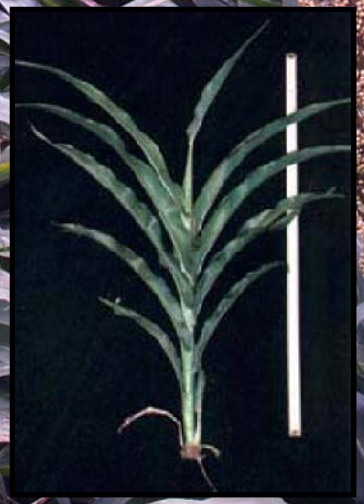
Vegetative

Growth stage	Days after emergence	Identifying characteristic
0	0	**Emergence** – coleoptile visible at soil surface
1	10	**3 leaf collars** – growth rate depends on temperature
2	20	**5 leaf collars** – rapid root development, growing point below soil surface
3	30	**Growing point differentiation** – ~ 8 leaf collars (7 to 10), rapid growth, nutrient uptake, and stem elongation

2,4-D at V5 to V6

Reproductive

Growth stage	Days after emergence*	Identifying characteristic
3	30	**Growing point differentiation** – ~ 8 leaf collars (7 to 10), rapid growth, nutrient uptake, and stem elongation
4	40	**Flag leaf visible** – final leaf visible in whorl, head developing
5	50	**Boot** – head extended into flag leaf sheath, all leaves expanded, max. light interception, head size determined
6	60	**Half bloom** – half of plants at some stage of bloom, half of DM accumulated



Sorghum Ergot

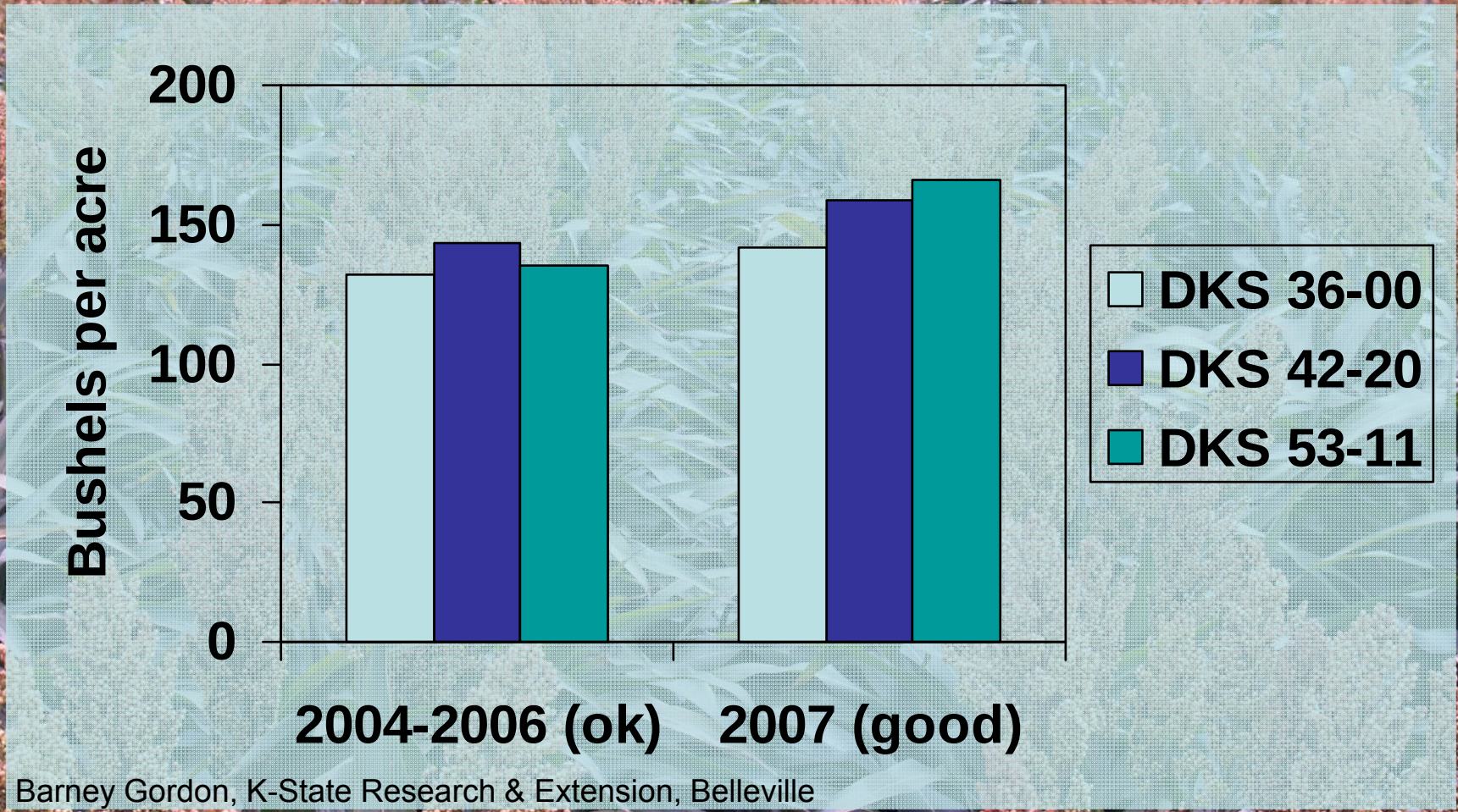
Grain Fill and Maturity

Growth stage	Days after emergence*	Identifying characteristic
7	70	**Soft dough** – rapid grain fill, from leaves and stalk
8	80	**Hard dough** – nutrient uptake complete, but DM at 75%
9	90	**Physiological maturity** – max. DM accumulation, formation of black layer

Sorghum Yield Formation

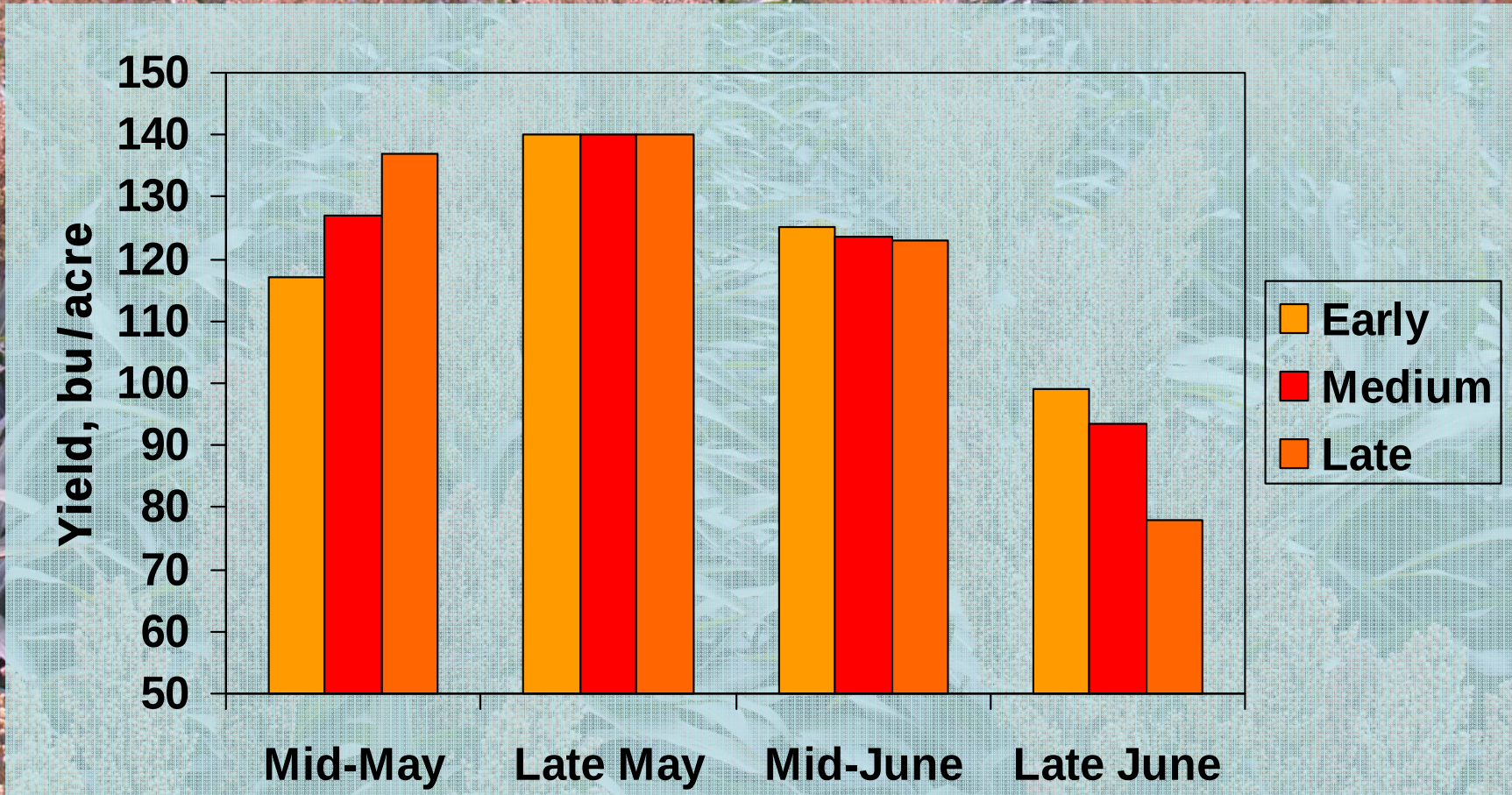
- Need warm temperatures and minimal weed competition for good early growth.
  - Root system, early (productive) tillers
  - Starter fertilizers especially helpful with early and/or no-till planting
- Head forms during 30 days before bloom.
  - Head size is determined before bloom
  - Be careful with herbicide applications
- Pollination can be affected by cool temperatures, or hot, dry winds
  - Seed set is determined during bloom (or maybe just before bloom)
  - Ergot, sorghum midge can reduce seed set
- Grain fill is very rapid soon after bloom.
  - Seed size is determined during grain fill
  - Grain fill saps stalk making it susceptible to rots
  - Need adequate fertility for max yield
  - Need healthy leaves for max yield (sooty stripe, greenbug, etc.)

Hybrid Maturity and Year



Barney Gordon, K-State Research & Extension, Belleville

Hybrid Maturity and Planting Date
Scandia 1994-1996



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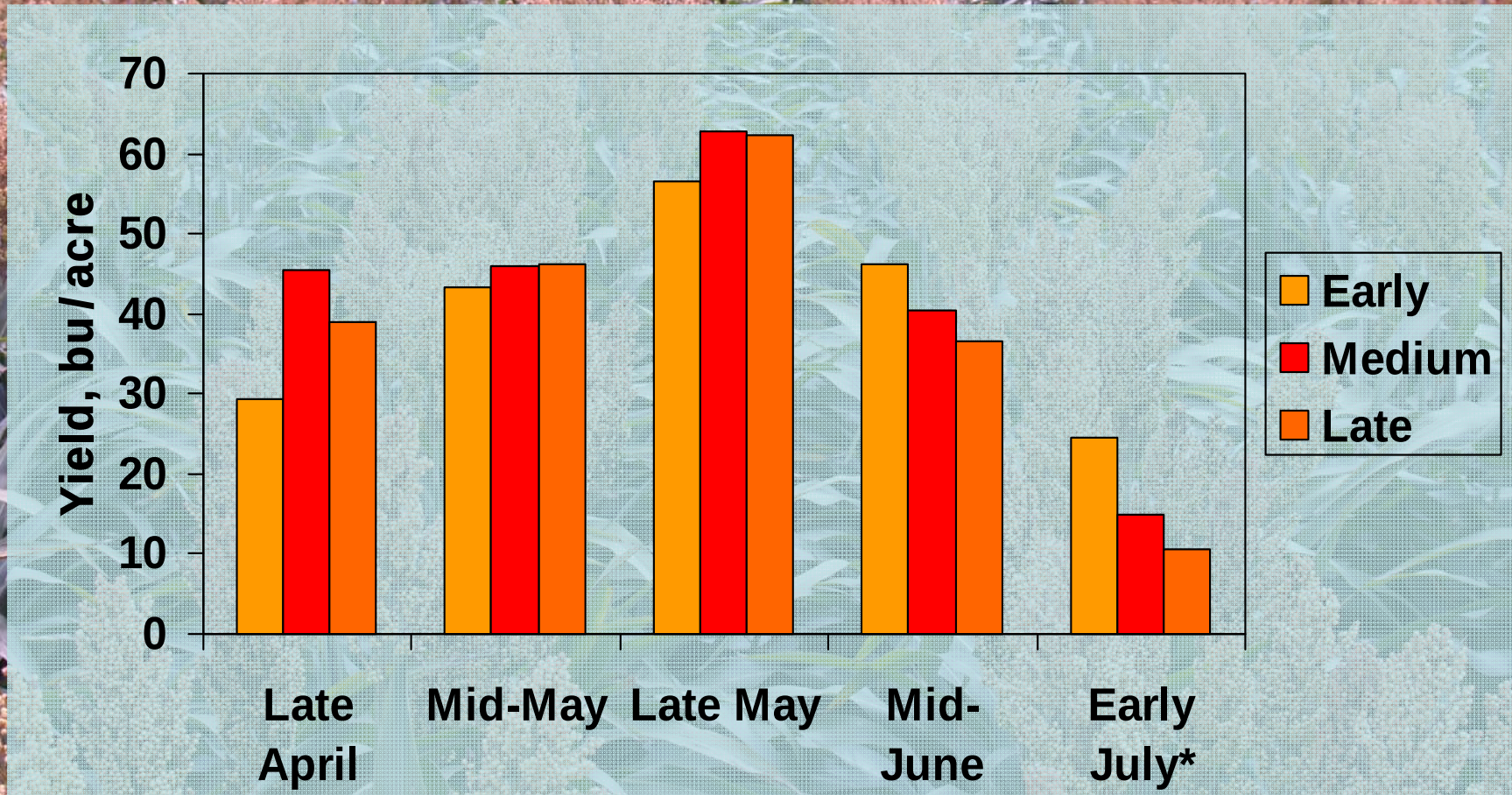
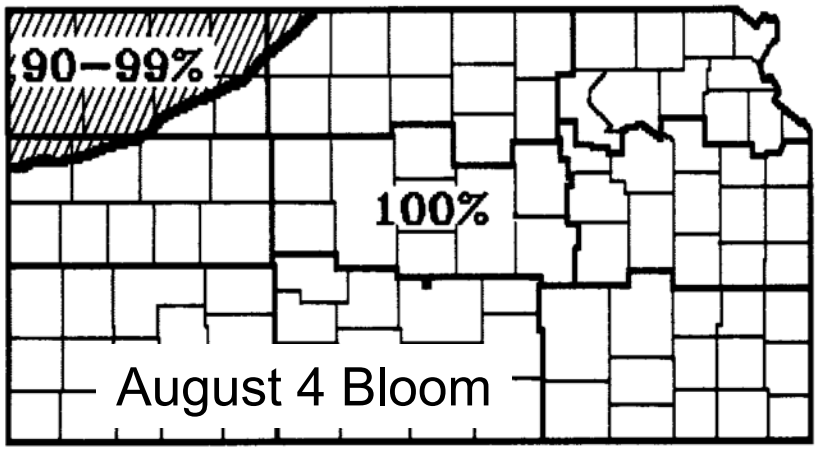
Hybrid Maturity and Planting Date St. John 1993-1995

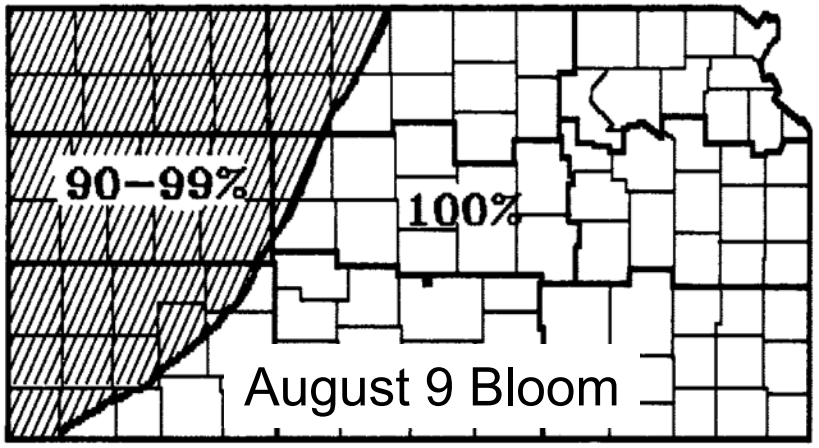


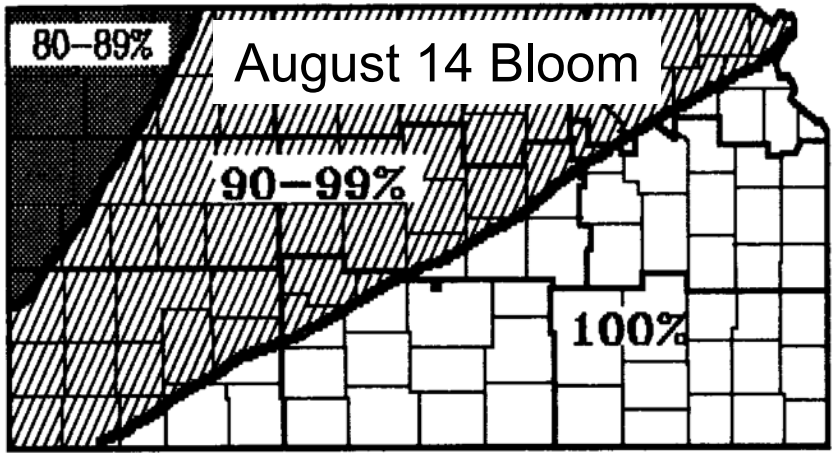
Vic Martin, Richard Vanderlip, St. John

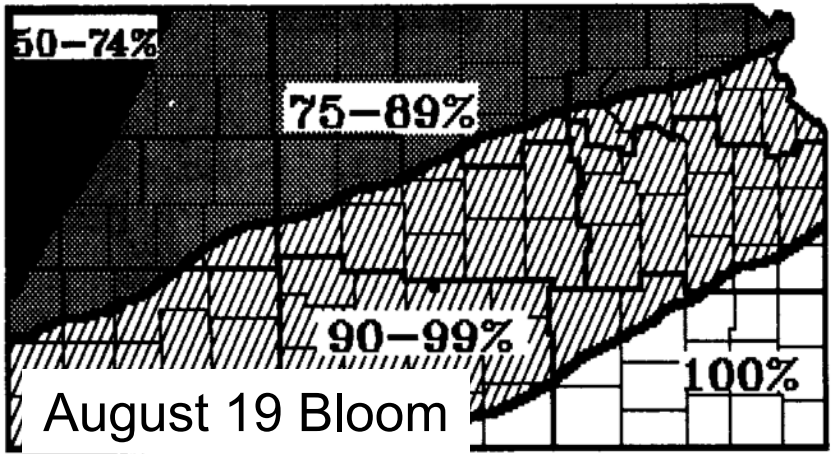
*1994-1995

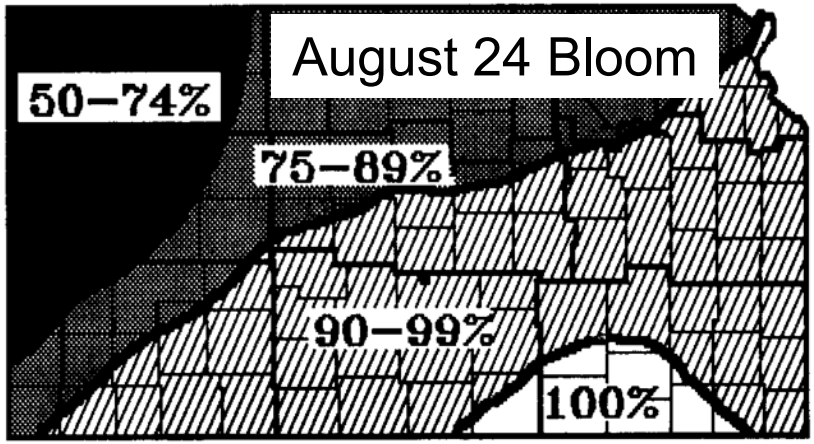
Probability of Sorghum Maturing Before a Freeze

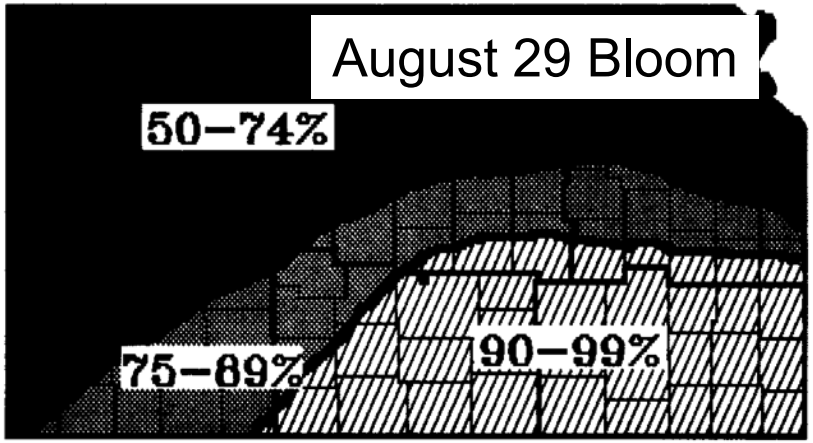




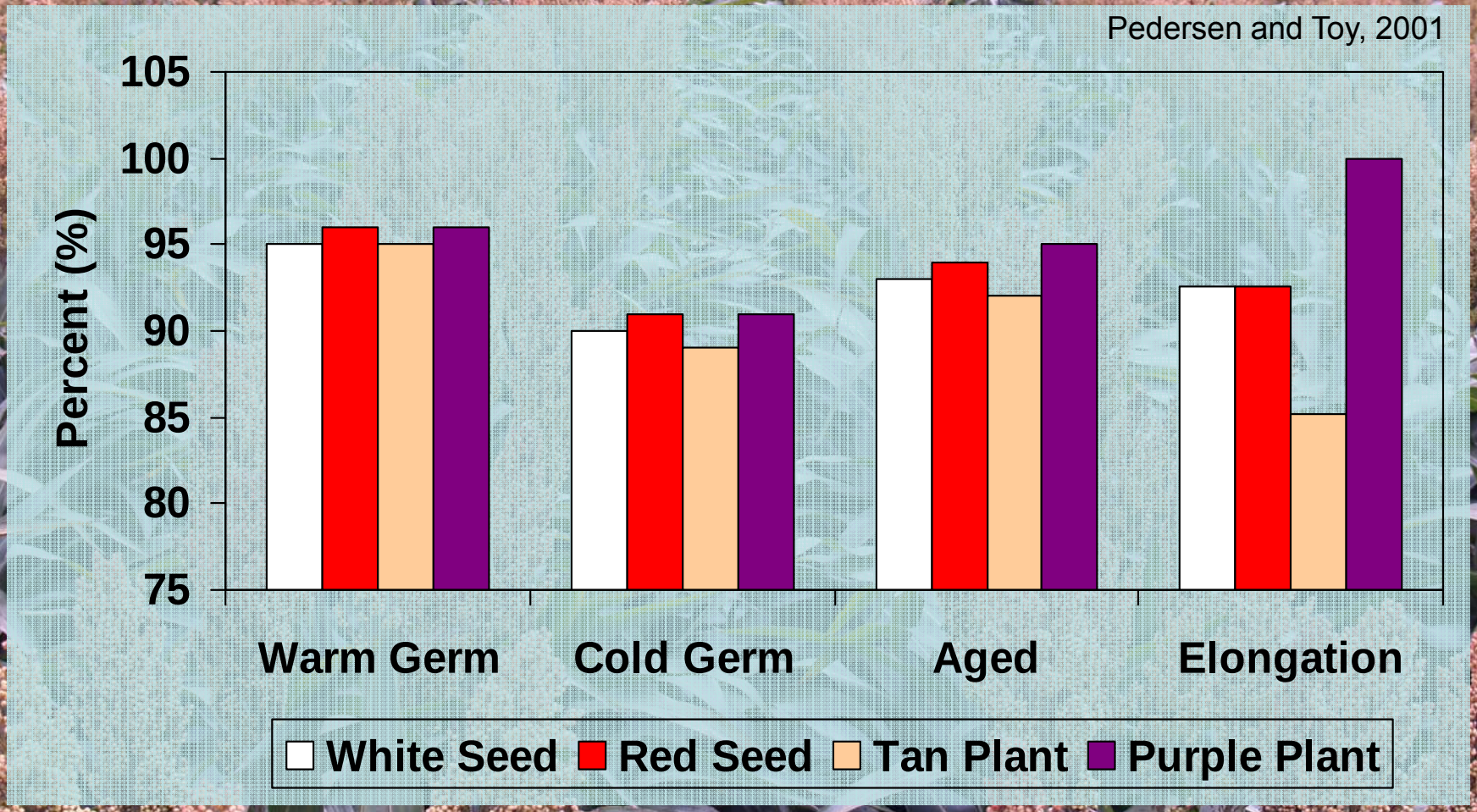

80–89%
August 14 Bloom
90–99%
100%


50–74%
75–89%
90–99%
100%
August 19 Bloom

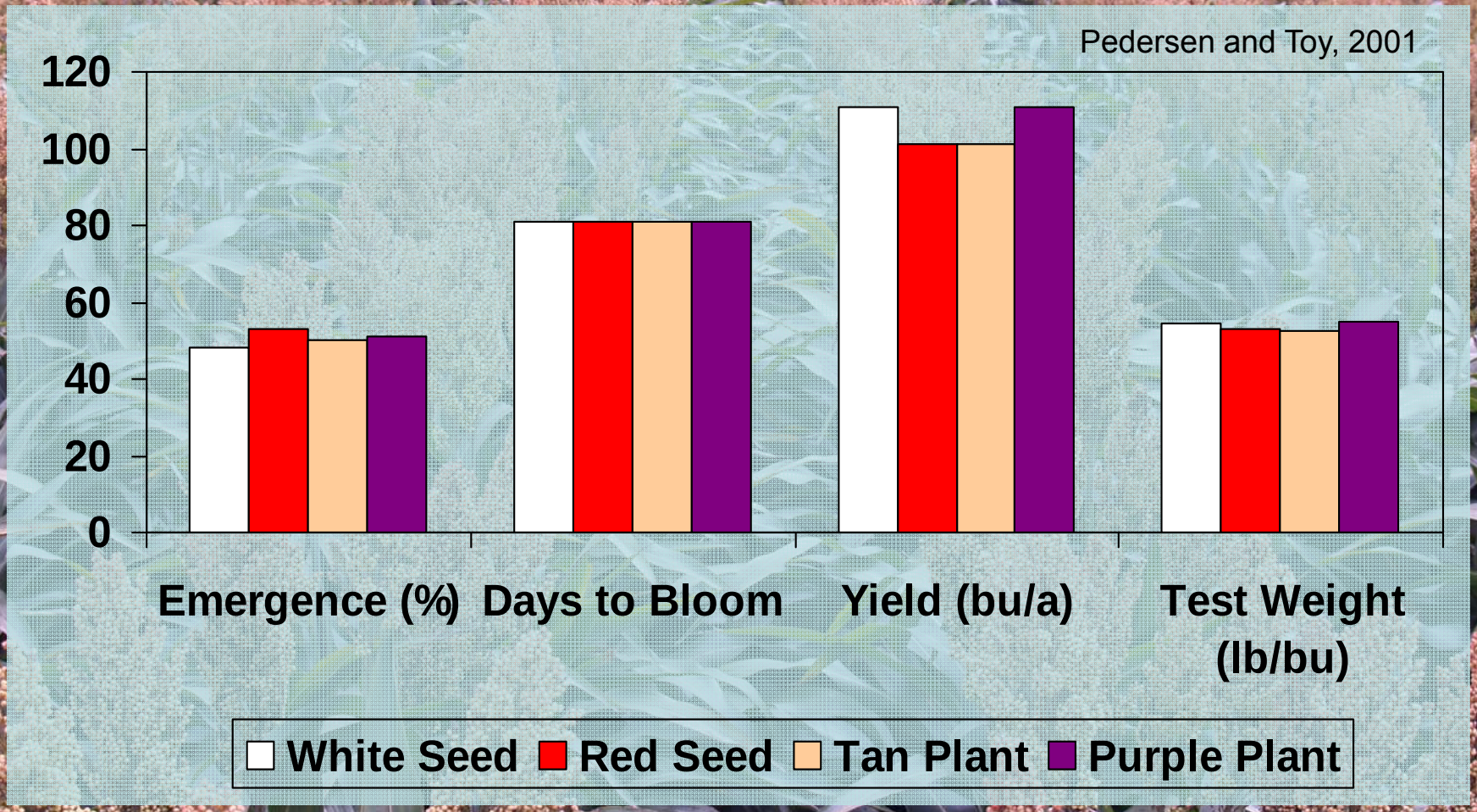

August 24 Bloom
50–74%
75–89%
90–99%
100%


August 29 Bloom
50–74%
75–89%
90–99%

Plant and Seed Color Effect on Laboratory Germination and Vigor



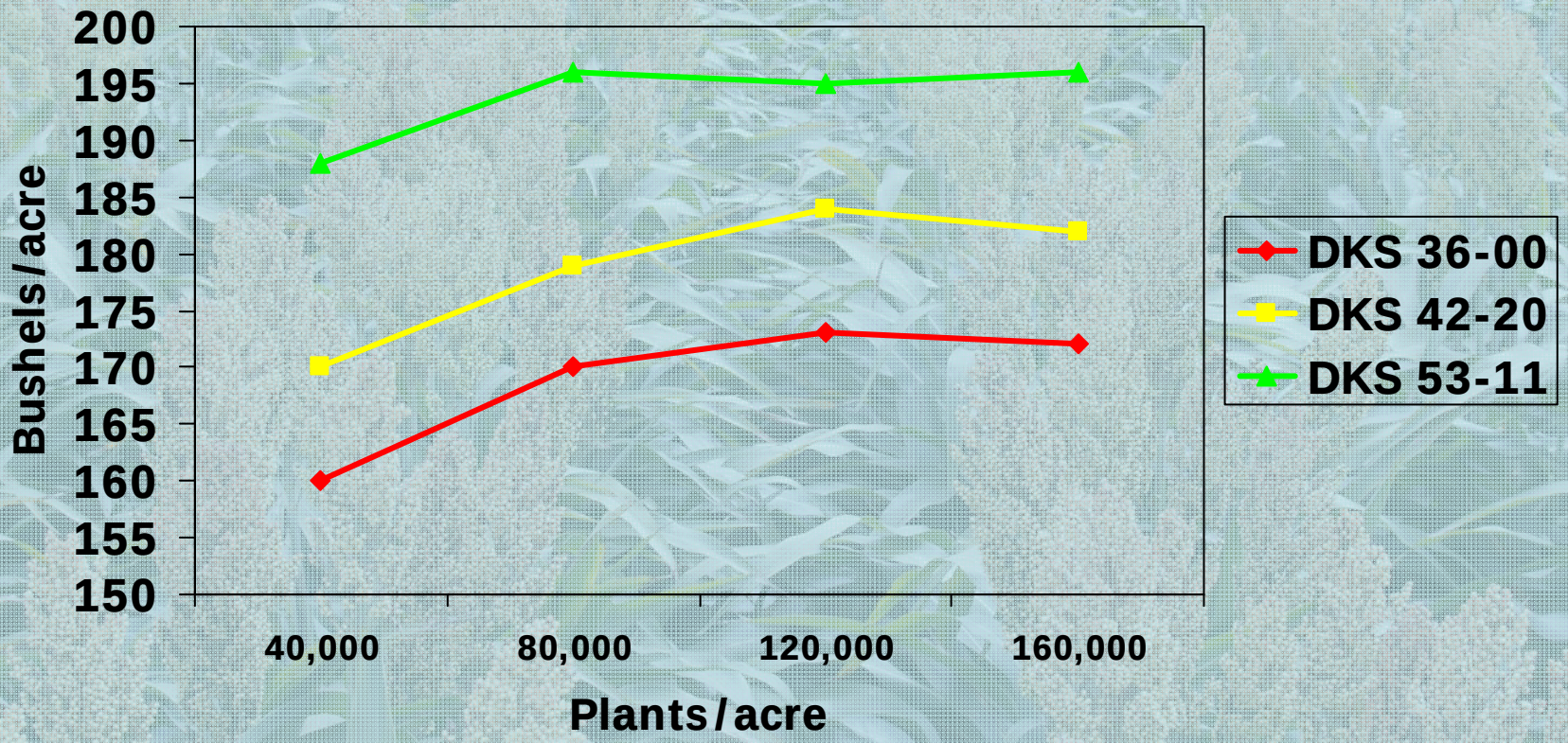
Plant and Seed Color Effect on Field Performance



Hybrid Selection Summary

- Fit hybrid maturity to available growing season and soil moisture
- Seed and plant color may influence germination and emergence, but hybrid and seed lot are more important
- Select high-yielding hybrids that resist stalk rots and stand well
- Use multiple sources of information to document hybrid performance over several locations and years

Hybrid and Plant Population Effects on Irrigated Grain Sorghum Yield



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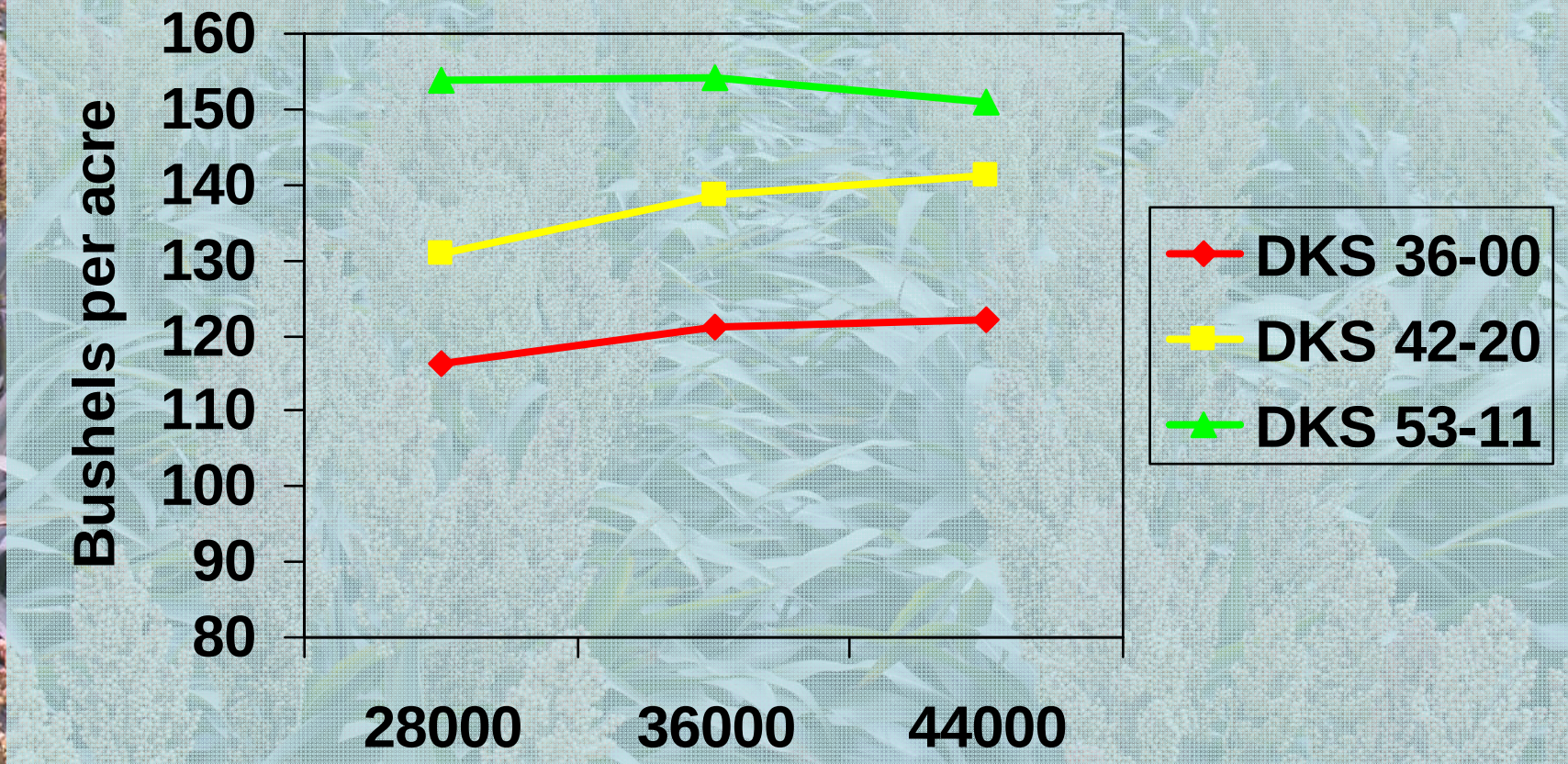
Hybrid Maturity and Population 2005 and 2006



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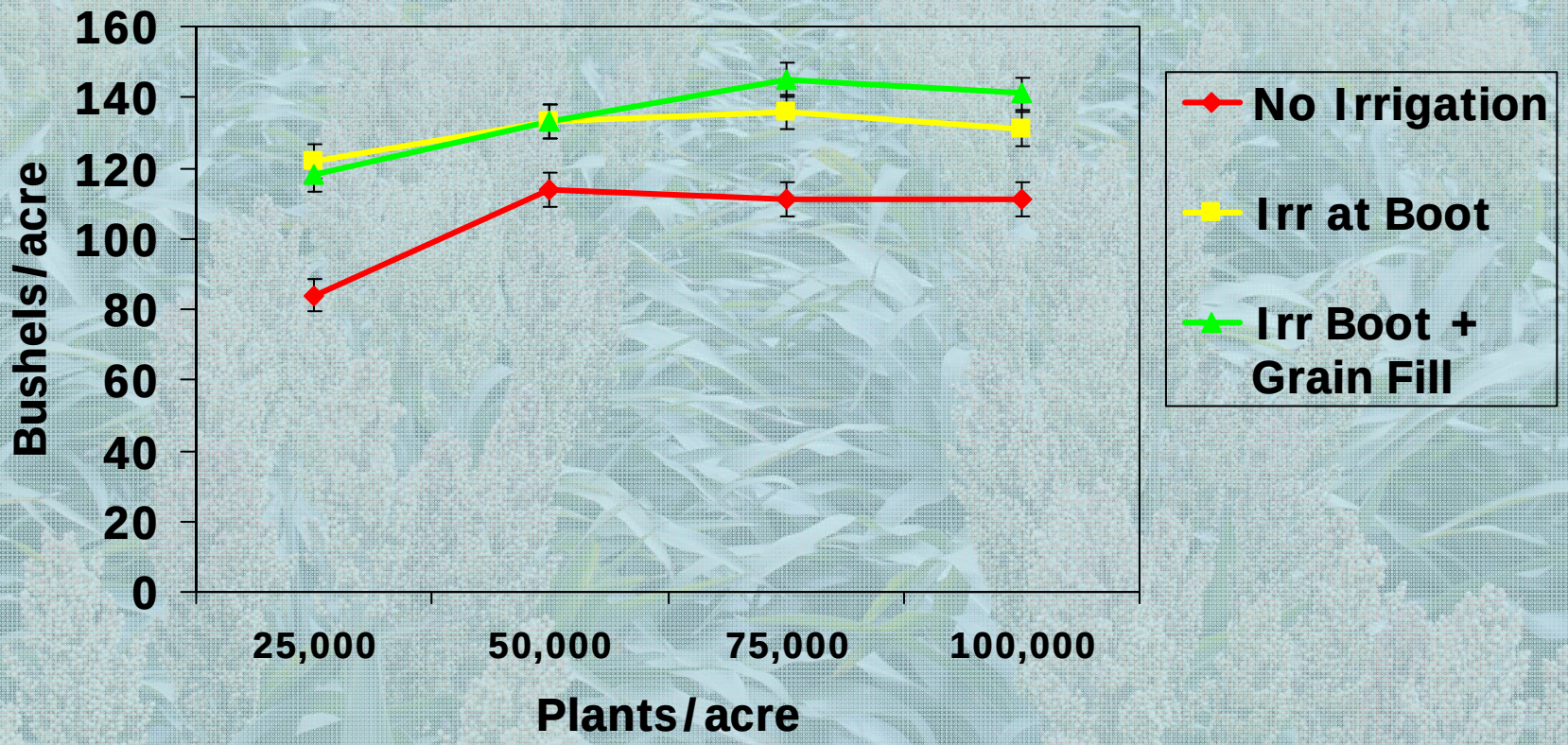
Irrigation and Plant Population Effects on Grain Sorghum Yield, Scandia 1991



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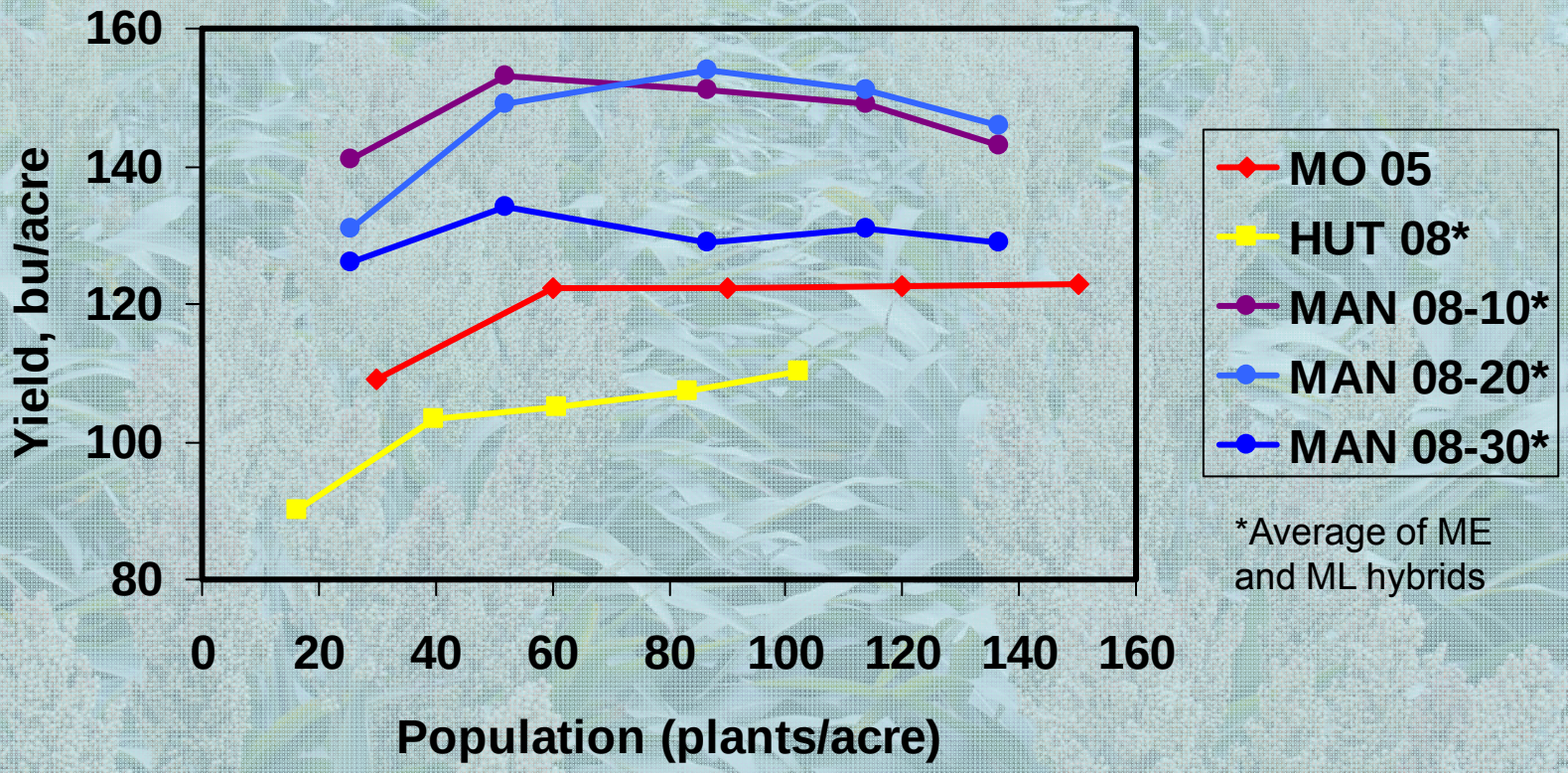
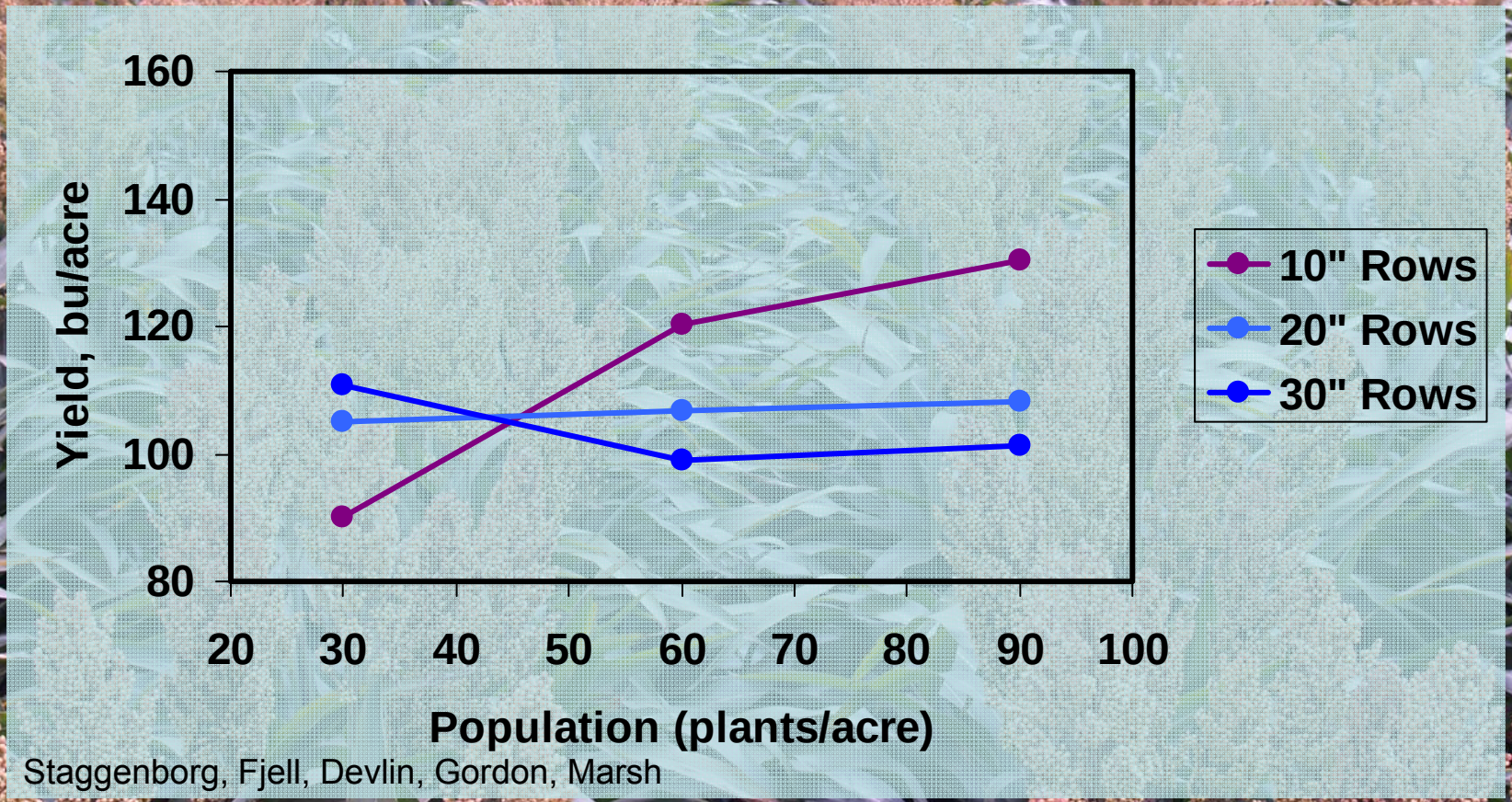
Plant Population Effect on Sorghum Yield



Plant Population Effect on Sorghum Yield, Belleville 1996

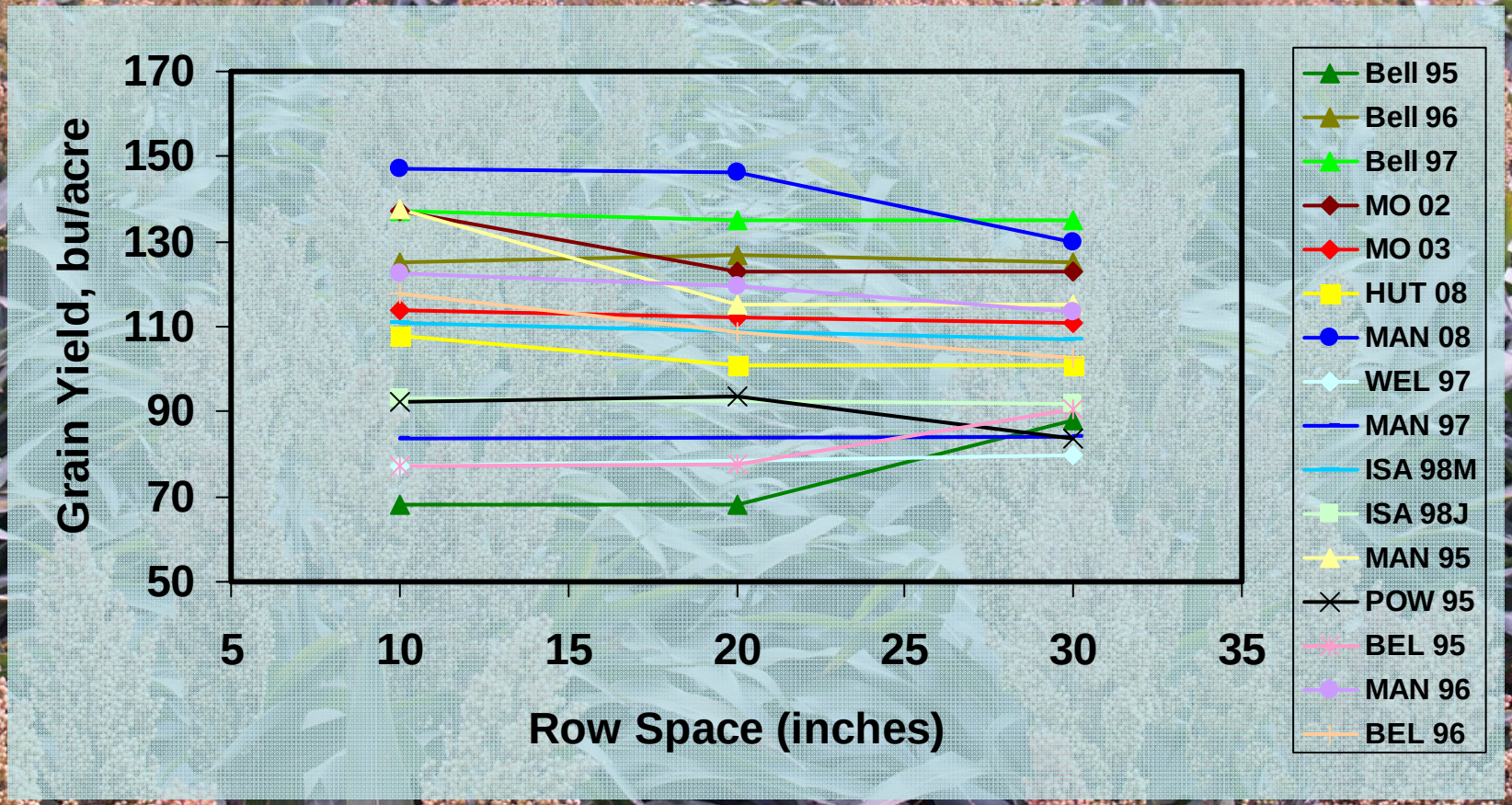


Staggenborg, Fjell, Devlin, Gordon, Marsh

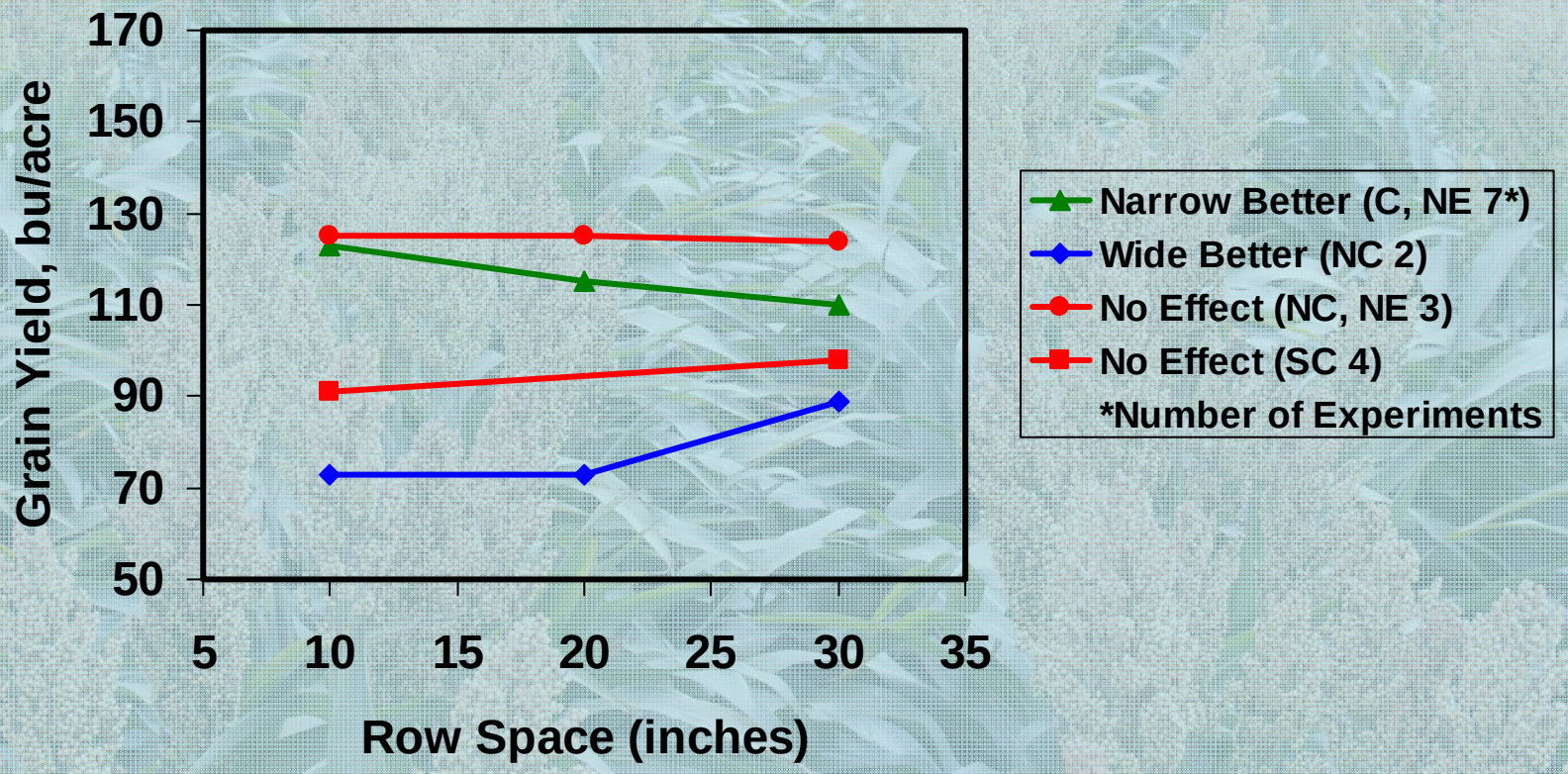
Population Summary/Conclusions

- ~ 40,000 plants/acre sufficient for Hutchinson
- 50,000 to 60,000 plants/acre sufficient for Manhattan, Missouri and Scandia dryland or limited irrigation
- 75,000 to 80,000 plants/acre sufficient for ≥2 irrigations and med-full season hybrids
- May need >80,000 plants/acre with irrigated early-medium maturity hybrids
- Fuller maturity hybrids maximized yield at lower populations than early-med hybrids (if full growing season was available)
- Narrow rows (<30”) were more responsive to population

Row Spacing Effect on Sorghum Yield – 16 Studies



Row Spacing Effect
Kansas Summary



Planting Date and Row Spacing Effect on Sorghum Yield (1997-1999)

Row Space (inches)	Late May	Late June
30	**135**	**115**
15	**132**	**125**

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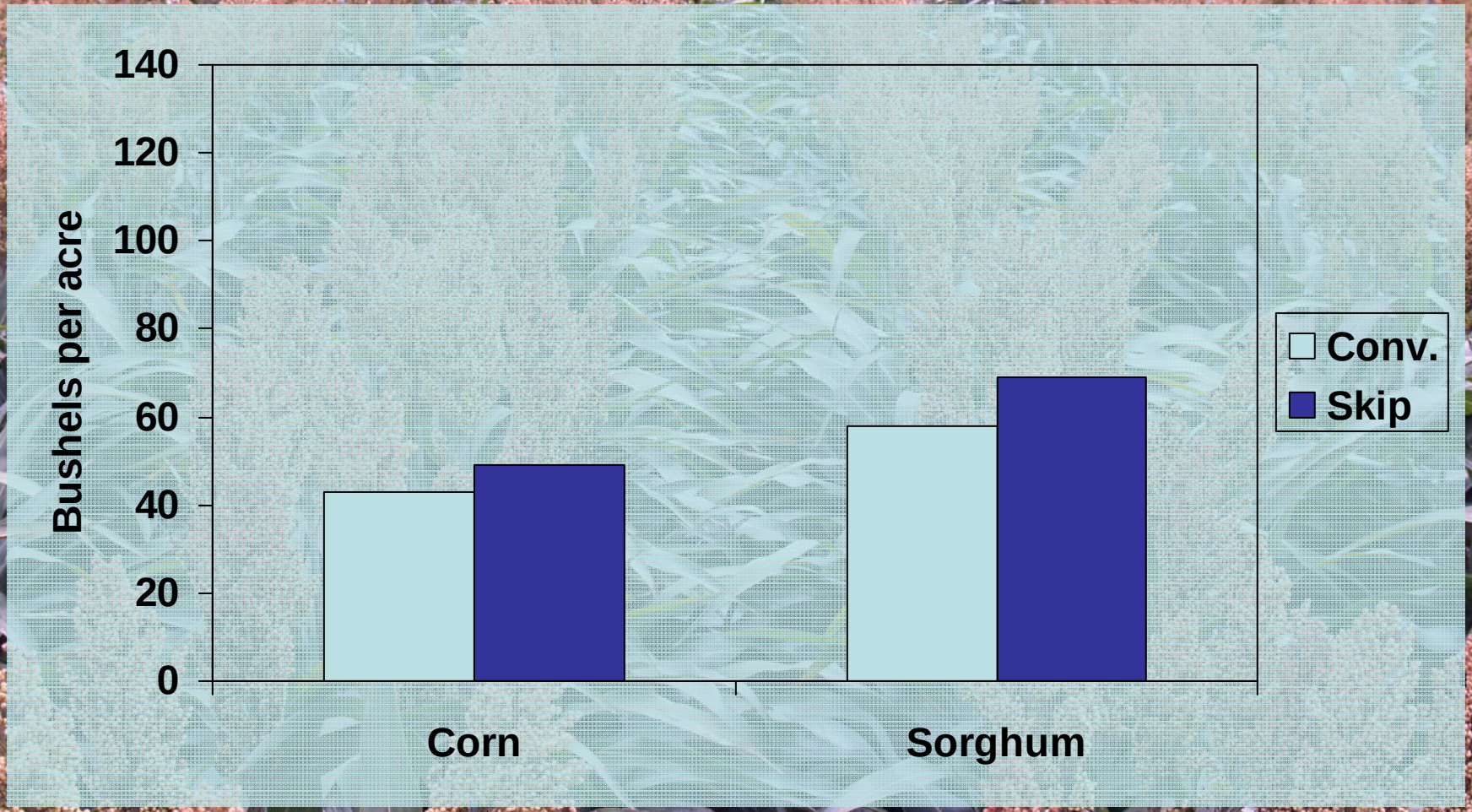
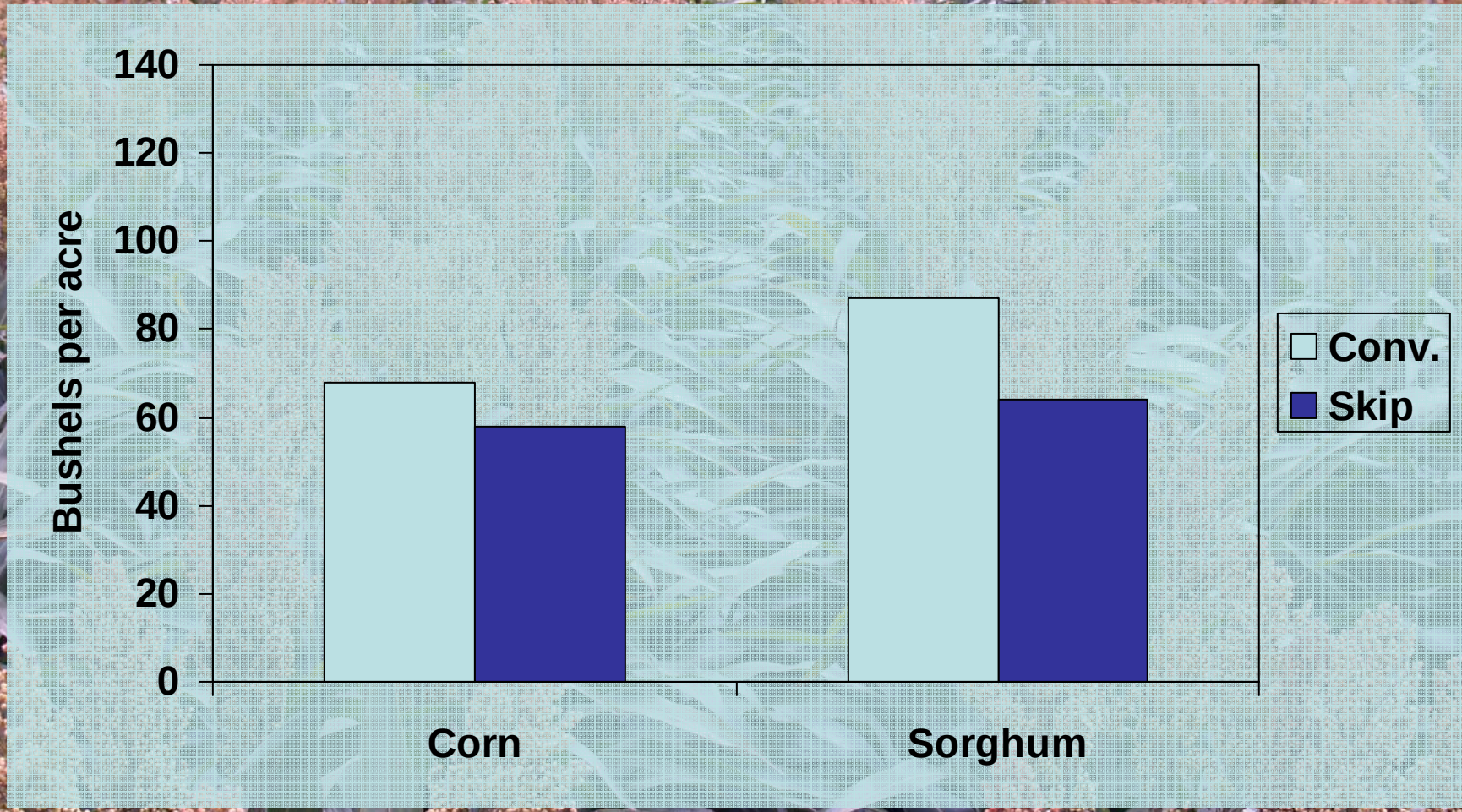
Skip-Row Planting

P2S2, 2007 Tribune, KS; Alan Schlegel and Lucas Haag



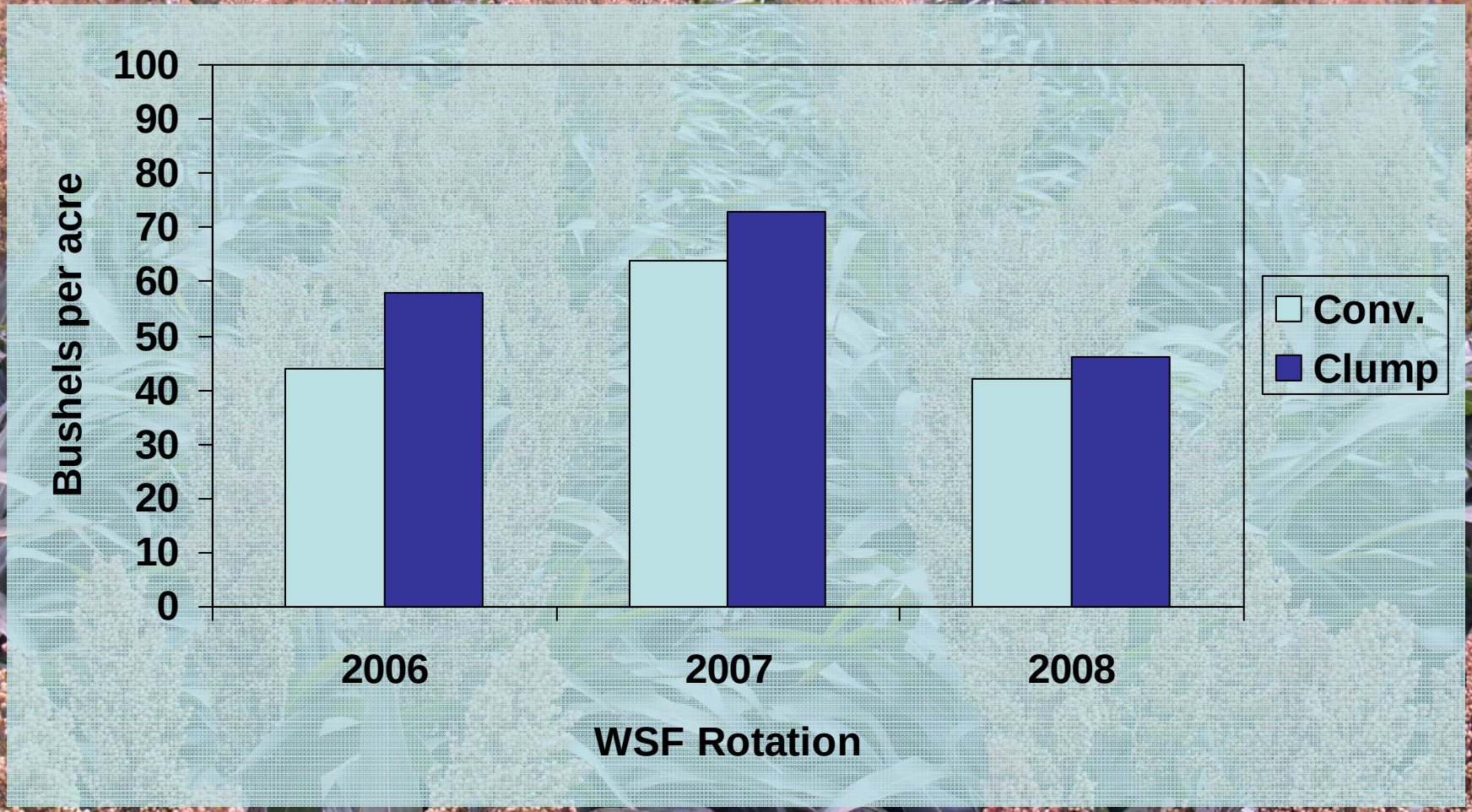
Skip-Row Planting

P2S2, 2008 Tribune, KS; Alan Schlegel and Lucas Haag



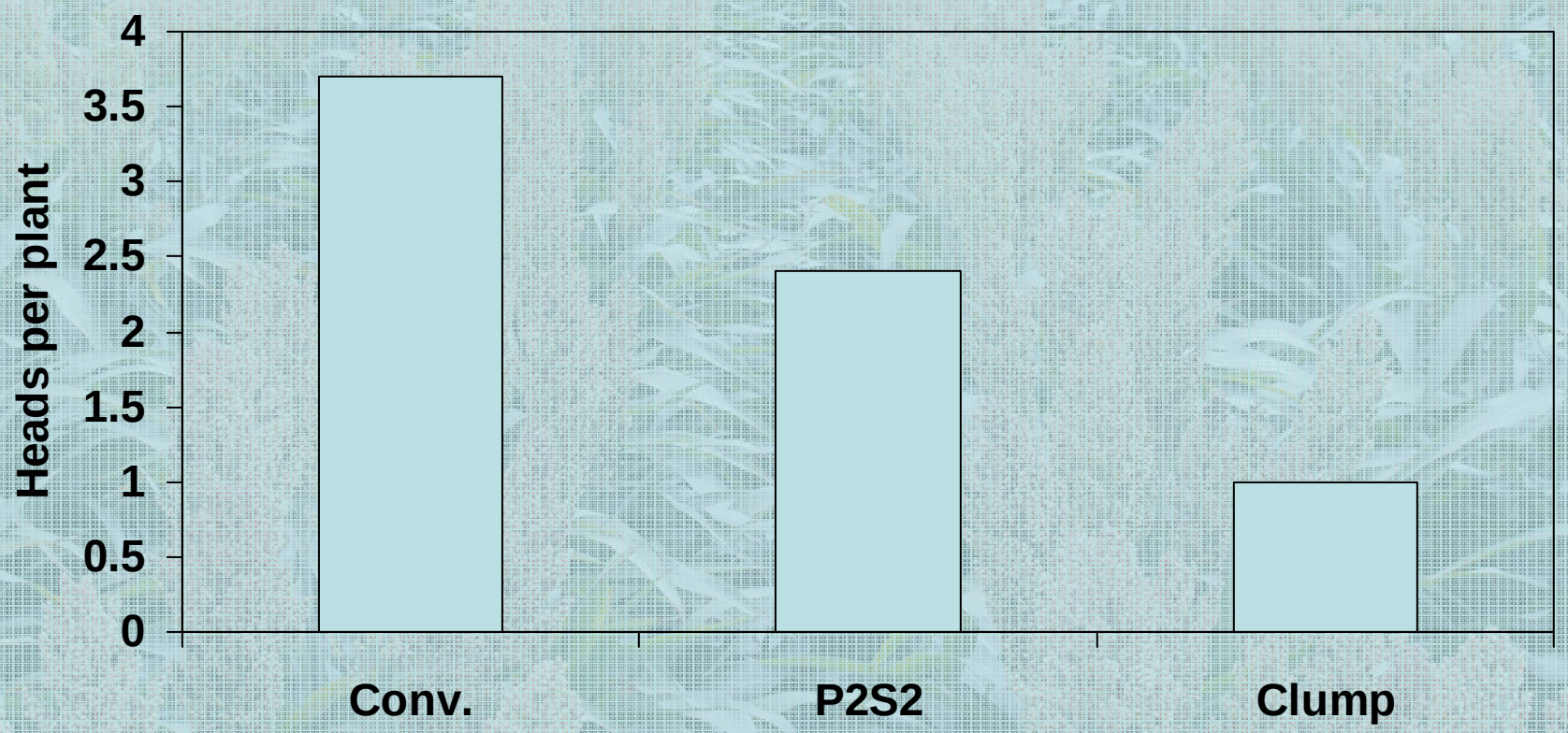
Clump Grain Sorghum Planting

Tribune, KS; Alan Schlegel and Lucas Haag



Planting Geometry Affects Tillering

Tribune, KS; Alan Schlegel and Lucas Haag

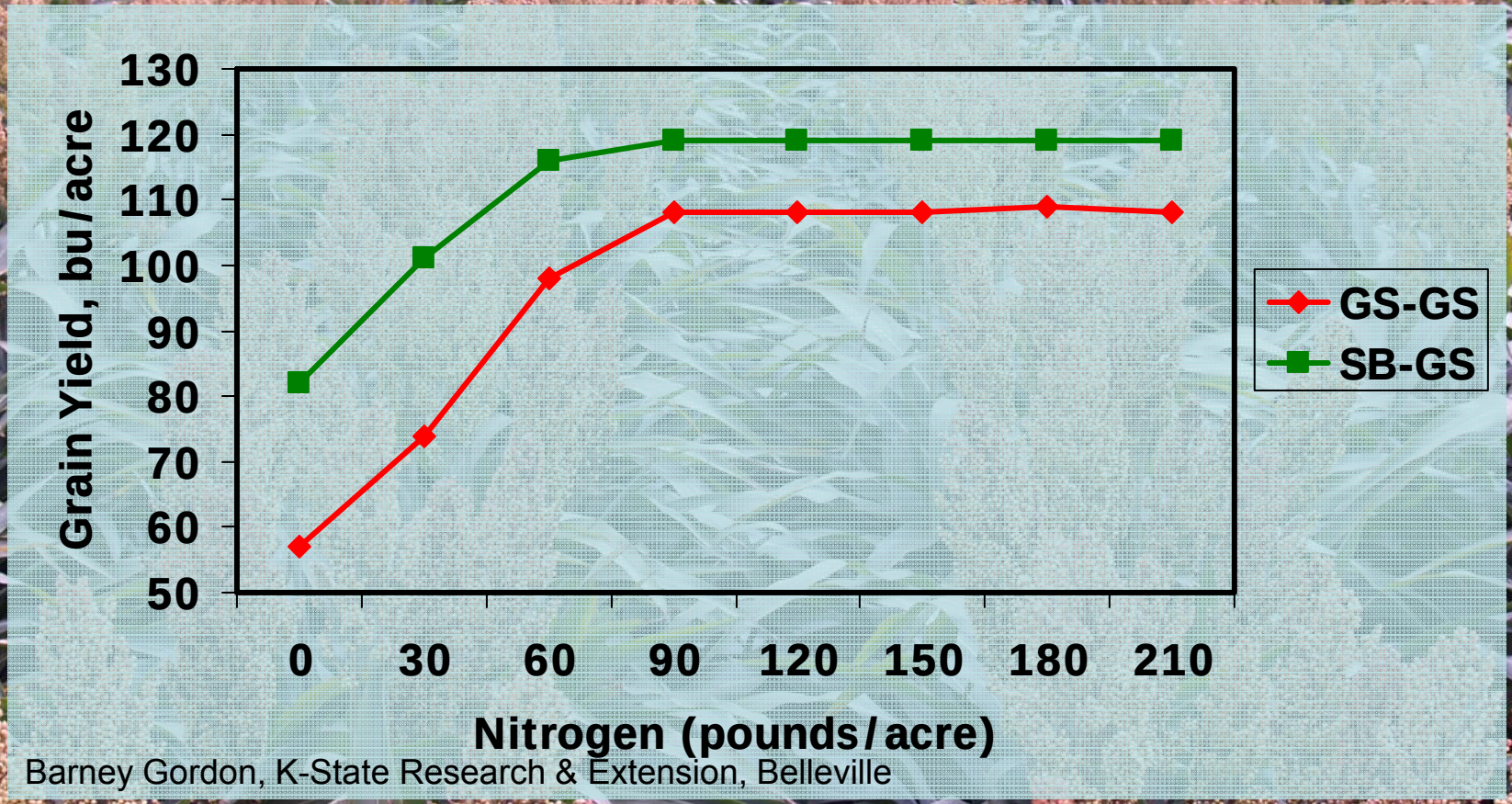


Row Spacing Summary/Conclusions

- Narrower rows may provide the opportunity to capture greater yields at higher populations in favorable environments (>heads/plant, larger heads)
- Narrow rows may be a detriment in dry environments
- Narrow rows may be more advantageous at later planting dates
- Hybrid maturity usually had no effect on row spacing response
- Select hybrids with resistance to stalk rots and excellent standability for narrow rows
- Skip row or clump planting may have merit in dry environments

Rotation and Tillage

Rotation and N Effect on Sorghum Yield (7 years)



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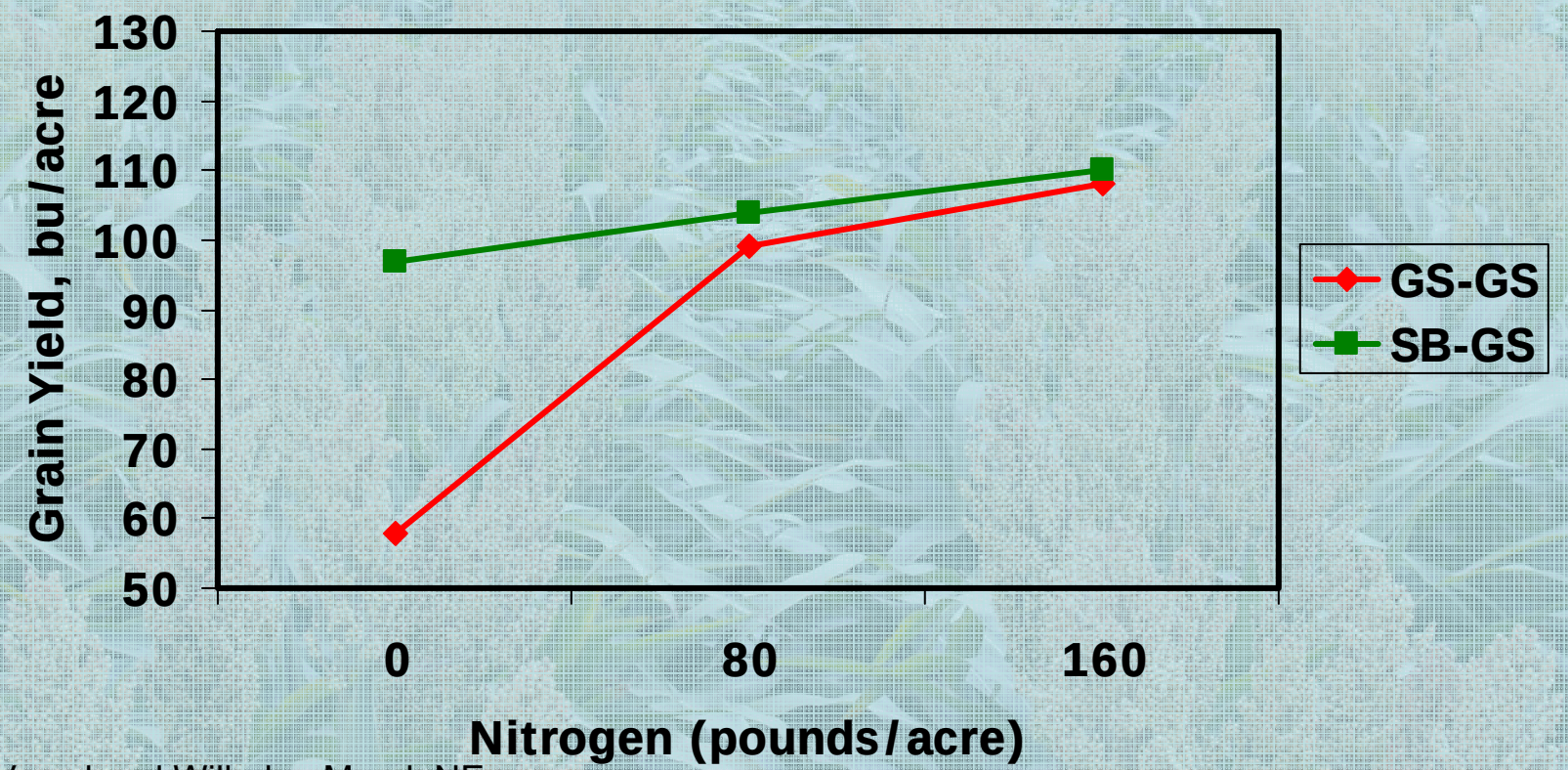
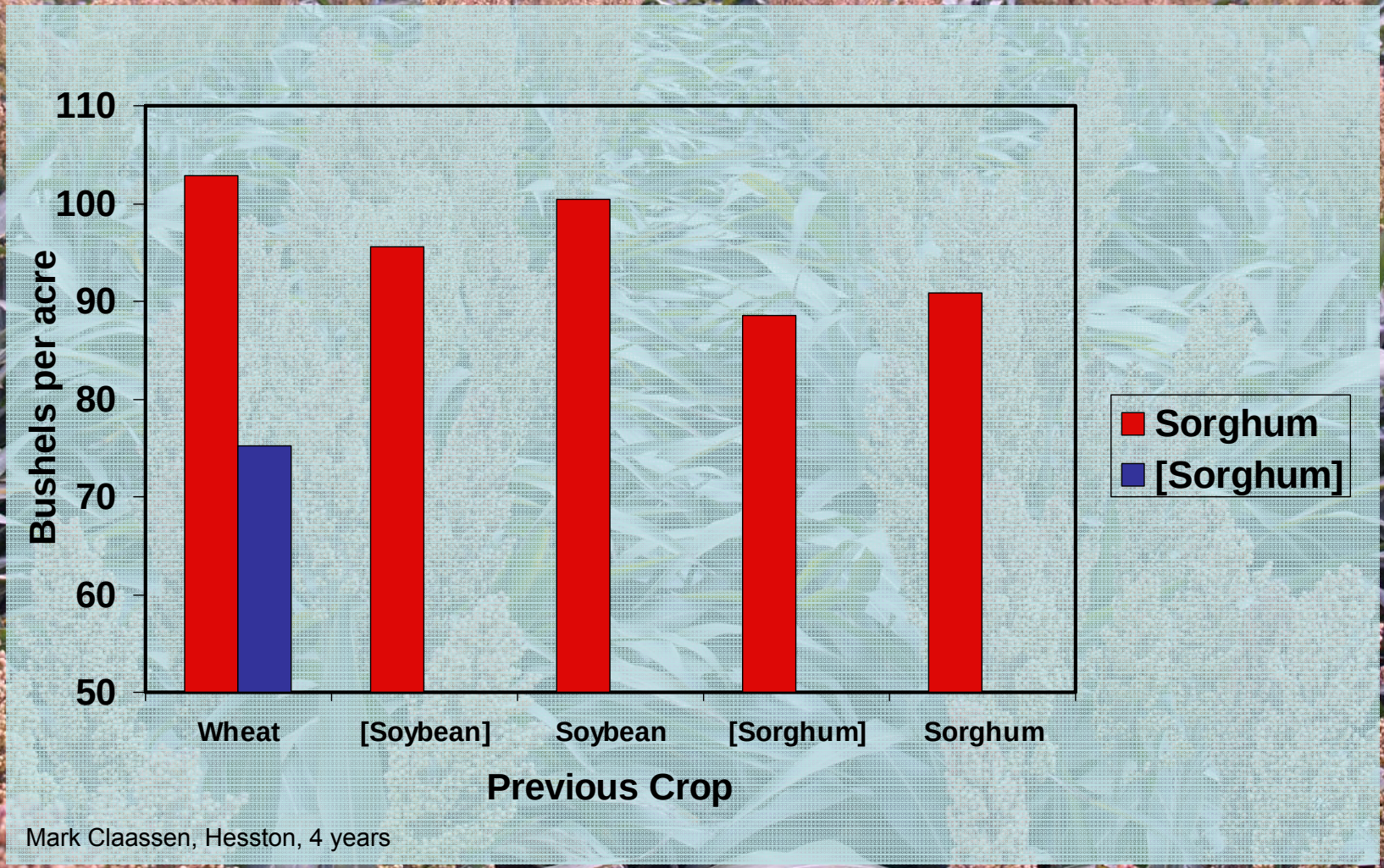
Rotation and N Effect on Sorghum Yield (20 years)



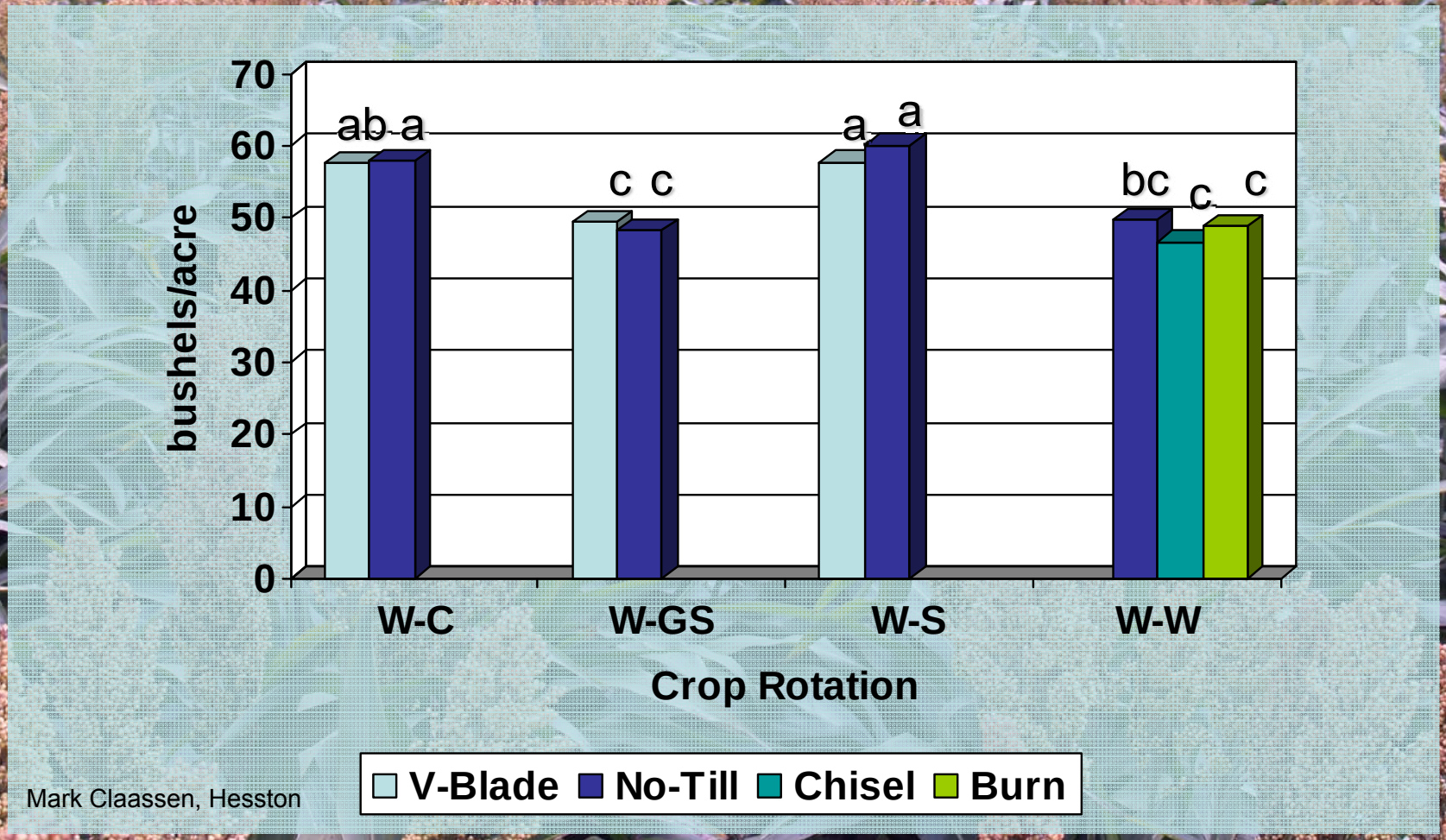
Varvel and Wilhelm, Mead, NE

Preceding Crop Effect on Sorghum Yield



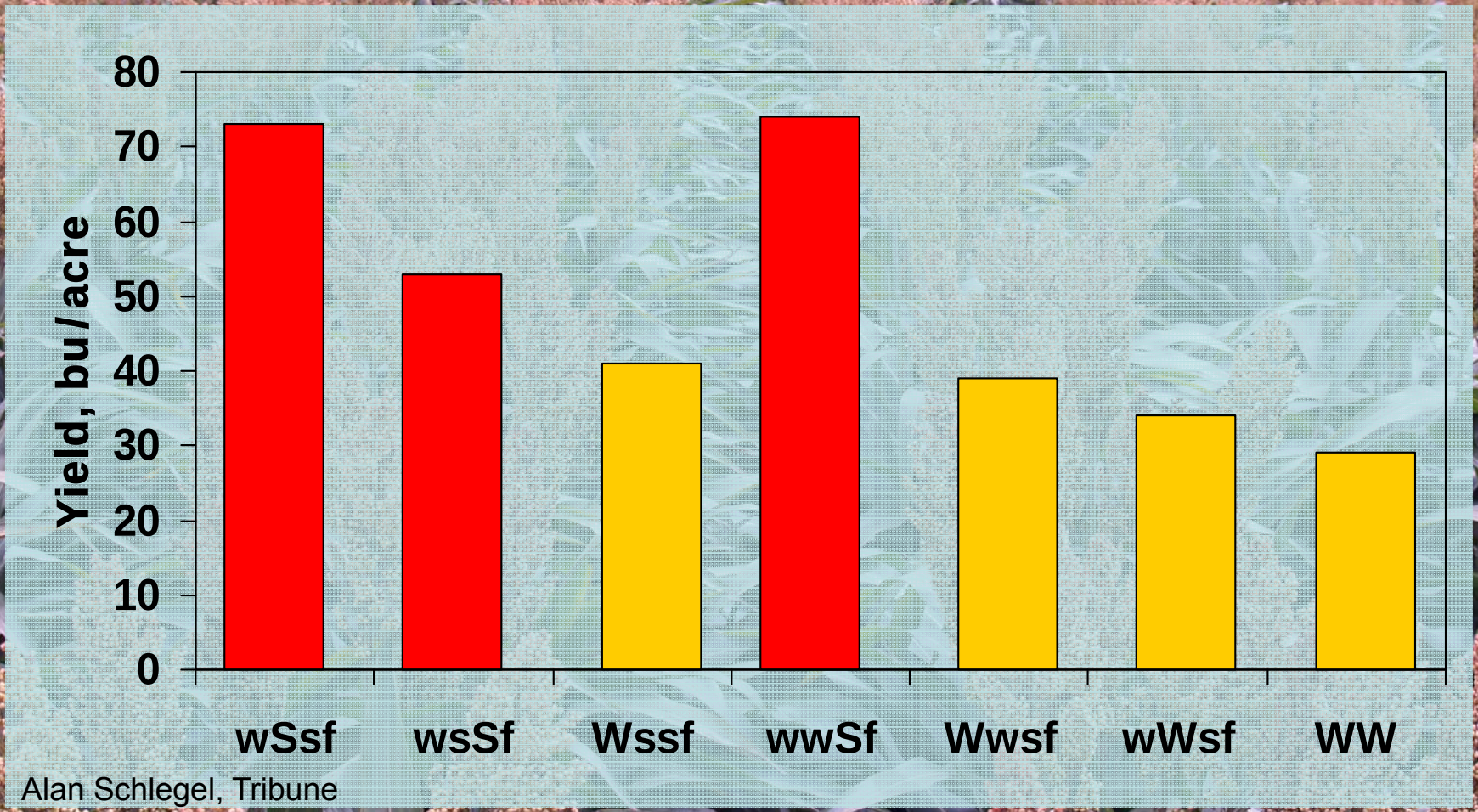
Mark Claassen, Hesston, 4 years

Rotation and tillage effects on 10-year average winter wheat yield.



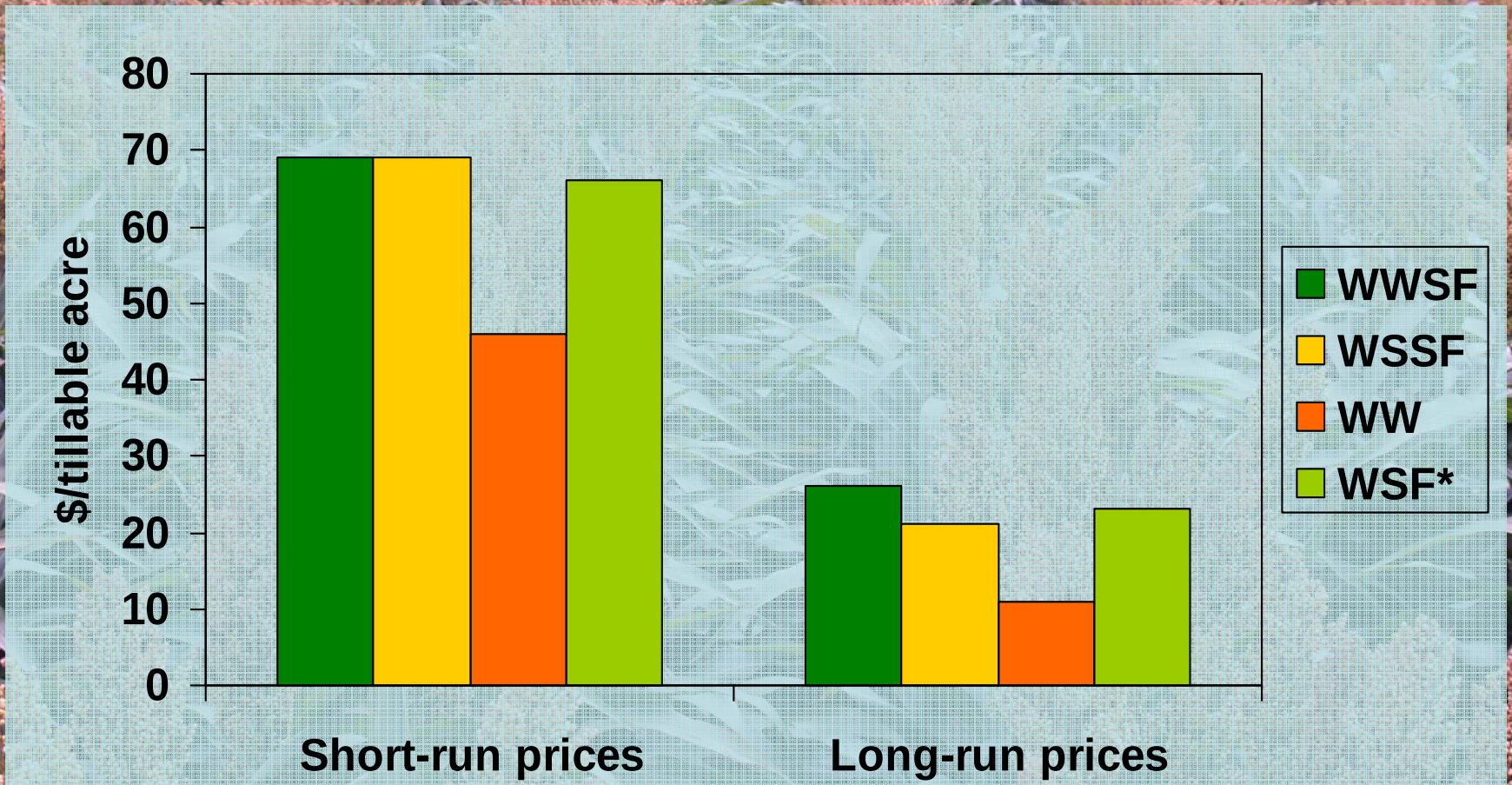
Mark Claassen, Hesston

Grain Sorghum and Wheat Response to Rotation – 11 Years, Tribune, KS



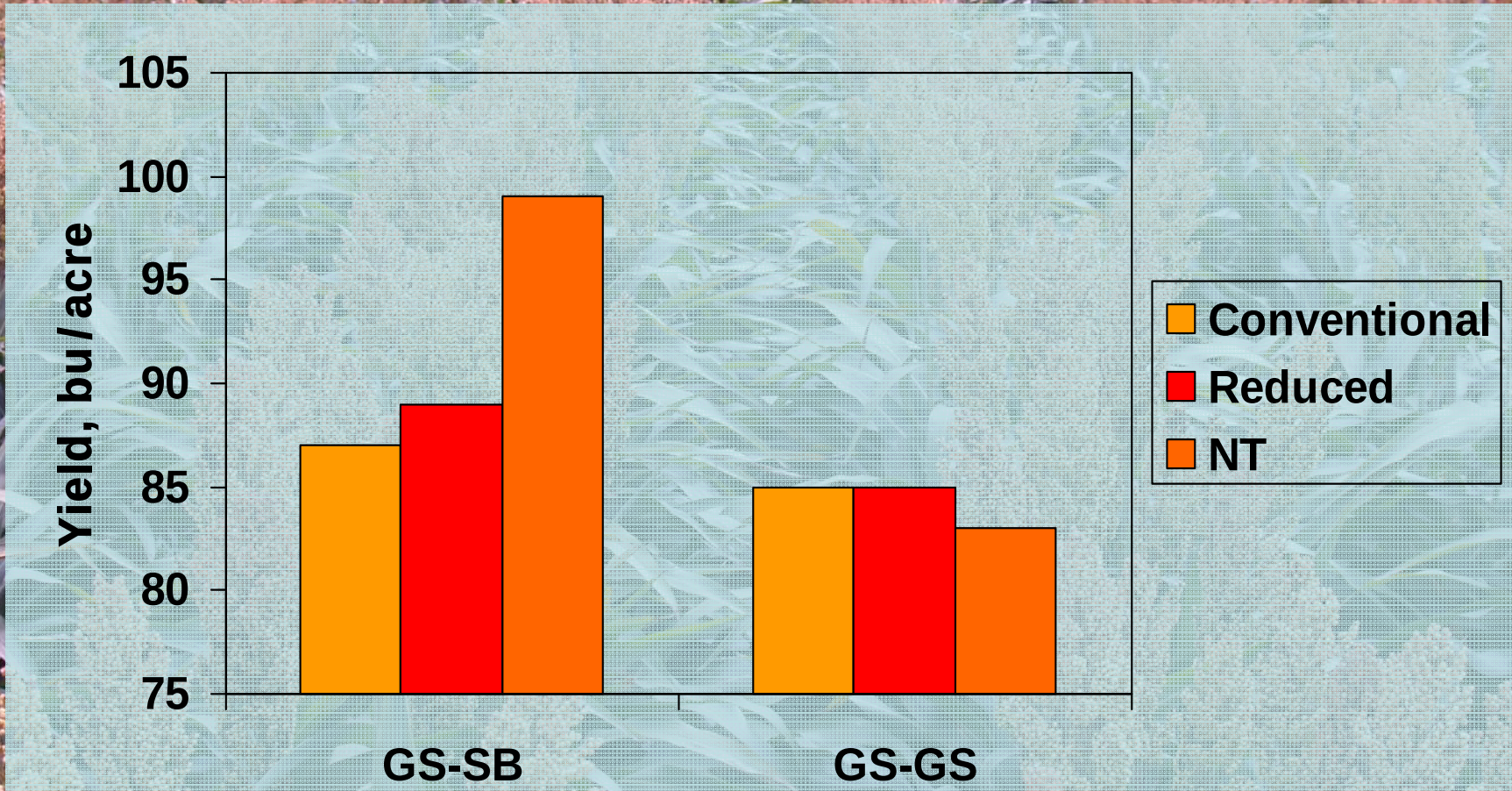
Alan Schlegel, Tribune

Net Returns for Grain Sorghum, Wheat Rotations – 11 Years, Tribune, KS



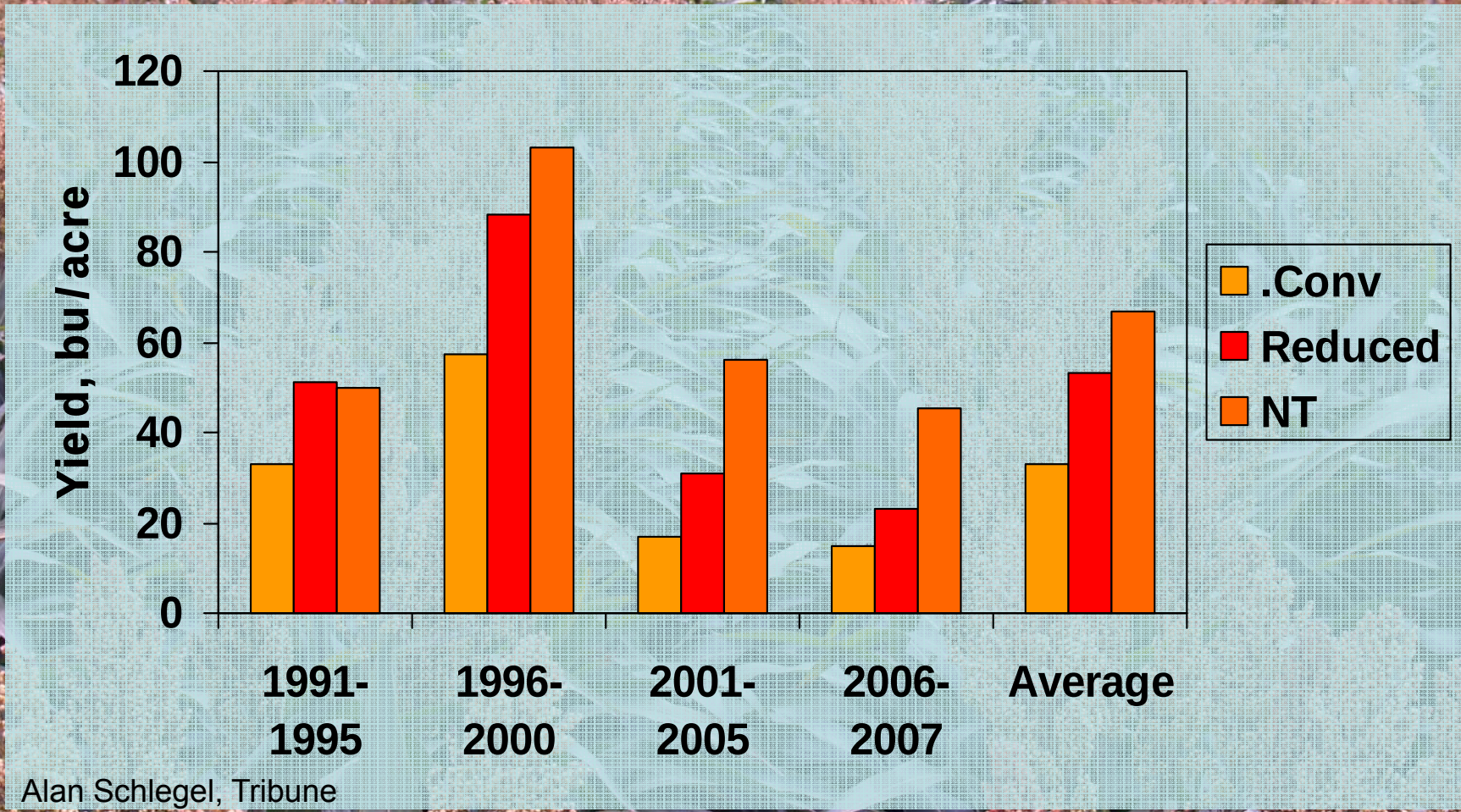
Alan Schlegel, Tribune; Troy Dumler, Garden City

Grain Sorghum Response to Tillage 31 Years, Manhattan, KS



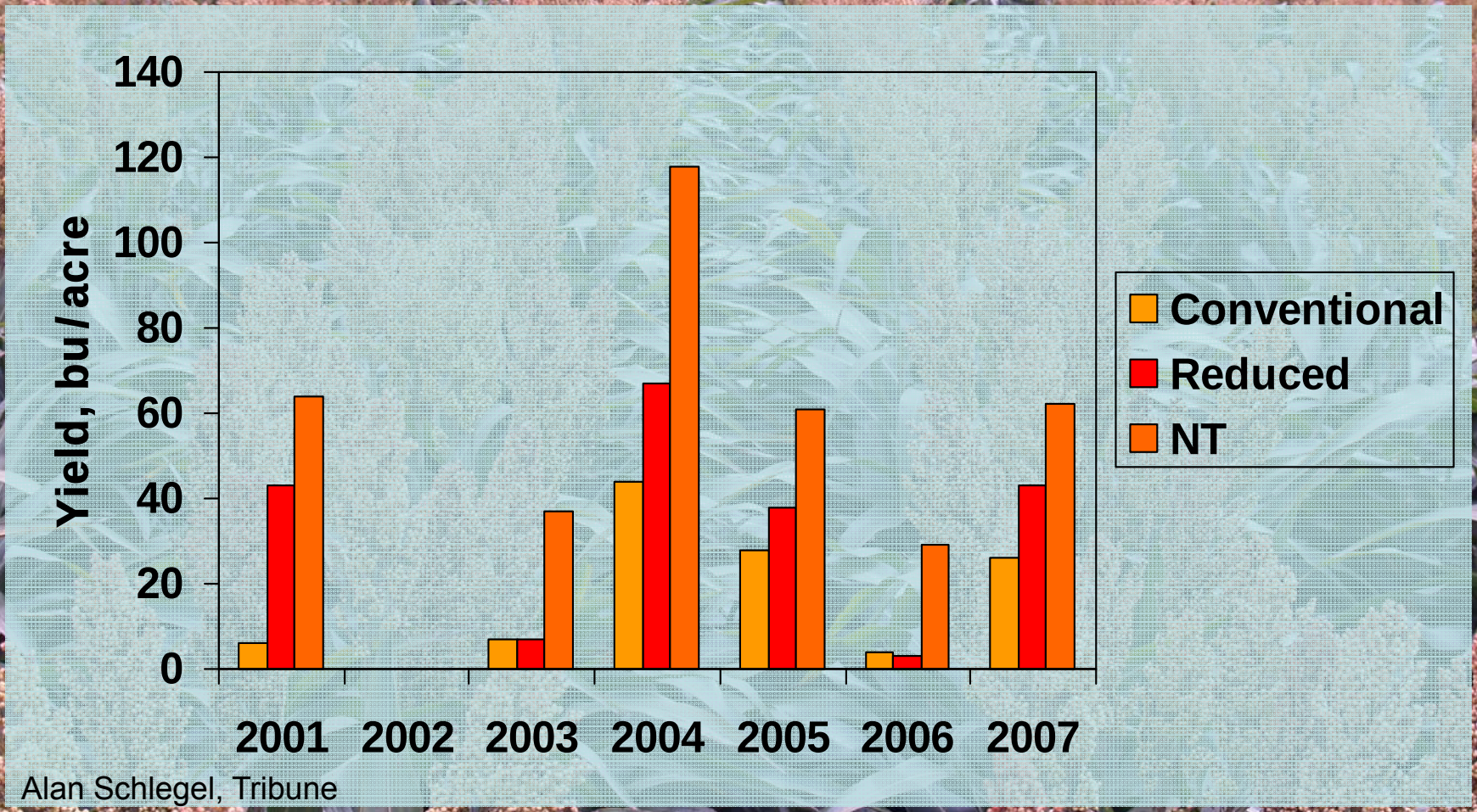
Dallas Peterson, Manhattan

Grain Sorghum Response to Tillage W-S-F, Tribune, KS



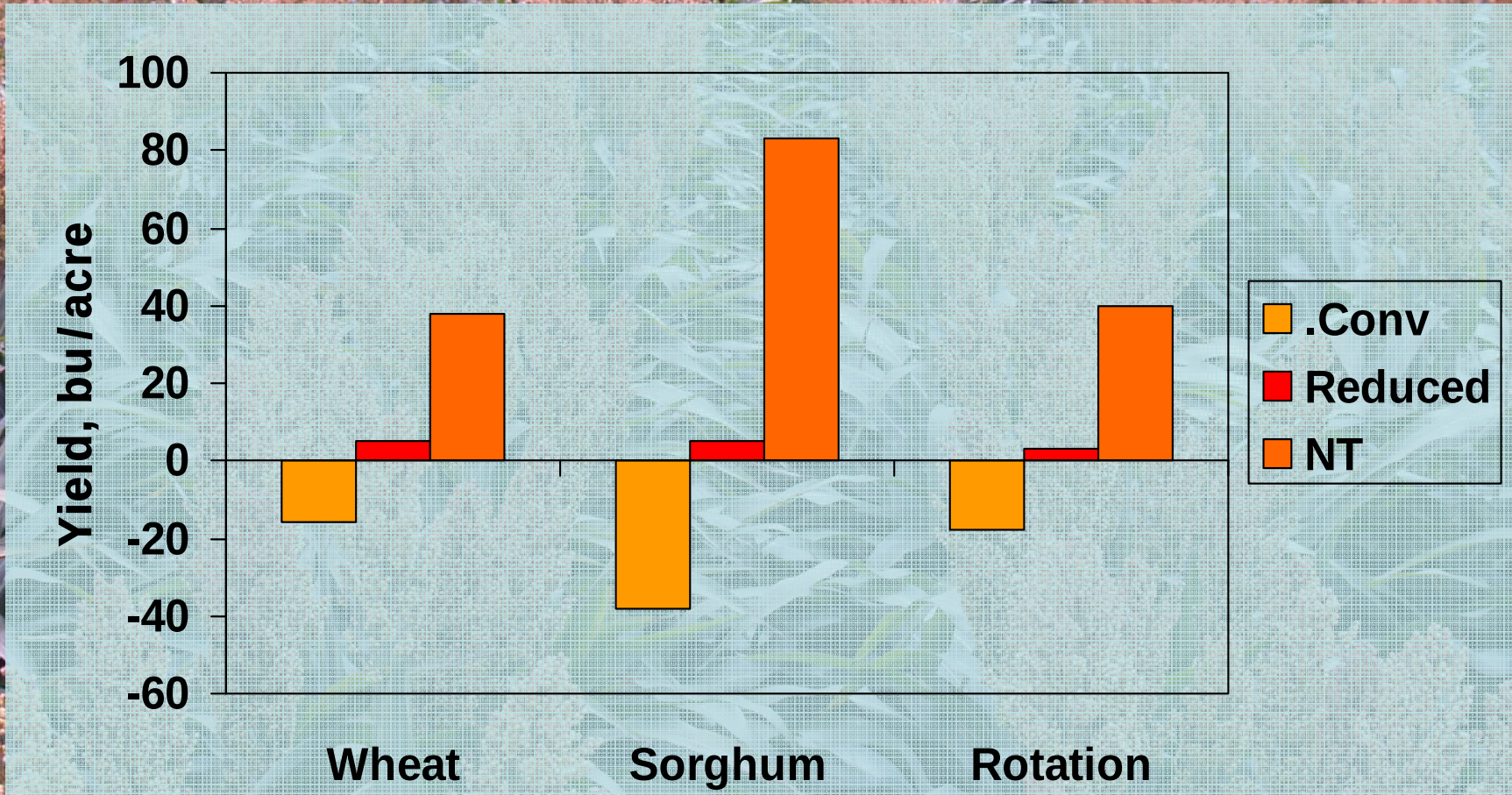
Alan Schlegel, Tribune

Grain Sorghum Response to Tillage W-S-F, Tribune, KS



Alan Schlegel, Tribune

Net Returns for Different Tillage Systems in W-S-F, 2001-2007 Tribune, KS

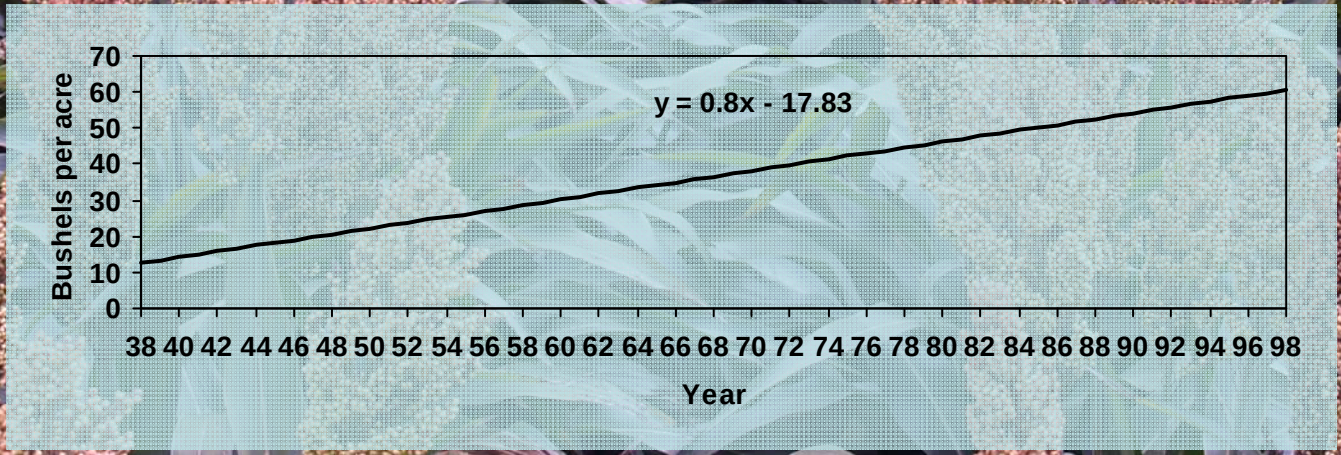


Alan Schlegel, Tribune;Troy Dumler, Garden City

Dryland Sorghum Yield Increases Over Time, Bushland, TX

- Yields increased 0.8 bu/a/year over 50 years
- Improved hybrids accounted for about 33% of yield increase
- Soil water content at planting was single largest other factor contributing to yield increases – related to reductions in tillage and increased surface residue

(P.W. Unger and R.L. Baumhardt. 1999. Factors related to grain sorghum yield increases: 1939 through 1997. Agron. J. 91:870-875.)



Rotation and Tillage Summary

- Sorghum almost always yields more when in rotation, regardless of N rate.
- Increasing the number of years between sorghum crops can enhance “rotation effect”.
- Rotation is critical for no-till success.
- No-till response can improve over time.
- No-till can save enough soil moisture to make a BIG yield difference.

Questions?