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response of COTTON CORN BERMUDAGRASS *to rates of* *N, P, and K*

AUBURN UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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Auburn Univerity Agricultural Experiment Station has established the policy that all research publications will use the elemental rather than the oxide basis for expressing fertilizer content. It is anticipated that at some time in the future fertilizers will be labeled with the elemental content of all nutrients. The following conversion table for changing pounds of P_2O_5 and K_2O to pounds of P and K lists all rates used in the circular:

Pounds P_2O_5	*Pounds P*	*Pounds K_2O*	*Pounds K*
20	9	20	17
30	13	30	25
40	18	40	33
50	22	50	42
60	26	60	50
80	35	80	66
90	40	90	75
100	44	100	83
120	54	120	100
200	88	200	166
400	176	400	332

$P_2O_5 \times .44 = P$ $\qquad$ $K_2O \times .83 = K$

$P \times 2.29 = P_2O_5$ $\qquad$ $K \times 1.20 = K_2O$

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response of
COTTON, CORN, BERMUDAGRASS
to rates of N, P, and K

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EXPERIMENTS TO DETERMINE the response of crops to rates of the various fertilizer elements have always been an important part of research by Auburn University Agricultural Experiment Station. Data from such research have been distributed in research reports and Experiment Station publications over the years. (See list of Station bulletins and circulars on soil fertility published since 1950, page 30.)

This kind of research continues to be necessary as management practices and yield potentials change. Results of recent experiments were used in revising Auburn University fertilizer recommendations in the spring of 1970. In this circular are presented some of the most recent data on cotton, corn, and bermudagrasses, using response curves and yield tables for the several test locations.

Yields are presented in line graphs that show the separate response to nitrogen (N), phosphorus (P), and potassium (K). In each case, when response to either N, P, or K was determined, the other two elements and lime were supplied in adequate amounts for the crop. Data on cotton and corn for years when yields were seriously limited by weather or some other factor besides fertility are not included in the averages. Therefore, fertilizer recommendations resulting from these data are based on responses at yield levels that may be reached with favorable conditions and using all recommended cultural practices. If averages had included data from all years, average yields would have been lower than those shown for these two crops. Averages for all years of

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[1] Professor, Department of Agronomy and Soils.

[2] Cooperation of personnel of the substations, experiment fields, and Main Station in collecting yield and soil-test calibration data over the years is acknowledged.

experiments are presented as appendix tables. Response curves for perennial grasses include data from all years of these experiments.

A principal objective of these experiments was to relate yield response from applied P and K to soil-test levels. Plots were sampled before experiments were established and usually at 2- or 3-year intervals during the experiments. Soil-test levels of P and K at the latest sampling are shown on the graphs by VL, L, M, H, and VH. These letters show the effect of applied fertilizer during the years an experiment was in progress. Soil-test level is shown only when it changes with increasing rate of applied P or K. Soil test ratings are based on the soil type and the crop.

Very low means that the crop may yield less than 50 per cent of its potential if the fertilizer nutrient is not applied.

Low means that the crop may yield only 50 to 75 per cent of its potential.

Medium soils will yield 75 to 100 per cent of their potential.

High is the desirable level, which should be the objective of most soil building programs. It means that supply of the nutrient is adequate for the crop. A small amount is usually recommended to maintain this level.

Very high means that soil supply of the nutrient is more than double the amount considered adequate, and further additions are not recommended until the level is lowered.

Locations of experiments reported here are indicated in the figures by labeling the curves by soil types. The units of the Experiment Station on which the soils are located are as follows:

Soil type	*Experiment Station unit*	*Location*
Dewey silt loam	Tennessee Valley Substation	Belle Mina
Hartsells fine sandy loam	Sand Mountain Substation	Crossville
Dothan fine sandy loam (formerly Norfolk)	Wiregrass Substation	Headland
Benndale fine sandy loam (formerly Kalmia)	Brewton Experiment Field	Brewton
Lucedale(M) fine sandy loam (formerly Magnolia)	Monroeville Experiment Field	Monroeville
Lucedale (P) sandy clay loam (formerly Greenville)	Prattville Experiment Field	Prattville
Savannah sandy clay loam	Upper Coastal Plain Substation	Winfield
Norfolk fine sandy loam	Lower Coastal Plain Substation	Camden
Decatur silt loam	Alexandria Experiment Field	Alexandria
Dothan sandy loam (formerly Norfolk)	Main Station	Auburn

COTTON

Rates of N, P, and K—1954-61, 1965-69

Fertilizer rate experiments for cotton, started in 1954 at seven locations, included six rates of N, five rates of P, and six rates of K. Treatments were replicated four times and were on the same plots throughout the experiments. Cotton was grown from 1954 through 1961 and corn from 1962 through 1964. From 1965 through 1969, plots were again planted in cotton and all plots received 0.5 pound boron (B) per acre.

The N rates were in 20-pound increments up to 100 pounds per acre during 1954-61. From 1962 through 1969, N rates were in

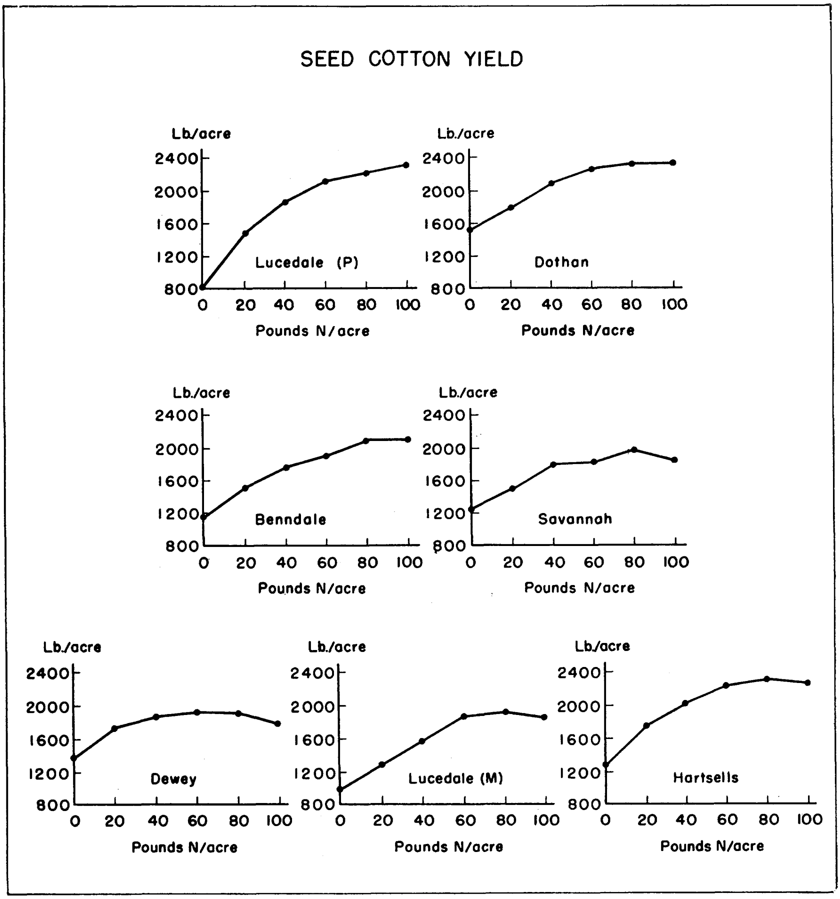

FIG. 1. Response of cotton to nitrogen, best 5 of 8 years (1954-61), at seven locations. (See Appendix Table 1.)

30-pound increments up to 150 pounds per acre. All plots in the N rate study received 44 pounds of P (100 pounds P_2O_5) and 83 pounds of K (100 pounds K_2O) per acre each year. When P and K were varied, plots received 80 pounds of N on cotton in 1954-61 and 120 pounds on corn and cotton during 1962-69.

RESPONSE TO N (Figures 1 and 2). Large increases from N were produced at all locations. The most practical rates during the 1954-61 period were 100 pounds on Lucedale at Prattville, 60 pounds on Dewey, and 80 pounds at the other locations. Uniformity of response to N obtained at different locations over a long period is illustrated by Figure 1. Since no satisfactory soil test for N has been developed, recommendations are based primarily on the crop. For cotton, the rate must be adjusted by growers based on experience with individual fields.

During the 1965-69 period, Figure 2, yields for the years included were about 2 bales of cotton per acre. The greatest response was on the Hartsells soil where 120 pounds of N was the best rate. On Benndale, Dewey, and the Lucedale at Prattville, 90 pounds was best. Yields on the Lucedale at Monroeville were

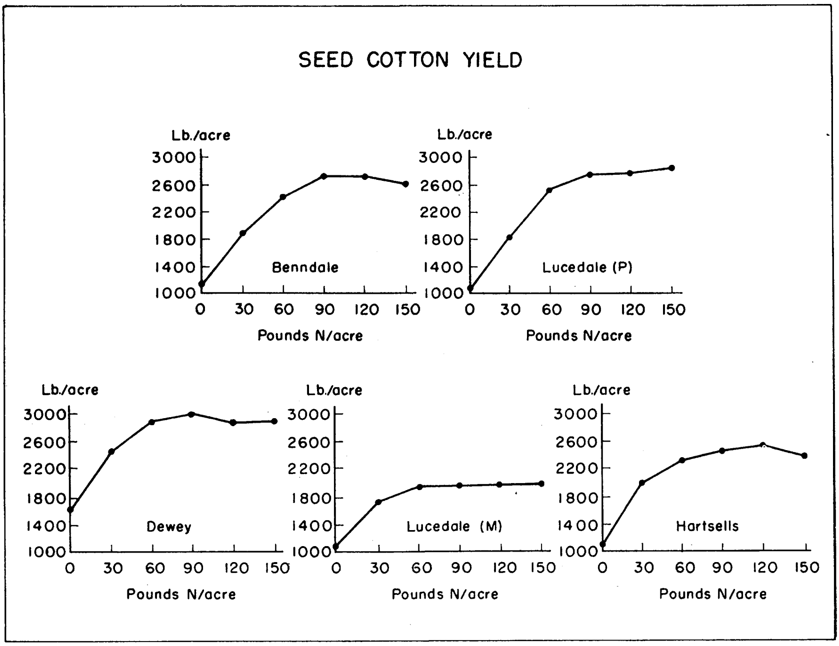

FIG. 2. Response of cotton to nitrogen, best 3 of 5 years (1965-69), at five locations. (See Appendix Table 2.)

limited by drought throughout the 5-year period. In 1967, the best year of the 5 at this location, 120 pounds of N produced 2,150 pounds seed cotton, an increase of 120 pounds over the 90-pound rate.

Figure 2 shows some decreases in yield from the 150-pound N rate because of excessive vegetative growth and increased damage from insects and boll rot. The average responses to successive 30-pound increments of N at the five locations were 740, 440, 100, 0, and −40 pounds of seed cotton per acre. Average increases per pound of N from 60, 90, and 120 pounds were 20, 14, and 11 pounds of seed cotton, respectively.

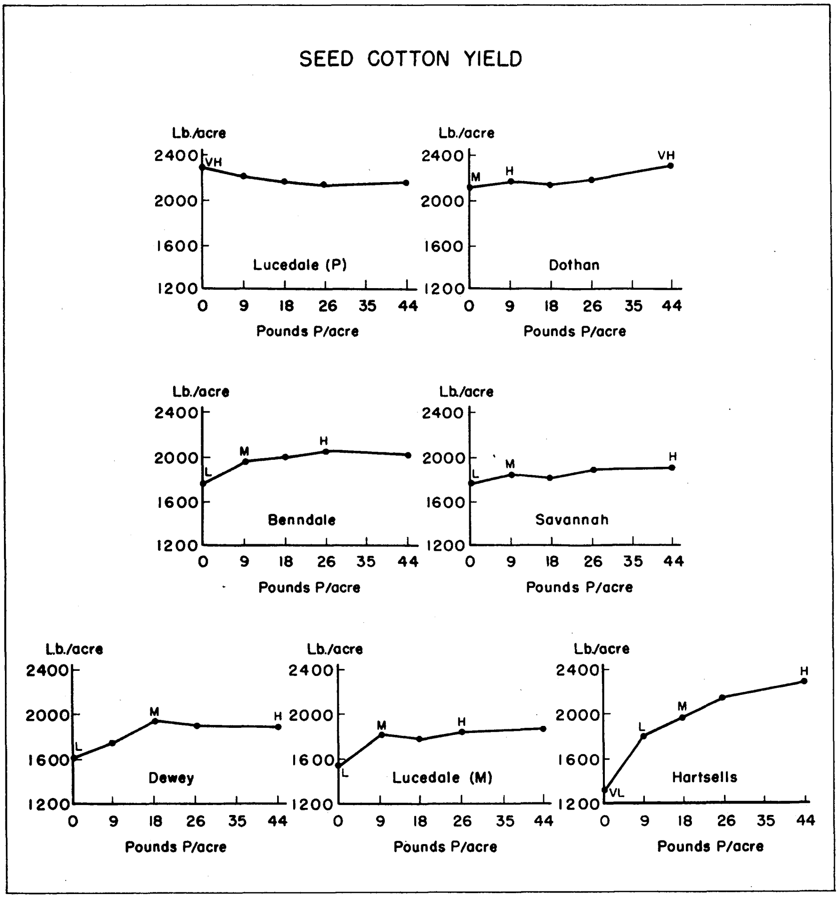

FIG. 3. Response of cotton to phosphorus, best 5 of 8 years (1954-61), at seven locations. Letters on yield lines indicate soil-test P levels in spring 1962 following application of indicated amounts of P for 8 years. (See Appendix Table 1.)

RESPONSE TO P (Figures 3 and 4). These curves show a close relationship between soil-test P and response to applied P. During the first 8 years, Figure 3, the five locations where the soil P level was **low** gave a good response, while the two where levels were **medium** and **high** did not respond. Applications of 9 to 17 pounds of P (20 to 40 pounds P_2O_5) for 8 years raised all of the **low** soils to **medium** and all were raised to **high** by 44 pounds of P within this period. Soils gave little response to applied P beyond the rate that raised them to the **medium** level, except in the case of the Hartsells soil.

Although yields were higher in the second period, Figure 4, less response to P was produced. This was because of the higher soil-test P levels resulting from annual fertilization. Even the 9-pound rate of P increased soil-test levels on all soils in 15 years. Rates of P that produced the highest yields resulted in rapid buildup of soil P to the **high** level. Response to P in the second period may be briefly summarized as follows: the Hartsells soil, which was **very low,** responded to 26 pounds P; soils that were **low** responded to 18 pounds P; **medium** soils responded to 9

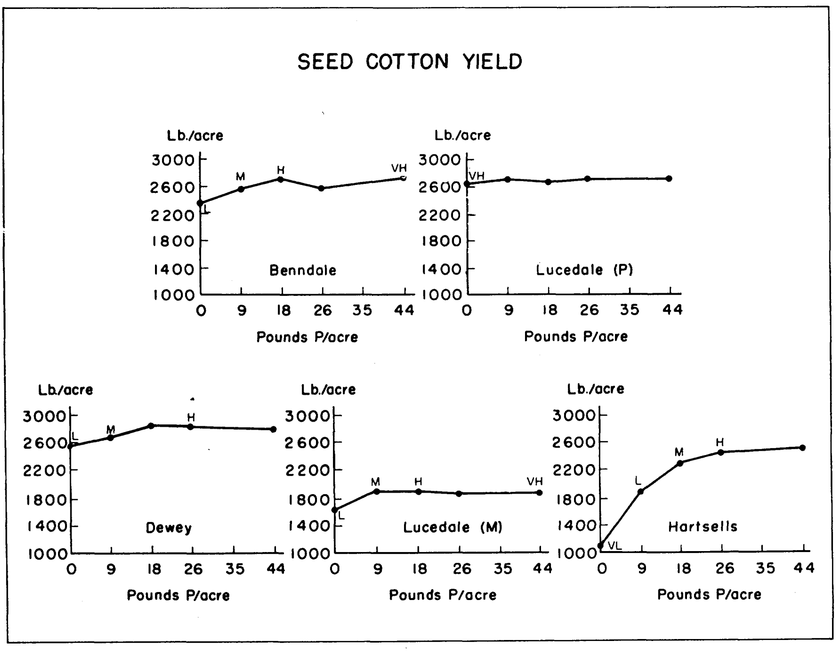

FIG. 4. Response of cotton to phosphorus, best 3 of 5 years (1965-69), at five locations. Letters on yield lines indicate soil-test P levels in spring 1969 following application of indicated amounts of P for 15 years. (See Appendix Table 2.)

pounds P; and when soils were **high** or **very high**, yields were not increased by P.

RESPONSE TO K (Figures 5 and 6). Where soil-test K was **low** or **very low**, there were large increases in yield from K fertilization. The sandy soils of the Coastal Plain and Sand Mountain were lower in K than soils with higher clay content. Rates of K to which response was obtained were closely related to soil-test levels. Soils testing **low** responded to 50 to 66 pounds of K (60 to 80 pounds K_2O) during both periods. The average yield on **low** testing soils—Kalmia, Magnolia, and Hartsells—shown in Figure

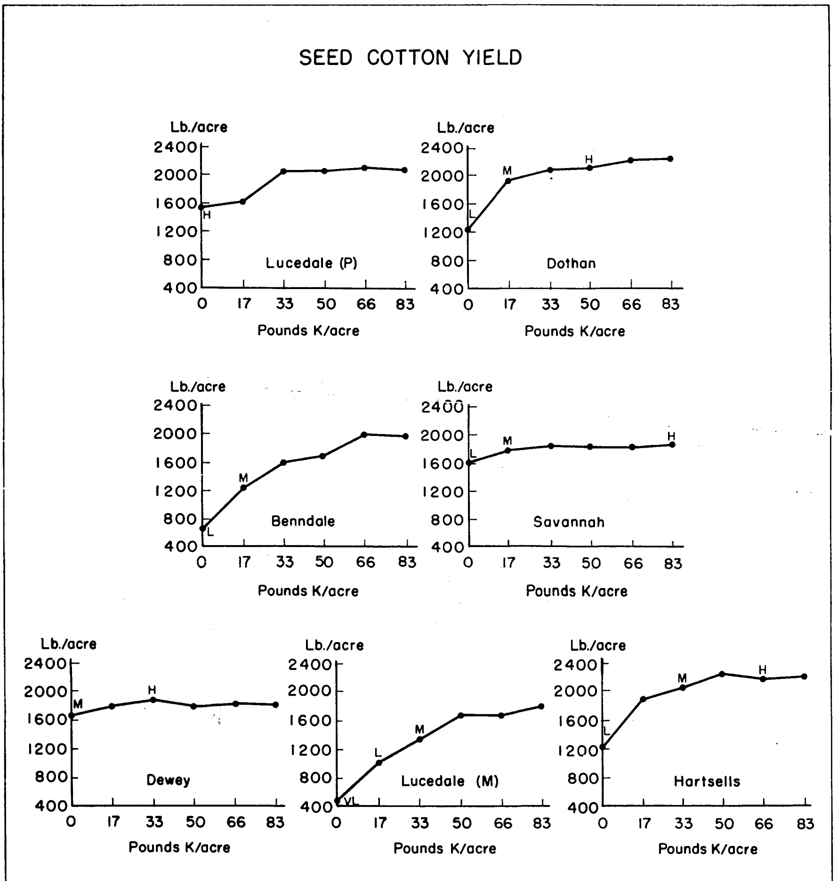

FIG. 5. Response of cotton to potassium, best 5 of 8 years (1954-61), at seven locations. Letters on yield lines indicate soil-test K levels in spring 1962 following application of indicated amounts of K for 8 years. (See Appendix Table 1.)

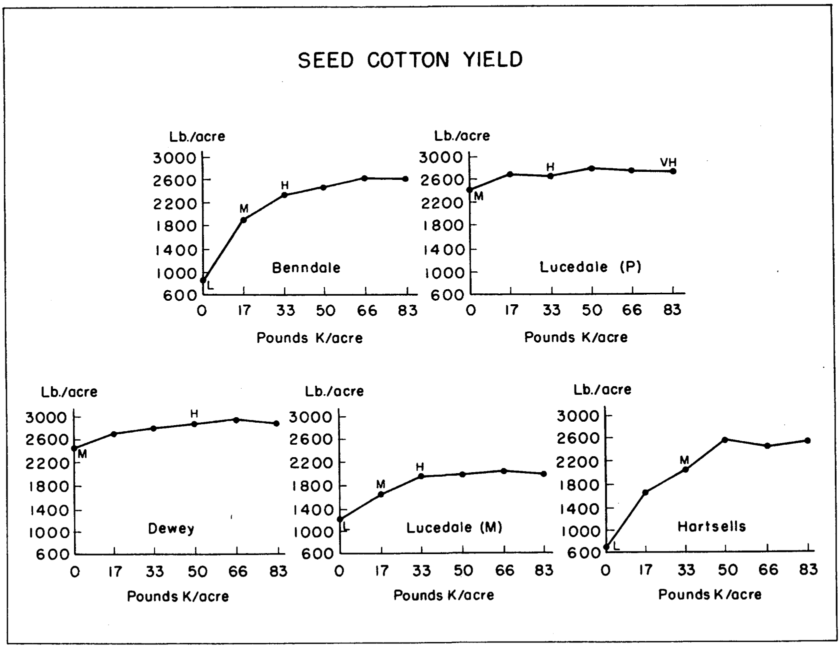

FIG. 6. Response of cotton to potassium, best 3 of 5 years (1965-69), at five locations. Letters on yield lines indicate soil-test K levels in spring 1969 following application of indicated amounts of K for 15 years. (See Appendix Table 2.)

6, were increased from 900 pounds seed cotton to 2,300 pounds seed cotton per acre by 50 pounds K. This was an average increase of 28 pounds seed cotton per pound of K. Soils testing **medium** responded to 17 to 33 pounds K, whereas soils testing **high** showed little or no response to applied K.

Soil-test K was increased by increasing rates of applied K. Application of 33 to 50 pounds K for 15 years raised the soil K level to **high** on all soils except Hartsells. Rates that produced best yields also increased soil K level on all soils.

Two-Year Rotation Fertilizer Experiments—1959-67

Response to K (Figure 7). Experiments were established in 1929 at seven locations to determine the response of cotton, vetch, and corn to fertilizers in a 2-year rotation. Included were four rates of K. Rates were increased as information accumulated and cultural practices and varieties improved. During the 9-year period, 1959-67, rates of K were 0, 25, 50, and 100 pounds per acre (0, 30, 60, and 120 pounds K_2O). Plots used as

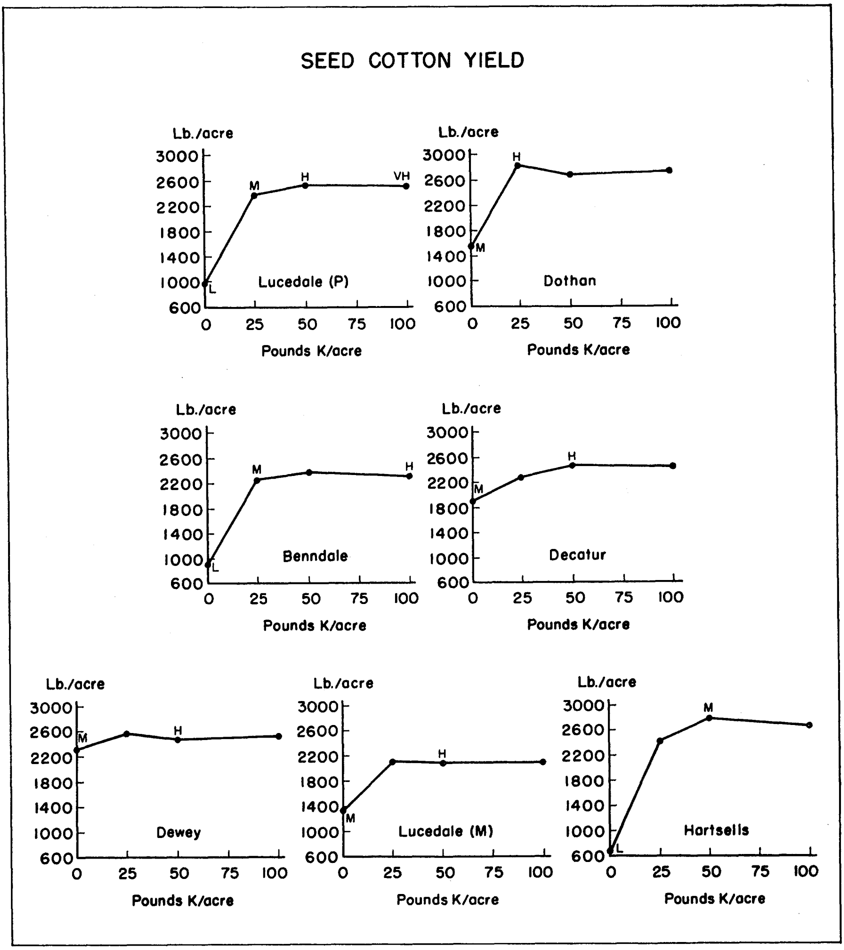

FIG. 7. Response of cotton to potassium in 2-year rotation, best 6 of 9 years (1959-67), at seven locations. Letters on yield lines indicate soil-test K levels in fall 1967 following application of indicated amounts of K during the test years.

checks had received no K since 1929. All plots received 120 pounds of N and 26 pounds of P per acre annually. Response to K in the best 6 of the last 9 years is shown in Figure 7. Soil-test K levels shown are from samples taken in 1969.

There was a large response to 25 pounds of K at all locations. On the three soils testing **low** in K, the average increase from 25 pounds of K was 1,420 pounds seed cotton. The increase for the four soils testing **medium** averaged 840 pounds seed cotton. The average increase from 25 pounds of K at all seven locations was 970 pounds, or 39 pounds seed cotton per pound of K.

The Hartsells, Benndale, Lucedale (P), and Decatur soils, three of which were **low** in soil-test K, responded to more than 25 pounds of K. Average response of these four soils to 50 pounds of K was 170 pounds seed cotton more than from the 25-pound rate. The other three soils, which tested **medium** in K, responded to only 25 pounds of K. None of the seven responded to more than 50 pounds of K.

Four of the soils that had been cropped from 1929 through 1967 without any applied K during this 39 years, tested **medium** in K in the fall of 1967. Soil-test K levels of all soils were increased by fertilization as indicated by the letters in Figure 7. All soils except the Hartsells and Benndale were increased to **high** by 50 pounds of K annually.

CORN

Yield of corn has increased in recent years as a result of higher yielding varieties and improved practices. Research has shown that N is the nutrient most frequently limiting yield of corn. The rate of N recommended has increased as yields have improved from better management and varieties. Rates recommended in 1970 are 150 pounds of N per acre on the sandy soils of northern Alabama and 120 pounds on other soils. Response of corn to P and K is closely related to fertility levels, but has been much less spectacular than has been reported by Midwestern States.

Recent results from two series of experiments on rates of fertilizer for corn are presented here. These data agree closely with results of previous experiments on rates of P and K for corn.

Rates of N, P, and K—1962-64

The plots used in the NPK experiments for cotton reported in Figures 1-6 were planted in corn from 1962 through 1964. Rates of N were 0, 30, 60, 90, 120, and 150 pounds per acre. Rates of P and K were in increments of 9 pounds of P and 17 pounds of K as for cotton. Results are reported for the best 2 of 3 years.

RESPONSE TO N (Figure 8). There was a good response to N at all locations. Although yields on the two Lucedale soils were limited by drought to less than 60 bushels, average yields at the seven locations were increased from 19 bushels without N to 83 bushels by 150 pounds of N per acre. Average yields for the six

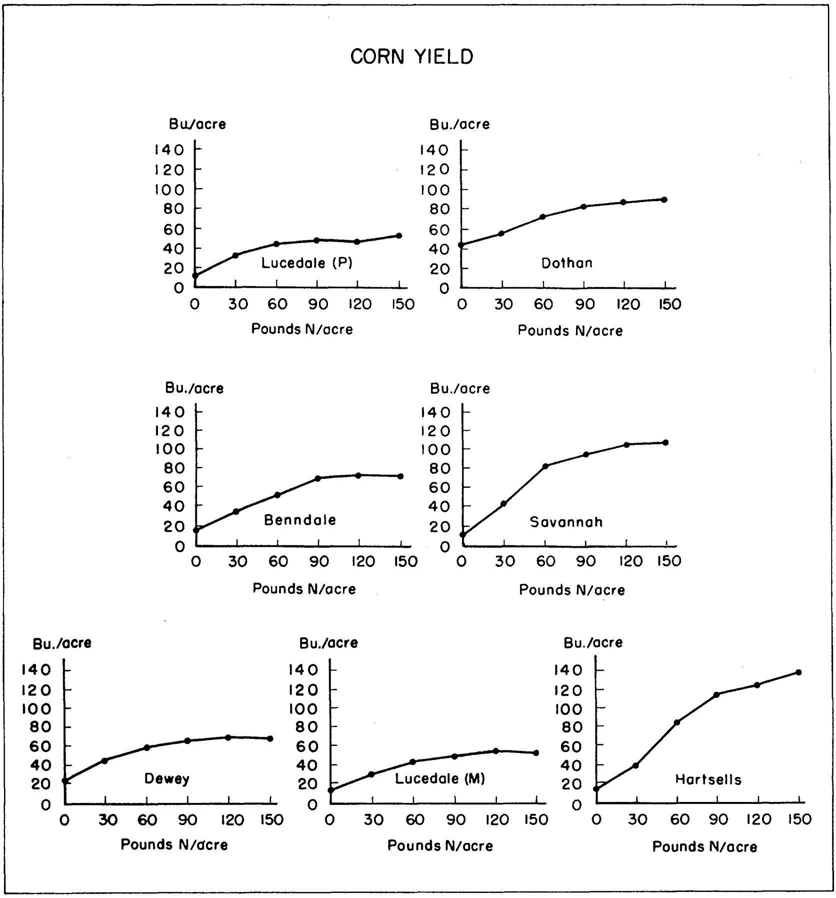

FIG. 8. Response of corn to nitrogen, best 2 of 3 years (1962-64), at seven locations.

successive rates of N from 0 to 150 pounds per acre were 19, 40, 63, 75, 80, and 83 bushels per acre. On the Hartsells soil at the Sand Mountain Substation, 150 pounds of N produced 11 bushels more than 120 pounds of N, whereas at the other locations the increase for 150 pounds over 90 pounds averaged only 5 bushels.

RESPONSE TO P (Figure 9). Corn was much less responsive to P than was cotton. On the Hartsells where the soil P level was **very low,** there was a response to 26 pounds applied P. At other locations where soil P was **low,** responses were small. At **medium** and **high** P levels, yields were not increased. Annual applications

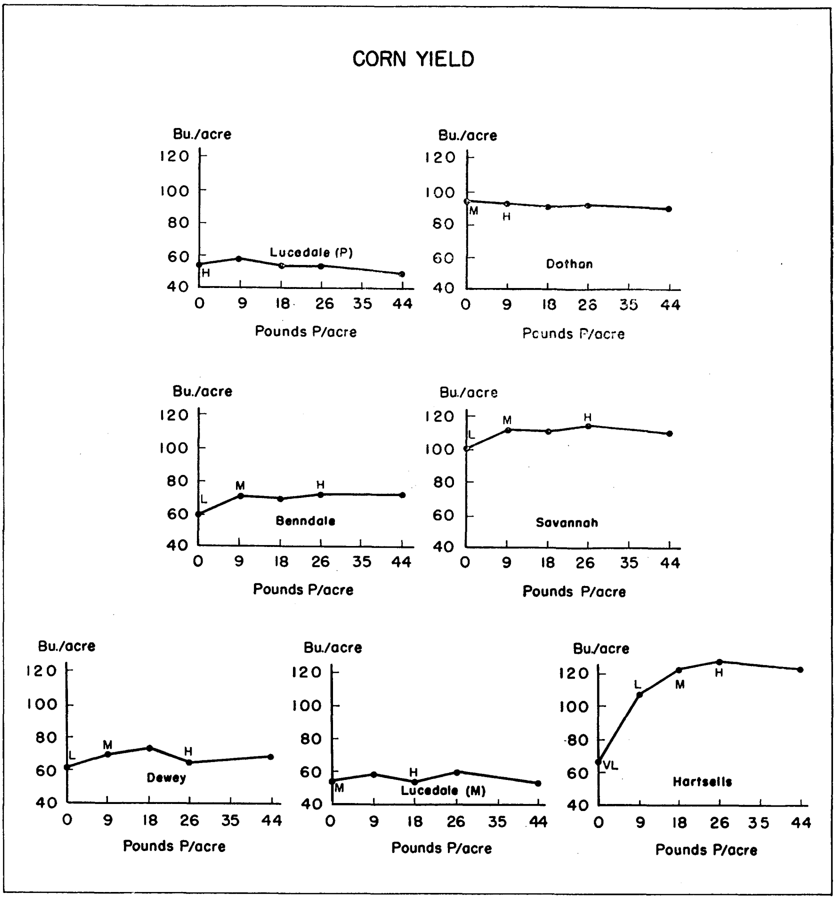

FIG. 9. Response of corn to phosphorus, best 2 of 3 years (1962-64), at seven locations. Letters on yield lines indicate soil-test P in spring 1965 following application of indicated amounts of P for 11 years. (See Appendix Table 4.)

of 26 pounds of P for 12 years increased all soils to **high** P levels. Some soils reached **high** with smaller applications.

RESPONSE TO K (Figure 10). Only one of the seven soils, Hartsells, was low in K for corn after 12 years without K fertilization. It produced 89 bushels of corn without K, and yield was increased to 124 bushels by 33 pounds of K. Kalmia was the only other soil that responded to more than 17 pounds of K. Application of 17 to 34 pounds of K raised soil K levels to **high** on all soils except the Hartsells, which required 50 pounds of K.

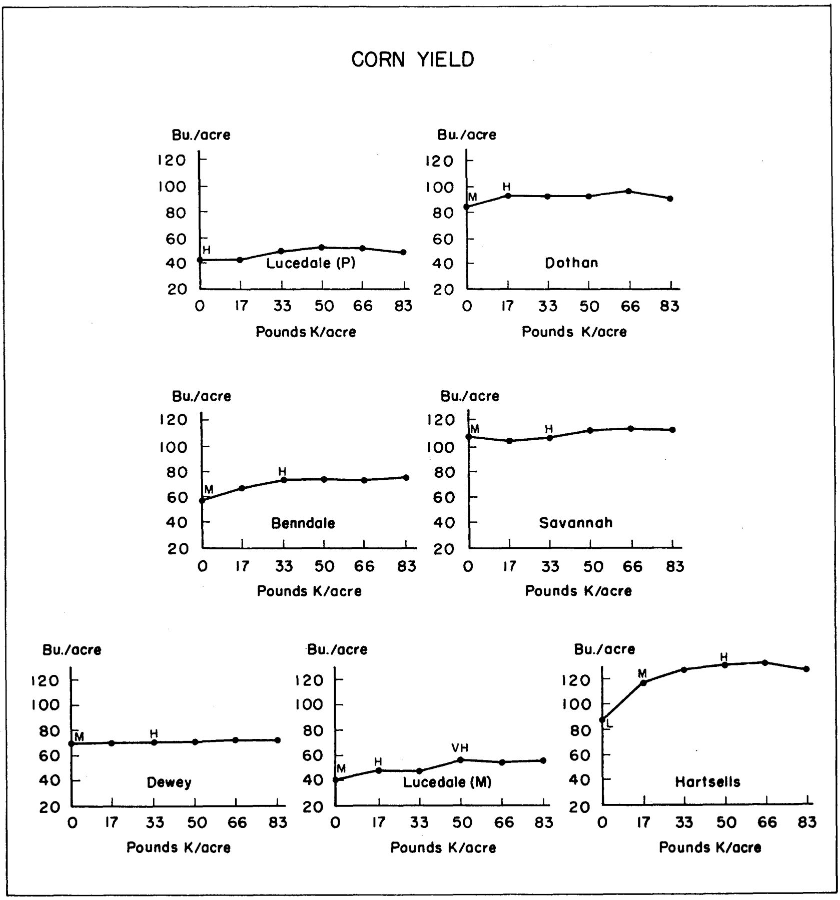

FIG. 10. Response of corn to potassium, best 2 of 3 years (1962-64), at seven locations. Letters on yield lines indicate soil-test K levels in spring 1965 following application of indicated amounts of K for 11 years. (See Appendix Table 4.)

Two-Year Rotation Fertilizer Experiments—1959-67

RESPONSE TO K (Figure 11). Data for cotton presented in Figure 7 are from a 2-year rotation of cotton, vetch, and corn. Yields of corn in the K study and soil-test K levels on samples taken in 1967 are presented. Check plots on six of the seven soils that had received no K since 1929 were **medium** in soil-test K and produced an average of 75 bushels of corn per acre without K fertilization. Application of 25 pounds of K increased yield to an average of 83 bushels. These six locations did not respond to more than 25 pounds of K. The yield on Hartsells, which was **low** in soil-test K, was increased from 67 bushels without K to 105 bush-

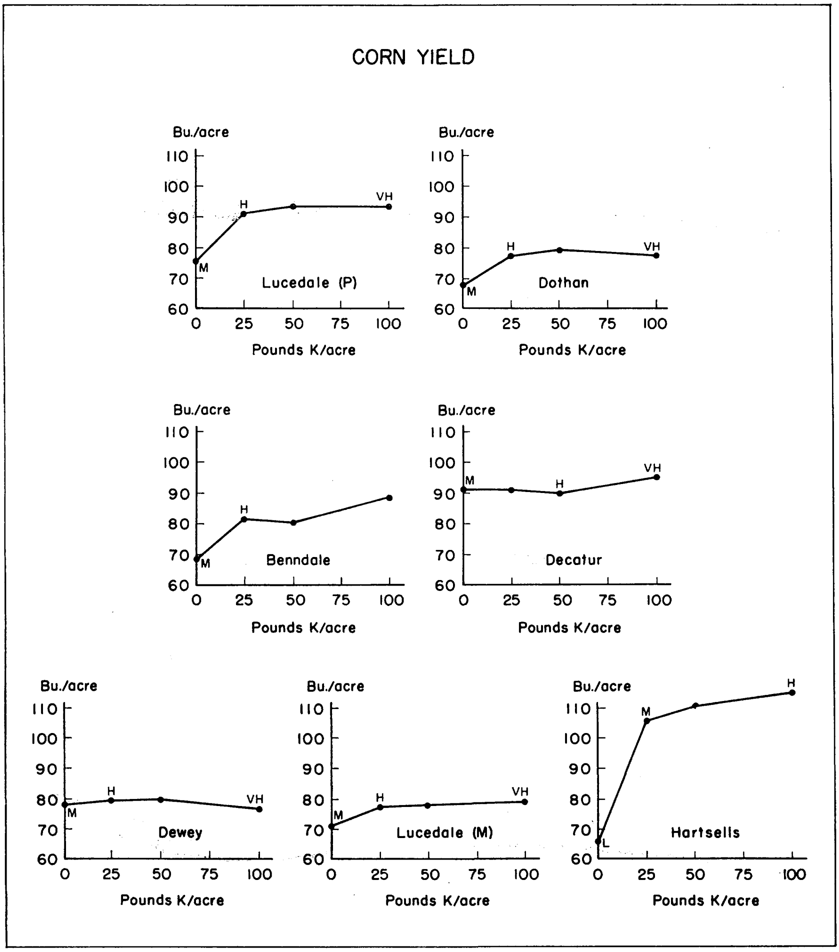

FIG. 11. Response of corn to potassium in 2-year rotation, best 6 of 9 years (1959-67), at seven locations. Letters on yield lines indicate soil-test K levels in fall 1967 following application of indicated amounts of K during the test years.

els by 25 pounds of K, and there was a small response up to 100 pounds K per acre.

Soil-test K was raised from **medium** to **high** by 25 pounds K on five of six soils. The Decatur soil was raised to **high** by 50 pounds K. Hartsells was raised from **low** to **medium** by 25 pounds K and to **high** by 100 pounds.

BERMUDAGRASS

Coastal bermuda and some other perennial summer grasses produce high yields of forage and remove large amounts of N and K from the soil when cut for hay. Fertilizer recommendations for these crops call for higher rates when forage is cut for hay than when it is grazed. These recommendations are based on experiments of several years' duration, long enough for removal of nutrients to have time to affect yields. Data from several such experiments are reported here, with the number of years for which yields were measured indicated on the graphs for each soil type (number in parenthesis).

Coastal Bermuda

RESPONSE TO N (Figure 12). Coastal Bermudagrass has the capacity to respond to high rates of N. Data from five experiments conducted for 3 to 8 years show similar responses to N at all locations. Average yields of dry weight for 0, 100, 200, and 400 pounds of N per acre were 2,600, 7,800, 11,400, and 14,700 pounds per acre, respectively. The increase of 3,300 pounds from 200 to 400 pounds N is about 17 pounds of dry hay per pound of N. Hay quality, especially protein content, also improves as N fertilization is increased. As a result of these and other data, Auburn

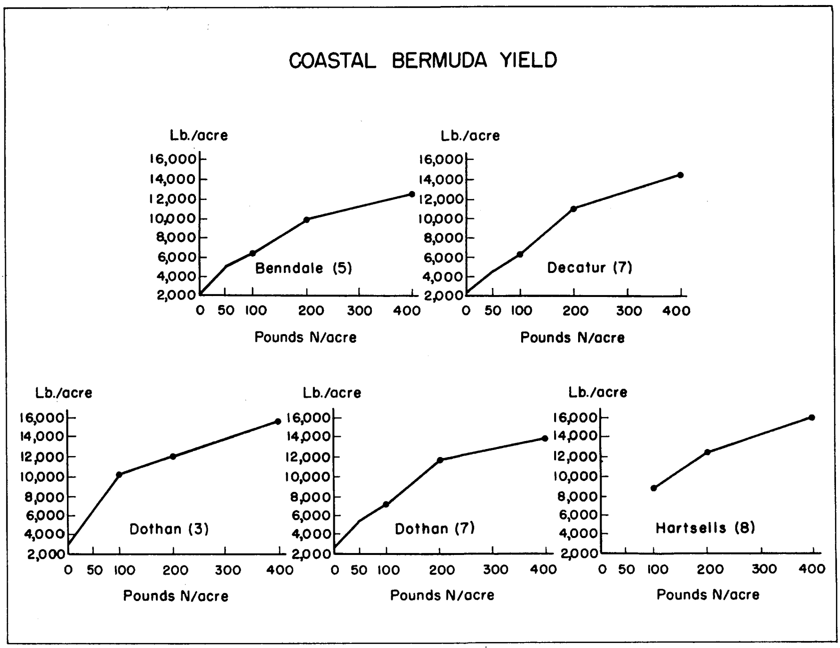

FIG. 12. Response of Coastal bermudagrass to nitrogen at five locations. Numbers in parenthesis are number of years of the experiment.

University now recommends 400 pounds N per acre for Coastal bermuda grown for hay. No data is available at the 300-pound N rate, which no doubt would be adequate for the needs of some growers. Rates for perennial grass pastures should be determined by the need and the degree of utilization by grazing animals.

RESPONSE TO P (Figure 13). Data from five experiments with Coastal bermuda show little response to P fertilization unless the soil supply was very deficient. In one test at the Lower Coastal Plain Substation (on which soil test data are not available) and in one on Norfolk soil at Marvyn, Alabama, where soil-test P was **very low,** there were large responses to P. Other experiments indicate that at **medium** or **high** soil-test levels, applications to maintain a **medium** to **high** level should be adequate for grasses such as bermuda or bahia. Coastal bermuda does not remove large amounts of P, since 1 ton of hay contains only about 4 pounds of P (9 pounds of P_2O_5). Soils used for hay production should be sampled every 2 or 3 years to check on soil fertility maintenance.

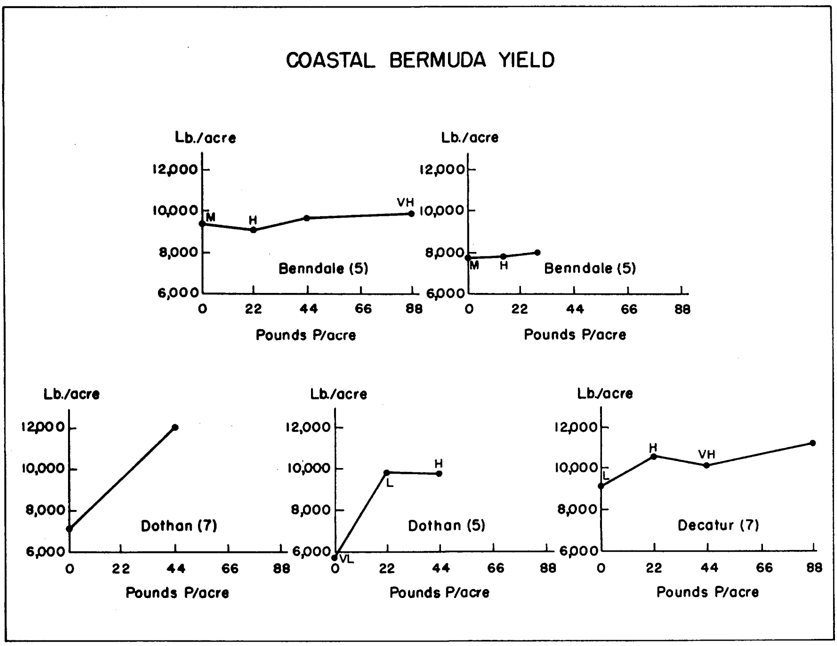

FIG. 13. Response of Coastal bermudagrass to phosphorus at five locations. Numbers in parenthesis are number of years of the experiment. Letters on yield lines indicate soil-test P levels following application of indicated amounts of P during the test years.

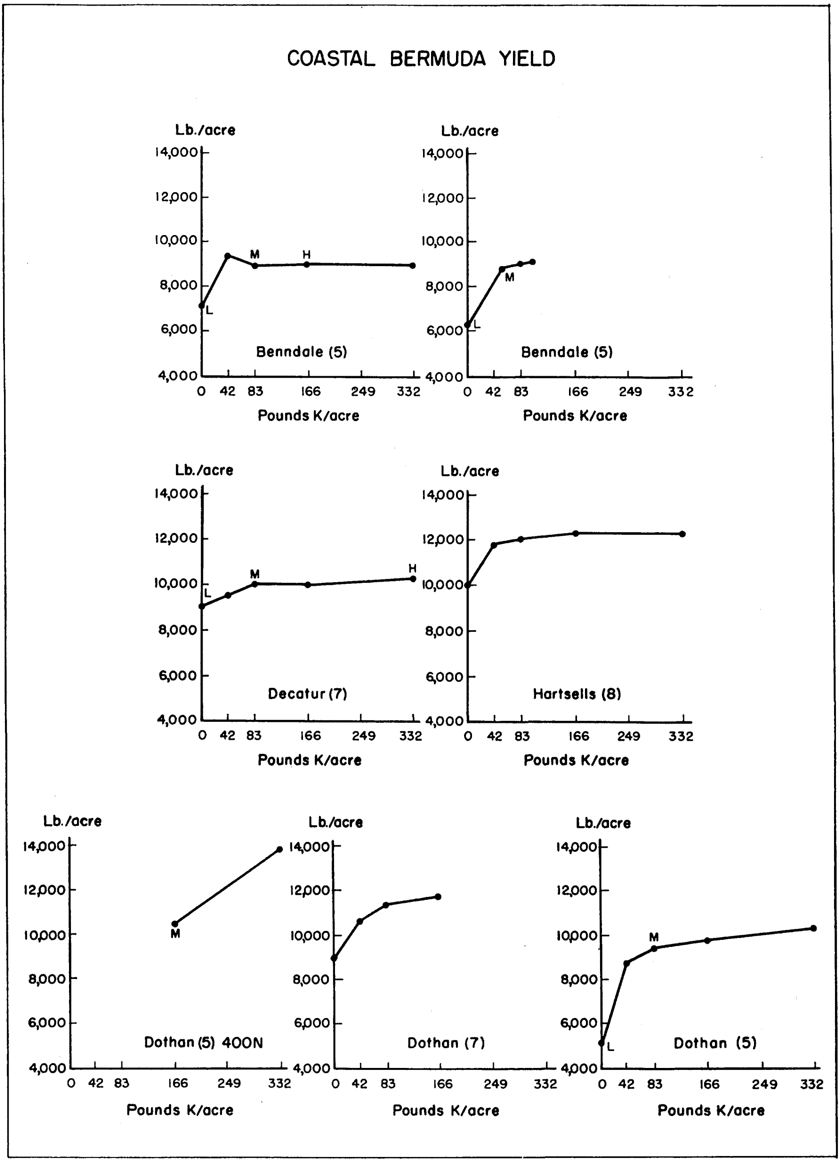

FIG. 14. Response of Coastal bermudagrass to potassium at seven locations. Numbers in parenthesis are number of years of the experiment. Letters on yield lines indicate soil-test K levels following application of indicated amounts of K during the test years.

RESPONSE TO K (Figure 14). In the six experiments on rates of K for Coastal bermuda, all produced large yield responses to 42 and 83 pounds K. Responses to higher rates of K were small. Average yields from 0, 42, 83, 166, and 332 pounds K were 7,700, 9,700, 10,100, 10,700, and 10,800 pounds dry hay per acre, respectively. At 200 pounds N per acre, which was used in most of these experiments, 83 pounds K produced near maximum yields and raised soil-test K levels to **medium** at the four locations where soil-test data were obtained. When K applications were 42 pounds per acre or less, soil-test K was **low** at the end of each experiment.

Only one experiment is presented in which rates of K were studied when 400 pounds of N was applied. It had only two rates of K—166 and 332 pounds per acre and was on a Dothan soil. The 332-pound K per acre rate raised the yield from 12,800 to 14,400 pounds dry hay per acre, an increase of 1,600 pounds. This demonstrates the need for high rates of K when N rate is raised above 200 pounds per acre.

In several of these experiments, plots that received no K suffered loss of stand from disease. Soil tests should be used as guide in determining rate of K to apply. Most of the sandy soils on which Coastal bermuda is grown should be maintained in the **medium** soil-test K range. It is not practical to build them to **high** K levels in most cases.

Tiflawn Bermuda

Response of zoysia matrella and Tiflawn bermuda to P and K were determined in 6- by 6-foot bins at Auburn on four soil types, from 1961 through 1966. All treatments included 400 pounds N per acre and plots were irrigated and clipped frequently (usually every 2 weeks) at lawn height. Clippings were removed from the plots. Yields and responses to P and K were similar to those normally obtained on Coastal bermuda and other forage grasses. Data were reported in Agricultural Experiment Station Bulletin 383, "Phosphorus and Potassium on Zoysia and Tiflawn Bermudagrasses on Four Soil Types." Six-year average yields of Tiflawn and soil-test ratings for P and K are presented in Figures 15 and 16. Soil-test ratings are for forage grasses based on average values for the two grasses in fall 1966. Yield data and response to P and K for zoysia were similar to that for Tiflawn, so zoysia data are not presented here.

RESPONSE TO P (Figure 15). Both grasses on all soils produced large responses to 22 pounds P. Responses to the second 22-

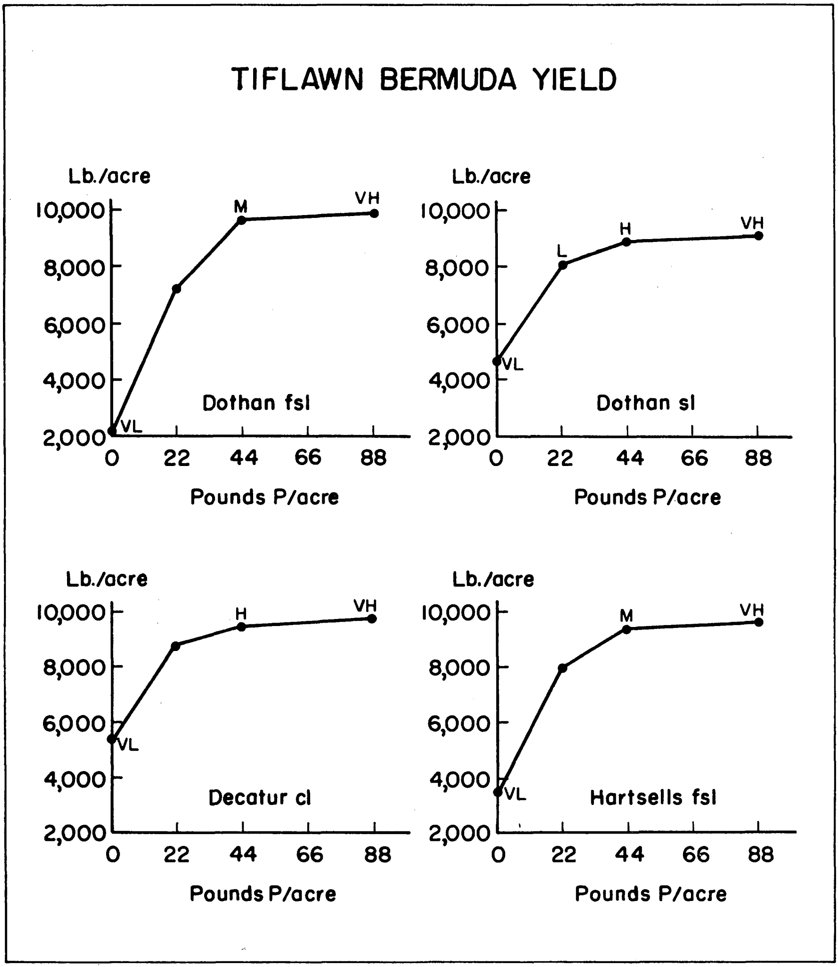

FIG. 15. Response of Tiflawn bermudagrass to phosphorus at four locations, 1961-66. Letters on yield lines indicate soil-test P levels in fall 1966 following application of indicated amounts of P during the test years.

pound increment were small, and no increases were obtained from more than 44 pounds P. All untreated soils were **low** in P throughout the tests. Under these conditions of frequent clipping and removal of high yields, 44 pounds of P were required to increase soil P appreciably. The 88-pound rate raised soil P to **very high** during the first 4 years of the experiment. Soils that had been raised to **medium** or **high** soil-test P levels did not respond to further applications of P.

RESPONSE TO K (Figure 16). Large responses to the first 42 pounds and small responses to the second 42 pounds of K were produced by both grasses on all soils. The 6-year average yields for 0, 42, 83, and 166 pounds K on the two grasses were 6,200, 8,900, 9,600, and 9,900 pounds, respectively. All untreated soils were **low** in K throughout the test. The 42-pound K rate raised soil-test K to **medium,** but 166 pounds were required to raise the level to **high.** Maintenance of the **medium** level with 83 pounds K annually would be the most practical K fertilization program

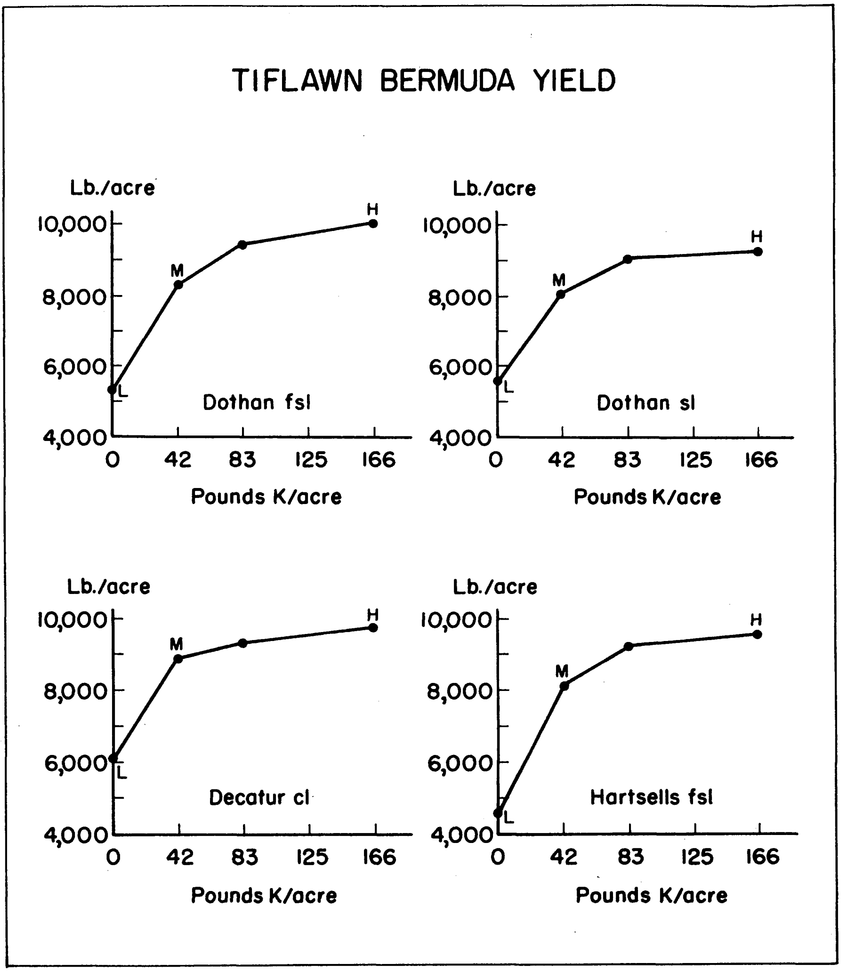

FIG. 16. Response of Tiflawn bermudagrass to potassium at four locations, 1961-66. Letters on yield lines indicate soil-test K levels in fall 1966 following application of indicated amounts of K during the test years.

under these conditions of 400 pounds N applications and irrigation.

SUMMARY AND CONCLUSIONS

Yields of cotton, corn, and bermudagrass from different rates of N, P, and K are presented in graphs. The figures also show the effects of P and K on buildup of these elements in different soils and the relationship between soil-test levels and response.

All three crops responded to higher rates of N than were recommended prior to 1970. Soils testing **low** in P or K produced large responses to these elements. Where P or K levels were **high** or **very high,** little or no response was produced. Rates of P and K that produced most profitable yields also increased levels of these elements in the soil.

These findings are reflected in changed fertilizer recommendations recently released by Auburn University, and published in Experiment Station Circular 176 "Fertilizer Recommendations and Computer Program Key Used by the Soil Testing Laboratory."

These changes include increased rates of N recommended for most crops. Rates of P and K suggested on soils testing **low** or **very low** were increased. On soils testing **high** in P or K, rates were reduced. On soils that have been raised to **very high** levels by previous fertilization, these elements are no longer recommended until the soil level drops back into the **high** range.

The data presented show the large increases in yield that may be expected from using proper kinds and amounts of fertilizer on deficient soils. The importance of using soil tests as the basis for fertilizing cotton, corn, and forage grasses, as well as other crops, is emphasized.

APPENDIX TABLE 1. RESPONSE OF COTTON TO RATES OF NITROGEN, PHOSPHORUS, AND POTASSIUM AT EIGHT LOCATIONS, 1954-61

Rate per acre, pounds	Seed cotton yield per acre, 8-year average[1]								
	Benndale fine sandy loam	Lucedale fine sandy loam	Dothan fine sandy loam	Hartsells fine sandy loam	Lucedale sandy clay loam	Savannah sandy clay loam	Decatur silt loam	Dewey silt loam	Average
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
N									
0	1,000	900	1,240	1,260	750	1,070	1,350	1,240	1,100
20	1,340	1,160	1,600	1,660	1,230	1,260	1,310	1,530	1,390
40	1,530	1,380	1,850	1,820	1,540	1,510	1,440	1,570	1,580
60	1,670	1,620	1,950	1,970	1,760	1,500	1,390	1,640	1,690
80	1,800	1,680	1,980	2,060	1,790	1,600	1,420	1,620	1,740
100	1,810	1,640	2,010	2,010	1,850	1,530	1,380	1,560	1,720
P									
0	1,610	1,400	1,840	1,300	1,880	1,480	1,330	1,360	1,520
9	1,690	1,620	1,880	1,710	1,820	1,530	1,390	1,460	1,640
18	1,770	1,580	1,940	1,820	1,790	1,500	1,360	1,630	1,670
26	1,830	1,660	1,960	1,980	1,770	1,560	1,630	1,610	1,750
44	1,800	1,680	2,000	2,060	1,790	1,600	1,420	1,640	1,750
K									
0	550	410	1,070	1,360	1,390	1,390	1,230	1,500	1,110
17	1,020	940	1,700	1,810	1,450	1,500	1,440	1,600	1,430
33	1,440	1,250	1,910	1,960	1,730	1,460	1,380	1,640	1,600
50	1,500	1,570	1,960	2,110	1,780	1,580	1,360	1,630	1,690
66	1,780	1,570	2,010	2,040	1,800	1,550	1,390	1,660	1,720
83	1,800	1,680	2,060	2,060	1,790	1,600	1,420	1,640	1,760
No lime	1,890	1,560	1,800	1,810	1,860	1,500	1,410	1,630	1,680
Lime	1,800	1,680	1,980	2,060	1,790	1,600	1,420	1,640	1,750
Original pH	*5.5*	*5.4*	*5.2*	*5.4*	*5.6*	*5.1*	*5.6*	*5.5*	
Original P, lb./acre	*18 L*	*29 M*	*79 H*	*16 L*	*93 H*	*58 H*	*40 H*	*8 L*	
Original K, lb./acre	*34 L*	*22 L*	*68 M*	*67 L*	*175 H*	*138 M*	*153 M*	*144 M*	

Standard treatment all locations: 80-100-100.

Data previously published in *Changing Patterns in Fertilizer Use*, 1968, Soil Science Society of America, p. 250.

[1] Line under yield figures in each column indicates the level of N, P, or K that gave best economic returns at that location.

Appendix Table 2. Response of Cotton to Rates of Nitrogen, Phosphorus, and Potassium at Seven Locations, 1965-69

Rate per acre, pounds	Seed cotton yield per acre, 5-year average							
	Benndale fine sandy loam	Lucedale fine sandy loam	Dothan fine sandy loam	Hartsells[1] fine sandy loam	Lucedale sandy clay loam	Savannah[2] sandy clay loam	Dewey[1] silt loam	Average
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
N								
0	1,140	1,010	1,330	990	1,050	1,130	1,570	1,170
30	1,760	1,610	1,500	1,890	1,780	1,300	2,300	1,740
60	2,160	1,870	1,740	2,170	2,380	1,730	2,620	2,100
90	2,360	1,840	1,530	2,270	2,460	1,650	2,720	2,120
120	2,350	1,840	1,650	2,320	2,450	1,930	2,580	2,160
150	2,270	1,840	1,630	2,030	2,430	1,780	2,580	2,080
P								
0	2,080	1,640	1,740	1,100	2,380	1,600	2,460	1,860
9	2,250	1,850	1,530	1,710	2,420	1,690	2,570	2,000
18	2,330	1,800	1,640	2,150	2,380	1,680	2,680	2,100
26	2,220	1,850	1,600	2,280	2,450	1,820	2,670	2,130
44	2,350	1,840	1,650	2,320	2,450	1,930	2,580	2,160
K								
0	970	1,150	750	640	2,220	1,650	2,330	1,390
17	1,830	1,680	1,630	1,630	2,420	1,820	2,550	1,940
33	2,130	1,820	1,740	2,040	2,400	1,800	2,560	2,070
50	2,280	1,830	1,570	2,360	2,590	1,800	2,700	2,160
66	2,380	1,860	1,634	2,310	2,460	1,770	2,690	2,160
83	2,350	1,840	1,650	2,320	2,450	1,930	2,580	2,160
No lime	2,280	1,700	980	1,810	2,230	1,700	2,630	1,900
Lime	2,350	1,840	1,650	2,320	2,450	1,930	2,580	2,160
1965 pH	*5.7*	*5.5*	*5.2*	*5.2*	*5.0*	*5.2*	*5.5*	
1965 soil-test P	*20 L*	*21 L*	*38 M*	*7 L*	*105 H*	*16 L*	*11 L*	
1965 soil-test K	*52 L*	*68 M*	*79 M*	*48 L*	*174 H*	*107 M*	*192 M*	

Standard treatment all locations: 120-100-100 + 0.5 B.
[1] 4-year average: 1965, 1966, 1968, 1969.
[2] 2-year average: 1965, 1969.

Appendix Table 3. Yields of Seed Cotton from Rates of Fertilizer With and Without Lime and Winter Legume in 2-Year Rotation Fertilizer Experiments at Seven Locations, 1960-67

Plot	Treatment					Seed cotton yield per acre, 8-year average							
	Lb. N	Lb. P	Lb. K	Lime[1]	Legume	Benndale fine sandy loam	Lucedale fine sandy loam	Dothan fine sandy loam	Hartsells[2] fine sandy loam	Lucedale sandy clay loam	Dewey[2] silt loam	Decatur[2] silt loam	Average
						Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1.	0	0	0			270	560	470	550	490	1,310	1,100	680
2.[3]	120	26	50	X		2,080	2,050	2,220	2,410	2,270	2,260	2,060	2,190
3.	0	26	50	X		1,230	1,590	1,640	1,500	1,370	1,770	1,430	1,510
4.	60	26	50		X	1,830	1,690	2,130	2,170	2,100	2,320	1,980	2,030
5.[4]	120	26	50	X		1,960	1,940	2,160	2,400	2,240	2,240	1,920	2,120
6.	120	26	0	X	X	760	1,300	1,370	560	990	2,060	1,680	1,250
7.	120	26	25	X	X	1,990	1,960	2,540	2,190	2,220	2,280	1,900	2,160
8.[5]	60	26	50	X	X	2,280	2,210	2,600	2,540	2,280	2,210	1,970	2,300
9.	0	0	0		X	390	780	820	440	670	1,210	900	740
10.	60	26	50	X		2,190	2,160	2,410	2,520	2,100	2,010	1,870	2,180
11.	60	26	50	X	X	2,160	2,080	2,590	2,500	2,340	2,090	1,970	2,250
12.[6]	60	0	50	X	X	2,050	2,080	2,350	2,020	2,250	1,950	1,910	2,090
13.	120	26	50	X		2,050	2,000	2,150	2,420	2,210	2,090	1,900	2,120
14.	120	26	50	X	X	2,070	1,920	2,430	2,380	2,300	2,180	2,010	2,180
15.	120	26	100	X	X	2,120	1,860	2,560	2,300	2,300	2,170	1,980	2,180
16.	0	26	50	X	X	1,660	1,970	2,000	1,940	1,690	1,570	1,740	1,800
17.	0	0	0			310	690	490	710	520	1,020	1,066	690

[1] Limed last in spring of 1963.
[2] Seven-year average; early freeze at Sand Mountain, Tennessee Valley, and Alexandria in 1967.
[3] One time application of muriate of potash in 1958 to plot 2.
[4] Plot 5 received calcitic limestone; all other limed plots received dolomite.
[5] Plot 8 received a minor element mixture applied broadcast in alternate years before planting vetch.
[6] Plot 12 received 5 pounds of gypsum annually.

APPENDIX TABLE 4. RESPONSE OF CORN TO RATES OF NITROGEN, PHOSPHORUS, AND POTASSIUM AT SEVEN LOCATIONS, 1962-64

Rate per acre, pounds	Corn yield per acre, 3-year average[1]							
	Benndale fine sandy loam	Lucedale fine sandy loam	Dothan fine sandy loam	Hartsells fine sandy loam	Lucedale sandy clay loam	Savannah sandy clay loam	Dewey silt loam	Average
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
N								
0	19	13	42	14	8	13	28	20
30	40	28	57	41	24	38	47	39
60	55	38	73	78	35	65	60	61
90	66	42	82	103	38	75	61	67
120	70	47	86	114	38	82	64	71
150	68	44	88	122	41	83	63	73
P								
0	61	50	88	64	43	80	59	64
9	71	49	88	98	47	87	65	72
18	68	46	88	111	45	85	69	73
26	71	52	90	115	45	89	64	75
44	70	47	86	114	38	82	64	71
K								
0	57	35	80	89	34	84	62	63
17	64	41	87	109	34	80	64	69
33	68	40	83	114	39	82	65	71
50	69	47	91	116	42	85	65	73
66	68	45	90	115	41	83	62	72
83	70	47	86	114	38	82	64	71
No lime	67	47	67	107	38	80	65	67
Lime	70	47	86	114	38	82	64	71
Untreated pH, 1962	*5.5*	*5.4*	*5.5*	*5.2*	*5.6*	*5.2*	*5.6*	
Untreated P, 1962	*23 L*	*23 L*	*39 M*	*15 L*	*133 H*	*17 M*	*11 L*	
Untreated K, 1962	*53 M*	*30 L*	*50 M*	*57 M*	*166 H*	*59 L*	*142 M*	

Standard treatment all locations: 120-100-100.

[1] Line under yield figures in each column indicates the level of N, P, or K that gave best economic return at each location.

APPENDIX TABLE 5. YIELDS OF CORN FROM RATES OF FERTILIZER WITH AND WITHOUT LIME AND WINTER LEGUME IN 2-YEAR ROTATION FERTILIZER EXPERIMENTS AT SEVEN LOCATIONS, 1960-67

Plot	Treatment					Corn yield per acre, 8-year average							
	Lb. N	Lb. P	Lb. K	Lime[1]	Legume	Benndale fine sandy loam	Lucedale fine sandy loam	Dothan fine sandy loam	Hartsells fine sandy loam	Lucedale sandy clay loam	Dewey silt loam	Decatur silt loam	Average
						Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
1.	0	0	0			10	19	20	9	13	20	27	17
2.[2]	120	26	50	X		70	65	63	96	79	66	85	75
3.	0	26	50	X		20	28	48	21	23	34	45	31
4.	60	26	50		X	66	58	60	81	75	63	82	69
5.[3]	120	26	50	X		67	60	59	95	77	64	82	72
6.	120	26	0	X	X	60	58	62	62	66	60	80	64
7.	120	26	25	X	X	74	64	71	95	79	59	81	75
8.[4]	60	26	50	X	X	79	64	69	93	79	61	78	75
9.	0	0	0		X	27	36	42	7	30	22	28	27
10.	60	26	50	X		58	52	62	65	62	52	70	60
11.	60	26	50	X	X	76	65	71	94	77	60	80	75
12.[5]	60	0	50	X	X	67	61	69	76	74	57	79	69
13.	120	26	50	X		66	60	58	92	77	63	79	71
14.	120	26	50	X	X	74	63	74	101	78	65	81	77
15.	120	26	100	X	X	79	65	73	104	78	63	83	78
16.	0	26	50	X	X	68	58	64	71	61	49	73	63
17.	0	0	0			10	20	18	11	10	16	24	16

[1] Limed in spring of 1963.
[2] One time application of muriate of potash in 1958 to plot 2.
[3] Plot 5 received calcitic limestone; all other limed plots received dolomite.
[4] Plot 8 received a minor element mixture applied broadcast in alternate years before planting vetch.
[5] Plot 12 received 5 pounds of gypsum annually.

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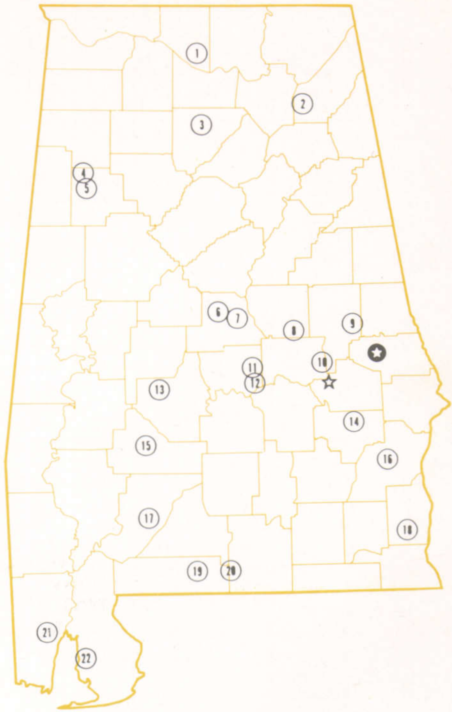

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.
☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. The Turnipseed-Ikenberry Place, Union Springs.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Solon Dixon Forestry Education Center, Covington and Escambia counties.
21. Ornamental Horticulture Field Station, Spring Hill.
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