Wisconsin Research with FGD Gypsum

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What is FGD Gypsum

- **Flue Gas Desulfurization Gypsum**
  - Mist of fine calcitic lime blown through gasses
  - Removes S and creates gypsum
  - Soon to be three power plants in SE Wis.
  - 500,000 tons produced by 2012
- **Beneficially re-use**
  - Drywall or other uses
  - Land application to crops
  - Avoid landfilling

Land Application Considerations

Material	Ca	S	Mg	As	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Zn
	--------- % ---------			---------- ppm ----------										
FGD	23.0	18.6	0.03	0.56	<0.5	1.30	<0.5	1.16	0.80	<0.3	0.51	0.73	5.51	3.88
Mined	19.1	15.2	1.35	<0.5	<0.5	1.38	0.53	1.33	2.92	<0.3	1.28	1.42	<1.5	0.91

Source: Ohio State Univ. Pub. ANR 20-05

Claims for FGD Gypsum

- **Source of S and Ca**
  - At suggested rates supplies many times crop need
- **Improvement in soil condition**
  - Improve soil aggregation
  - Increase infiltration
  - Reduce bulk density and compaction
- **Reduce P loss**

2010 FGD Gypsum Studies

- **Arlington alfalfa**
  - 2009 – 2010
  - Component of national study
  - 0, 1, 2, and 4 t/a as FGD or mined material
  - Yield, soil properties, Hg movement
- **Arlington corn**
  - No-till vs. chisel, 6 N rates, w/ or w/o FGD
  - Yield and earleaf N concentration
- **N. and E. Wis. on-farm studies**
  - 0, 0.5, 1, and 2 t FGD/a; 30 lb S/a as fert.
  - Yield, leaf concentration, physical properties, dissolved reactive P

Alfalfa Yield and FGD Gypsum

	Seeded 2009			Seeded 2010	
Treatment	Cut 1	Cut 2	Cut 3	Cut 1	Cut 2
	---------- t DM/a ----------				
Control	1.8	1.2	1.2	1.2	1.0
FGD 1 t/a	1.8	1.2	1.2	1.3	1.2
FGD 2 t/a	1.8	1.4	1.2	1.3	1.3
FGD 4 t/a	1.7	1.2	1.1	1.3	1.2
Fert. 1 t/a	1.8	1.3	1.2	1.1	1.2
Fert. 2 t/a	1.8	1.2	1.2	1.1	1.3
Fert. 4 t/a	1.8	1.5	1.0	1.2	1.3
Source	0.88	0.24	0.49	0.04	0.86
Rate	0.10	0.61	0.05	0.60	0.58
S * R	0.55	0.08	0.29	0.44	0.77

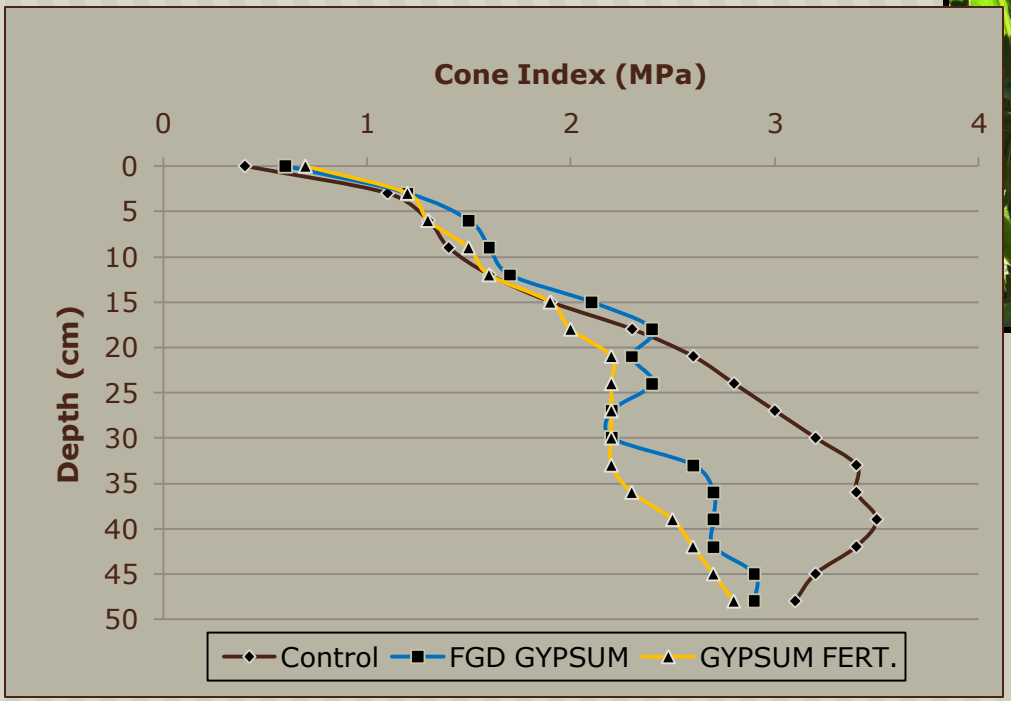
FGD Effect on Physical Properties

Effect on bulk density and hydraulic conductivity

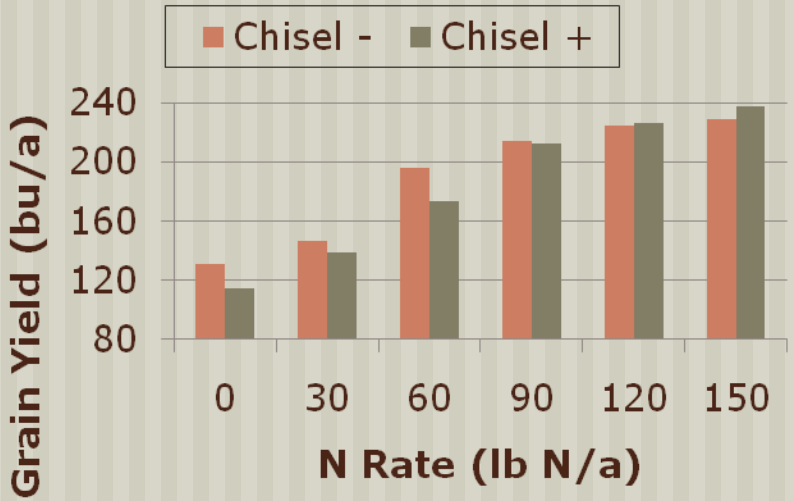
Treatment	Bulk density	Saturated hydraulic conductivity
	g/cc	cc/hr
Control	1.36	3.08
FGD 4 t/a	1.33	4.74
Fert. Gyp. 4 t/a	1.34	3.72
Pr>F	0.85	0.42
LSD	NS	NS

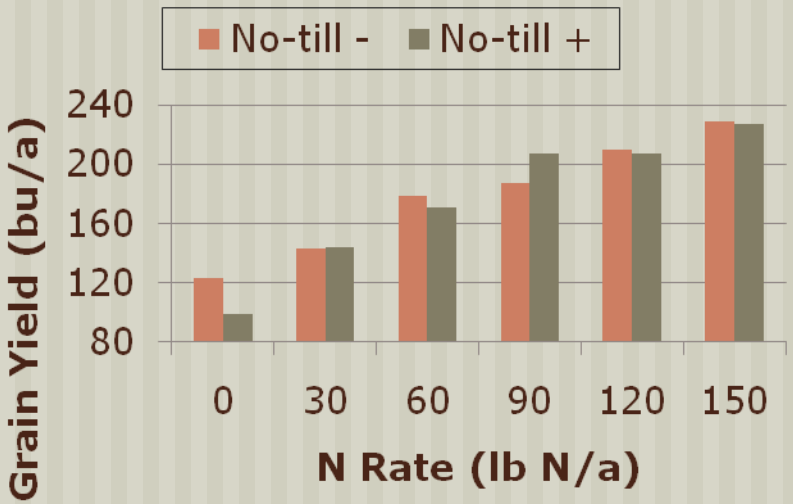
FGD Effect on Physical Properties

Effect on penetration resistance



FGD Gypsum and N Management

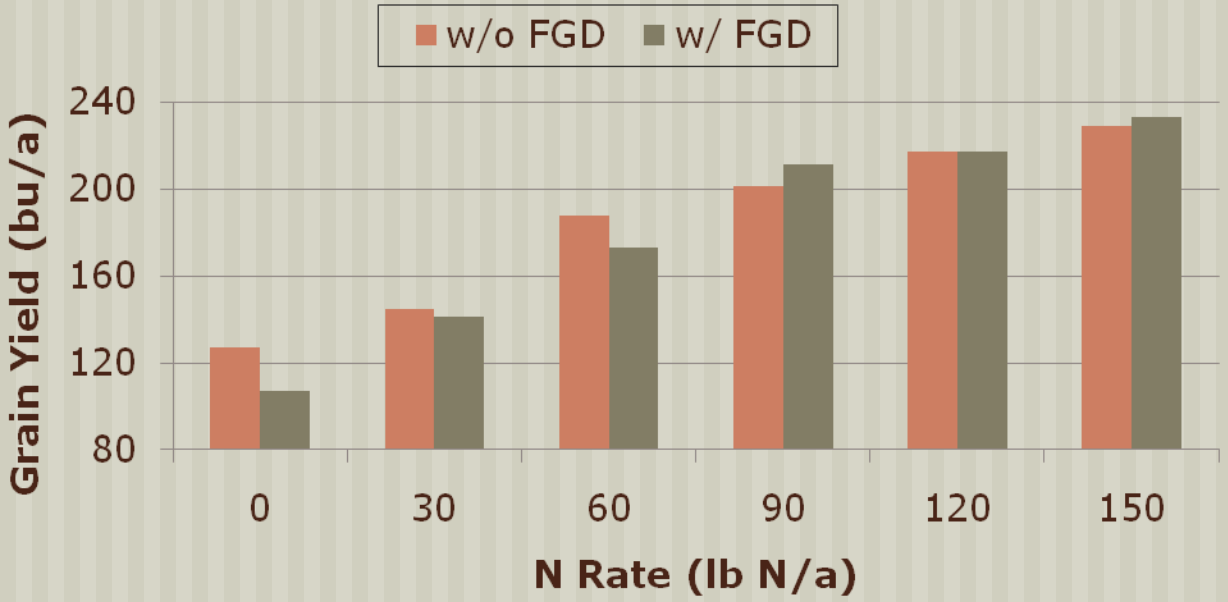




OSU study

- Improved N use efficiency with gypsum
- Reduced N rates possible

FGD Gypsum and N Management



Interactive effect between N rate and FGD gypsum (p=0.10)

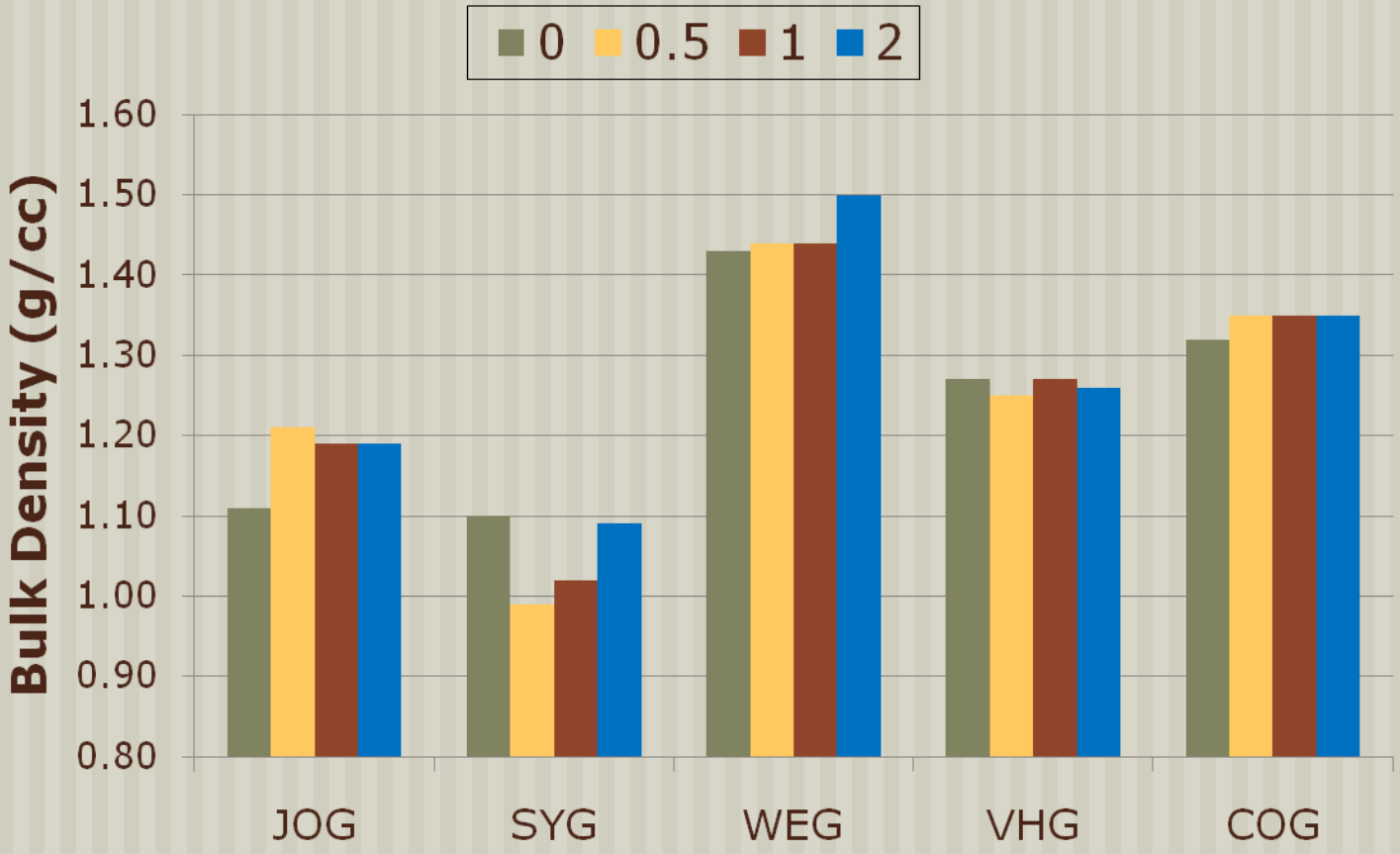
On-farm FGD Gypsum Studies - Soils

Site ID	Web Soil Survey Name	Physical Analysis				
		Sand	Silt	Clay	Texture	Soil test P
E. Wis.		---------- % ----------				ppm
COG	Manawa silty clay loam	47	37	16	Loam	59
JUG	Kewaunee silt loam	31	51	18	Silt loam	23
STG	Kewaunee silt loam	53	33	14	Sandy loam	36
SVG	Namur silt loam	61	29	10	Sandy loam	35
SZG	Sisson fine sandy loam	53	26	14	Sandy loam	49
VHG	Kewaunee silt loam	41	40	19	Loam	63
VWG	Oshkosh silt loam	35	42	23	Loam	62
WEG	Oshkosh silt loam	43	35	22	Loam	83
N. Wis.						
JOG	Amnicon-Cuttre complex	27	34	39	Clay loam	24
PTG	Amnicon-Cuttre complex	19	34	47	Clay	45
SYG	Amnicon-Cuttre complex	34	26	40	Clay loam	7

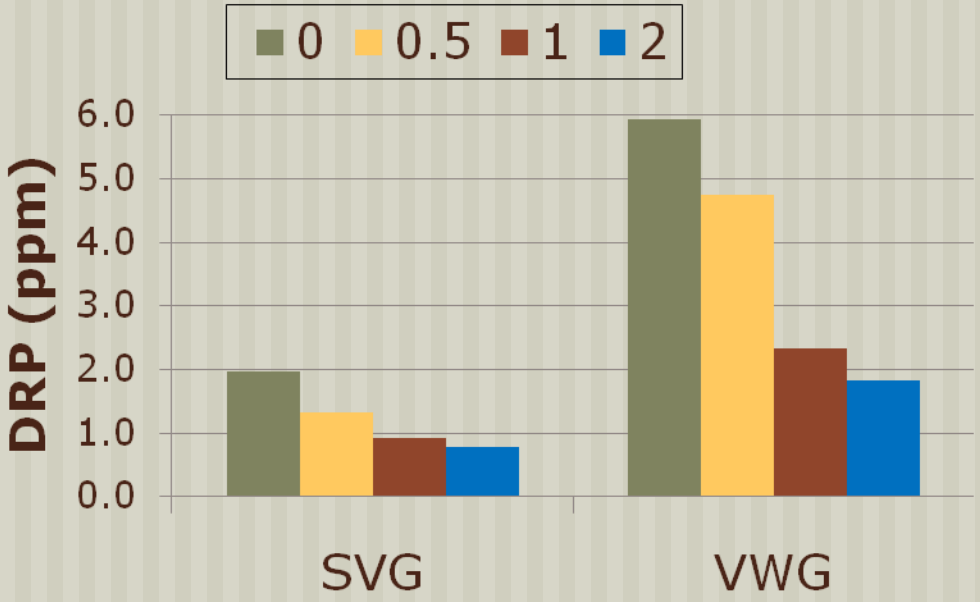
On-farm FGD Gypsum Studies - Yield

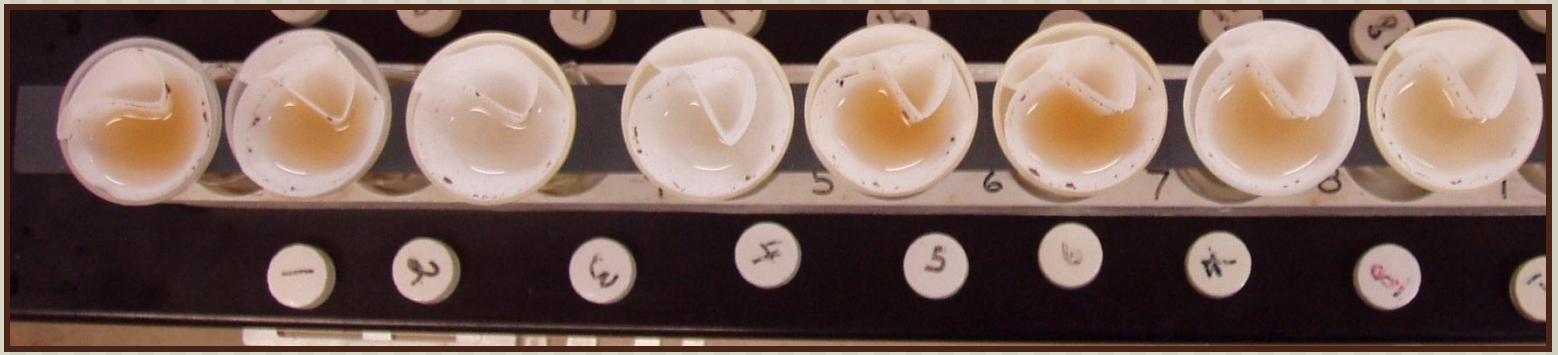
	Site						
Treatment	COG	STG	SVG	SZG	SYG	JOG	PTG†
	---------- bu/a ----------						
Control	157	210	195	178	148	179	47
30 lb S/a	166	226	208	169	159	164	49
FGD 0.5 t/a	138	213	212	177	170	158	56
FGD 1 t/a	144	213	220	176	181	170	44
FGD 2 t/a	135	217	217	191	194	164	48
Pr>F	0.76	0.79	0.10	0.33	0.49	0.44	<0.01
LSD	NS	NS	NS	NS	NS	NS	4

On-farm FGD Gypsum Studies – Bulk Density



On-farm FGD Gypsum Studies – DRP





Summary

- FGD gypsum is an excellent source of S and Ca for crops
- Research on the efficacy of gypsum as a soil conditioner is just underway
- FGD gypsum did not consistently influence crop yield
- While there is a trend for improved soil physical conditions more study is needed
- Limited analysis shows high rates of gypsum may reduce DRP in soils
- At this time there is no specific recommendation for FGD gypsum use