EVALUATION OF TWO PRODUCTS FOR ENHANSING PHOSPHATE FERTILIZER EFFICENCY IN COTTON PRODUCTION

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Introduction

The rapid increase in phosphorus fertilizer prices has generated increased interest in phosphorus fertilization practices. Not all of the phosphorus fertilizers applied to your fields is available for plants to use. When P fertilizers are added to soil, a complex series of reactions follow. These reactions are dependent on soil mineralogy and pH. The end result is that not all of the P contained in fertilizers is available for plants to utilize, this phenomenon is called "P fixation". In acid or neutral soils when phosphorus fertilizers are applied to soils a percentage of the P may be strongly absorbed on the surface of soil clay minerals. In calcareous soils, phosphorus may also strongly bond with soil calcium to form insoluble compounds. The percentage of P becoming unavailable may range from 25 to 90% depending on soil composition, pH, and calcium level.

The objectives of this research were to:

1. Evaluate phosphorus enhancement additives for cotton production.
2. Identify situations where these products may be profitably used in cotton production

Methods and Materials

This test was conducted at three locations representing the major cotton soil types of Missouri: sand(Dundee sandy loam, Clarkton, MO), silt loam (Tiptonville silt loam, Portageville, MO), and Clay (Sharkey clay, Portageviile, MO). Two different commercially available materials (Avail™, Specialty Fertilizer Products, Belton, MO and C.A.L.F..A®, Plant BioTech, Inc., Deming, NM) for enhancing phosphorus efficiency were evaluated. Each of these materials was applied to granular triple super phosphate (TSP) at the rate of 0.25% w/w. Three rates coated and non coated TSP (25, 50 &100 lbs P_2O_5/acre) were compared to untreated check. The experimental design for this small plot evaluation was a randomized complete block with four replications. Soil samples were collected at pin head square and tested for plant available phosphorus. Petiole samples were collected at full bloom and phosphorus content determined. Each plot was harvested and resulting lint ginned with fiber properties being determined. Statistical analyses of the data were preformed with ARM. Each site location was analyzed separately.

Results

Yield results for 2009 are presented as Tables 1, 2, and 3. Phosphorus fertilizer treatments produced significant differences in lint yields at two of the tree sites in 2009 (sand and clay). Numerical but not statistical differences were found in yields for the silt loam site. When yields were averaged for all products, the 100 lbs/a rate produced the numerically greatest yields at all three sites. When the yields for each product were averaged for all P rates the untreated TSP produced the numerically greatest yield at the sand and clay sites. On the silt loam site CALFA coated TSP produced the numerical greatest yields when averaged for all P rates.

Table 1. Cotton lint yields for phosphorus treatments on a sand soil, Clarkton, MO 2009.

P rate	Yield †			
	TSP	TSP + Avail	TSP + CALFA	Average all products
lb P_2O_5 $acre^{-1}$	-----lb $acre^{-1}$-----			
0	633ab			
25	616ab	652ab	622ab	630
50	728a	597b	655ab	660
100	672ab	650ab	658ab	660
Average all rates	672	633	645	

† Values followed by the same letter were not significantly different at the P=0.1 level.

Table 2. Cotton lint yields for phosphorus treatments on a silt loam soil, Portageville, MO 2009.

P rate	Yield †			
	TSP	TSP + Avail	TSP + CALFA	Average all products
lb P_2O_5 $acre^{-1}$	-----lb $acre^{-1}$-----			
0	683a			
25	739a	758a	719a	739
50	747a	742a	781a	757
100	739a	789a	814a	781
Average all rates	742	763	771	

† Values followed by the same letter were not significantly different at the P=0.1 level.

Table 3. Cotton lint yields for phosphorus treatments on a clay soil, Portageville, MO 2009.

P rate	Yield †			
	TSP	TSP + Avail	TSP + CALFA	Average all products
lb P_2O_5 $acre^{-1}$	-----lb $acre^{-1}$-----			
0	625abc			
25	622abc	686a	552c	620
50	591abc	686a	558bc	612
100	675ab	597abc	611abc	626
Average all rates	629	565	573	

† Values followed by the same letter were not significantly different at the P=0.1 level.

Results for soil and petiole samples collected at midseason are presented as Tables 4, 5, and 6. When soil test P levels at pin-head square were averaged for all products, the 100 lbs/a rate produced the numerically greatest levels at the sand and silt loam sites. However, the 50 lbs/a rate produced the numerically greatest level at the clay site. When the soil test P levels for each product were averaged for all P rates the CALFA treated TSP produced the numerically greatest levels at the sand and clay sites. At the silt loam site Avail treated TSP produced the numerically greatest P levels

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Table 3. Soil test P values and petiole P for phosphorus treatments on a sand soil, Clarkton, MO 2009.

P rate	Soil test P @ pin head square†					Petiole P @ full bloom†			
	TSP	TSP + Avail	TSP + CALFA	Average all products		TSP	TSP + Avail	TSP + CALFA	Average all products
lb P_2O_5 $acre^{-1}$	-----lb P $acre^{-1}$-----					-------% P------			
0	105d					0.13b			
25	111bcd	107cd	106cd	108		0.16ab	0.17ab	0.16ab	0.16
50	113bcd	118a-d	125abc	119		0.18ab	0.16ab	0.17ab	0.17
100	135a	117a-d	129ab	127		0.14ab	0.21a	0.19ab	0.18
Average all rates	120	114	120			0.16	0.18	0.17	

† Values followed by the same letter were not significantly different at the P=0.1 level.

Table 4. Soil test P values and petiole P for phosphorus treatments on a silt loam soil, Portageville, MO 2009.

P rate	Soil test P @ pin head square†				Petiole P @ full bloom†			
	TSP	TSP + Avail	TSP + CALFA	Average all products	TSP	TSP + Avail	TSP + CALFA	Average all products
lb P_2O_5 $acre^{-1}$	-----lb P $acre^{-1}$-----				-------% P------			
0	95bc				0.27b			
25	100abc	101abc	92c	98	0.30ab	0.30ab	0.33ab	0.31
50	105abc	110ab	97bc	104	0.35ab	0.32ab	0.30ab	0.32
100	104abc	106abc	113a	108	0.31ab	0.31ab	0.37a	0.33
Average all rates	103	106	101		0.32	0.31	0.33	

† Values followed by the same letter were not significantly different at the P=0.1 level.

Table 5. Soil test P values and petiole P for phosphorus treatments on a clay soil, Portageville, MO 2009.

P rate	Soil test P @ pin head square†				Petiole P @ full bloom†			
	TSP	TSP + Avail	TSP + CALFA	Average all products	TSP	TSP + Avail	TSP + CALFA	Average all products
lb P_2O_5 $acre^{-1}$	-----lb P $acre^{-1}$-----				-------% P------			
0	85ab				0.17b			
25	80b	86ab	93ab	86	0.23a	0.24a	0.24a	0.24
50	93ab	90ab	98ab	98	0.24a	0.24a	0.23a	0.24
100	87ab	104a	92ab	92	0.23a	0.25a	0.24a	0.24
Average all rates	87	93	94		0.23	0.24	0.24	

† Values followed by the same letter were not significantly different at the P=0.1 level.

When petiole P levels at full bloom were averaged for all products, the 100 lbs/a rate produced the numerically greatest levels at all sites. When petiole P levels for each product were averaged for all P rates, treatments with a coating, Avail or CALFA were numerically greater than uncoated TSP at all three sites. At the sand and clay sites Avail coated products produced the greatest numerical yields, while on the silt loam site CALFA produced the greatest P levels.

Conclusions

At all locations, adding P did not increase yields; however, there were numerical yield increases in the silt loam. At each site, P additives did increase soil test values. Based on one year data, P additives were not effective in terms of yield in sand and clay soils. Yield, soil test P levels, and petiole P levels show more response to P fertilization and additive on silt loam. More study is needed.