COTTON YIELD AND CHANGES IN SOIL TEST PHOSPHORUS OVER TIME

M. Wayne Ebelhar
Mississippi State University
Stoneville, MS

Abstract

Cotton yield response to fertilizer phosphorus (P) applications with and without AVAIL® Phosphorus Fertilizer Enhancer has been evaluated on silty clay loam soil in the Mississippi Delta under rain-fed (dry-land) conditions from 2010 through 2014. The P applications were made for the first three of the study with residuals monitored in subsequent years. Soil test P has been observed throughout the study with annual samples from each plot. The study area was located on Dundee and Forestdale silty clay loam (Typic Endoaqualfs). The P rates were 0, 20, 40, and 60 lb P/acre (0, 100, 200, and 300 lb CSP/acre) with and without AVAIL® (0.5 gal/ton). The P applications were made in the fall after harvest, but prior to any fall tillage (2010 was spring application). The fertilizer was pre-weighed, then hand-applied as a broadcast to the entire plot. The eight treatments were arranged in a randomized complete block design with six replications. All cultural practices (herbicides, insecticides, cultivation, etc) were maintained uniformly throughout the growing season. After defoliation, the center two rows of each plot were harvested with a spindle picker adapted for plot harvest. Random grab samples were taken during the harvest and used to determine lint percentage and lint yield. Soil samples were taken following harvest and prior to additional P applications. All data was summarized and analyzed with SAS (Statistical Analysis Systems) with significance determined by Fisher's Protected Least Significant Difference (LSD). Seedcotton and lint yields were determined each year with the lint percent based on the grab samples taken at harvest and ginned through a 10-saw micro-gin. The analysis of variance is summarized in Table 1 for all treatments and interactions for seedcotton, lint percent and lint yield. There was no significant difference due to any treatment effect in any of the years.

Table 1. Evaluation of phosphorus rates with and without AVAIL® P Fertilizer Enhancer. Analysis of variance for all treatments. Tribbett Satellite Farm, Tribbett, MS

FACTOR	COMPONENT	2010	2011	2012	2013	2014
		PROB. > F				
Treatment	Seedcotton	0.4565	0.6175	0.6954	0.4881	0.9585
	% Lint	0.6545	0.0104	09.9317	0.7660	0.0906
	Lint	0.2677	0.5690	0.5286	0.5400	0.9942
Interaction	Seedcotton	0.7212	0.8469	0.8849	0.8522	0.7223
	% Lint	0.9806	0.0610	0.9664	0.3718	0.0121
	Lint	0.7610	0.7823	0.8961	0.9081	0.9618

Since there was no interaction effects in any of the years for seedcotton or lint cotton yields, the main effects were evaluated and shown in Table 2. There was no significant response to increasing P application rate and also no significant effect of AVAIL® with respect to seedcotton or lint yield. The only significance occurred in 2011 where P rate significant affected the lint percent. Lint yields varied from year to year with good yields in all but 2011 where yields were less than half of the other four years (Table 3). Lint yields were especially good in 2012, 2013, and 2014 but no response to treatments. Even with six replications, the variability was high as evidenced by LSD's

Evaluation of phosphorus rates with and without AVAIL® P Fertilizer Enenhancer. Analyis of variance for main effects, P rates and AVAIL® rates. Tribbett Satellite Farm, Tribbett, MS.

Table 2. Evaluation of phosphorus rates with and without AVAIL® P Fertilizer Enhancer. Analysis of variance for main effects, P rates and AVAIL® rates. Tribbett Satellite Farm, Tribbett, MS.

FACTOR	COMPONENT	2010	2011	2012	2013	2014
		PROB. > F				
P Rate	Seedcotton	0.3397	0.3207	0.3064	0.1425	0.9259
	% Lint	0.3399	0.0073	0.6520	0.9144	0.9999
	Lint	0.1881	0.2997	01851	0.1580	0.9370
AVAIL	Seedcotton	0.1566	0.3387	0.5901	0.9321	0.7053
	% Lint	0.2445	0.8907	0.5095	0.5719	0.3177
	Lint	0.0892	0.3471	0.4851	0.8856	0.5990

Table 3. Evaluation of phosphorus rates with and without AVAIL® P Fertilizer Enhancer. Cotton lint yields as affected by P rates and AVAIL® rates. (2010 to 2014) Tribbett Satellite Farm, Tribbett, MS.

P Rate (lb P/A)	AVAIL (gal/ton)	Cotton Lint Yield (lb/Acre)				
		2010	2011	2012	2013	2014
0	0	1222	546	1411	1501	1539
20	0	1271	584	1496	1608	1513
40	0	1266	597	1462	1574	1485
60	0	1265	618	1473	1617	1529
0	0.5	1257	560	1396	1512	1531
20	0.5	1352	564	1490	1649	1547
40	0.5	1291	556	1459	1582	1527
60	0.5	1283	593	1416	1579	1539
LSD (0.05)		92 ns	77 ns	116 ns	156 ns	150 ns

Soil samples were taken each year following harvest and analyzed for extractable P through the Soil Testing and Plant Analysis Laboratory at Mississippi State University using the Lancaster extractant. Soil test P levels tended to increase with increasing rate of P fertilizer. There was no difference between AVAIL® treatments so means are shown averaged across AVAIL® levels (Table 4). When looking at P removal, it has been estimated that 12 lb P/1000 lb lint can be removed. Therefore, even with 1600 lb/acre lint yields only about 20 lb P/acre is removed. Soil test levels at the initiation of the study showed soil P levels at greater than 100 lb P/acre with quite a bit oif fluctuation from year to year even though no P was applied directly to the plots. Some movement does occur with primary and secondary tillage. With time there was a buildup of soil test P, especially at the higher P application rates. There is some concern about the annual differences that are evident and further study is underway to look at the cyclic levels of both P and K through the year and from year to year.

Table 4. Extractable soil test phosphorus (lb P/acre) for continuous cotton under rain-fed conditions. Five-year summary (2010-2014). Analysis completed by Soil Testing Plant Analysis Lab at Mississippi State University. Research conducted at Tribbett Satellite farm, Tribbett, MS.

PHOSPHORUS		Extractable Soil Test Phosphorus (lb P/Acre)				
(lb P/A)	(lb P_2O_5/A)	2010	2011	2012	2013	2014
0	0	111.5	103.2	122.3	134.0	108.1
20	46	131.8	110.7	126.2	138.5	120.6
40	92	146.7	130.3	128.0	152.7	133.8
60	138	129.8	136.1	134.1	166.7	148.1
LSD (0.05)		25.8 ns	11.0	16.3 ns	23.0	24.5