A NEW METHOD FOR INFLUENCING PHOSPHATE AVAILABILITY TO PLANTS

The Fertilizer Industry Roundtable

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A NEW METHOD FOR INFLUENCING PHOSPHATE AVAILABILITY TO PLANTS

Objective…

Treat Microenvironments, Not Acres

PHOSPHORUS FERTILIZERS THE PROBLEM

- Crop recovery limited to 5 – 25% of applied phosphate fertilizer during the season of application. (Mortvet, 1994)
- At high pH, P is fixed by Ca and Mg.
- At low pH, P is fixed by Fe and Al.

PHOSPHORUS FERTILIZERS THE SOLUTION

- Specialty Fertilizer Products has developed & patented a family of di-carboxcyclic copolymers.
- Can be used as a coating on granular phosphates or mixed into liquid phosphate fertilizers.

PHOSPHORUS FERTILIZERS THE SOLUTION

- These compounds have an extremely high exchange capacity – approximately 1.8 eq / 100 gms.
- Polymeric structure is very specific to attracting and adsorbing multivalent cations.
- Functionality is not affected by pH, temperature ranges or ionic strength.
- The co-polymer is biodegradable and water soluble.

PHOSPHORUS FERTILIZERS THE SOLUTION

Mode of Action

- The compound sequesters antagonistic cations out of solution.
- Phosphorous is left unfixed and available to the crop.
- Due to phosphate immobility this results in highly concentrated zones of available phosphorus for the plants.

Experimental material effects on MAP solubility in various solutions

Treatment Applied % Experimental Material	Cation ppm	Mgm P/Gram MAP	% of Total P in Solution
0.00	Al 100	236.9	45.5
0.25	Al 100	298.4	57.4
0.50	Al 100	284.5	54.7
0.75	Al 100	326.0	62.7
1.00	Al 100	309.4	58.9
0.00	Ca 100	251.5	48.4
0.25	Ca 100	295.8	56.9
0.50	Ca 100	314.1	60.4
0.75	Ca 100	310.4	59.7
1.00	Ca 100	308.2	59.3
0.00	Fe 100	289.9	55.8
0.25	Fe 100	316.7	60.9
0.50	Fe 100	303.5	58.4
0.75	Fe 100	329.2	63.3
1.00	Fe 100	305.2	58.8

Factors Affecting The Effectiveness of Phosphorus Fertilization

- **Method of application**

Method of Fertilizer Application

Winter Wheat – University of Arkansas

Treatment Applied	Yield Bu/Acre
Control	46.7
MAP Banded	54.7
MAP Broadcast	58.2
MAP + Exp. Product, Banded	76.9
MAP + Exp. Product, Broadcast	65.6
Broadcast Seeded, MAP	55.1
Broadcast Seeded, MAP + Exp.	68.3
LSD (0.05)	7.5

30 lb P_2O_5/Acre, Soil P test low, Soil pH = 7.6

Method of Fertilizer Application
Liquid Fertilizer – Indiana Farmer

Treatment Applied	2001	2002	2003
	----------	Yield Bu/A	----------
Am. Polyphosphate	168	180	192
Am. Polyphosphate + Exp.	176	194	204

200 lbs 10-34-0/A, row applied at planting, pH = 7.6


FLUID
STARTER
0 2
SFP


FLUID
STARTER
2 SFP 0

Factors Affecting The Effectiveness of Phosphorus Fertilization

- Method of application
- **Type of crop**

Phosphorous Availability Enhancement

Collards – Auburn University, Alabama

Treatment Applied	Fresh Wt lbs/plot
Control	1.4
MAP Banded	5.2
MAP Broadcast	3.9
MAP + Exp. Product, Banded	5.5
MAP + Exp. Product, Broadcast	4.7

pH 6.2

Phosphorous Availability Enhancement

Kansas State University, University of Missouri

Treatments	Bromegrass Miami Co, KS	Bromegrass Miami Co, KS	Fescue Lawrence Co., MO
No P	5100	3210	3096
MAP	5290	4160	4392
MAP + Exp.	6010	4710	4724

Low P Soils, 20 lb P2O5/A, Acidip pH.
Brome - 90 lb N/A, Fescue - 100 lb N/A

Factors Affecting The Effectiveness of Phosphorus Fertilization

- Method of application
- Type of crop
- **Soil pH**
  - **pH levels below 5.5**

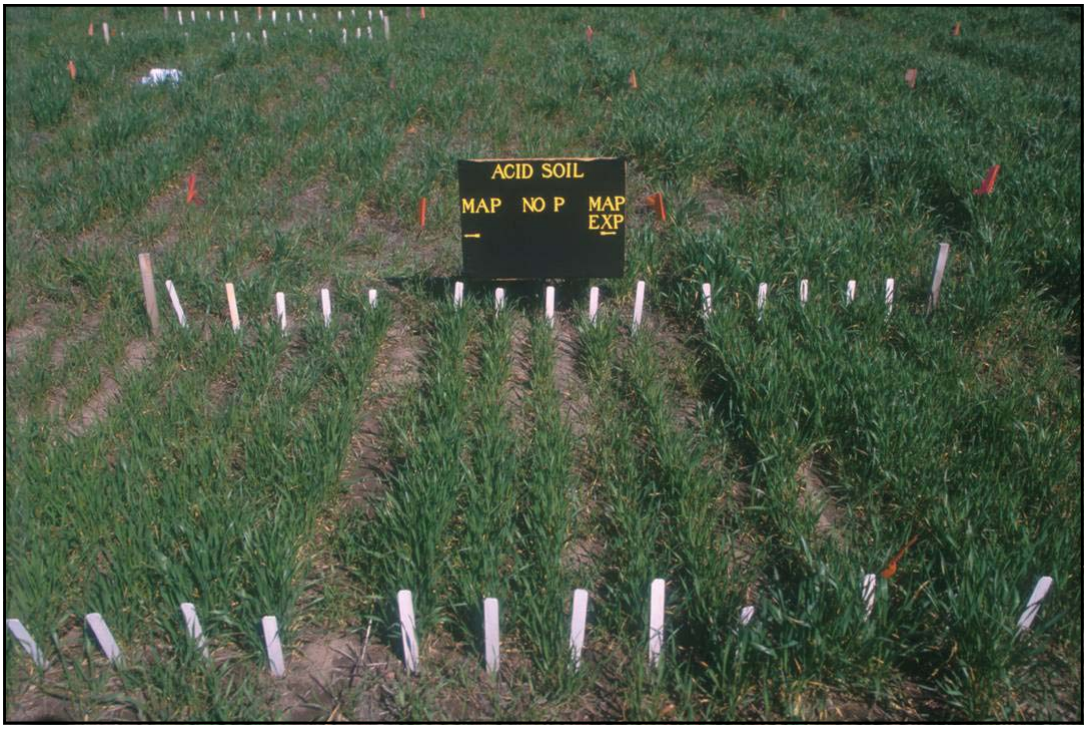
Wheat Response to Enhance P Availability

Winter Wheat – Rice County, Kansas

Treatment Applied	Grain Yield Bu/Acre
Control	31.6
MAP	34.2
MAP + Experimental Product	39.5
LSD (0.10)	7.2

20 lb p2o5/A banded at planting

Murphy Agro, Kansas State Univ.



Factors Affecting The Effectiveness of Phosphorus Fertilization

- Method of application
- Type of crop
- **Soil pH**
  - pH levels below 5.5
  - **pH levels between 5.5 and 7.0**

Corn Response to Enhanced P Availability
University of Missouri

Treatment Applied	Yield Bu/Acre
Control	135
MAP Banded	132
MAP Broadcast	132
MAP + Exp. Product, Banded	157
MAP + Exp. Product, Broadcast	151
LSD (.10)	13

20 lb P_2O_5/A
Soil Test Bray P-1 = 10, Soil pH = 5.9

Factors Affecting The Effectiveness of Phosphorus Fertilization

- Method of application
- Type of crop
- **Soil pH**
  - pH levels below 5.5
  - pH levels between 5.5 and 7.0
  - **pH levels above 7.0**

Corn Response to Enhanced P on High pH Soil

University of Minnesota - Lamberton

Treatment Applied	Dry Weight g/6 plants	P %	P Uptake mg/6 plants	Yield Bu/Acre
Control	14.5	0.306	44	108
MAP Banded	18.8	0.309	58	116
MAP + Exp. Banded	19.3	0.328	64	122
LSD (.10)	2.7	0.016	10	5

20 lb P2O5/a, Soil pH = 7.8, Soil test P = Low

Corn Response to Enhanced P on High pH Soil

University of Minnesota - Waseca

Treatment Applied	Yield Bu/Acre
Control	136
50 DAP Broadcast	155
50 DAP + Exp Broadcast	175
LSD (.10)	18

Exp Coating 0.25%
Soil pH = 7.3, Soil test P = 7 ppm Olsen

Factors Affecting The Effectiveness of Phosphorus Fertilization

- Method of application
- Type of crop
- Soil pH
  - pH levels below 5.5
  - pH levels between 5.5 and 7.0
  - pH levels above 7.0
- **Soil Test P**

Wheat Response to Enhance P on Medium P Soil

Texas A&M University

Treatment Applied	Yield Bu/Acre
Control	30.1
Map 25 lb P2O5/A	29.5
Map 50 lb P2O5/A	32.4
MAP + Exp. 25 lb P2O5/A	37.6
MAP + Exp. 50 lb P2O5/A	37.8
LSD (.10)	7.6

Soil pH = 7.3, Soil test P = Medium

Irrigated Corn Response to Enhanced P

Kansas State University

Treatment Applied	2002	2002	2003
	---------- Bu/A ----------		
Control	172b	119c	169c
60 MAP	193a	173b	195b
60 MAP + Exp.	201a	194a	210a

P banded at planting

Soil pH = 6.8, Soil P = 25-38 ppm Bray 1.


MAP
STARTER
60 P_2O_5
CK
SFP


MAP
EXP
60 P
MAP

Irrigated Soybean Response to Enhanced P

Kansas State University

Treatment Applied	2002	2003
	--------- Bu/A ---------	
Control	51.8c	32.3c
60 MAP	62.2b	46.7b
60 MAP + Exp.	72.8a	57.5a

P broadcast preplant
Soil pH = 6.8, Soil P = 38 ppm Bray 1


MAP
EXP
MAP
60 P

Factors Affecting The Effectiveness of Phosphorus Fertilization

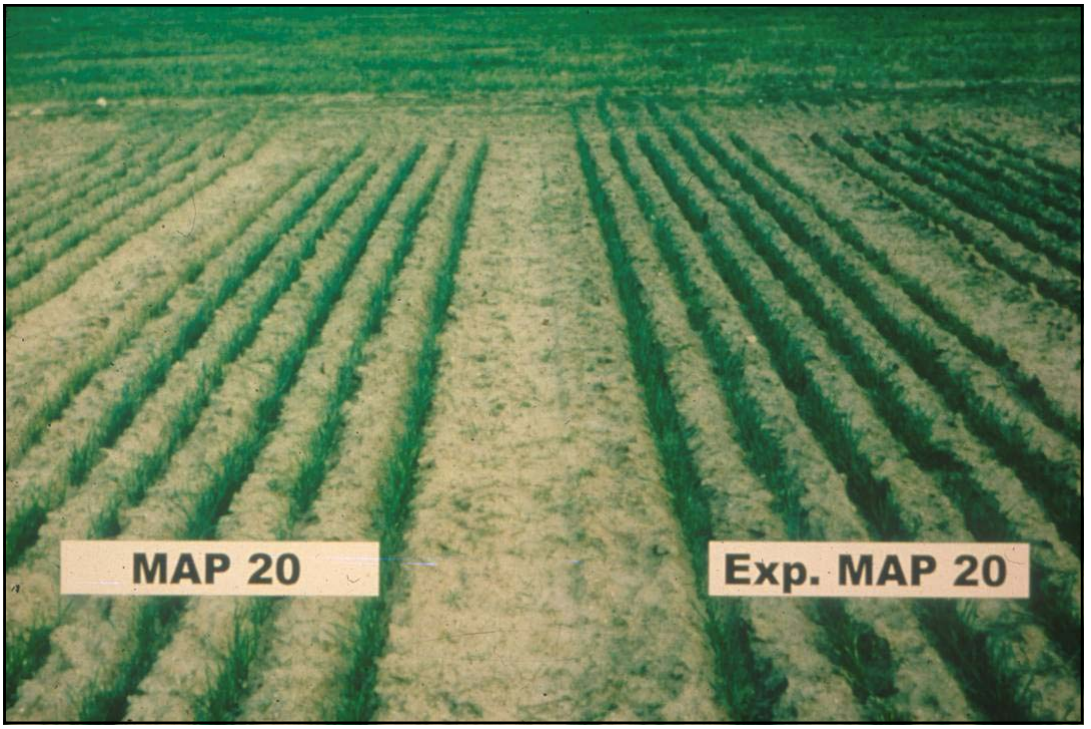
- Method of application
- Type of crop
- Soil pH
  - pH levels below 5.5
  - pH levels between 5.5 and 7.0
  - pH levels above 7.0
- Soil Test P
- **P Application Rates**

Wheat Response to Enhanced P Availability

SARDI - Australia

Treatment Applied	Grain Yield kg/ha	Total DM kg/ha	Heads/M2
MAP 4 Lbs/Acre	1689	5913	254
Enhanced MAP 4 Lbs/Acre	1879	7140	299
MAP 10 Lbs/Acre	1944	7024	274
Enhanced MAP 10 Lbs/Acre	1955	8184	312
MAP 20 Lbs/Acre	2081	7681	290
Enhanced MAP 20 Lbs/Acre	2241	7894	309
LSD (0.10)	132	1186	49

P banded at seeding, soil 70% calcium carbonate



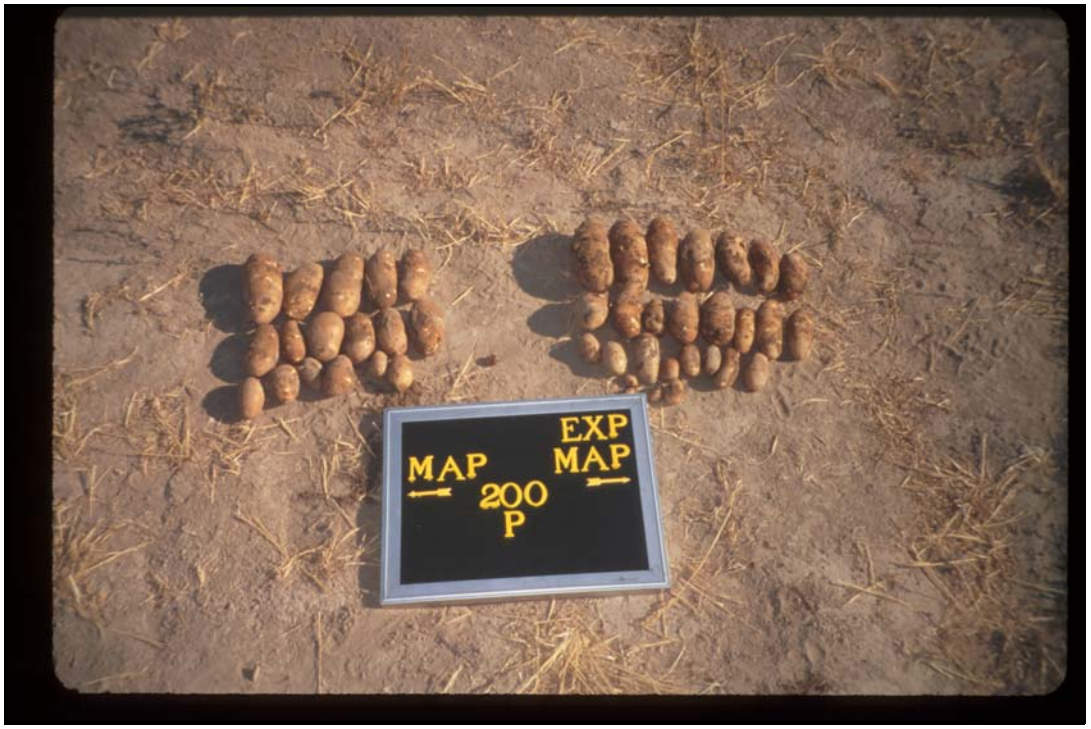
Factors Affecting The Effectiveness of Phosphorus Fertilization

- Method of application
- Type of crop
- Soil pH
  - pH levels below 5.5
  - pH levels between 5.5 and 7.0
  - pH levels above 7.0
- Soil Test P
- P Application Rates
- **Improved Economics**

Potato Yield & Return Responses to Enhanced P Availability

University of Idaho

Treatment Applied	Yield CWT/A	Petiole P%	Gross Return
Control	311a	.225d	1456
MAP 60 lb P205/Ac	330ab	.253cd	1546
MAP 120 lb P205/Ac	344bc	.275bc	1591
MAP + Exp 60 lb P2O5/A	339ab	.288ab	1575
MAP + Exp 120 lb P2O5/A	369c	.308a	1791



Conclusions

- Influencing or controlling reactions in the microenvironment around the fertilizer granule has proven to have significant benefits to the availability of applied nutrient P.
- This in turn gives a favorable plant response.

Conclusions

- A wide spectrum of crops can be affected at normal fertilization rates.
- Significant potential to improve crop yields and farmer profits.
- Positive implications for improving environmental footprint of P fertilizer use.