

IMPACT OF AGRONOMIC PRACTICES ON SOYBEAN GRAIN COMPOSITION

Dr. Roger Borges - UWEX Soybean Agronomist



We plant **SOYBEANS**

We grow **SOYBEANS**

We harvest **SOYBEANS**

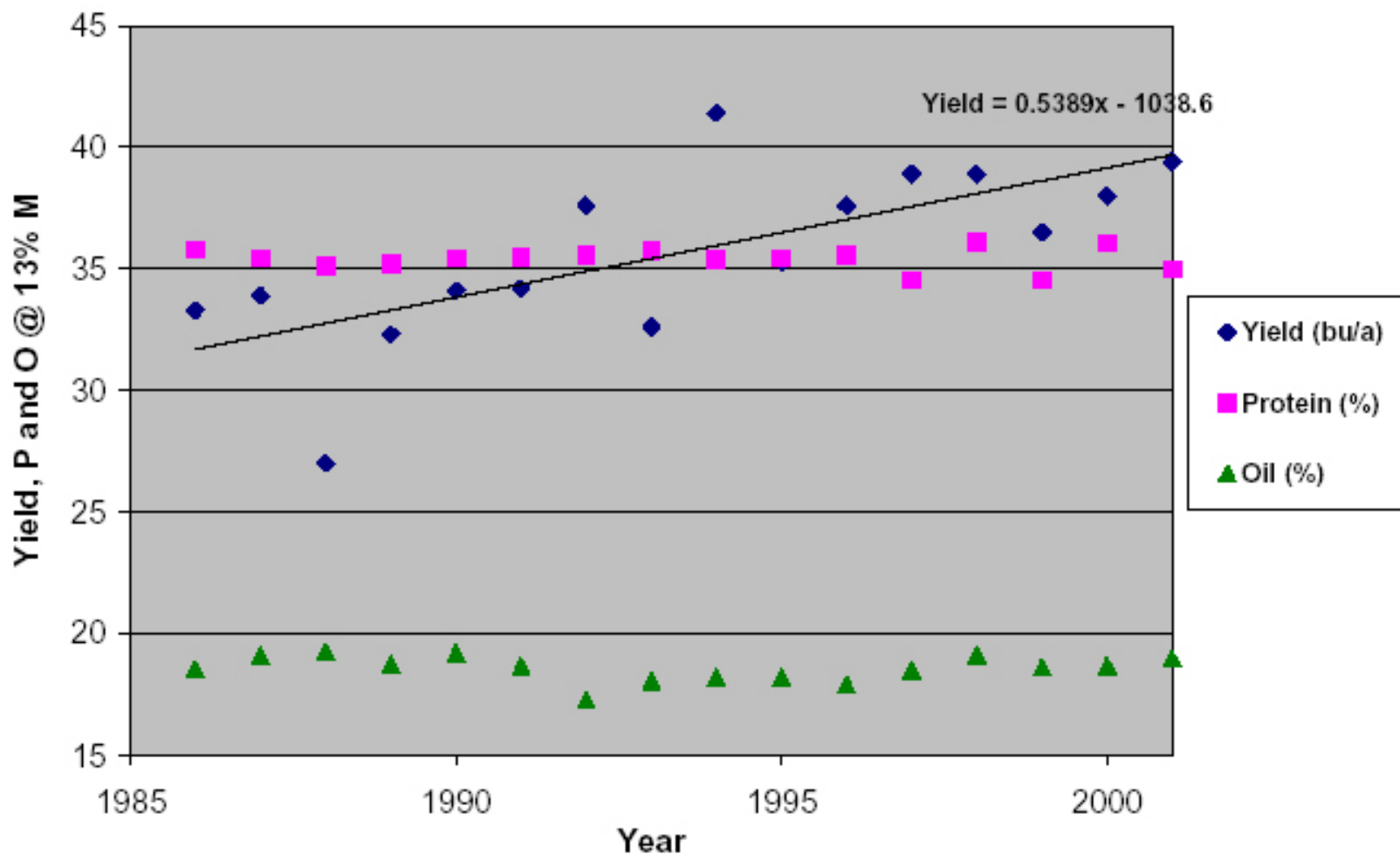
We try to sell **SOYBEANS**

The customer buys **PROTEIN AND OIL**





Trends in US Soybean Yield, Protein, and Oil





KNOWN

- Variety selection can make a difference
- The protein and oil content of a single variety changes with years and locations





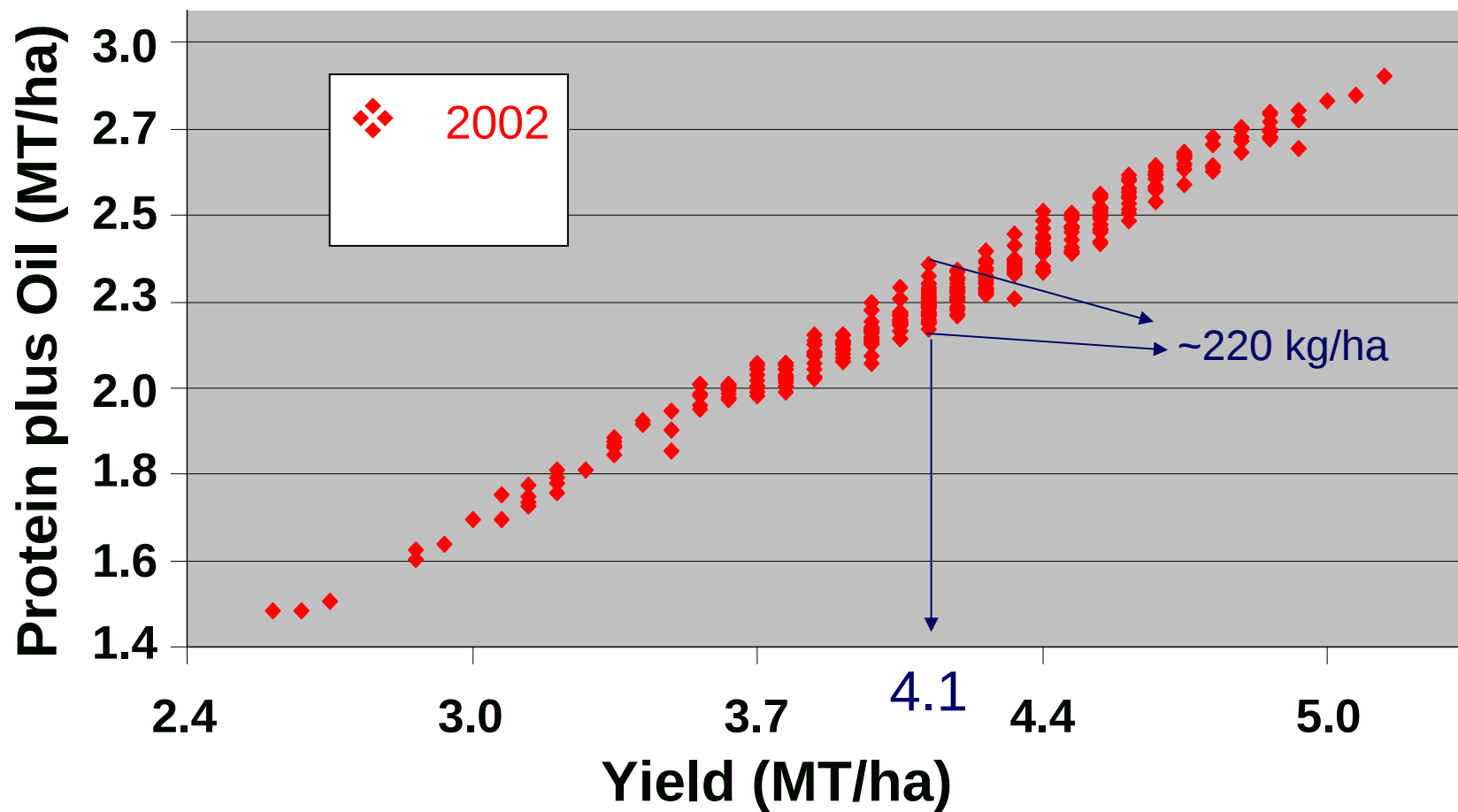
OPEN QUESTIONS

- Which field conditions can impact the composition of soybean grain?
- Can management practices have an impact on the grain composition of a chosen soybean variety?
- Which management practices have relevant quantitative impact on soybean's output per acre?
- Is there a need to re-evaluate existing, or issue new, management recommendations that incorporate grain composition considerations?



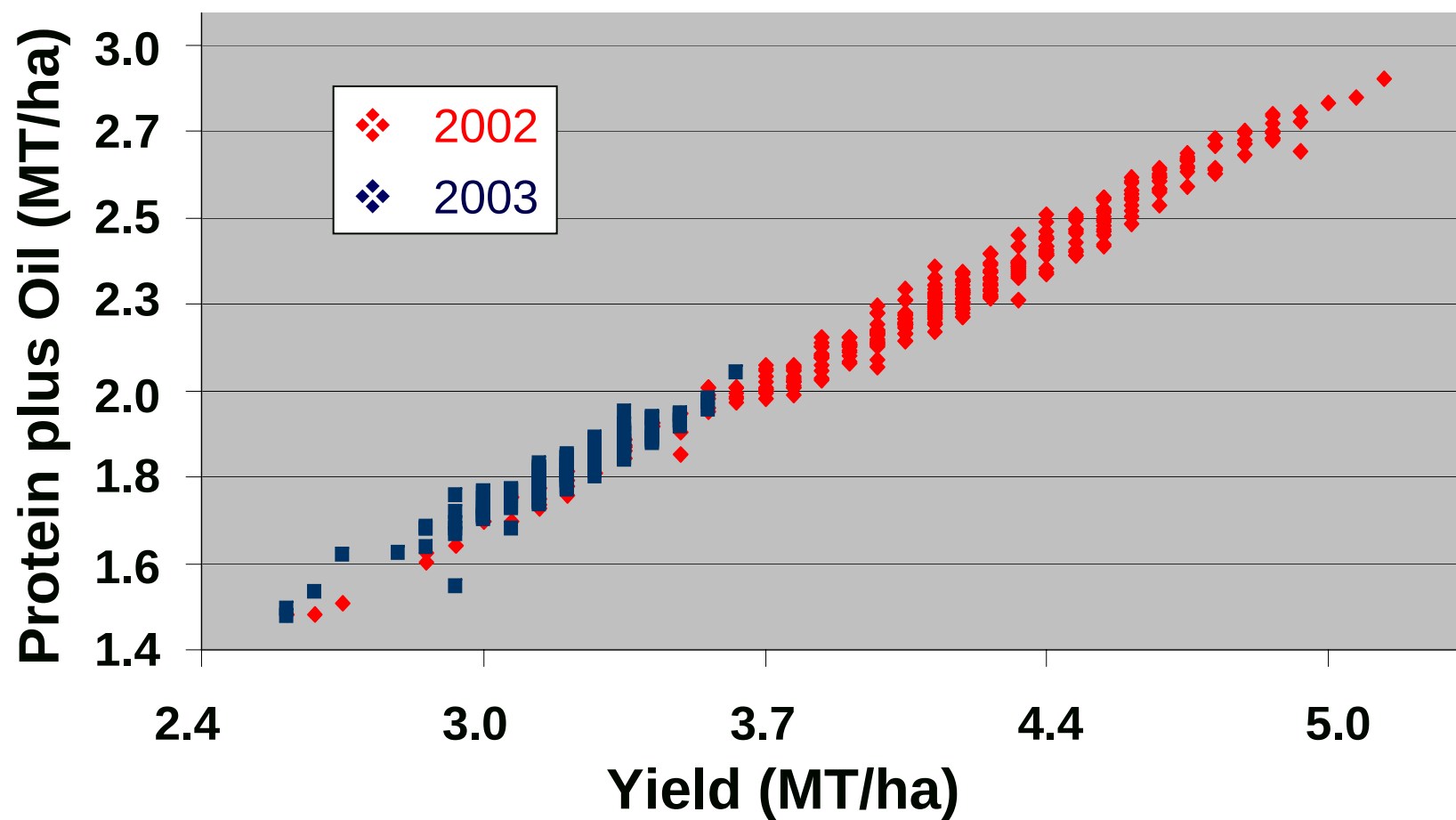


VARIETY SELECTION



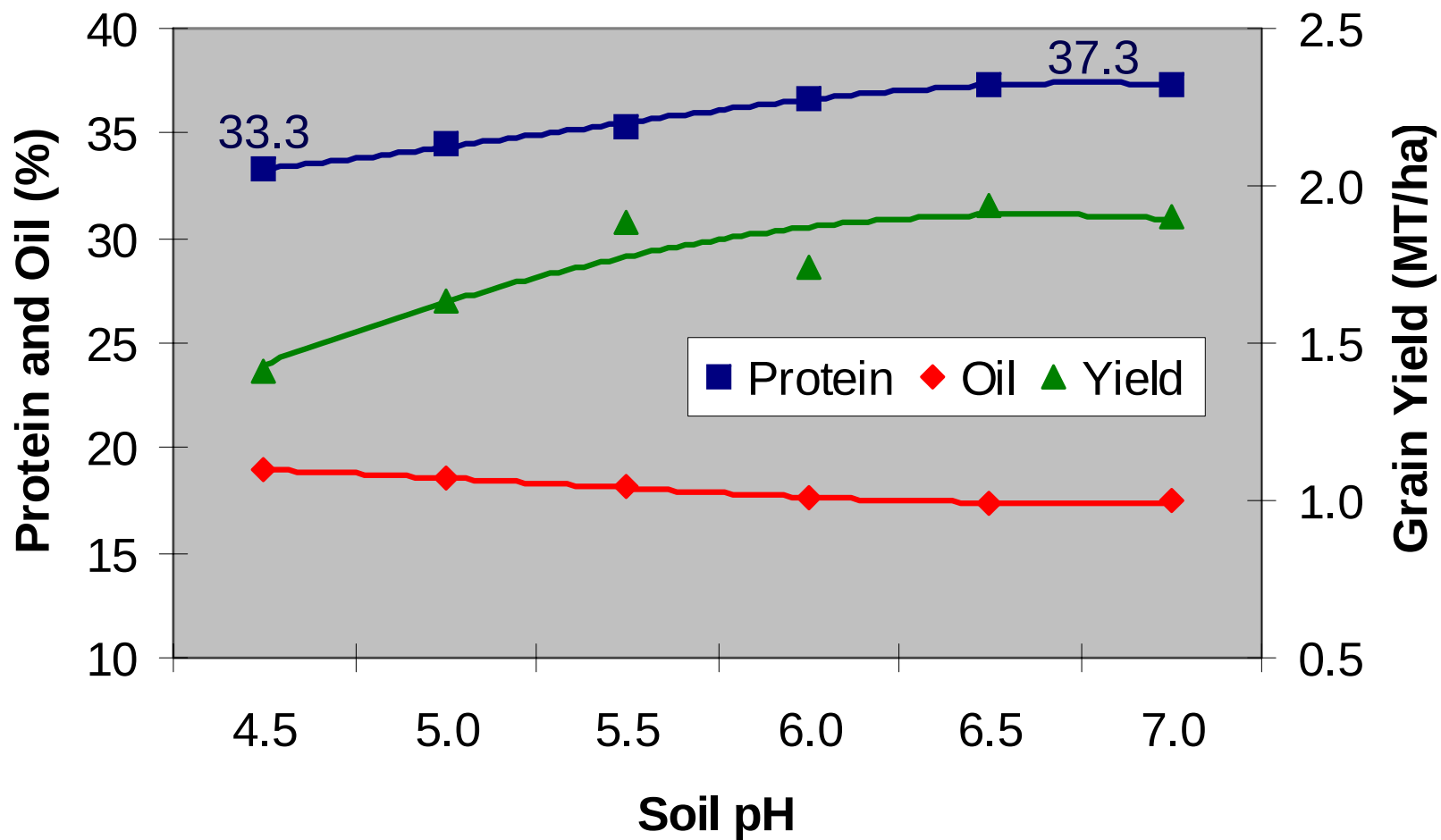


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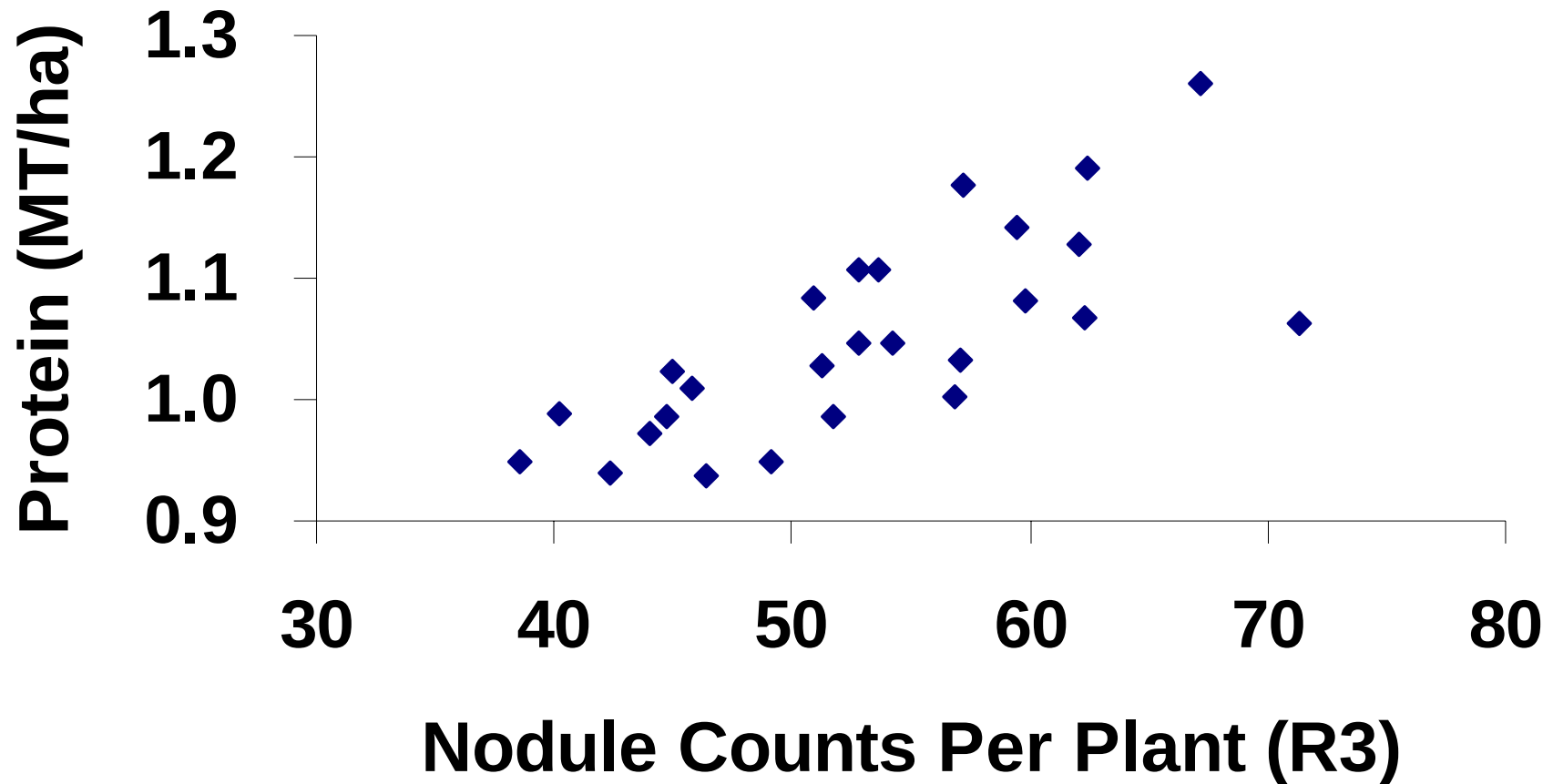


SOIL pH





NITROGEN FIXATION





NITROGEN

Treatments	Yield MT/ha	Protein %
Raw Seed	1.55 c*	31.4 e*
Raw Seed + Urea	2.09 b	35.9 c
Raw Seed + Fall Manure	2.29 b	35.9 c
Raw Seed + Spring Manure	2.09 b	34.8 d
Inoculated Seed	3.10 a	43.5 a
Inoculated Seed + Urea	2.89 a	41.5 b
Inoculated Seed + Fall Manure	2.96 a	40.8 b
Inoculated Seed + Spring Manure	2.96 a	42.8 a

* Values following by the same letter within columns are not significantly different at the 5% probability level.

Source: Timmerman and Brolley 2003 ASA-CSSA-SSSA Annual Meetings





PHOSPHORUS

- “Stark (1924) showed an increase in soybean protein content with phosphate applications.”

Stark R. W. 1924. Am. Soc. Agron. J. 16, 636-645.





POTASSIUM

- “Significant increases in daidzein, genistein, and total isoflavone were observed with direct deep-banded K or residual surface-applied K on low-K soils.”

Vyn et al. J. Agric. Food Chem. 2002, 50, 3501-3506

- “Appropriate K management could be an effective approach to increase isoflavone concentration for soybeans produced on low- to medium-K soils.”

Vyn et al. J. Agric. Food Chem. 2002, 50, 3501-3506



Row Spacing and Seeding Rate

Row Spacing	Seeding Rate seeds/ha/1000	Yield MT/ha	Protein %	Oil %
19 cm		3.28	35.6	18.8
75 cm		2.99	35.2	19.0
	Low	3.07	34.9	19.1
	Med	3.13	35.6	18.8
	High	3.21	35.8	18.8
19 cm	375	3.26	35.0	19.0
19 cm	500	3.23	35.8	18.7
19 cm	625	3.35	36.1	18.6
75 cm	190	2.89	34.8	19.2
75 cm	310	3.02	35.3	19.0
75 cm	440	3.07	35.6	18.9
Means		3.14	35.4	18.9
<u>Probability %</u>	Row Spacing (RS)	5.2	0.4	0.4
	Seeding Rate (S)	>50	<0.1	<0.1
	RS x SR	>50	>50	36.0
<u>LSD 10%</u>	Row Spacing (RS)	3.2	0.1	0.1
	Seeding Rate (S)	NS	0.3	0.1
	RS x SR	NS	NS	NS



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	Seeding Rate (S)	NS	0.3	0.1
	RS x SR	NS	NS	NS

Soybean Aphid Date of Planting Study

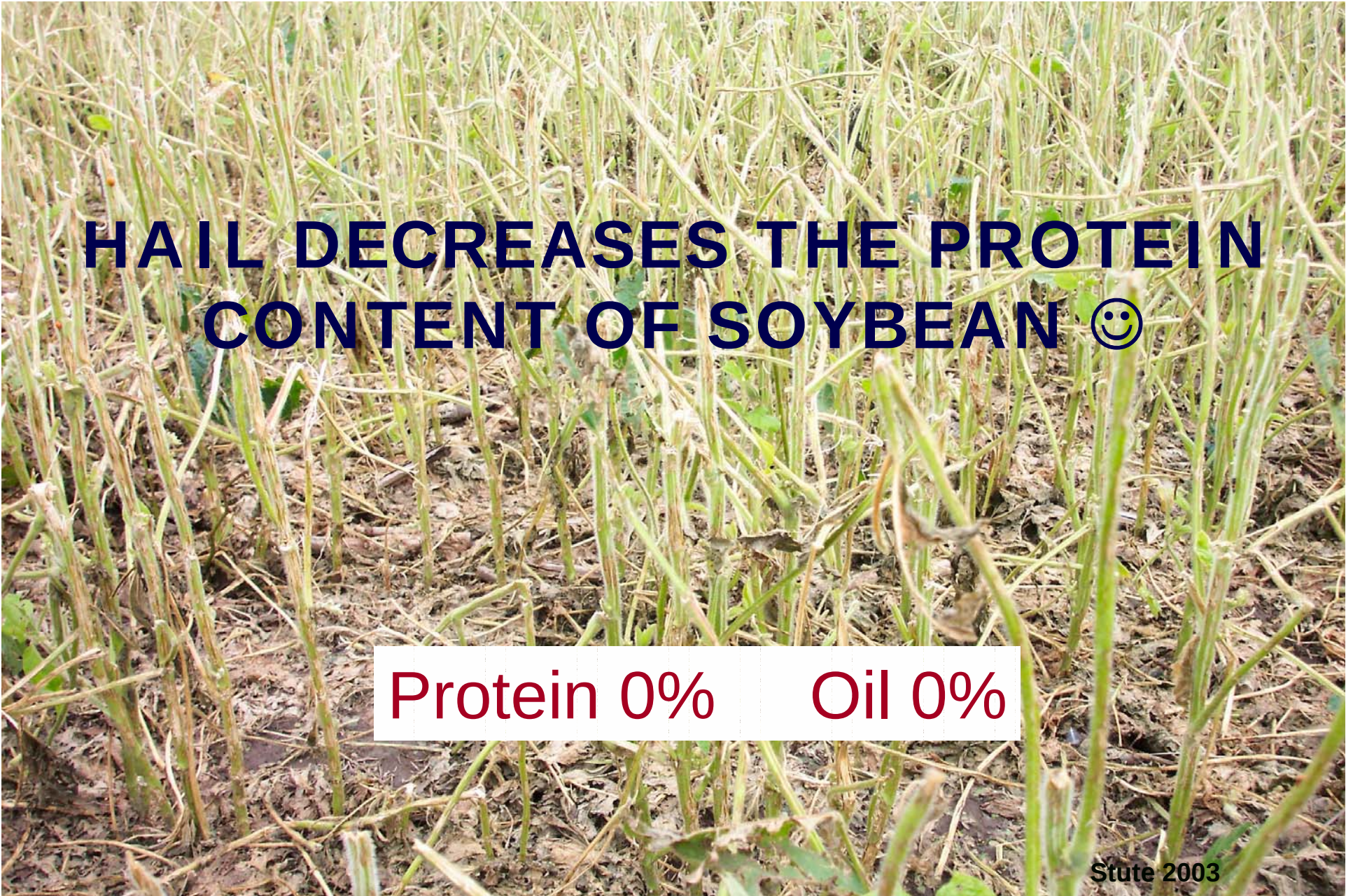
Planting Date	Grain				
	Yield	Height	Protein	Oil	Fiber
	MT/ha	cm	%	%	%
4-May	2.71	83.8	37.7	19.2	4.8
21-May	2.76	86.3	38.0	19.2	4.8
9-Jun	2.75	81.3	35.9	18.8	5.0
Means	2.74	83.8	37.2	19.0	4.9
Probability %	>50	>50	<0.1	19.9	0.1
LSD 10%	NS	NS	0.5	NS	0.1
C.V. %	9.9	9.1	0.9	1.6	0.7

Paper Mill Residue Effect on Soybean yield and Grain Composition

Paper mill residue	Nitrogen	Grain Yield	Height	Seed composition		
				Protein	Oil	Fiber
MT/ha	kg/ha	MT/ha	cm		%	
0	0	1.24	52	35.7	19.1	5.1
27	0	1.29	58	35.6	18.7	5.1
27	70	1.29	57	35.9	18.8	5.1
54	0	1.33	57	37.3	17.9	5.0
54	70	1.41	58	37.9	17.2	4.9
80	0	1.58	61	38.3	16.9	4.9
Means		1.36	57	36.8	18.1	5.0
<u>Probability %</u>		>50	46.3	4.4	1.2	15.7
<u>LSD 10%</u>		NS	NS	0.7	0.4	NS
<u>C.V. %</u>		20	9	3	4	2

Effect of Manure on Soybean Grain Composition

Manure treatment	Variety	Grain		Plant height cm	Seed composition		
		Yield MT/ha	Moisture %		Protein %	Oil %	Fiber %
No manure		0.94	15.1	45	41.3	18.5	4.81
Liquid dairy manure 67200 lt/ha		1.96	13.7	67	39.9	18.8	4.99
	Trelay 2101RR	1.27	15.2	52	40.8	18.4	4.91
	Pioneer 91B03	1.24	13.9	52	41.0	18.7	4.85
	NK S08-R4	1.55	14.2	56	40.3	18.2	4.97
	Pioneer 90B73	1.73	14.3	65	40.1	19.2	4.88
No manure	Trelay 2101RR	0.78	16.4	42	41.8	18.2	4.78
No manure	Pioneer 91B03	0.73	14.5	41	41.5	18.4	4.80
No manure	NK S08-R4	0.91	14.8	44	41.2	18.3	4.86
No manure	Pioneer 90B73	1.32	14.5	55	40.7	19.0	4.80
Liquid dairy manure	Trelay 2101RR	1.76	13.9	62	39.8	18.6	5.04
Liquid dairy manure	Pioneer 91B03	1.74	13.3	64	40.6	19.0	4.90
Liquid dairy manure	NK S08-R4	2.18	13.7	69	39.5	18.2	5.08
Liquid dairy manure	Pioneer 90B73	2.14	14.1	75	39.5	19.3	4.96
Means		1.45	14.4	56	40.6	18.6	4.90
<u>Probability %</u>	Manure (M)	<0.1	12.0	<0.1	0.2	14	0.3
	Variety (V)	<0.1	14.6	<0.1	1.1	<0.1	<0.1
	M x V	1.6	34.2	>50	25.1	31	1.8
<u>LSD 10%</u>	Manure (M)	2.8	NS	1.7	0.4	NS	0.06
	Variety (V)	1.7	NS	1.3	0.5	0.3	0.04
	M x V	3.4	NS	NS	NS	NS	0.08
C.V. %		10	9	8	2	2	1



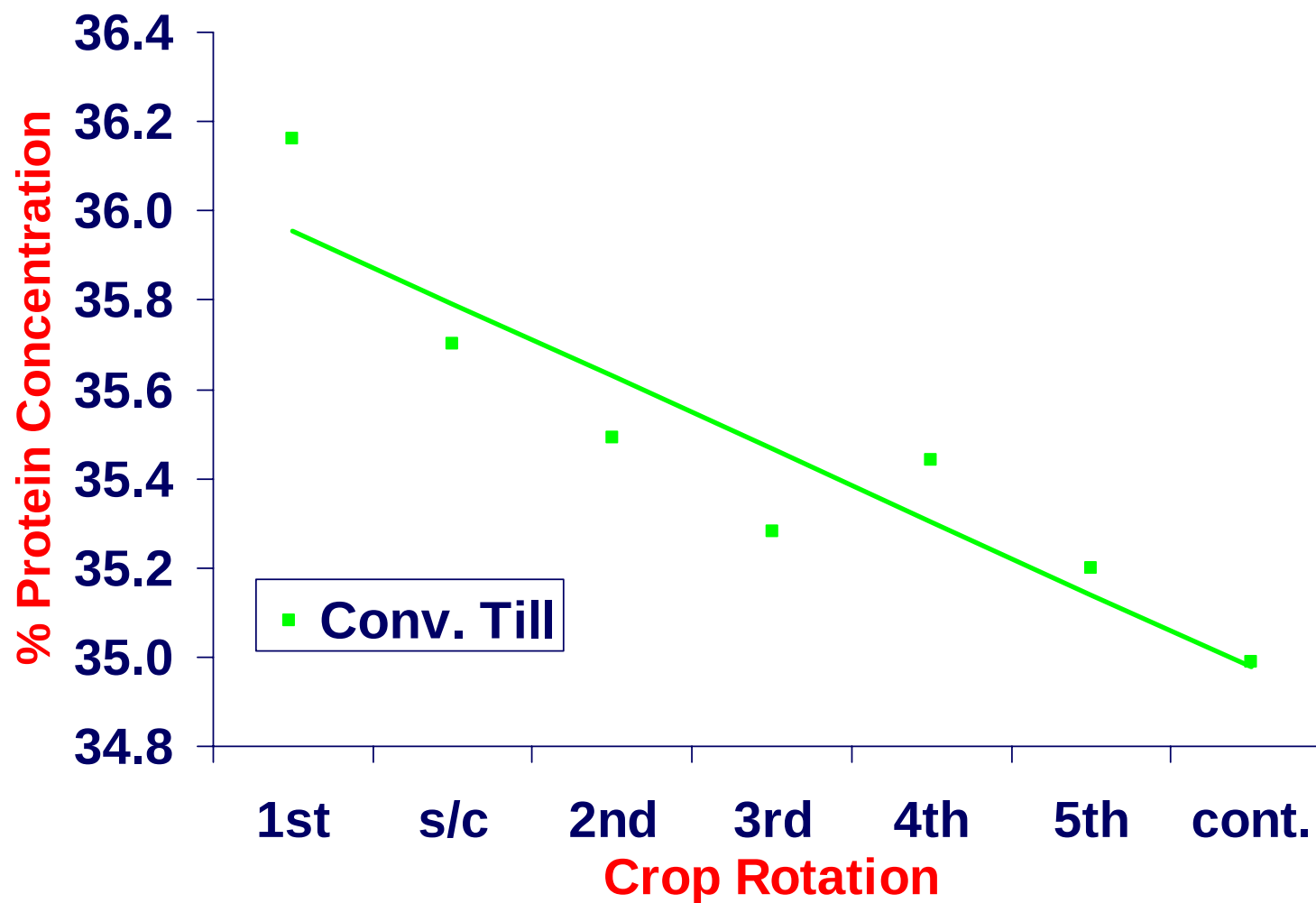
HAIL DECREASES THE PROTEIN CONTENT OF SOYBEAN 😊

Protein 0% Oil 0%

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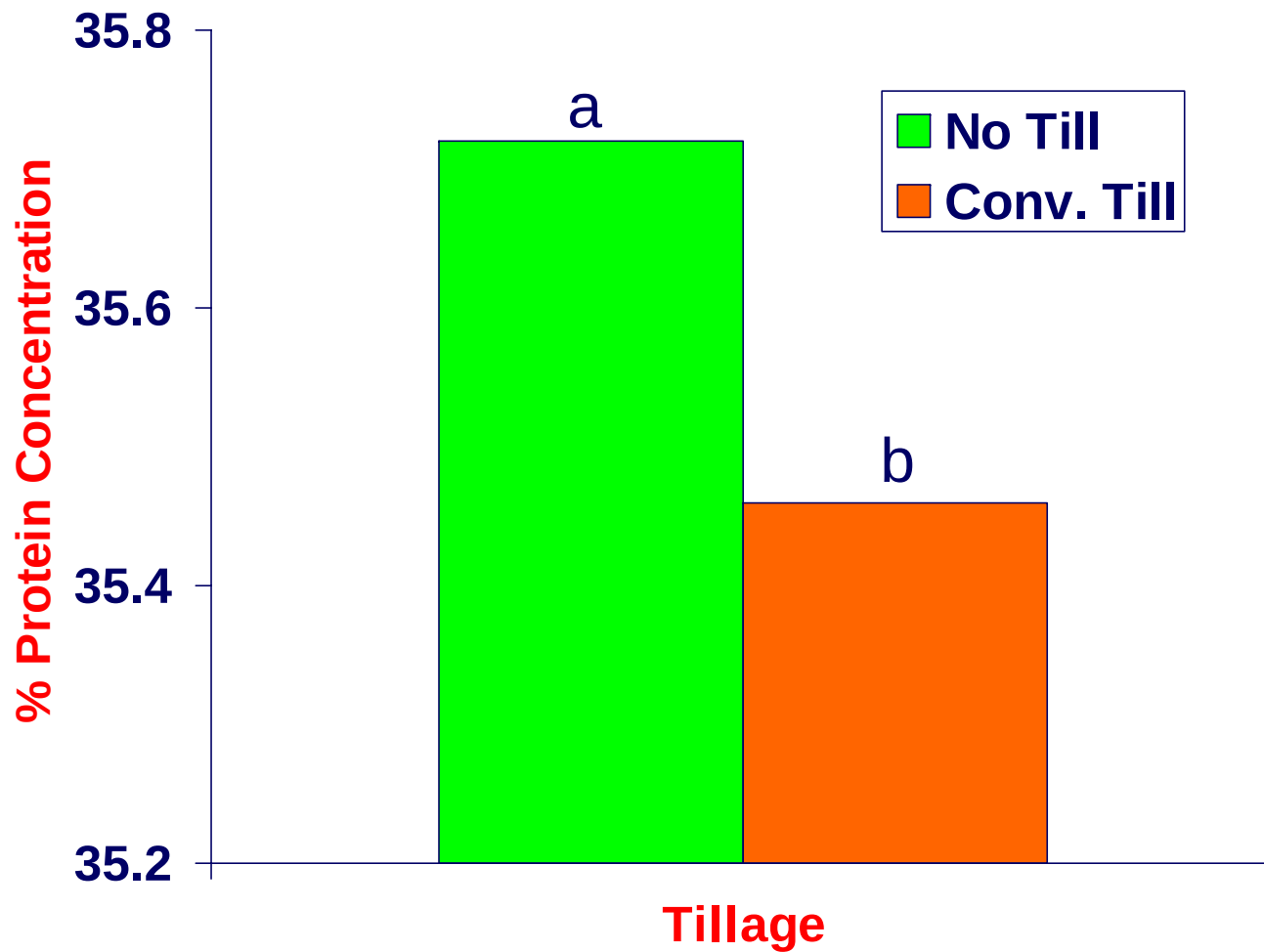


CROP ROTATION



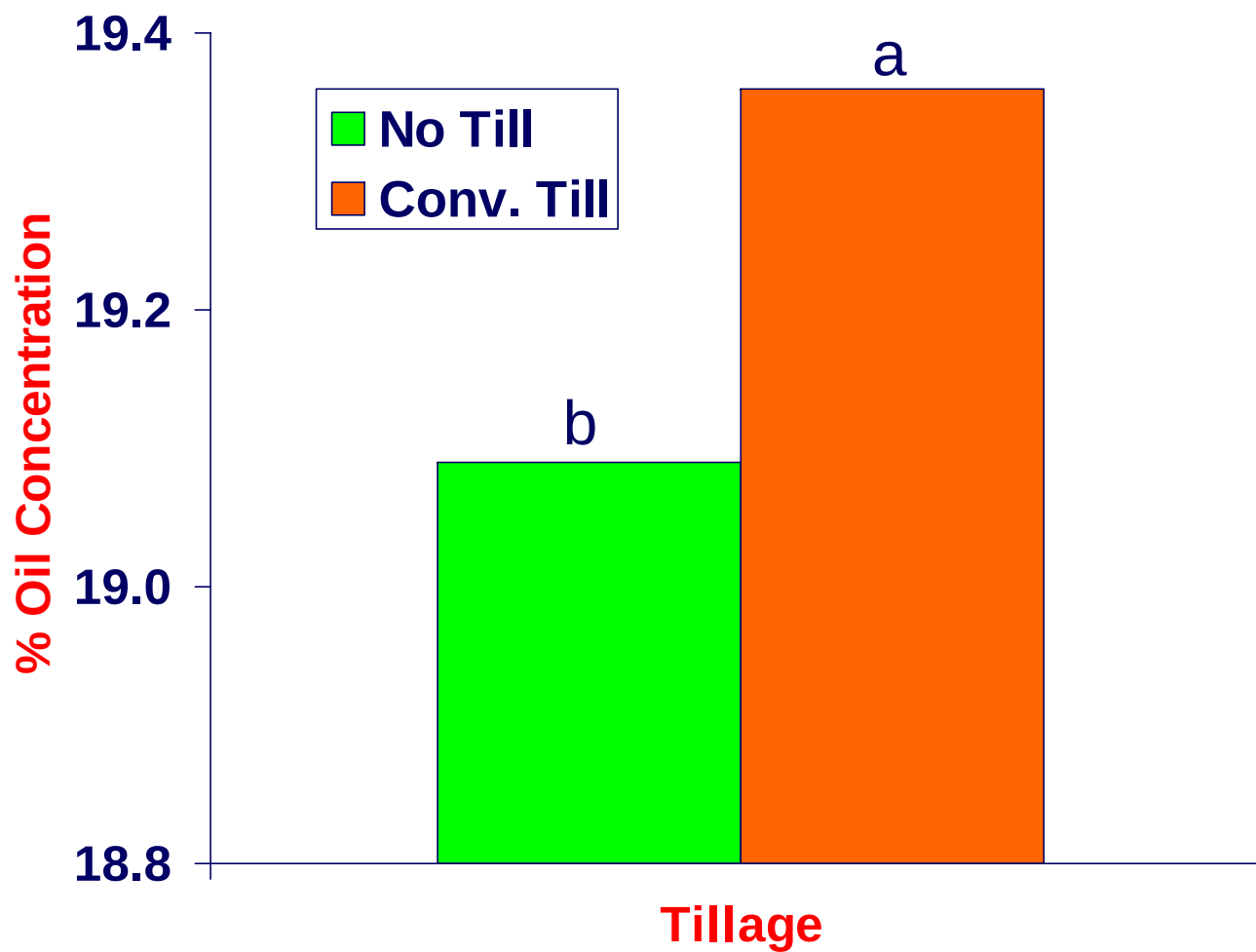


TILLAGE





TILLAGE





CURRENT STATE OF KNOWLEDGE

- Management practices can have a significant impact on soybean grain composition
- The relationship between yield and protein content of soybean can be manipulated through management practices.
- Protein and oil tend to be negatively correlated.
- Variety selection is the most effective known way to increase the protein and/or oil content of soybean grain.
- Sound conclusions on grain composition studies will typically require multiyear data.



THANK YOU!