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Effect of AVAIL® Polymer Applied to Phosphorus Fertilizers on Dry Matter Production and P uptake of Fescue at Princeton, KY

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A study was conducted near Princeton, KY to determine if a polymer (AVAIL®) applied to diammonium phosphate (DAP, 18-46-0) and monoammonium phosphate (MAP, 11-52-0) would increase (P) phosphorus use efficiency in fescue production on a low P testing soil, when compared to an untreated phosphate fertilizer. AVAIL® (Specialty Fertilizer Products, Belton, MO) is presently being sold in Kentucky as a product to improve phosphorus fertilizer efficiency.

METHODS

The 2-year study was located at the University of Kentucky Research and Education Center at Princeton and the soil type was a Zanesville silt loam. The P soil tests (0 to 6 inch depth) from the study areas were 16 lb P/acre in 2006 and 12 lb P/acre in 2007. The "low" soil test P range is from 0 to 30 lb/acre. Potash and lime were added according to soil test recommendations from the University of Kentucky (AGR-1). The crop was fescue.

All P fertilizer treatments were as monoammonium phosphate (MAP) in 2006 and as diammonium phosphate (DAP) in 2007, both with and without AVAIL®. Nitrogen was then applied to all plots to bring the total added to 100 lb N/ac in 2006 and 75 lb N/ac in 2007. The fertilizer applications were made on April 11 in 2006 and on March 12 in 2007. The first harvest was made about 6 weeks after the fertilizer application and tissue sub-samples were taken and dried for dry matter calculations and P analysis.

Nitrogen was re-applied at 60 lb N/ac for a second harvest. No P fertilizers were applied at this time. The second harvest was made 5 weeks after the first harvest. The plots were soil sampled (6 cores/ plot) to a 4 inch depth after each harvest.

The AVAIL® polymer was applied at 0.25% by weight for those treatments.

The treatments were:

2006	
1.	0 P (check)
2.	30 lb/ac P_2O_5 as 11-52-0 without polymer
3.	30 lb/ac P_2O_5 as 11-52-0 with polymer
4.	60 lb/ac P_2O_5 as 11-52-0 without polymer
5.	60 lb/ac P_2O_5 as 11-52-0 with polymer
6.	90 lb/ac P_2O_5 as 11-52-0 without polymer
7.	90 lb/ac P_2O_5 as 11-52-0 with polymer

2007	
1.	0 P (check)
2.	50 lb/ac P_2O_5 as 18-46-0 without polymer
3.	50 lb/ac P_2O_5 as 18-46-0 with polymer
4.	100 lb/ac P_2O_5 as 18-46-0 without polymer
5.	100 lb/ac P_2O_5 as 18-46-0 with polymer

RESULTS

Yield: The results of the dry matter yields are found in Tables 1, 2, and 3. The yields recorded at the first harvest are in Table 1. The second harvest is in Table 2 and the combined yield, for the 2 harvests in any one year, is found in Table 3.

Table 1. Dry Matter Yield of the First Fescue Harvest for the Different Polymer and P_2O_5 Treatments

	Treatment		Dry Matter Yield
	lb P_2O_5/ac	Polymer	ton/ac
2007			
1.	0	-	1.39
2.	50	-	1.66
3.	50	Yes	1.50
4.	100	-	1.73
5.	100	Yes	1.71
			N.S.
2006			
1.	0	-	1.89
2.	30	-	1.65
3.	30	Yes	2.00
4.	60	-	2.01
5.	60	Yes	1.71
6.	90	-	1.85
7.	90	Yes	1.86
			N.S.

Table 2. Dry Matter Yield of the Second Fescue Harvest for the Different Polymer and P_2O_5 Treatments

	Treatment		Dry Matter Yield
	lb P_2O_5/ac	Polymer	ton/ac
2007			
1.	0	-	1.01
2.	50	-	1.06
3.	50	Yes	1.06
4.	100	-	1.21
5.	100	Yes	0.96
			N.S.
2006			
1.	0	-	0.81
2.	30	-	0.75
3.	30	Yes	0.75
4.	60	-	0.87
5.	60	Yes	0.70
6.	90	-	0.77
7.	90	Yes	0.80
			N.S.

Table 3. Dry Matter Yield of the Combined Fescue Harvests (1 plus 2) for the Different Polymer and P_2O_5 Treatments

	Treatment		Dry Matter Yield
	lb P_2O_5/ac	Polymer	ton/ac
2007			
1.	0	-	2.40
2.	50	-	2.72
3.	50	Yes	2.56
4.	100	-	2.94
5.	100	Yes	2.67
			N.S.
2006			
1.	0	-	2.70
2.	30	-	2.40
3.	30	Yes	2.75
4.	60	-	2.88
5.	60	Yes	2.41
6.	90	-	2.62
7.	90	Yes	2.76
			N.S.

There was a strong trend for increased dry matter with increasing P_20_5 rate in the first harvest, but it was not statistically significant. There was definitely no response in the second harvest and also none when the harvests were combined. Though the soil test P was low, there was no statistical response to added rates of P_20_5, and there was no response to AVAIL® on the MAP or DAP granules.

Tissue P Concentration

The fescue tissue P concentration found in the harvested dry matter is found in Tables 4 (first harvest) and 5 (second harvest).

Table 4. Fescue Tissue P Concentration at the First Harvest

	Treatment		Tissue P
	lb P_2O_5/ac	**Polymer**	**%**
2007			
1.	0	-	0.181 C
2.	50	-	0.270 B
3.	50	Yes	0.263 B
4.	100	-	0.334 A
5.	100	Yes	0.330 A
			LSD = 0.022
2006			
1.	0	-	0.172 D
2.	30	-	0.214 C
3.	30	Yes	0.226 C
4.	60	-	.0279 AB
5.	60	Yes	0.261 B
6.	90	-	0.287 A
7.	90	Yes	0.298 A
			LSD = 0.022

The P concentration of the fescue gave a nice response to added P, in both harvests. The increase in tissue P was directly related to the amount of P_20_5 added. This direct relationship to added P fertilizer rates is seen in the numerical values and the statistical rankings. There was little numerical difference, and no statistical difference, between the AVAIL® coated and uncoated MAP, or DAP, treatments at any rate of P_20_5. This indicates that the added P_20_5 was equally available to the fescue crop, with or without the polymer, though the P_20_5 availability was reduced at the second harvest. The reduced availability was probably due to P removal in the first harvest and/or soil fixation of P since the fertilizer had been added.

Table 5. Fescue Tissue P Concentration at the Second Harvest

	Treatment		Tissue P
	lb P_2O_5/ac	**Polymer**	**%**
2007			
1.	0	-	0.141 D
2.	50	-	0.164 C
3.	50	Yes	0.164 C
4.	100	-	0.217 A
5.	100	Yes	0.193 B
			LSD = 0.011
2006			
1.	0	-	0.182 E
2.	30	-	0.199 DE
3.	30	Yes	0.223 CD
4.	60	-	0.275 A
5.	60	Yes	0.239 BC
6.	90	-	0.269 A
7.	90	Yes	0.263 AB
			LSD = 0.028

Phosphorus Uptake

The phosphorus uptake was calculated by multiplying dry matter yield by the tissue P concentration. This gives a measure of the P in the harvested plant material. The P uptake for the first and second harvests is found in Tables 6 and 7, respectively.

Table 6. Fescue P Uptake in the First Harvest			
	Treatment		P Uptake
	lb P_2O_5/ac	Polymer	lb P/ac
		2007	
1.	0	-	5.04 C
2.	50	-	8.98 B
3.	50	Yes	7.68 B
4.	100	-	11.54 A
5.	100	Yes	11.31 A
			LSD = 2.05
		2006	
1.	0	-	6.60 D
2.	30	-	7.08 CD
3.	30	Yes	9.08 ABC
4.	60	-	11.22 A
5.	60	Yes	8.88 BCD
6.	90	-	9.55 AB
7.	90	Yes	11.19 A
			LSD = 2.30

Table 7. Fescue P Uptake in the Second Harvest			
	Treatment		P Uptake
	lb P_2O_5/ac	Polymer	lb P/ac
		2007	
1.	0	-	2.91 C
2.	50	-	3.50 BC
3.	50	Yes	3.47 BC
4.	100	-	5.24 A
5.	100	Yes	3.71 B
			LSD = 0.74
		2006	
1.	0	-	2.94 C
2.	30	-	2.98 C
3.	30	Yes	3.35 C
4.	60	-	4.74 A
5.	60	Yes	3.35 C
6.	90	-	4.06 AB
7.	90	Yes	4.04B
			LSD = 0.67

The P uptake was related to the P_20_5 fertilization rate, but was not as closely related as was the P concentration. This was due to the lack of dry matter response to added P. There was increased P uptake with the addition of P fertilizer, in most cases. At the same rate of P fertilizer, the total P uptake with AVAIL® was statistically equal to or less than that found without AVAIL®, and neither treatment was favored.

Soil Test P

Soil samples were taken after each harvest to determine the amount of available soil P according to the Mehlich 3 extraction method. The soil test results after the first and second harvests are found in Tables 8 and 9, respectively.

Table 8. Mehlich 3 Soil Test P After the First Harvest			
	Treatment		Soil Test P
	lb P_2O_5/ac	Polymer	lb P/ac
		2007	
1.	0	-	16 B
2.	50	-	21 B
3.	50	Yes	23 B
4.	100	-	38 A
5.	100	Yes	34 A
			LSD = 8.2
		2006	
1.	0	-	15 B
2.	30	-	17 B
3.	30	Yes	19 B
4.	60	-	19 B
5.	60	Yes	18 B
6.	90	-	25 A
7.	90	Yes	26 A
			LSD = 5.2

Table 9. Mehlich 3 Soil Test P After the Second Harvest			
	Treatment		Soil Test P
	lb P_2O_5/ac	Polymer	lb P/ac
	2007		
1.	0	-	17 C
2.	50	-	21 B
3.	50	Yes	20 B
4.	100	-	36 A
5.	100	Yes	35 A
			LSD=4
	2006		
1.	0	-	15 D
2.	30	-	17 CD
3.	30	Yes	17 CD
4.	60	-	21 AB
5.	60	Yes	19 BC
6.	90	-	22 A
7.	90	Yes	22 A
			LSD = 2.6

The soil test P was consistently and directly related to the amount of fertilizer P_20_5 applied, at both sampling times. This indicates that the applied P generally improved P availability and not all was used by the fescue crop prior to second harvest growth. Use of the AVAIL® polymer resulted in no difference in the amount of extractable P at equal P fertilization rates, regardless of sampling event.

DISCUSSION

The results from two years of evaluating different rates of P_20_5 fertilizer, with and without AVAIL® polymer, reveal the following:

1) Despite the fact that this soil had a history of low fertilizer use, resulting in a low P soil test, there was no statistical difference in fescue dry matter yield due to any treatment, either different rates of P_20_5 or use of the polymer. This indicates that there was enough P for maximum dry matter growth at harvest if enough time was available for P uptake.

2) The fescue tissue P concentration was closely related to the amount of P_20_5 fertilizer added. As the phosphate fertilizer rate was increased, it was reflected in the P concentration in the dry matter. There were no differences in fescue tissue P concentrations due to the polymer.

3) Fescue P uptake was related to both P concentration and dry matter, so gave a mixed result. There was an increase in P uptake due to added P_20_5 fertilizer but this "trend" was not linear. There were no differences in fescue P uptake due to the polymer.

4) Soil testing found increased available soil P with increasing P_20_5 application, but no differences due to polymer were observed.

CONCLUSIONS

After two years of testing, it appears that the AVAIL® polymer on MAP or DAP will not increase the availability of the phosphorus in these phosphate fertilizers to fescue as evaluated under the conditions described in this report.

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