

RE-EVALUATION OF MISSOURI SOIL TEST RECOMMENDATIONS FOR COTTON FERTILIZATION

Gene Stevens, University of Missouri

Introduction

Current University of Missouri potassium and phosphorus soil test calibrations for cotton are based on field research conducted more than 25 years ago. Fertility field experiments with cotton were conducted at Malden, Bragg City, Bell City, and Portageville, Missouri from 1956 to 1961. In recent years, several cotton studies have been conducted with starter fertilizer and foliar potassium at Portageville, Missouri. Some chlorophyll meter work with nitrogen rates has also been done. However, a thorough evaluation of soil test fertilizer recommendations on cotton has not been made in many years. A study was begun in 1997 to improve on existing soil test calibrations for potassium, phosphorus, and lime by conducting field experiments testing cotton response to varying fertilizer and lime rates.

Materials and Methods

Soil samples were collected and tested at the University of Missouri Rhodes Farm at Clarkton, the University of Missouri Lee and Marsh Farms at Portageville, and the Lewis Rone Farm at Portageville. Small plots (35 feet long X four rows wide) were established with four replications at each site. Separate tests were conducted for phosphorus, potassium, and lime. All phosphorus, potassium, and lime were broadcast applied preplant by hand. An attempt was made to make other nutrients optimum except the nutrient being tested in a particular test. Broadcast lime or fertilizer was uniformly applied across the test area at the recommended rate based on current soil test recommendations. The lime test at the Marsh Farm was begun in 1996. The remaining tests were started in 1997. Plots were mechanically harvested for yield.

Results and Discussion

Two of the sites (Rone and Rhodes Farms) had initial soil K levels below the current soil test recommended target levels (Table 1). The current soil K target for cotton in Missouri is based on the formula: $RecK=220 + 5(CEC)$. For the soils in the study, the soil K target ranged from 242 to 263 lb ammonium acetate extractable K/acre. At the Lee Farm, where untreated check plots tested just 7 lb K/acre below the target, no significant yield response to potassium fertilizer was found (Table 2). Cotton at the Rone and Rhodes Farms showed yield response to potassium (Figures 1 and Table 3 and 4). Soil samples taken in 6-inch increments to 3 feet showed that the potassium was concentrated in the surface on the soil at the Lee Farm (Figure 2). This soil has a greater concentration of clay in the subsoil than the other two sites, which may have inhibited K migration in the soil profile. Total K₂O fertilizer for the two seasons was plotted against soil test levels in the 0 to 6-inch depth after harvest in 1998 (Figure 3). Results showed that the soil K levels increased very slowly with increased rates of potash. Generally, it took 6 to 7 lb K₂O fertilizer/acre to increase the soil K level 1 lb K/acre.

Soil tests from all of the test sites showed that even the untreated check plots had soil phosphorus levels greater than the 45 pound P per acre threshold for applying phosphorus as currently used by the University of Missouri (Table 1). Phosphorus fertilizer did not increase yields significantly above the untreated check in 1997 or 1998 (Tables 5-7). However, yields were increased significantly with phosphorus at the Lee Farm in 1999. When total P₂O₅ fertilizer for two seasons was plotted against soil test levels after harvest in 1998, results showed that the soil P levels did not increase at all on the Rone Farm and very little on the Rhodes Farm. At the Lee Farm, it took approximately 10 lb P₂O₅ to increase the soil P level 1 lb P/acre.

Results from the lime test at the Marsh Farm are shown in Table 8. The recommended lime application to achieve a pH of 6.0 for this soil was 1295 ENM (2.9 tons/acre for 452 ENM/ton white calcite lime). Yields were increased significantly with lime in 1996. The highest cotton yields were achieved with 3 tons lime/acre. However, yields declined sharply when excessive lime rates were applied. No significant yield differences between the untreated check plots and lime treatments were found in 1997 and 1998.

Summary

Potassium had a greater effect on cotton yields than phosphorus. All of the test sites had high initial soil levels of phosphorus. However, it is not usual for cotton production soils in Southeast Missouri to be high in phosphorus. Results showed that the current target P and K soil target test levels for cotton do not need to be changed. The only time that a significant effect of P in this study was found was on the Lee Farm in 1999 (1 out of 8 tests). Although the K target level were satisfactory, the current recommendation for an 8-year build-up period for achieving a target soil level is too slow. On one soil that was significantly below the target K level, cotton yields were increased 64 percent by applying potash. Results from the lime test showed that the current lime recommendations are satisfactory. Reductions in yield from high lime rates suggest that too much lime may have a negative impact on micronutrient availability.

Table 1. Three-year average soil test results from untreated check plots and target P and K soil values from current University of Missouri recommendations.

Site	CEC	pH _{salt}	Untreated Check P	Current Target P	Untreated Check K	Current Target K
-----pounds per acre-----						
Rone Farm Portageville	7.4	5.0	52	45	224	257
Lee Farm Portageville	8.6	6.1	70	45	256	263
Rhodes Farm Clarkton	4.4	4.2	139	45	209	242

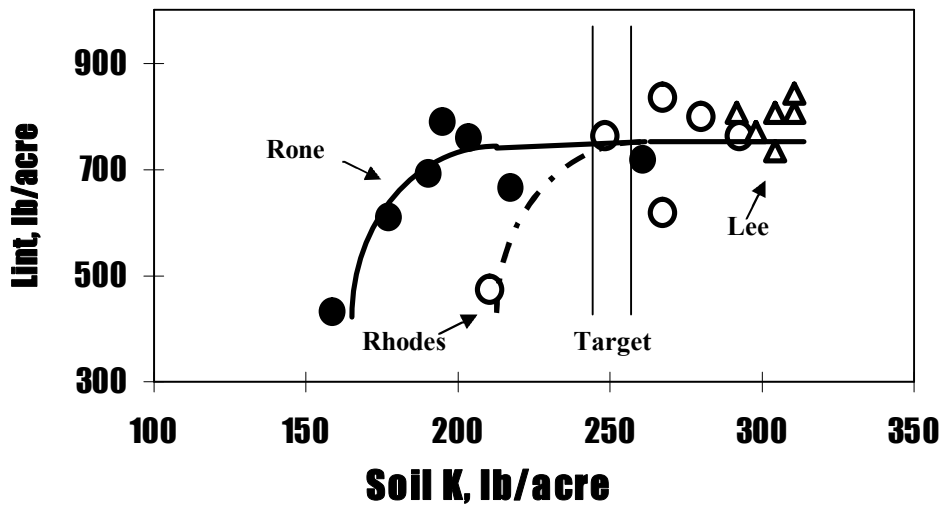


Figure 1. Effect of soil potassium levels on cotton yields in 1997.

Table 2. Cotton lint yields from varying rates of muriate of potash at Lee Farm.

Lb K ₂ O/acre	1997	1998 (hail damage)	1999	Three year average
0	782	245	804	610
35	781	133	788	767
70	751	359	781	405
105	706	207	850	588
140	804	239	829	624
280	777	225	814	605
400	764	244	808	605
LSD.05	ns	ns	ns	
CV (%)	8	36	11	

Table 3. Cotton lint yields from varying rates of muriate of potash at Rone Farm.

Lb K ₂ O/acre	1997	1998	1999	Three year average
0	465	411	526	467
35	647	639	529	605
70	687	619	643	649
105	749	603	618	656
140	776	481	598	618
280	624	535	824	661
400	699	505	590	598
LSD.05	162	172	-	
CV (%)	17	22	-	

The farmer accidentally harvested part of the test in 1999.

Table 4. Cotton lint yields from varying rates of muriate of potash at Rhodes Farm.

Lb K ₂ O/acre	1997	1998	Two year average
0	423	320	371
35	704	265	484
70	799	238	518
105	566	243	404
140	765	300	532
280	729	174	451
400	572	366	469
LSD.05	306	ns	
CV (%)	32	42	

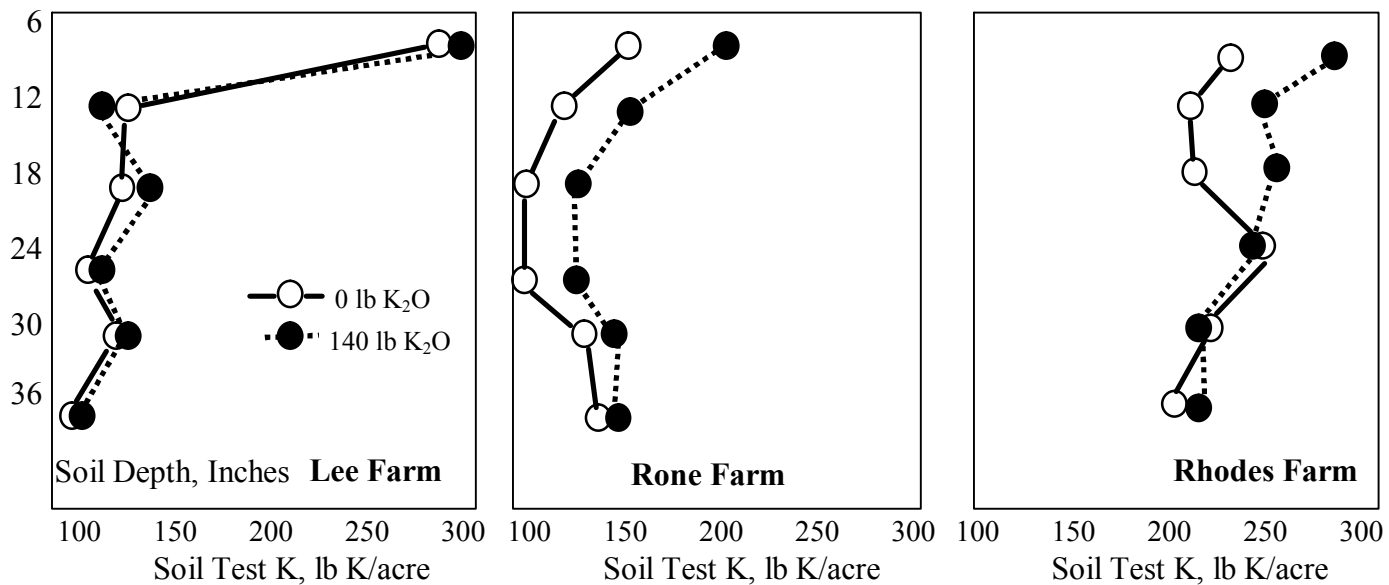


Figure 2. Soil test potassium levels from 0 to 36-inch depth from untreated plots and plots with 140 lb K₂O.

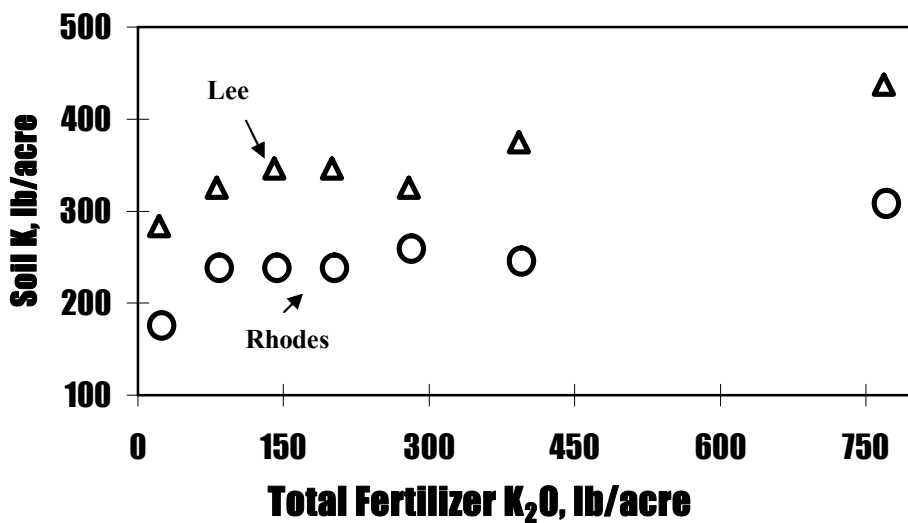


Figure 3. Effect of cumulative K fertilizer rates on soil test levels at the Lee and Rhodes Farms after two years.

Table 5. Cotton lint yields from varying rates of phosphorus at Rone Farm.

Phosphorus, lb P ₂ O ₅ /acre	1997	1998	1999	Three year average
0	622	430	721	591
25	658	485	850	664
50	591	482	769	614
75	622	486	788	632
150	610	434	742	595
300	549	417	714	560
LSD.05	ns	ns	-	
CV (%)	21	13	-	

The farmer accidentally harvested part of the test in 1999.

Table 6. Cotton lint yields from varying rates of phosphorus at Lee Farm.

Phosphorus, lb P ₂ O ₅ /acre	1997	1998 (hail damaged)	1999	Three year average
0	613	147	727	493
25	635	176	782	531
50	581	173	824	526
75	590	160	841	530
150	684	189	851	574
300	683	197	825	568
LSD.05	ns	ns	115	
CV (%)	17	25	2.08	

Table 7. Cotton lint yields from varying rates of phosphorus at Rhodes Farm.

Phosphorus, lb P ₂ O ₅ /acre	1997	1998	Two year average
0	791	317	554
25	659	316	487
50	765	357	561
75	807	374	590
150	890	432	661
300	854	456	655
LSD.05	148	ns	
CV (%)	12	27	

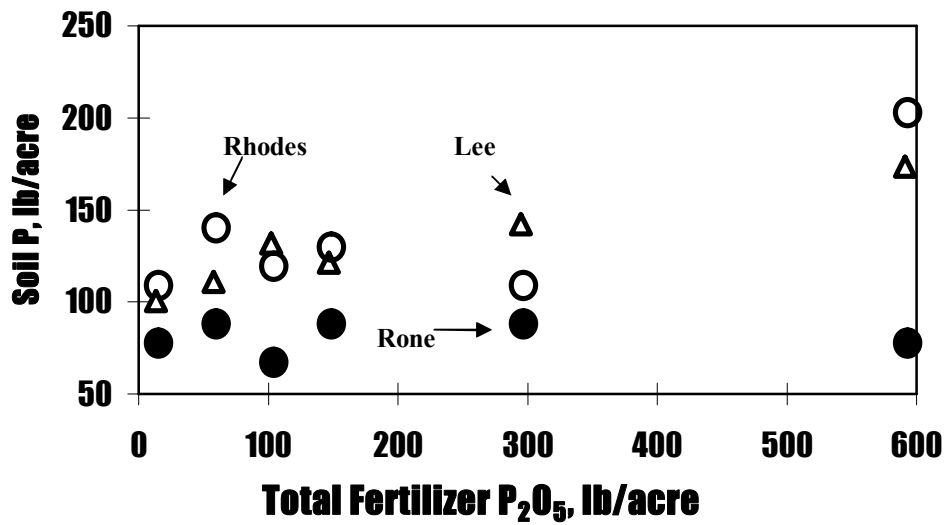


Figure 4. Effect of cumulative P fertilizer rates on soil test levels at the Lee, Rone, and Rhodes Farms after two years.

Table 8. Cotton lint yields from varying rates of ag lime applied at the Marsh Farm (452 ENM white lime) at Portageville in 1996.

Ag Lime Tons/acre	1996	1997	1998	Three-year average
0	833	779	479	697
1	841	795	531	722
2	910	739	455	701
3	921	750	540	737
4	733	698	429	620
5	723	641	424	596
LSD.05	154	272	ns	
CV (%)	13	25	15	

Recommended lime from soil test at the Lee Farm in 1996 was 1295 ENM/acre.