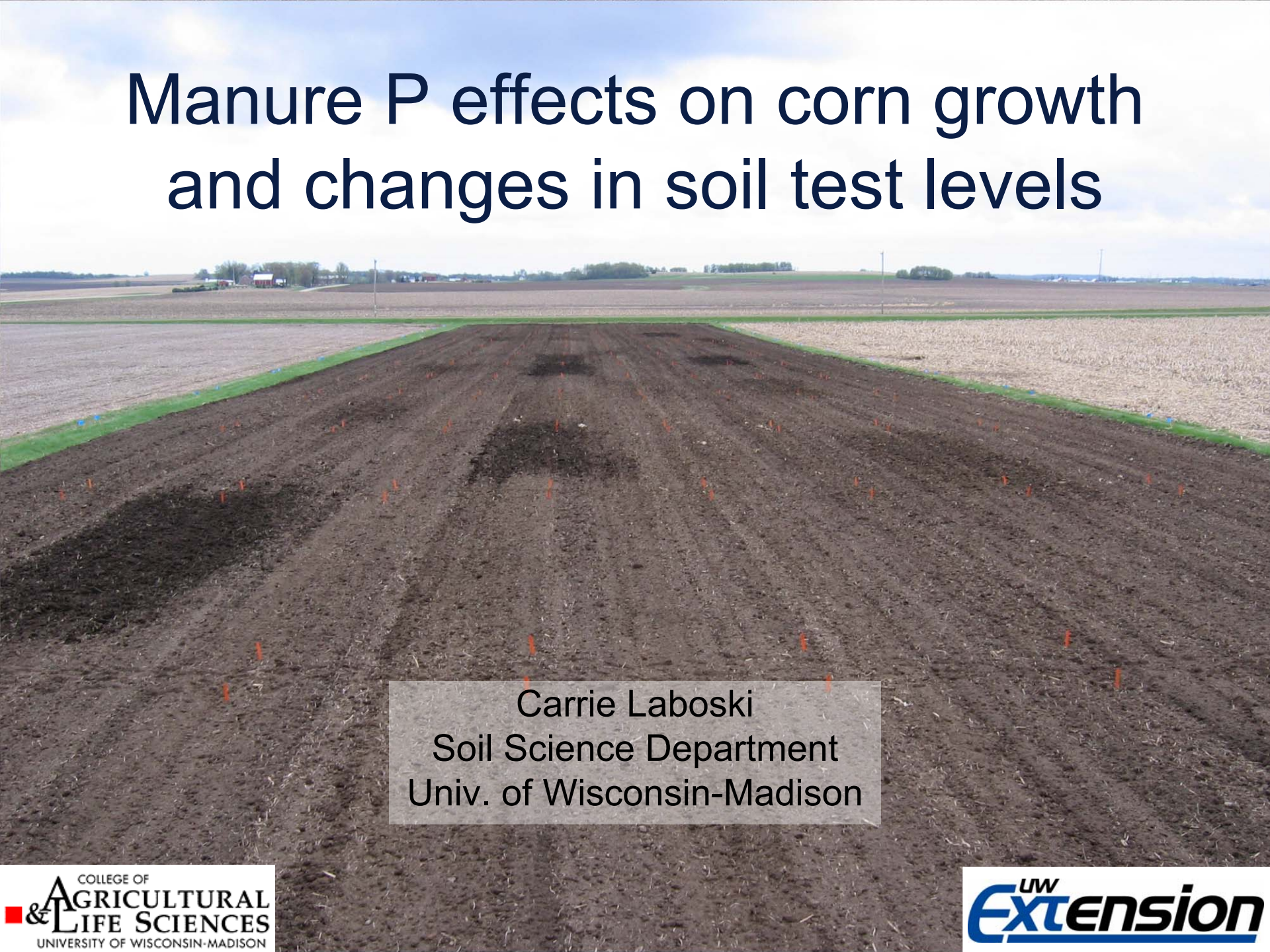
Manure P effects on corn growth and changes in soil test levels



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Info. used in A2809 & P Index

- Estimating crop P removal
  - 0.38 lb P_2O_5/bu in grain and 3.6 lb P_2O_5/T in silage
- Manure credits
  - 60% of total P is available 1st year; 10% 2nd year
  - Same for all species/storage/handling
- P applied in excess of crop removal will increase soil test P
  - P buffer capacity (PBC) same for all P sources
  - 18 lb P_2O_5/a/ppm for medium/fine-textured soils

Info. used in P Index

- Water extractable P (WEP) used in P Index as one factor in estimating potential for P loss in runoff

- WEP estimated from soil test P (STP)
  - Based on two equations:
    - One for coarse-textured soils
    - One for medium- and fine-textured soils
  - Regardless of P source and soil series

Past Research

- Crop availability perspective:
  - Fertilizer P increased yield and P uptake more than manure P
  - Manure and fertilizer P increased yield and P uptake similarly
  - Only a handful of studies
- Soil test perspective
  - Manure P increased soil test more, less, & equal to fertilizer
  - Relationship between STP & WEP dependent on P source
  - Predominately lab studies

Objectives

1. Assess the availability of manure P for corn growth
   - Is 60% availability for 1st yr correct?
2. Determine effect of residual manure P on corn growth
   - Is there really a 2nd yr credit?
3. Compare silage and grain P concentrations (crop removal estimates) to published values

Objectives

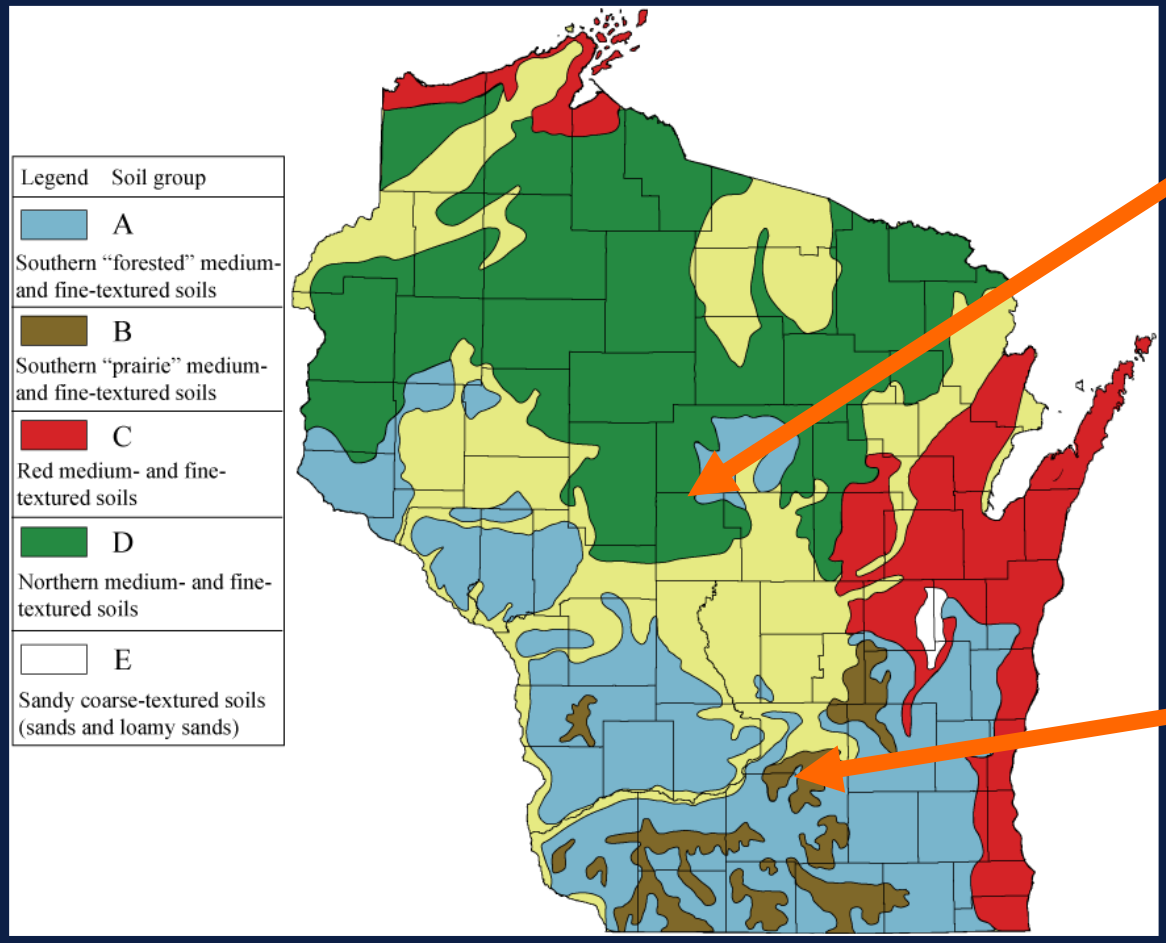
4. Determine if P source and soil series affect the relationship between WEP and STP

5. Determine effect of P source and soil series on P buffer capacity (PBC)

6. Evaluate differences in PBC between field and laboratory studies

Materials & Methods

Location



Withee silt loam
14 ppm P
2.7 % OM

Plano silt loam
15 ppm P
3.6 % OM

Manure characteristics

Manure	Total N	NH_4-N	P_2O_5	K_2O	S	DM*
						%
Arlington						
Dairy Slurry (lbs/1000 gal)	34.3	14. 9	12.0	24.2	1.64	10.3
Swine Slurry (lbs/1000 gal)	22.9	17.6	11.4	13.7	1.08	2.7
Dairy Solid (lbs/ton)	10.8	3.9	3.71	7.43	0.59	18.9
Poultry Pellets (lbs/ton)	70.6	8.8	77.1	51.2	3.85	84.0
Marshfield						
Dairy Slurry (lbs/1000 gal)	20.2	10.2	8.83	19.0	1.34	6.1
Swine Slurry (lbs/1000 gal)	25.2	17. 6	10.7	12.5	1.02	2.8
Dairy Solid (lbs/ton)	9.5	2.7	3.79	12.6	2.68	19.9

*DM, dry matter

Design

- Randomized complete block design
- 3 or 4 replications
- Plot: 10 x 30 ft
- Row spacing: 30”
- Adapted corn hybrids planted

Treatments

- 2005 P sources
  - Fertilizer (0-46-0)
  - Dairy slurry
  - Dairy semi-solid
  - Swine slurry
  - Pelletized poultry litter
- 2006 P source
  - Fertilizer (0-46-0)
- Three target rates
  - 80, 160, 240 lb P_2O_5/a

Actual P Application Rates

	Phosphorus Application Rate		
Source	**Low**	**Medium**	**High**
	lb P_2O_5/a		
Arlington			
Fertilizer	84	168	251
Dairy Slurry	76	153	229
Dairy Solid	67	135	202
Swine Slurry	63	127	188
Poultry Pellets	78	155	233
Marshfield			
Fertilizer	84	168	251
Dairy Slurry	57	114	174
Dairy Solid	70	137	206
Swine Slurry	59	119	178

Soil Sampling

- Pre-application and post-harvest
  - 0 to 6”
- Bray 1-P (STP)
- Water extractable P (WEP)

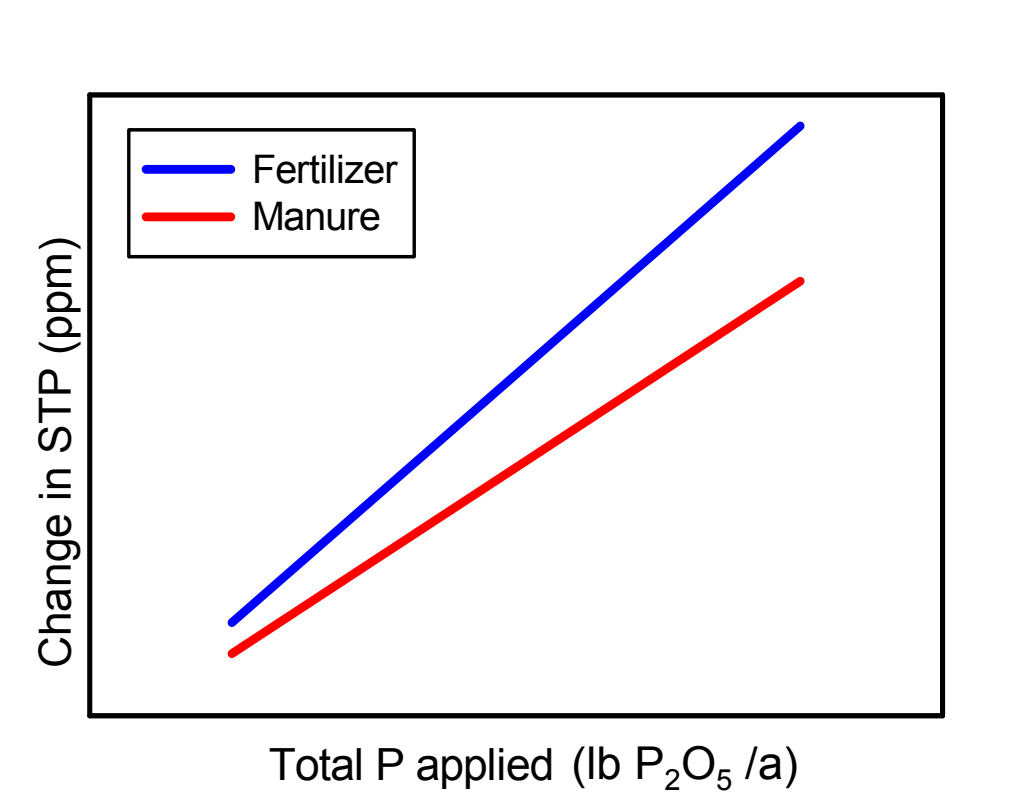
Plant Sampling

- V5 whole plant
- R1 ear leaf
- R6 whole plant (silage)
- Grain samples

2005 Field Study & Incubation

Results: Soil Data

P Buffer Capacity (PBC)



- PBC= $\frac{\text{lb } P_2O_5/a}{1 \text{ ppm}}$
- PBC = $\frac{1}{\text{slope of P source}}$

PBC in 2005

Source	PBC
	lb $P_2O5/_a$/ppm
Arlington	
Fertilizer	13.1 a
Dairy Slurry	9.0 a
Dairy Semi-solid	9.8 a
Swine Slurry	10.6 a
Poultry	12.5 a
Marshfield	
Fertilizer	16.6 a
Dairy Slurry	19.0 a
Dairy Semi-solid	28.0 a
Swine Slurry	24.9 a

- Currently UW uses 18 lb P_2O_5/a/ppm
- Lab incubation showed:
  - Plano < Withee
  - Overall trend:
    - Dairy sources ≥ Swine > Poultry = Fertilizer
  - PBCs for a P source different than assumed:
    - Plano < 18 lb P_2O_5/a/ppm
    - Withee fert. & poultry <18
    - Withee swine = 18
    - Withee dairy >18

WEP and STP Relationship

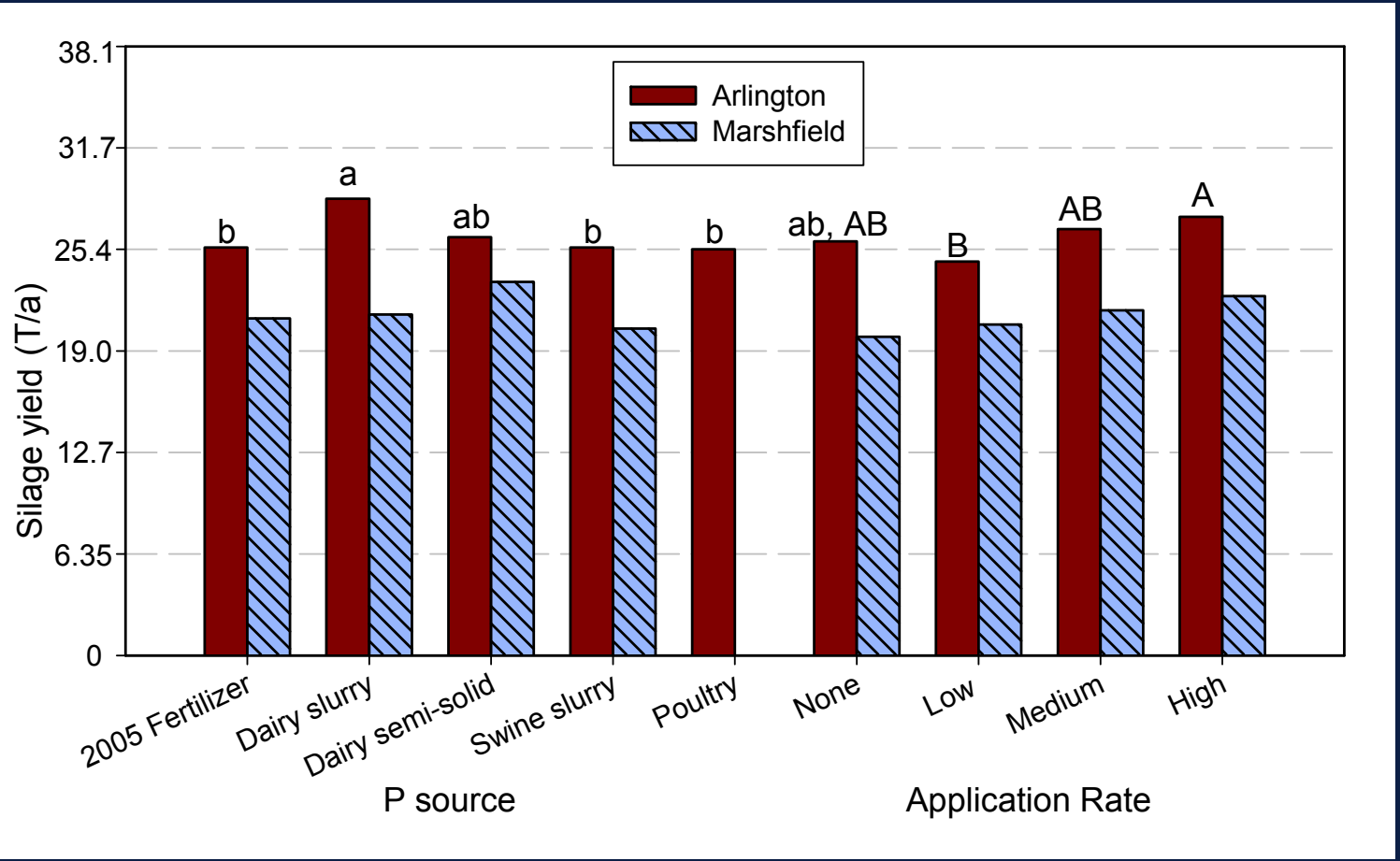
- R^2 improved when separated by P source
  - Except dairy slurries
- WEP and STP relationship is P source and soil series dependent
- Similar trends between soils
- Results similar to lab incubation

Source	Intercept	Slope	R^2
All loc. & sources	**-1.39**	**0.102**	**0.80*****
Arlington			
All sources	**-1.64**	**0.104**	**0.72*****
Fertilizer	-2.85	0.136 a	0.95***
Dairy slurry	1.69	0.014 b	0.01^{NS}
Dairy semi-solid	-2.45	0.144 a	0.91***
Swine slurry	-0.81	0.071 b	0.79**
Poultry	-0.95	0.075 b	0.94***
Marshfield			
All Sources	**-1.37**	**0.107**	**0.91*****
Fertilizer	-2.12	0.113 b	0.97***
Dairy slurry	-1.12	0.102 b	0.77***
Dairy semi-solid	-2.53	0.158 a	0.92***
Swine slurry	-1.95	0.120 ab	0.92***

2005 & 2006 Field Study

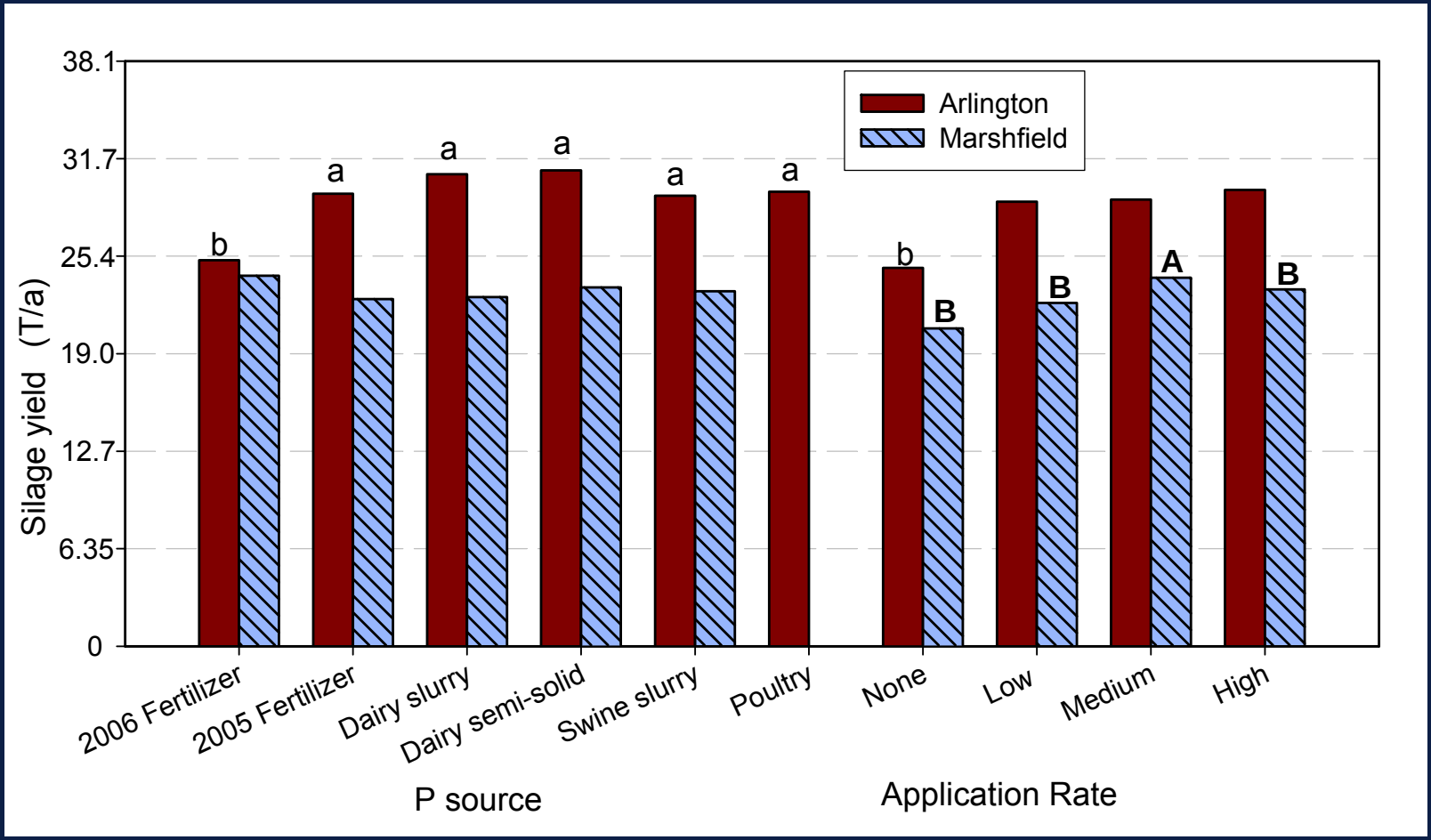
Results: Crop

2005 Silage



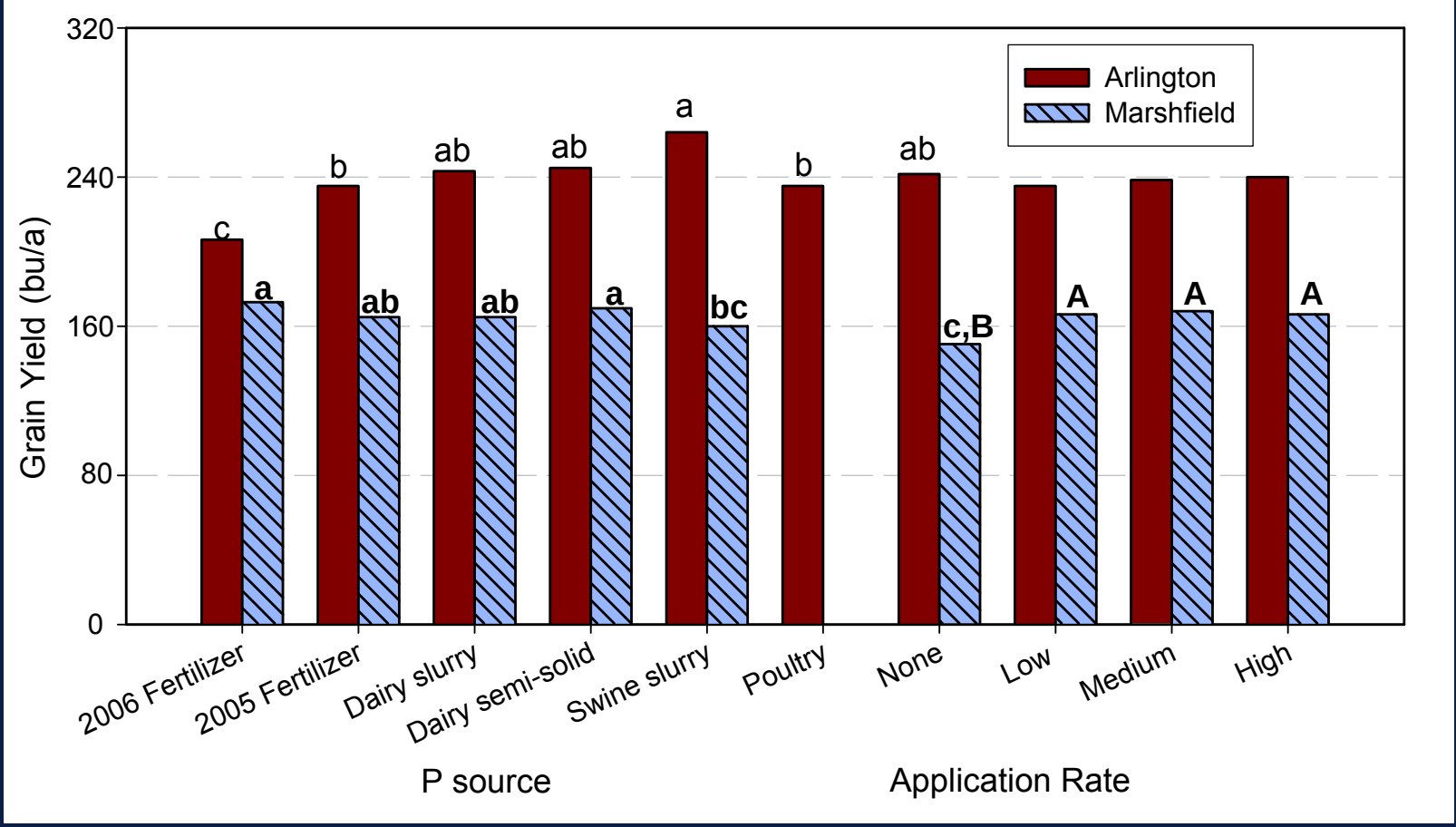
- Arlington P uptake:
  Rate: none < low=med=high
  Source: C=SS=F=DSS<P≤DS
- Marshfield P uptake:
  Rate: none ≤ low ≤ med ≤ high
  Source: NS

2006 Silage



- Arlington P uptake:
  Rate: none < low=med=high
  Source: C≤06F< others
- Marshfield P uptake:
  Rate: none=low<med=high
  Source: NS

2006 Grain



- Arlington P uptake:
  Rate: none < low=med=high
  Source: control < others
- Marshfield P uptake:
  Rate: none=low=med<high
  Source: C=06F=DS≤SS=05F≤DSS

Crop Removal – 2006

P Source	Silage		Grain	
	Arlington	Marshfield	Arlington	Marshfield
	lb P_2O_5/T		lb P_2O_5/bu	
Control	2.1	2.9	0.23	0.27
Fertilizer 06	2.9	3.0	0.30	0.24
Fertilizer 05	2.6	3.0	0.30	0.28
Dairy slurry	2.9	3.0	0.29	0.27
Dairy semi-solid	2.9	3.0	0.29	0.30
Swine	2.9	3.0	0.29	0.28
Poultry	2.7		0.28	
A2809	3.6		0.38	

Conclusions

- PBC in the field was not sig. different for all P sources applied on a given soil
  - PBC was dependent on soil series
  - CVs were high
- In the lab, PBC was dependent upon P source and soil series
- Relationship between STP and WEP was P source and soil series dependent

Conclusions

- Manure P was as available as fertilizer P for crop growth and development
  - 1st year availability is 100%
- Residual manure P and fertilizer P affected crop growth similarly
  - There is no 2nd year credit
- Grain and silage removal less than expected

Conclusions

- Are we ready to change recommendations?
- NO!
  - More research need
    - Based on 2 soil series and 6 manure sources
  - Need to use this information to evaluate numerous scenarios to determine the impact it will have on farms

Questions?