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POTASSIUM REQUIREMENTS *of Crops on* ALABAMA SOILS

AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY
E. V. Smith, *Director*
Auburn, Alabama

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Cover – Leaves from cotton plants show the varying stages of rust resulting from potassium deficiency.

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POTASSIUM

REQUIREMENTS of Crops on

ALABAMA SOILS[1]

R. D. ROUSE, *Soil Chemist*

AFTER ALABAMA land was cleared of native vegetation for cultivation, it was soon found that soils required the addition of fertilizer for good crop production.

Early fertility studies showed the need for phosphorus was greater than for potash. Therefore, fertilizers high in phosphorus in relation to potassium were generally recommended. It has become apparent that years of fertilization with such fertilizers has resulted in a buildup of soil phosphorus on many soils and frequently a depletion of soil potassium.

An analysis of 50,000 soil samples sent to the Soil Testing Laboratory from all parts of the State during 1953-58 showed that only 7 per cent of the soils need a fertilizer high in phosphorus and low in potassium, 75 per cent need a fertilizer with equal amounts of phosphorus and potassium, and 18 per cent need a fertilizer low in phosphorus and high in potassium. Therefore, no one fertilizer can be generally recommended to meet the needs of all soils. Land that has not been fertilized to any extent still needs a fertilizer relatively high in phosphorus. Land that has been cropped and fertilized may need a fertilizer with any one of three ratios of phosphorus to potassium.

The purpose of this report is (1) to summarize results of potassium research conducted by the Auburn Agricultural Experiment Station, (2) to give crop responses to applied potassium, and (3) to relate these responses to soil test values. This infor-

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[1] The data reported are from field and laboratory investigations by the Agricultural Experiment Station of Auburn University extending over a period of 30 years. The experiments were conducted by members of the department of agronomy and soils working cooperatively with superintendents of the substations and experiment fields and farmers.

mation is intended to provide farmers and agricultural workers with a better understanding of potassium needs of various crops when produced under varying conditions of soil fertility and cropping sequences.

SOURCES of POTASSIUM

Most potassium used in fetilizer is potassium chloride. This applies to mixed fertilizers of various grades and straight potassium materials. However, there are certain exceptions. Potassium used in "tobacco special" is mainly in the form of potassium sulfate. When a source of water-soluble magnesium is needed, as on some soils for potatoes, a form of potassium-magnesium sulfate can be used. There is also a small amount of potassium nitrate on the market. All of these sources of potassium are water-soluble and are readily available to plants. Available sources of commercial potassium are listed below:

Commercially Available Sources of Potassium

Common name	Chemical name and formula	Per cent K_2O
Muriate of potash	Potassium chloride (KCl)	60
Sulfate of potash	Potassium sulfate (K_2SO_4)	44
Sulfate of potash-magnesia	Potassium-magnesium sulfate (K_2SO_4-$MgSO_4$)	25[1]
Sulpomag	Potassium-magnesium sulfate	21[2]
Nitrate of potash	Potassium nitrate (KNO_3)	44[3]

[1] Also contains 8 per cent MgO.
[2] Also contains 18 per cent MgO.
[3] Also contains 12 per cent N.

POTASSIUM REQUIREMENTS of CROPS

General

The amount of potassium needed to prevent low crop yields depends on (1) the level of available potassium in the soil, (2) the plant species and yield level, (3) the efficiency with which the plant can obtain potassium from the soil, and (4) the level of other plant nutrients.

The effect of increasing amounts of available potassium in the soil on yield of cotton on Hartsells fine sandy loam at the Sand Mountain Substation is shown in Figure 1. These various levels of soil potassium have developed as a result of 18 years of differential potassium treatment. It is evident that smaller amounts of

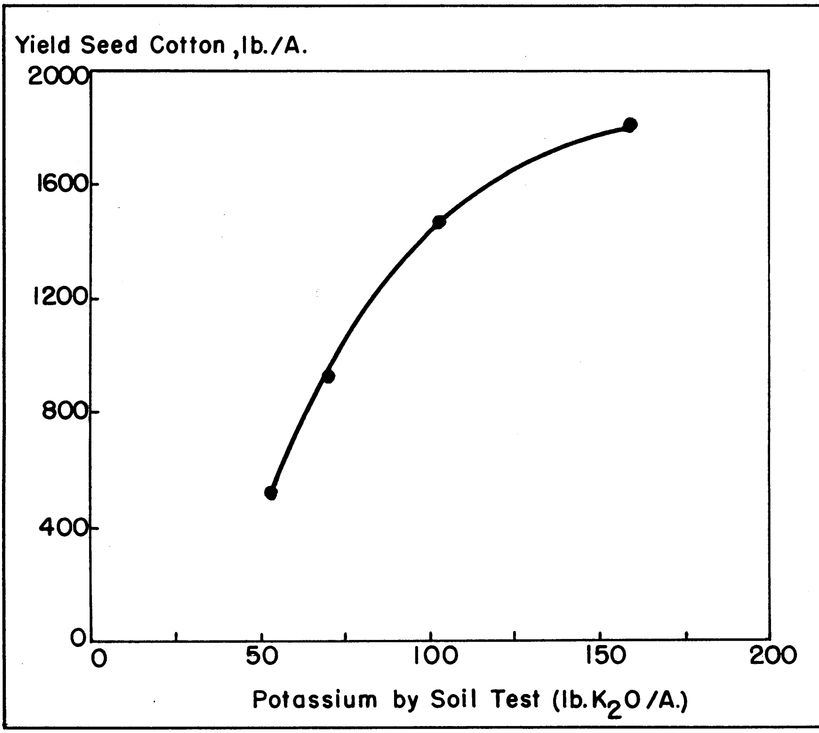

FIGURE 1. Relation between soil test potassium and cotton yield on Hartsells fine sandy loam—Sand Mountain 1952.

applied potassium are required for maximum yields as the level of soil potassium increases.

A comparison between annual lespedeza and alfalfa shows the effect of crop species and yield expected. Annual lespedeza will make maximum yield when dry matter has a potassium content of 1 per cent, whereas a dry matter content of at least 2 per cent potassium would be required for maximum yield of alfalfa. Where other factors permit a yield of 2 tons of lespedeza hay, the equivalent of about 50 pounds of K_2O would be removed; under the same condition, 4 tons of alfalfa would be produced and the equivalent of 200 pounds of K_2O removed.

Peanuts and cotton offer a good comparison of crops having different efficiencies for obtaining potassium from the soil. In a 2-year rotation experiment of cotton and peanuts at the Wiregrass Substation on Norfolk fine sandy loam, cotton yields were increased from 132 to 1,250 pounds of seed cotton per acre by an application of 156 pounds of K_2O (60 to peanuts and 96 to cotton). Peanuts showed no increase in yield. Thus, peanuts can obtain sufficient potassium at a soil level extremely deficient for cotton.

The importance of balancing the supply of available plant nutrients was pointed out by Rogers *(3)*. He reported results showing that lime increased or decreased yields of cotton and corn depending on the amount of potassium applied and the soil level of available potassium.

Some crops do not produce maximum yields when most of the potassium needs comes from fertilizer applied in the drill that season. Therefore, potassium should be applied for the

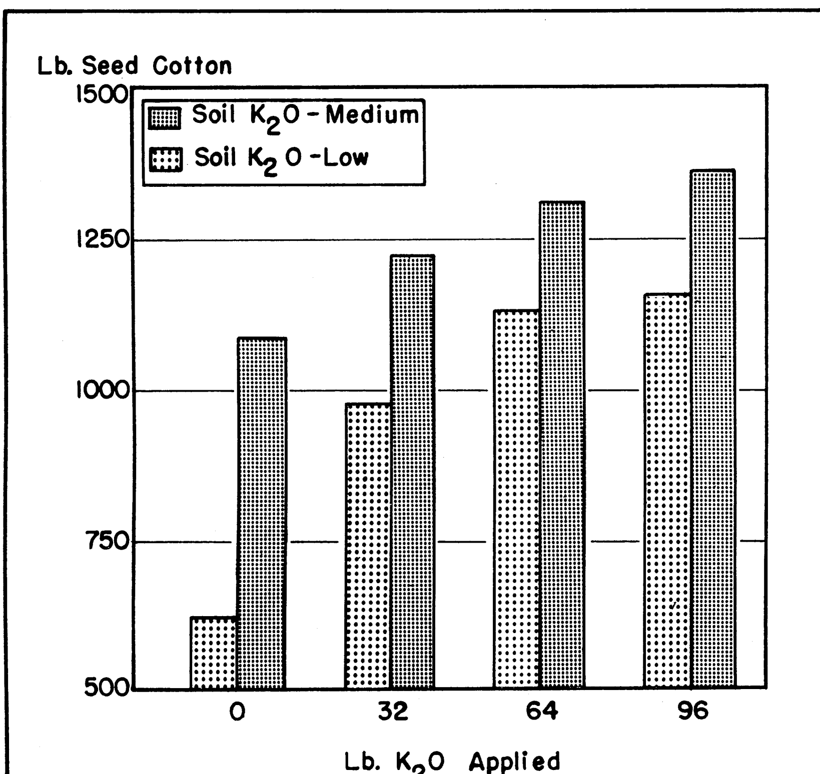

FIGURE 2. Effect of potassium fertilizer on yield of seed cotton at 3 different soil levels of soil potassium on Kalmia sl, Brewton Field 1957-58.

purpose of building or maintaining the potassium reserves in the soil in addition to producing a good yield. Data from the cotton experiment shown in Figure 1 are an example. When the experiment was begun, the soil potassium level was medium. Forty-eight pounds of K_2O applied annually to cotton for 18 years maintained this level and gave maximum yields. However, where less than 36 pounds of K_2O was applied the soil level decreased to low. On plots that began receiving 48 pounds of K_2O after the soil potassium level had been cropped to a low value, the application had to be repeated for 5 or 6 years before the soil potassium content was back to medium and sufficient to produce maximum yields *(4)*. During the first 4 years, yields on the depleted soil were only 70 to 80 per cent of maximum. The fifth year the yield was 90 per cent, the sixth year maximum, and the soil level was up to medium.

Similar results were obtained in an experiment on Kalmia sandy loam at the Brewton Field, Figure 2. In this experiment rates of potassium were applied at 2 residual levels. On soil testing low the highest yield was only 85 per cent of that made on soil testing medium. This emphasizes that (1) yield is dependent upon total available supply, not just that applied as fertilizer and (2) a rate of potassium adequate to maintain yields over a long period may not be adequate for a depleted soil.

In Relation to Soil Potassium

Potassium occurs in the soil in several forms: (1) It may be a part of the crystal of primary minerals, (2) it may be a part of the crystal of certain secondary or clay minerals, or (3) it may be held on the surfaces of the very fine organic or clay particles. Since the potassium in primary minerals has remained in this form throughout the ages, it is understandable that it is very resistant to weathering and is of negligible value in any one year. It does, however, play a part in the long-time potassium fertility status of the soil. The clay minerals are more subject to change and the potassium in these minerals, though not readily available to plants, is more likely to become available to a crop. Therefore, it has a greater influence on the potassium fertility status of soils. The potassium held on the surface of soil particles is considered available potassium. It can be displaced by leaching with a weak salt or acid solution and, therefore, is referred to as exchangeable. This is the form that correlates best with crop response to added fertilizer and is the form that is measured by the Soil Testing Laboratory. Research has been underway for many years on the amount of this form of potassium in relationship to crop responses from added potassium.

In 1942, Volk *(11)* summarized results of nearly 600 fertilizer tests with cotton conducted over the State. These data showed a relationship between soil test potassium and response in yields to added increments of potassium. They also served as a guide for succeeding work by illustrating that differences in soil characteristics should be taken into consideration in making fertilizer recommendations on the basis of soil analysis. When all potassium response data are considered, soils of the State can be divided into 3 general groups for the purpose of calibrating chemical soil tests.

(I) Sandy Coastal Plain soils

(II) Clay loam Coastal Plain soils, Piedmont soils, Appalachian Plateau soils, grey soils of Limestone Valleys, Highland Rim soils, and lime soils of the Black Belt

(III) Red soils of the Limestone Valleys and acid soils of the Black Belt

When the soils are thus grouped, ranges of values can be determined that represent low, medium, or high levels of soil potassium. The ranges of available K_2O in pounds per acre for the three soil groups according to research information are:

	Group I	Group II	Group III
Low	less than 75	less than 100	less than 150
Medium	75-150	100-200	150-300
High	more than 150	more than 200	more than 300

These are values obtained from extracting the soil with a weak acid (0.05 *N* HCl and 0.025 *N* H_2SO_4). All available potassium figures reported in this report are in these terms. Most of the data were obtained as exchangable potassium by the standard procedure of leaching with 1 *N* ammonium acetate, but have been converted to soil test values by multiplying Group II by 0.80 and Group III by 0.75. Group I required no factor.

Response To Applied Potassium

CONTINUOUS COTTON. Many of the early studies were conducted at low levels of nitrogen and/or without adequate boll weevil control. These conditions did not permit maximum response to potassium *(11, 12)*. However, those studies that included determination of soil potassium are of value in estimating the rates needed to maintain soil potassium. Table 1 gives

TABLE 1. COTTON RELATED TO RATES OF APPLIED POTASSIUM WITH RESULTING CHANGES IN AVAILABLE SOIL POTASSIUM (10 YR. AV.)[1]

Soil	K_2O per acre				Treatment K_2O lb. per acre				
	Available		To maintain		0	12	24	48	96
	init.	final[2]	init.	med.	Yield seed cotton per acre				
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Decatur clay[3]	323 (H)	190 (M)	96	48	1,510	1,658	1,576	1,549	1,457
Hartsells fsl[4]	72 (L)[5]	49 (L)	24	48	1,057	1,328	1,349	1,348	1,390
Norfolk fsl[6]	112 (M)	69 (L)	48	48	1,190	1,371	1,424	1,463	1,409
Stough sl[7]	184 (H)	79 (M)	48	48	722	1,121	1,237	1,373	1,469

[1] 1930-39 except Stough 1938-47, 36 lb. of N and 60 lb. P_2O_5 applied to all plots.
[2] Where no potash had been added.
[3] Tennessee Valley Substation.
[4] Sand Mountain Substation.
[5] Soil test values of low, medium and high are indicated in parentheses after lb.
[6] Wiregrass Substation.
[7] Aliceville Field.

TABLE 2. RESPONSE OF COTTON TO APPLIED POTASSIUM IN RELATION TO SOIL POTASSIUM (AVERAGE 1954-57)[1]

Treatment K_2O/a.	Seed cotton per acre							
	Decatur cl[2]	Decatur cl[3]	Greenville scl[4]	Hartsells fsl[5]	Kalmia sl[6]	Magnolia sl[7]	Norfolk sl[8]	Savannah fsl[9]
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Init. avail.	184 (M)	175 (M)	154 (M)	80 (L)	46 (L)	34 (L)	69 (L)	167 (H)
0	1,040	1,362	1,446	1,576	754	394	1,184	1,209
20	1,165	1,362	1,338	1,750	1,122	887	1,850	1,186
40	1,126	1,376	1,568	1,793	1,462	1,095	2,022	1,226
60	1,130	1,395	1,582	1,886	1,517	1,345	....	1,254
80	1,142	1,412	1,584	1,852	1,734	1,345	2,144	1,203
100	1,155	1,374	1,561	1,849	1,753	1,417	2,234	1,239

[1] All treatments received 80 pounds of N and 100 pounds of P_2O_5 except Tennessee Valley where 60 pounds of N was used and Wiregrass where 72 pounds of N was used. The potassium rates on Norfolk were 0, 24, 48, 72, and 96 pounds per acre.
[2] Alexandria Field.
[3] Tennessee Valley Substation.
[4] Prattville Field.
[5] Sand Mountain Substation.
[6] Brewton Field.
[7] Monroeville Field.
[8] Wiregrass Substation.
[9] Upper Coastal Plain Substation.

results of an experiment with rates of applied potassium to cotton, conducted at 4 locations over a 10-year period. Differences are apparent in soils as to potassium levels, the rate of decrease with cropping, and the annual amounts of potassium needed to maintain yields and soil potassium. However, all plots were maintained at the medium level of soil potassium with an annual rate of 48 pounds of K_2O per acre.

The results of a current experiment at eight locations, Table 2, show that on soils testing low cotton responded to applications of 60 to 100 pounds of K_2O, whereas, on those testing medium or high, a response was not obtained to more than 40 pounds. However, by the third year cotton on the low potassium plots even at the medium and high locations were showing potassium deficiency symptoms and will probably show a yield response in another year or two.

SIDEDRESSING COTTON WITH POTASSIUM. In studies conducted by Volk *(12)* prior to 1940, results showed potassium to be more efficient when applied ahead of or at planting time than when applied as a sidedressing. Recent studies confirm earlier studies, although the advantage of preplanting applications over split applications is not as great as was previously reported, Table 3. The 5-year average yields show only a slight advantage from applying all potassium at planting over split applications. Most of the increase came from the first year of the study when a definite advantage from applying all the potassium at planting was obtained. The data show that a benefit can be expected from sidedressing with additional potassium when inadequate potassium has been applied at planting.

TABLE 3. EFFECT OF SPLIT APPLICATION OF POTASH ON COTTON YIELD, KALMIA SL, BREWTON EXPERIMENT FIELD, 1952-56

K_2O per acre[1]		Seed cotton per acre					
At planting	Sidedressed	1952	1953	1954	1955	1956	Av.
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	0	866	362	344	428	380	476
32	0	1,314	1,199	1,204	1,316	1,121	1,231
16	16	1,107	997	1,120	1,460	1,130	1,163
64	0	1,544	1,188	1,459	1,946	1,523	1,532
32	32	1,271	1,316	1,505	1,825	1,510	1,485
96	0	1,409	1,197	1,542	2,039	1,498	1,537
32	64	1,316	1,163	1,502	2,014	1,559	1,511
128	0	1,523	1,136	1,537	2,210	1,753	1,632

[1] All plots received 80 lb. of N and P_2O_5 per acre. Initial available potassium —low (52 lb. K_2O per acre).

This is also shown by the following results obtained on Norfolk sandy loam at the Wiregrass Substation:

YIELD SEED COTTON PER ACRE (7 YR. AV.)

	Lb.
No sideressing	1,208
Sidedressing (60 lb. K_2O)	1,448

This cotton was grown in a 2-year rotation with peanuts on a soil testing low in potassium. The peanuts received 80 pounds of K_2O per acre. The cotton received 42 pounds of potassium per acre at planting time. The sidedressing was applied at chopping.

SODIUM AS A SUBSTITUTE FOR POTASSIUM. Research has not shown that plants require sodium. It is essential for animals. However, research shows sodium to be a substitute for a part of the potassium needs of some plants. Numerous studies have been conducted to determine the extent to which it can substitute for some of the potassium needs of cotton *(7, 10)*. In general, sodium has been beneficial only at low potassium levels, although some experiments have indicated benefits at near adequate levels of potassium. Results of a recent field study conducted to determine the value of sodium for cotton are shown in Table 4. Sodium did not increase cotton yields consistently, except at the 32-pound per acre rate of potassium. These yields were less than those obtained from 64 pounds of potassium. This is in line with most of the previous work and leads to the conclusion that, when fertilizing for high yields of cotton, no substitution for potassium should be expected from sodium under Alabama field conditions.

TABLE 4. RESPONSE OF COTTON TO SODIUM AT THREE RATES OF POTASH, 1952-56[1]

Treatment K_2O per acre[2]	Na_2O per acre[3] 0	32	64	96	Av.
	Yield seed cotton per acre				
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	479	----	----	----	----
32	1,231	1,284	1,312	1,326	1,288
64	1,532	1,527	1,586	1,534	1,545
96	1,537	1,657	1,536	1,633	1,591
128	1,632	----	----	----	----
Av. 32, 64, 96	1,433	1.489	1,475	1,498	

[1] Kalmia sl, Brewton Experiment Field.
[2] Initial available potassium—low (52 lb. K_2O per acre).
[3] Initial available sodium (31 lb. Na_2O per acre).

TABLE 5. RESPONSE OF COTTON, WINTER LEGUME AND CORN GROWN IN A 2-YEAR ROTATION TO APPLIED POTASSIUM (AV. 1930-48)

Treatment	Norfolk fsl	Greenville scl	Kalmia sl	Magnolia fsl	Stough sl	Decatur clay	Hartsells fsl	Decatur cl
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Yield seed cotton per a. without potassium	1,120	997	315	778	758	926	916	1,378
Increase in yield from 45 lb. K_2O per rotation	95	253	649	396	448	113	693	88
Increase in yield from 90 lb. over 45 lb. K_2O	–7	16	318	68	6	47	99	–6
Vetch yield green wt. per a. without potassium	10,044	11,429	5,981	10,824	10,067	10,064	8,409	12,269
Increase in yield from 45 lb. K_2O per rotation	1,550	1,694	3,007	3,740	1,935	1,094	3,191	858
Increase in yield from 90 lb. over 45 lb. K_2O	662	9	161	711	557	185	292	124
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Yield of corn per a. without potassium	31.1	42.5	29.7	38.1	39.0	33.3	49.8	40.2
Increase in yield from 45 lb. K_2O per rotation	0.1	1.3	10.2	4.3	3.0	0.7	4.6	0.1
Increase in yield from 90 lb. over 45 lb. K_2O	0.2	–0.3	1.9	0.0	–1.0	1.3	–0.1	–0.4

TABLE 6. EFFECT OF POTASH APPLICATIONS AND CROPPING TO A 2-YEAR ROTATION OF COTTON-WINTER LEGUME-CORN ON THE AVAILABLE SOIL POTASSIUM AND SOIL TEST RATING 1930-50

Treatment per 2-year rotation	Norfolk fsl	Greenville scl	Kalmia sl	Magnolia sl	Stough sl	Decatur clay	Hartsells fsl	Decatur cl
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Original K	114 (M)	178 (M)	40 (L)	161 (H)	184 (H)	228 (M)	116 (M)	452 (H)
After 20 years no K	87 (M)	90 (L)	38 (L)	78 (M)	87 (M)	140 (L)	54 (L)	236 (M)
After 20 years 45 lb. K	135 (M)	159 (M)	61 (L)	141 (M)	151 (H)	214 (M)	104 (M)	260 (M)
After 20 years 90 lb. K	162 (H)	209 (H)	85 (M)	218 (H)	243 (H)	278 (M)	140 (M)	442 (H)

COTTON IN ROTATION WITH OTHER CROPS. A 2-year rotation of cotton-winter legume-corn, where the winter legume is not grazed, has been in progress at 8 locations in the State since 1930, Table 5. At the beginning of the experiment, available potassium was medium or high at all locations except one. A study of the change in available potassium with treatment over 20 years, Table 6, and yield response of the three crops to potassium shows that this cropping system requires a relatively low rate of potassium (45 pounds of K_2O per 2-year rotation) to maintain soil potassium and yield. Except for Kalmia sandy loam, which has a very sandy subsoil, the available potassium was maintained at a medium or high level by an application of 45 pounds of K_2O per 2-year rotation. Only 4 locations showed a response to more than 45 pounds of K_2O.

Other cropping systems require much higher rates. For example, on Norfolk fine sandy loam at the Wiregrass Substation, continuous cotton did not respond to rates higher than 48 pounds of K_2O per acre; yet, when cotton was grown in a 2-year rotation with harvested peanuts, at least 96 pounds of K_2O were needed for maximum yield of cotton. In this rotation peanuts received 60 pounds of K_2O, Table 7.

Additional treatments were introduced in this experiment in 1951 to compare methods of correcting extreme potassium deficiency, Table 8. The comparisons are between (1) single broadcast application of 360 pounds of K_2O followed by 48 pounds of K_2O annually to cotton and (2) 60 pounds of K_2O applied as a sidedressing in addition to annual applications of 24,

TABLE 7. EFFECT OF INTRODUCING PEANUTS IN ROTATION WITH COTTON ON POTASSIUM NEEDS OF COTTON[1]

Rate of K_2O to cotton	Continuous cotton		Cotton-peanut rotation			
			No potash to peanuts		60 lb. K_2O to peanuts	
	Yield seed cotton 1930-40	K_2O[2] 1940	Yield seed cotton per a. 1940-50	K_2O 1950	Yield seed cotton per a. 1951-57	K_2O 1957
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	1,190	67 (L)	204	36 (L)	120[3]	28 (L)
12	1,371	87 (M)	164	32 (L)	287	46 (L)
24	1,424	92 (M)	330	42 (L)	518	46 (L)
48	1,463	115 (M)	708	50 (L)	1,067	54 (L)
96	1,409	163 (H)	1,378	82 (M)	1,742	92 (M)

[1] Norfolk fine sandy loam, Wiregrass Substation.
[2] K_2O in 1930 was 117 lb. (M).
[3] Peanuts received no potash on this treatment.

TABLE 8. A COMPARISON OF A SINGLE LARGE APPLICATION OF POTASSIUM WITH ANNUAL SIDEDRESSING IN CORRECTING SEVERE POTASSIUM DEFICIENCY ON COTTON IN A 2-YEAR ROTATION OF COTTON AND PEANUTS

Treatment no.	K_2O per acre[1]		Soil test			Yield seed cotton per acre			
	1940-50	1951-57	1950	1952	1958	1946-50	1951	1957	1951-57
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1	24	48[2]	37 (L)	88 (M)	74 (L)	221	1,177	1,499	1,460
2	24	24[3]	38 (L)	49 (L)	72 (L)	126	403	1,422	937
3	48	48[3]	60 (L)	62 (L)	90 (M)	282	796	1,793	1,266
4	48	96[3]	53 (L)	59 (L)	119 (M)	250	951	1,949	1,493
5[4]	24	48	39 (L)	41 (L)	54 (L)	190	441	914	661
6	96	96	82 (M)	68 (L)	92 (M)	618	1,378	2,001	1,742

[1] All plots limed in 1951 and 1955. All plots received 36 lb. of N and 60 lb. of P_2O_5 until 1955 at which time the N was increased to 60 lb. per acre. Peanuts grown in alternate years. Prior to 1951 they did not receive fertilizer and beginning in 1951 they received 30 lb. P_2O_5 and 60 lb. K_2O per acre.

[2] A single broadcast application of 360 lb. K_2O made in 1951.

[3] 60 lb. K_2O per acre applied as a sidedressing to cotton.

[4] Treatments 5 and 6 are shown for comparison. Treatment 5 received no corrective application; treatment 6 has received 96 lb. of K_2O to cotton throughout the period of the test.

48, and 96 pounds of K_2O at planting. The large broadcast application the first year increased yield more than applying as much as 96 pounds under and sidedressing with 60 pounds of K_2O annually. However, by the seventh year the high annual rate was superior. The average yields for the period are about the same for the two treatments. This indicates that, for immediate yield improvement on the extremely potassium-deficient soils, a broadcast application is probably needed. However, to maintain good yields of cotton in rotation with peanuts, large annual applications are required. This is also borne out in the soil test values, since the available potassium has continued to increase with a high annual rate. There has been a slight decrease following the large single application when the annual rate was only 48 pounds of K_2O.

COTTON FOLLOWING HAY CROPS. Severe potassium deficiency has frequently been encountered when cotton is planted after such crops as alfalfa, sericea, or annual lespedeza that received inadequate potassium. Studies have been made on several soils following these crops, and at all locations potassium applications higher than recommended rates were required to prevent potassium deficiency symptoms and to obtain top yields *(5)*. The severity of the deficiency can be determined in advance by a

TABLE 9. YIELD OF COTTON AS AFFECTED BY DIFFERENT POTASSIUM TREATMENTS ON EXTREMELY POTASH DEFICIENT SOIL

Number	Treatment: K_2O per acre[1]				Yield of seed cotton per acre	
	1957	1958				
	Drill	Broadcast	Drill	Sidedress	1957	1958
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1	0		0		333	412
2	60		60		1,158	1,819
3	120		60		1,589	2,400
4	240		60		1,679	2,794
5	0		60		347	1,656
6	0		120		243	2,203
7	0	120			333	2,155
8	0			120	225	2,213
9	0	60	60		302	1,934
10	0		60	60	243	2,270
11	0		30		158	1,075
12	0	120	60		351	2,270
13	0	240	60		343	2,261
14	0	240[2]	60		288	2,746

[1] Soil test low—40 lb. K_2O per acre. All treatments received 100 lb. N and 75 lb. P_2O_5 in 1957 and 175 lb. N and 75 lb. P_2O_5 in 1958.
[2] P_2O_5 from Potassium Meta Phosphate 28 per cent K_2O.

soil test if it is suspected that insufficient potassium was applied to the hay crop.

Research is in progress to determine methods of application that will increase the efficiency of applied potassium. Past studies have shown that, regardless of the method of application, large total amounts must be applied. For example, an experiment on Chesterfield sandy loam at the Main Station showed no advantage from various combinations of broadcast, drill, and sidedressing over high rates applied in the drill, Table 9.

CORN, GRAIN SORGHUM, AND OATS. Corn and cotton require about the same amount of potassium to produce satisfactory yields. Neither removes large amounts of potassium unless corn is harvested for silage. However, corn is much more efficient than cotton in obtaining potassium from the soil. Unless the soil is very low in soil potassium, marked responses are not obtained from potassium additions. This is shown by data from experiments conducted at 9 locations for 5 years on areas previously well fertilized, Table 10.

Experiments at Aliceville Experiment Field, Sand Mountain Substation, and Gulf Coast Substation were continued for a second 5-year period with no appreciable increases in response, Table 11. Soil test values for potassium were not available for the beginning of the experiment, but were obtained after 10 years of cropping. These data indicate that 20 to 40 pounds of K_2O applied annually to continuous corn is sufficient to maintain these soils at a medium potassium level. Therefore, this amount should be adequate for soils not already depleted to a low potassium level.

When the soil has been depleted of available potassium, corn yields are increased by applications of potassium. In an experiment on Decatur clay loam at Alexandria Experiment Field, the yield of corn following 2 years of Kobe lespedeza harvested for hay was increased from 33.6 bushels to 45.5 bushels per acre. On Kalmia sandy loam at Brewton Experiment Field following 5 years of sericea lespedeza, the yield of corn was increased from 56.8 bushels to 88.0 bushels per acre by an application of 48 pounds of K_2O. In contrast, a similar test on Norfolk sandy loam at the Wiregrass Substation showed no response to potassium, Table 12. The Kalmia soil tested low in potassium, whereas the Norfolk soil tested medium. Similar results were obtained in the 2-year rotation experiment, Table 5.

TABLE 10. RESPONSE OF CORN TO APPLICATIONS OF POTASSIUM ON SOIL PREVIOUSLY WELL FERTILIZED (1947-51)

Treatment[1] K_2O per acre	Yield of corn per acre								
	Decatur cl	Stough sl	Kalmia sl	Magnolia sl	Greenville scl	Boswell fsl[2]	Marlboro sl[3]	Hartsells fsl	Cecil sl[4]
Lb.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
0	55.0	36.9	50.2	52.0	49.7	30.4	57.6	65.5	54.5
20	55.0	40.9	54.0	51.0	51.2	32.8	61.1	69.4	51.9
40	57.6	41.8	55.6	52.2	53.2	31.9	66.2	68.3	45.7
60	54.3	40.1	55.3	53.4	53.0	33.3	63.2	68.0	44.9
80	54.3	41.4	54.3	53.4	52.8	36.1	65.7	69.2	52.8

[1] All treatments received 80 pounds N and P_2O_5 per acre.
[2] Tuskegee Field.
[3] Gulf Coast Substation.
[4] Piedmont Substation.

TABLE 11. RESPONSE OF CORN TO APPLICATION OF POTASSIUM (SECOND 5-YEARS 1953-57)[1]

K_2O per acre	Corn yield per acre and soil test values[2] on different soils					
	Marlboro sl		Hartsells fsl		Stough sl	
	Yield	Value	Yield	Value	Yield	Value
Lb.	*Bu.*		*Bu.*		*Bu.*	
0	58.7	62 (L)	50.7	71 (L)	32.7	75 (L)
20	62.0	86 (M)	53.8	108 (M)	34.6	112 (M)
40	67.0	114 (M)	51.2	189 (M)	35.9	154 (H)
60	64.0	134 (M)	52.1	157 (H)	35.2	237 (H)
80	66.5	168 (H)	56.0	170 (H)	34.0	253 (H)

[1] A continuation of the experiment in Table 10.
[2] Soil test values 1956 only.

Grain sorghum had about the same potassium requirement as corn, Table 12, but oats were slightly less responsive. A number of other studies on various soils of the State show that for all grain crops 20 to 40 pounds of K_2O is adequate except where soil potassium has been depleted to a low level or where small grain is to be grazed during the winter.

TABLE 12. RESPONSE OF CORN, GRAIN SORGHUM, AND OATS TO POTASSIUM APPLICATION (2-YEAR ROTATION)[1]

K_2O per acre[2]	Kalmia sl[3]			Norfolk sl[4]		
	Corn	G. sorghum	Oats	Corn	G. sorghum	Oats
	(3-yr. av.)	(3-yr. av.)	(1-yr. av.)	(3-yr. av.)	(2-yr. av.)	(3-yr. av.)
Lb.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
0	56.8	17.1	49.2	74.8	29.4	42.8
24	76.1	28.1	68.1	74.7	28.8	45.4
48	88.0	33.4	80.7	73.5	30.4	49.8

[1] Data by Fred Adams, associate soil chemist.
[2] Corn received 116 lb. N and 48 lb. P_2O_5 per acre. Oats and grain sorghum each received 50 lb. N and 48 lb. P_2O_5 per acre.
[3] Brewton Field—soil test for K_2O 58 lb. per acre (L).
[4] Wiregrass Substation—soil test for K_2O 98 lb. per acre (M).

ANNUAL LEGUMES. The amount of potassium needed by various winter and summer legumes grown alone depends on their productive capacity and potassium content of the plant required for maximum yield. However, the way in which these plants are utilized has the greatest bearing on fertilizer requirements for sustained production. When grown for green manure purposes, they are not potassium depleting. Volk (9) reported that winter legumes actually conserve soil potassium. Results of his studies on 8 soils ranging from sandy loams to clays showed that a

TABLE 13. RESPONSE IN YIELD PER ACRE OF SEVERAL CROPS TO POTASSIUM ON NORFOLK SANDY LOAM—MAIN STATION

K_2O annually	Soil test K_2O[1]	Peanuts		Vetch forage	Soybeans	Oats		Cr. clover	Seed cotton	White clover
		Nuts	Hay			Forage	Grain			
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Bu.*	*Lb.*	*Bu.*	*Lb.*	*Lb.*	*Lb.*
0	40 (L)	1,852	3,427	1,300	13.5	870	50.5	1,539	37	400
25	60 (L)	2,819	4,732	2,719	17.7	1,025	61.9	1,961	522	1,499
50	70 (L)	2,940	5,420	3,300	25.9	1,064	57.5	2,138	1,304	1,511
100	90 (M)	3,333	5,582	3,566	30.3	1,214	64.1	3,005	2,126	1,869

[1] These soil test values were maintained as nearly as possible throughout this series of crops.

winter legume after cotton in a 2-year rotation of cotton and corn reduced the leaching losses of potassium applied to cotton and corn by an average of 17 per cent. On some soils the winter legumes resulted in the conservation of as high as 30 per cent of the applied potassium.

Data in Table 5 show that in a cotton-winter legume-corn rotation, winter legumes (mainly vetch and crimson clover) respond to a potassium application when the soil is low or medium but not when the soil level is high. However, since the winter legume actually conserves soil potassium, the potassium applied for their production should be credited toward soil buildup and production of the following crop rather than charged to the production of the winter legume. In contrast, if these same crops are removed for hay or silage, they become potassium-depleting and if grazed they would be intermediate, depending on management.

The responses of certain plant species to applied and residual potassium are shown in Table 13. These crops were grown in succession on plots that had 4 different levels of soil potassium. These potassium levels resulted from past cropping and differential potassium applications. Potassium was applied to these crops annually at rates indicated to maintain soil potassium at the initial level. These data indicate that all legumes responded to potassium. This response was intermediate with respect to cotton, a very responsive crop, and to oats, the crop in this sequence showing the least response.

PEANUTS. Peanuts produce satisfactory yields with lower levels of available potassium than cotton. However, when peanuts are grown continuously, their potassium requirement can be de-

TABLE 14. EFFECT OF CONTINUOUS CROPPING ON RESPONSE OF DIXIE RUNNER PEANUTS TO POTASSIUM[1]

Treatment[2] K_2O per a.	Available K_2O per a.		Yield per acre			
	1949	1955	1950	1951	1952	1953
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
			Nuts-Hay	Nuts-Hay	Nuts-Hay	Nuts-Hay
0	77	48	3,485-6,000	1,444-2,809	2,306-4,836	1,852-3,427
25	78	60	3,621-6,313	1,800-2,426	2,900-4,733	2,819-4,732
50	85	70	3,583-6,031	1,636-3,188	2,756-5,728	2,940-5,420
100	98	88	3,390-6,750	1,680-3,299	3,169-6,398	3,333-5,582

[1] Norfolk sandy loam, Main Station.
[2] All plots received 60 lb. P_2O_5 per acre each year and were limed as needed to maintain pH above 6.0.

termined. Data in Table 14 show that on Norfolk sandy loam no response was obtained from potassium in 1950, the first year peanuts were grown on this soil. By 1953, the fourth crop of peanuts, yields of both nuts and vines had decreased where less than 100 pounds of K_2O per acre had been applied annually. Similar results were obtained in an experiment at the Wiregrass Substation on soil that had been depleted by continuous cropping with peanuts. The application of 120 pounds of K_2O per acre resulted in a yield increase from 762 to 1,948 pounds of nuts per acre the first year the treatment was applied. At both of these locations the soil tested very low in potassium.

TABLE 15. EFFECT OF POTASSIUM FERTILIZATION ON SOYBEAN YIELD

Treatment[1]	Yield of Soybeans per acre			
K_2O per acre	Norfolk fsl 1953[2]	Kalmia sl 1953-57[3]	Marlboro sl 1954-57[4]	Norfolk sl 1955[5]
Lb.	*Bu.*	*Bu.*	*Bu.*	*Bu.*
0	14.1	19.6	33.2	13.5
25	16.1	22.8	37.8	17.7
50	15.8	26.0	36.6	25.9
75	15.9			
100	14.9	24.0	35.3	30.3
Exchangeable K_2O[6]	83 (M)	50 (L)	55 (L)	40 (L)

[1] All tests received 100 lb. P_2O_5 per acre. All tests except location 4 were limed and all except location 2 received 25 lb. of N per acre at planting.
[2] Lower Coastal Plain Substation.
[3] Brewton Field.
[4] Gulf Coast Substation.
[5] Main Station.
[6] Potassium values for year of test at locations 2 and 5 and in 1956 at locations 3 and 4.

SOYBEANS FOR OIL. The ability of soybeans to obtain potassium from the soil is between that of peanuts and cotton. They are also intermediate in the amount of potassium removed in harvest.

Results from soybean fertility experiments conducted at 17 locations on farmers' fields in Jackson County showed that 76 per cent of the fields were low in potassium. Five of the locations showing most response to treatment gave an average increase of 27 per cent from addition of 60 pounds of K_2O. The effect of potassium on soybean yields at 4 locations in the Coastal Plain is shown in Table 15. The greatest responses were obtained at Brewton and Auburn, the two with the lowest soil test values for potassium.

ALFALFA. Alfalfa requires the highest rate of potassium of any legume grown in Alabama. This is the result of a combined high productive capacity and high plant content of potassium required for maximum yield. Sturkie and Wilson *(8)* reported that at least 200 pounds of K_2O per acre annually is needed to meet the requirements of alfalfa on most soils. The fact that some soils of the State produce satisfactory yields of alfalfa for a number of years with smaller additions has led to attempts to produce alfalfa with low applications of potassium. In addi-

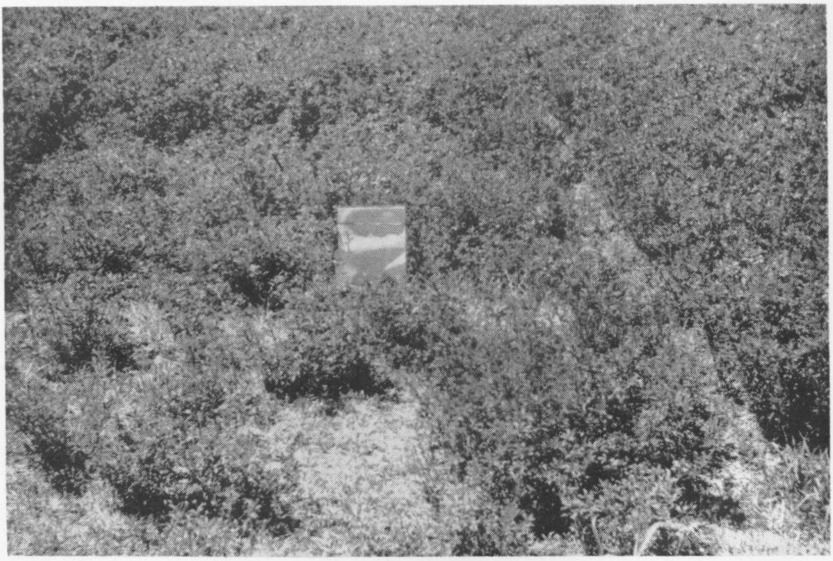

FIGURE 3. Loss of alfalfa stand as a result of low potassium. Plot in foreground received no potassium, plots on right and in background received 200 lb. K_2O annually.

tion to decreased production and eventual loss of stand, Figure 3, this practice has resulted in severe yield reduction of the crop planted after alfalfa. The effect on cotton was discussed under cotton following hay crop and has been previously reported by the Auburn Station in 1956 *(5)*.

SERICEA. Sericea lespedeza is recognized as a crop adapted to the less productive soils of the State. It has a lower potassium requirement than alfalfa and can be grown on some soils for a number of years without showing a response to potassium. However, it is potassium-depleting when removed for hay but less depleting when grazed. Unless adequate potassium applications are made, yields will decline as soil potassium is depleted.

A test on Boswell fine sandy loam at the Tuskegee Experiment Field showed that sericea gave a good response to 60 and 120 pounds of K_2O, Table 16. When cotton was planted on this area, after the test had been discontinued, extreme potassium deficiency was observed where no potassium had been applied to sericea. This was true even though the cotton received a uniform application of 42 pounds of K_2O per acre and followed a crop of grain sorghum that was uniformly fertilized at the same rate.

Following this and other tests showing that sericea requires potassium for maximum yields and to prevent soil depletion, tests were conducted at 7 locations on soils previously fertilized (soil test values for potassium are not available) to determine potassium response above 60 pounds of K_2O per acre annually. No response to rates above 60 pounds was obtained at any location the first 5 years, Table 17. The test was continued for

TABLE 16. SERICEA YIELDS WITH DIFFERENT RATES OF PHOSPHORUS AND POTASSIUM[1]

P_2O_5 per acre	K_2O per acre	Soil test potassium[2]	Hay per acre	
			1946	1943-46
Lb.	*Lb.*		*Lb.*	*Lb.*
40	0	L	1,585	2,007
40	60	M	2,840	2,690
80	60	M	3,710	3,294
80	120	H	5,030	3,826

[1] Boswell fine sandy loam—Tuskegee Field.

[2] Samples taken two years after the experiment was discontinued. The area had been uniformly fertilized and cropped to grain sorghum and cotton. (Available K_2O values at time of sampling: 0 K_2O—98, 60 K_2O—168, 120 K_2O—228. Ratings in table are estimated.)

TABLE 17. RESPONSE OF SERICEA LESPEDEZA TO RATES OF POTASSIUM ABOVE 60 POUNDS K_2O PER ACRE

K_2O per acre	6-Year average-yield per acre-1948-53[1]			
	Hartsells fsl	Decatur cl	Lloyd cl	Greenville scl
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
60	6,025	4,902	5,377	6,466
120	6,060	5,156	5,524	7,115
240	6,363	5,144	5,060	6,714
	6-Year av.-1948-53			3-Yr. av. 1954-56
	Magnolia sl	Kalmia sl	Boswell fsl	Boswell fsl[2]
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
60	6,648	6,548	6,915	7,022
120	6,684	6,619	6,977	8,153
240	6,772	6,230	7,262	8,390

[1] Hartsells 1950-55.
[2] By 1957 soil test value of plots receiving 60 lb. K_2O was 46 lb./a. K_2O (Low). By 1957 soil test value of plots receiving 240 lb. K_2O was 249 lb./a. K_2O (High).

an additional 3 years on the Boswell soil in view of the difference in response obtained in this test and the one reported in Table 16. The data reported in the last column of Table 17 show that, although there was sufficient potassium in this soil for 60 pounds K_2O per acre per year to maintain yield for 6 years, when the test was continued for an additional 3 years at least 120 pounds K_2O per acre annually was needed to maintain yields.

CLOVER-GRASS MIXTURES FOR PERMANENT PASTURE. Many small plot experiments with various clover-grass mixtures have been conducted to determine the potassium requirements of permanent pasture mixtures. Yield results from such experiments have not always been satisfactory because of difficulty in obtaining and maintaining uniform stands. Results of several satisfactory tests are reported in Tables 18, 19, and 20. The yields reported should be considered only as relative for a location since the number of clippings made varied with location and year.

All locations except those on bottom land gave some response to potassium. It has been shown in Alabama *(1)* as well as a number of other states that, in addition to yield response, potassium additions encourage growth of legumes in the mixture. Without adequate potassium grass growth frequently limits the growth of legumes, Figure 4. This would be expected since studies with individual plant species have shown most legumes to be more sensitive to potassium deficiency than grasses. How-

TABLE 18. RESPONSE OF CLOVER-GRASS MIXTURE TO POTASSIUM ON BLACK BELT SOILS

K_2O per acre	White clover-Dallisgrass yield per acre dry matter						
	Sumter clay (1)			Houston clay (2)	Vaiden clay (3)		Lufkin clay (4)
	Loc. 1	Loc. 2	Loc. 3		Loc. 1	Loc. 2	
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	553	2,719	1,768	1,982	4,234	2,160	4,185
30	1,170	2,574	2,203	2,145	4,327	2,110	----
60	1,263	2,910	2,806	2,379	4,500	2,276	4,664
90	1,030	3,405	2,575	2,656	4,313	2,354	----
120	1,420	3,267	----	2,782	5,314	----	4,791

Data for Sumter location 3, Vaiden location 2 and Lufkin by E. M. Evans, associate agronomist.

(1) Sumter—Loc. 1 Soil test K—medium (170 lb./a.) at beginning of experiment.
Loc. 2 Soil test K—medium (180 lb./a.) at beginning of experiment.
Loc. 3 Soil test K—low (57 lb./a.) on no K_2O plots at end of experiment.

(2) Houston Soil test K—medium (170 lb./a.) at beginning of experiment.

(3) Vaiden—Loc. 1 Soil test K—high (432 lb./a.) at beginning of experiment.
Loc. 2 Soil test K—medium (166 lb./a.) on no K_2O plots at end of experiment.

(4) Lufkin Soil test K—medium (151 lb./a.) on no K_2O plots at end of experiment.

ever, both grasses and legumes can be expected to respond to potassium on most Alabama soils especially after a period of cropping. The amount needed to sustain production will depend to a large degree on yield level and method of harvesting.

Results of experiments on Norfolk sandy loam at the Wiregrass Substation show the effect of management of pasture crops on potassium requirements, Table 21. All plots were limed according to soil tests and received an annual application of 140 pounds per acre of P_2O_5 and K_2O. Several rates of nitrogen were applied to Coastal Bermudagrass, common Bermudagrass and

TABLE 19. RESPONSE OF CLOVER-GRASS TO POTASSIUM ON PIEDMONT SOILS

K_2O per acre	Crimson-clover-Bermuda	Ladino clover-Dallisgrass
	Yield per acre dry matter	Yield per acre dry matter
	Appling gravelly sandy loam (1)	Lloyd clay loam (2)
Lb.	*Lb.*	*Lb.*
0	3,559	3,535
40	4,108	3,469
60	----	3,643
80	4,157	4,046
160	5,105	

Data by E. M. Evans, associate agronomist.

(1) Appling soil test—low (46 lb. K_2O/a.) on no K_2O plots at end of experiment.

(2) Lloyd soil test—high (230 lb. K_2O/a.) at beginning of experiment.

TABLE 20. RESPONSE OF CLOVER-GRASS MIXTURE TO POTASSIUM ON COASTAL PLAIN SOILS

K_2O per acre	White clover-Dallisgrass yield per acre dry matter				
	Isogora fsl[1]	Susquehanna fsl[2]	Kalmia sand[3]	Av. 7 loc. upland sl	Av. 3 loc. bottom land
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	707	4,227	1,790	1,472	2,381
30				2,044	2,363
40	1,572	4,851	1,856		
60	1,405	5,284			
80	1,950	5,480	2,080		
160			2,120		

Data by E. M. Evans, associate agronomist.

[1] Isogora soil test—low (34 lb./a. K_2O) on no K_2O plots at end of experiment.

[2] Susquehanna soil test—low (60 lb./a.) on no K_2O plots at end of experiment.

[3] Kalmia soil test—low (67 lb./a. K_2O) at beginning of experiment.

Bahiagrass overseeded in the winter with legumes. One series of plots was grazed and another clipped. The change in soil potassium over the 5-year period shows that a much greater depletion of potassium occurred when the crop was clipped and all forage removed than when grazed. However, the potassium depletion increased as the rate of nitrogen increased under either method of harvesting. Based on changes in soil potassium, 140 pounds of K_2O per acre annually sustained production of these

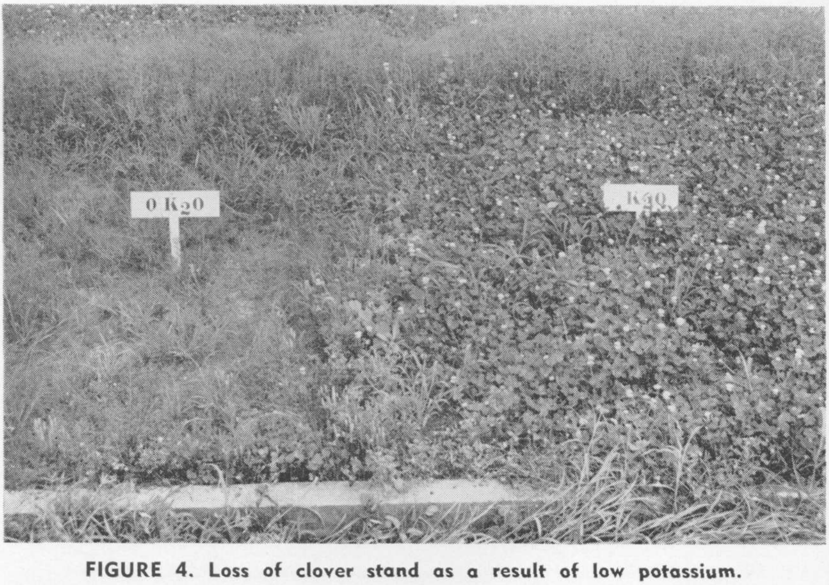

FIGURE 4. Loss of clover stand as a result of low potassium.

TABLE 21. EFFECT OF RATE OF NITROGEN FERTILIZATION OF WARM SEASON PERENNIAL GRASS WHEN GRAZED AND WHEN HARVESTED FOR HAY ON YIELDS OF COASTAL BERMUDAGRASS AND ON AVAILABLE SOIL POTASSIUM[1]

Rate of nitrogen per acre[2]	Coastal Bermudagrass yield dry matter per acre 1953-58 grazed	Coastal Bermudagrass yield dry matter per acre 1953-58 clipped	Soil test potassium K_2O per acre[3] 1952	Soil test potassium K_2O per acre[3] 1957-58 grazed	Soil test potassium K_2O per acre[3] 1957-58 clipped
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	5,050	3,860	108 (M)	153 (H)	126 (M)
80	7,813	6,508	108 (M)	162 (H)	88 (M)
160	11,303	8,740	108 (M)	108 (M)	83 (M)
320	13,419	11,238	108 (M)	82 (M)	46 (L)

Data by E. M. Evans, associate agronomist.

[1] Norfolk fine sandy loam, Wiregrass Substation.

[2] All plots fertilized with 140 lb. of P_2O_5 and K_2O annually and limed according to soil test recommendations.

[3] Soil data average from plots planted to Coastal Bermudagrass, common Bermudagrass and Bahiagrass with and without winter legumes.

crops under grazing when as much as 160 pounds of N was applied annually. When all forage was clipped and removed, this amount of potassium was adequate only when no nitrogen was applied. Thus, the amount of potassium fertilizer needed for these crops would vary considerably depending on rate of nitrogen applied and method of harvesting.

DISCUSSION

Results of fertility research show that the soils of Alabama cannot maintain high yields of most plants without potassium additions. Experiments have been conducted that enables general or average fertilizer recommendations to be made. However, the fertilizer potassium required to sustain production of a crop over many years may not be the amount needed for any one year on a given field. This is dependent upon the level of available soil potassium, the rate of other fertilizer elements applied, and the general fertility of the soil. The level of available nutrients and the acidity of the soil varies from field to field depending on the soil, past cropping, and fertilizer practices. Much of the fertility research has been directed toward finding chemical means of measuring these factors and correlating them with crop response to fertilizer additions. The yield response of a number of crops to applied potassium along with the soil test values for potassium reported, illustrate the variation in needs from one location to another. These needs vary with the level of available potassium in the soil. Soil testing calibration research must be a continuing process to keep abreast of changing crops and management practices. Present research continues to confirm and refine the relationship that first began to appear 20 years ago. Therefore, in view of the reliability of soil test calibration and the wide variation in potassium needs from one field to another, potassium fertilizer recommendation for a specific field should be made only on the basis of soil test.

SUMMARY

Studies have been conducted throughout the State to determine the potassium needs of crops grown on the various soils. No attempt has been made in this report to review all the earlier work, although it served as a valuable guide for recent studies. The results of potassium studies up to the present time lead to the following conclusions:

1. Soils vary in their capacity to supply potassium, and even the most productive soils of Alabama require additions of potassium fertilizer to offset that lost by cropping and leaching.

2. Crops vary in potassium needs and in ability to obtain sufficient potassium from the soil. This necessitates different potassium recommendations on the same soil for different crops and cropping systems.

3. Soils that are low in available soil potassium should receive potassium fertilizer additions large enough to build up the level if maximum production is to be obtained.

4. No advantage was found from dividing potassium fertilizer for cotton into a planting application and a sidedressing. However, when the planting application is inadequate a response is obtained from a sidedressing.

5. In cotton production sodium should not be considered as a substitute for potassium when fertilizing for maximum yields.

6. Because of original differences in soil levels and differences resulting from past cropping and fertilization, the most efficient potassium fertilizer recommendation for a given crop on a particular field can be given only when the soil test value for potassium is known.

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