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By

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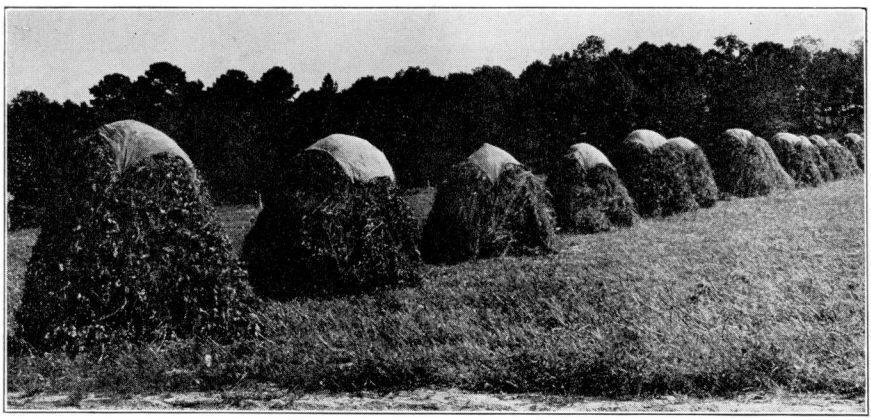

AGRICULTURAL EXPERIMENT STATION
OF THE
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By
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PROVIDING feed for work animals and other livestock is one of the big problems facing Alabama farmers. If it must be bought, the cost materially increases the expense of farm operation. If produced economically, it would result in a large saving to the farmers of the State. With increasing interest in feed and forage production, information is needed that will enable farmers to produce these at a lower cost. The purpose of this circular is to present results of experiments with hay and feed crops at the Alabama Experiment Station. The results of these experiments should be of some value to those farmers who are not producing enough feed, as well as to those who must reduce the cost of producing it.

All of the results herein reported were obtained on poor land which would not produce more than 10 to 15 bushels of corn per acre without fertilizer. Larger yields than those reported could be produced on most farms in Alabama if similar methods were used.

CROP MIXTURES FOR HAY

Cowpeas, Soybeans, Sorghum, or Sudan Grass Alone or in Mixtures.—In an experiment at Auburn cowpeas, soybeans, sorghum, or Sudan grass were planted separately and in mixtures for hay during the nine-year period, 1922-1930, inclusive. These crops were planted in drills or broadcast. No fertilizer was applied to any plot in the experiment. The details of the experiment and the average yields are presented in Table 1.

The results in Table 1 show that cowpeas made more hay than soybeans in both drilled and broadcast plantings; the yields of both crops were larger when broadcast. However, the hay on the broadcast plot of soybeans usually contained a high percentage of weeds, and, therefore, the yield of soybeans was less than on the drilled plot. The grasses produced more hay when drilled. Mixtures of cowpeas or soybeans with sorghum or Sudan grass produced more hay than either cowpeas or soybeans alone.

The crops in this experiment were usually planted after oats, which was too late for maximum yields, especially of soybeans. The crops used, as well as the method and time of planting, are similar to those generally used in Alabama. The yields of hay

TABLE 1.—Yields Produced by Cowpeas, Soybeans, Sorghum, or Sudan Grass Alone or in Mixtures.

Plot No.	Crop	Pounds of seed per acre	Method of seeding	9-year average yield of hay 1922-1930
				Lbs. per acre
1	Cowpeas	60	Broadcast	1,602
2	Cowpeas Sudan grass	60 20	Broadcast	1,919
3	Sudan grass	20	Broadcast	1,271
4	Soybeans	60	Broadcast	1,201
5	Soybeans Sudan grass	60 20	Broadcast	1,442
6	Cowpeas Sorghum	60 20	Broadcast	1,952
7	Sorghum	20	Broadcast	1,565
8	Cowpeas	30	Drilled	1,482
9	Soybeans	30	Drilled	1,120
10	Sudan grass	10	Drilled	1,304
11	Sorghum	10	Drilled	2,087

were low, varying from 1,100 pounds to 1 ton per acre. These yields are too low to be profitable. Such results are discouraging to a farmer who is attempting to produce hay by this method as it requires too much land to produce enough hay for the farm needs. Methods of producing larger yields will be discussed in later paragraphs.

Vetch, Austrian Winter Peas, or Oats Alone or in Mixtures.—In another experiment two varieties of vetch, Austrian winter peas, or oats, alone or in mixtures, were planted broadcast or in drills for hay. Planting was usually done about October 15. Each plot in the experiment received 400 pounds of superphosphate and 50 pounds of muriate of potash per acre at planting. Table 2 shows the average results of this experiment.

TABLE 2.—Yields Produced by Vetch, Austrian Winter Peas, or Oats, Alone or in Mixtures.

Plot No.	Crop	Pounds of seed per acre	Method of seeding	2-year average yield of hay 1927 and 1929
				Lbs. per acre
1	Oats	64	Broadcast	1,043
2	Oats Hairy vetch	64 20	Broadcast	1,883
3	Hairy vetch	20	Broadcast	1,516
4	Oats Monantha vetch	64 20	Broadcast	2,653
5	Monantha vetch	20	Broadcast	1,578
6	Oats Austrian winter peas	64 60	Broadcast	2,613
7	Austrian winter peas	60	Broadcast	3,499
8	Oats Hairy vetch	64 20	Drilled	2,055
9	Oats Monantha vetch	64 20	Drilled	1,810
10	Oats Austrian winter peas	64 60	Drilled	3,237

The results in Table 2 show that the largest yields were made by mixtures of oats with Austrian winter peas, monantha vetch, or hairy vetch, in the order named. They yielded in the same order when planted alone. Plots which were drilled produced more hay than those which were broadcast, except in the case of monantha vetch.

Crimson Clover or Hairy Vetch Alone or in Mixtures With Oats.—Crimson clover or hairy vetch were planted alone or in mixtures with oats during the five-year period, 1921 to 1925, inclusive. The crops in this experiment were planted about October 15. The fertilizer treatment varied, but an average of 264 pounds of superphosphate and 60 pounds of kainit per acre was used. The results of this experiment are shown in Table 3.

It may be seen from Table 3 that crimson clover produced a larger yield of hay than hairy vetch, both alone or in a mixture with oats. Oats planted with either of these crops increased the yield of hay.

The use of crimson clover was discontinued because it was difficult to obtain a stand. The young plants are seriously injured by hot, dry weather in the fall. Crimson clover is also

TABLE 3.—Yields of Crimson Clover or Hairy Vetch Alone or in Mixtures With Oats.

Plot No.	Crop	5-year average yields of hay 1921-1925
		Lbs. per acre
1	Oats and crimson clover	2,796
2	Crimson clover	2,313
3	Hairy vetch	2,267
4	Oats and hairy vetch	2.378

undesirable because if it is not cut by the time the plants are in full bloom it may form hair balls in the stomachs of animals.

VARIETIES OF SOYBEANS FOR HAY AND SEED

Table 4 gives the average yields of hay and seed produced by different varieties of soybeans in the variety test during the fourteen-year period, 1923-1936, inclusive. The beans were cut for hay when the pods were filled. This is about the stage at which hogs are usually turned into the field if beans are to be hogged down.

TABLE 4.—Yields of Hay and Seed in Variety Test of Soybeans.

Variety	14-year average yield per acre 1923-1936	
	Hay	Seed
	Pounds	Bushels
Otootan	3,176	5.9
Biloxi	3,080	8.4
Tarheel Black	2,567	9.1
Mammoth Yellow	2,493	8.9
Laredo	2,411	9.4
Easy Cook	2,986[1]	11.8[1]
Tokio	2,990[2]	10.1[2]
Chiquita	2,637[1]	11.6[1]
Matthews	3,255[3]	12.5[3]

[1] 10-year average 1917-1936
[2] 7-year average 1930-1936
[3] 6-year average 1931-1936

The results presented in Table 4 show that Otootan, and Biloxi produced the largest yield of hay. Of the varieties tested, the Biloxi, Mammoth Yellow, Tarheel Black, and Tokio are coarse-stemmed and are not recommended for hay. The Otootan and Laredo are fine-stemmed and make hay of excellent quality with a low percentage of waste in feeding.

The Easy Cook is an edible bean that may be used for human food. It has made a very good yield of hay and seed.

The Matthews bean is a promising new variety that has made excellent yields of hay and seed. It has been tested for only six

years; during these six years, it has not produced as much hay as the Otootan.

FERTILIZER EXPERIMENTS WITH HAY CROPS

Influence of Lime and Phosphate on Yields.—In an experiment on Cecil sandy loam soil, lime and phosphate were applied at different rates in 1926. In the fall of 1930 muriate of potash was applied at the rate of 200 pounds per acre to all plots and phosphate was applied at one half the rate used in 1926. No fertilizers have been used since. Oats and Austrian winter peas or hairy vetch were planted broadcast each fall, and Otootan soybeans were planted in 30-inch rows each spring after the fall crop was harvested. All crops were harvested for hay. The fertilizer treatments and 10-year average increase in yields are given in Table 5.

The data presented in Table 5 show that the largest increase in yield was obtained from basic slag, the next largest was from superphosphate and lime, and the third largest was from lime alone. These results indicate that lime and phosphate were important factors in the growth of the crops used in this experiment. Rock phosphate was the poorest source of phosphorus used in this test.

These results show the value of fertilizing hay crops. The plot which received 3,000 pounds of basic slag in 10 years produced nearly 12 tons of hay more than the unfertilized plots. This increased yield of hay cost a little over one dollar per ton.

TABLE 5.—Influence of Lime and Phosphate on Yields of Hay of Oats and Austrian Winter Peas or Hairy Vetch Mixture and Soybeans.

Plot	Treatment[1]			Ave. annual increased[2] yield of hay		
	Material	Lbs. per acre		10-year average 1927-1936		
		1926	1930	Oats and Austrian winter peas or hairy vetch	Soybeans	Total
1	Ground rock phosphate	2,000	1,000	282	90	372
2	Superphosphate	2,000	1,000	506	330	836
3	Basic slag	2,000	1,000	1,138	1,115	2,353
4	Lime	4,000	——	499	534	1,033
5	Superphosphate Lime	1,000 4.000	500 ——	684	821	1,505

[1]All plots including check plots received 200 pounds per acre of muriate of potash in the fall of 1930.

[2]The increased yield is the increase over the average of the two nearest check plots. The average yield of all check plots was 1,637 pounds of oats and Austrian winter peas or hairy vetch hay and 1,663 pounds of soybean hay with a total of 3,300 pounds of hay.

FIGURE 1.—Otootan soybeans fertilized with lime and phosphate produced 3,440 pounds of hay per acre.

FIGURE 2.—Otootan soybeans without fertilizer produced 1,425 pounds of hay per acre.

The results of this experiment also show the possibilities of hay production when intensive methods are employed. By planting both spring- and summer-harvested crops on well-fertilized land, more than enough hay was produced on an acre to feed a mule for one year. By planting two crops per year the annual yield was approximately twice as large as it would have been if only one crop had been grown.

Influence of Soil Acidity on the Growth of Forage Crops.—In another experiment on Cecil sandy loam soil the effect of soil acidity on the growth of a number of different crops was studied. The area devoted to this experiment included plots which had been fertilized with nitrate of soda, calcium cynamid, or ammonium sulfate each year for a period of about 20 years. The crops used in this study were planted in rows across the fertilized plots so that all crops grew under the various treat-

FIGURE 3.—Sorghum on moderately acid land. This land was fertilized with calcium cyanamid over a period of 20 years.

ments. All hay crops were harvested for hay and corn was harvested for stover, the weight of the entire plant being recorded. No nitrogenous fertilizers were applied directly to any crop reported on in this table, but were applied to the fall-planted crops which preceded the summer crops of soybeans, cowpeas, sorghum, corn, and Sudan grass discussed here.

It was not the purpose of this experiment to study the direct effects of different sources of nitrogen on the yields of the forage crops grown in this experiment, but to study the effect of the soil reactions resulting from their use over a period of 20 years. It was particularly desired to compare the growth of these crops on land made very acid by the use of ammonium sulfate over this long period with the growth made by the same crops on the same land made less acid by the slight accumulation of lime from the same amount of nitrogen in the form of calcium cyanamid.

The fertilizer treatments of the winter crops preceding the crops of soybeans, cowpeas, sorghum, corn, and Sudan grass and three-year average yields are presented in Table 6.

TABLE 6.—Influence of Soil Acidity on the Yields of Various Forage Crops.

Plot No.	Treatment*	Acidity** 1927	Pounds of air-dry forage per acre—3-year average yield 1927-1929.				
			Laredo soybeans	Cowpeas	Sorghum	Corn. Entire plant	Sudan grass
		pH					
1	Nitrate of soda	5.43	1,248	1,288	2,847	1,531	1,283
2	Calcium cyanamid	5.63	1,518	1,238	4,343	2,108	2,088
3	No treatment	5.33	794	1,091	1,761	1,117	739
4	Ammonium sulfate	4.58	444	991	355	828	176

*Each plot received 22.5 pounds of nitrogen per acre annually. All plots were treated uniformly with phosphate and potash.

**The degree of acidity on the plot which received ammonium sulfate was highest with the untreated, nitrate of soda, and calcium cyanamid plots following in the order named.

The data presented in this table show that the yields of all crops used were lower on Plot 4 than on any of the other plots, including Plot 3, which received no nitrogen. This low yield was the result of the very acid condition of the soil caused by the long-continued use of ammonium sulfate. Sudan grass, sorghum, and soybeans suffered more serious injury than corn and cowpeas. In contrast with the small yields of Sudan grass, sorghum, and soybeans on the very acid soil, these crops made larger yields than corn and cowpeas on Plot 2 which was considerably less acid due to the accumulated effect of lime added by calcium cyanamid used over the 20-year period. The results obtained in this experiment emphasize the fact that Sudan grass, sorghum, and soybeans are not adapted to very acid soils and are benefited by lime.

FIGURE 4.—Sorghum on land made very acid by the use of ammonium sulfate for a period of 20 years.

Effect of Rate and Time of Applying Nitrate of Soda on the Yield and Protein Content of Sudan Grass.—The influence of nitrate of soda on the yield and protein content of Sudan grass hay was studied on sandy soil at Auburn during the five-year period, 1926-1930, inclusive. Studies on the rate and time of applying nitrate of soda on yields and protein content were also made. The results of this experiment are presented in Table 7.

The most profitable rate of applying nitrate of soda, based on the results in Table 7, was 100 to 200 pounds per acre. Although the yields varied widely, due to seasonal conditions, applications of 100 to 200 pounds were always profitable. The increase in yield produced by 200 pounds of nitrate of soda varied from 700 to 2,300 pounds per acre, with an average increase of 1,200 pounds.

Nitrate of soda was more profitable when applied soon after the grass plants were up than when half was applied when the grass plants were up and the other half soon after the first cutting.

The results in the table show that the percentage of protein in Sudan grass hay was materially increased by the use of nitrate of soda. An increase in the amount of nitrate of soda was usually followed by an increase in the percentage of protein in the hay.

TABLE 7.—Effect of Rate and Time of Applying Nitrate of Soda on the Yield and Protein Content of Sudan Grass.

Plot No.	Treatment		5-year average yields of hay 1926-1930					
			1st cutting		2nd cutting		Total	
	Nitrate of soda per acre	Stage of growth at which applied	Yield per acre	Protein	Yield per acre	Protein	Yield per acre	Protein
	Lbs.		Lbs.	%	Lbs.	%	Lbs.	%
1	None		1,312	5.9	432	6.9	1,744	6.1
2	600	When grass was up	3,060	10.8	1,315	7.6	4,375	9.8
3	400	When grass was up	2,787	9.7	1,021	7.1	3,808	9.0
4	None		1,333	5.7	589	7.2	1,922	6.1
5	200	When grass was up	2,335	6.9	839	6.3	3,174	6.6
6	100	When grass was up	2,080	7.1	731	6.7	2,811	7.0
7	None		1,370	5.7	586	6.9	1,956	6.0
8	100 100	When grass was up After first cutting	1,971	6.7	860	6.9	2,831	6.8
9	200 200	When grass was up After first cutting	2,328	7.3	1,035	8.4	3,363	7.6
10	None		1,460	5.0	584	6.4	2,044	5.4
11	300 300	When grass was up After first cutting	2,625	8.4	1,355	8.1	3,980	8.3

Effect of Fertilizer and Crop Treatments on the Yield of Johnson Grass.—The effects of fertilizer and crop treatments on the growth of Johnson grass were studied on sandy land at Auburn during the three-year period, 1927-1929, inclusive. This experiment included direct fertilizer treatments, oats and vetch for hay, vetch and Austrian winter peas turned under to supply nitrogen for Johnson grass, and small legumes growing among Johnson grass plants. The details of this experiment are shown in Table 8.

The results presented in Table 8 show that large annual yields of hay were made by following a winter hay crop with Johnson grass, and that Johnson grass must be reseeded each year on this soil. It is also shown that a crop of winter legumes should be cut for hay rather than turned for Johnson grass. Furthermore, small legumes grown in connection with Johnson grass did not supply enough nitrogen to increase materially the yield of Johnson grass hay. In addition to the foregoing, it is shown that Johnson grass responded well to nitrogen and lime, and that there was no response to phosphorus on this soil.

TABLE 8.—The Effect of Fertilizer and Crop Treatments on the Yield of Johnson Grass.

Plot No.	Treatment (Applied fall of 1926 except N)	Yield of hay per acre					
		1927			1928	1929	
		Winter crop	Johnson grass	Total		Winter crop	Johnson grass***
			Lbs.	Lbs.			Lbs.
1	P N		4,310	4,310	No		150
2	L N		6,000	6,000	results.		800
3	P L N		5,710	5,710	Oats		1,550
4	P K N		6,105	6,105	and		1,350
5	P K L N		6,380	6,380	vetch		1,850
6	K L N		6,520	6,520	killed		2,850
7	N		5,220	5,220	by cold.	Killed	550
8	P K monantha vetch plowed in**		1,500	1,500	Johnson grass failed to come back on some of the plots	by cold	900
9	P K N Oats*	3,780	6,645	10,425			1,350
10	P K Hop clover		2,290	2,290			2,350
11	0		2,015	2,015			600
12	P K N Oats and vetch*	3,720	7,235	10,955			1,600
13	P K		1,765	1,765			2,950
14	0		1,730	1,730			1,350
15	P K L Black Medic		3,430	3,430			2,900
16	P K Austrian peas plowed in		4,245	4,245			2,000

P = 1000 lbs. superphosphate
K = 500 lbs. muriate of potash
L = 4000 lbs. ground limestone
N = 400 lbs. nitrate of soda
* = Had N to oats and to Johnson grass
** = Made very little growth
*** = Reseeded to Johnson grass in the spring. Only one cutting made.

Influence of Fertilizers on the Yields of Oats, Austrian Winter Peas, and Sudan Grass.—The results of the preceding experiment showed that Johnson grass was unsatisfactory for this soil, and that it was possible to make large yields of hay by using both summer and winter crops. Consequently, in the fall of 1929, the experiment was changed, substituting Sudan grass for Johnson grass and growing a winter crop on Plots 9 to 16, inclusive. The results for 1930 are presented in Table 9.

TABLE 9.—The Influence of Different Fertilizer Treatments on the Yields of Oats, Austrian Winter Peas, and Sudan Grass.

Plot No.	Treatment	Yield—pounds hay per acre 1930		
		Oats and peas	Sudan* grass	Total
1	0 Applied spring of 1930		800	800
2	P K		1,000	1,000
3	P N		3,000	3,000
4	P K N		3,600	3,600
5	P K N		3,900	3,900
6	K N		3,400	3,400
7	0		900	900
8	N		3,000	3,000
9	N One application to fall crop and one to spring crop	4,050	550	4,600
10	P K L " " " " " " " " " "	3,750	1,400	5,150
11	0 " " " " " " " " " "	2,300	100	2,400
12	P K N " " " " " " " " " "	3,600	1,050	4,650
13	P K L N " " " " " " " " " "	3,750	1,700	5,450
14	0 " " " " " " " " " "	2,600	200	2,800
15	P N " " " " " " " " " "	4,150	1,700	5,850
16	K L N " " " " " " " " " "	4,200	1,700	5,900

* = Sudan grass planted in April on Plots 1-8 and after oats and peas on 9-16. Only one cutting made in each case due to dry weather.
P = 200 lbs. superphosphate
K = 25 lbs. muriate of potash
L = 2 tons ground limestone each 5 years
N = 200 lbs. nitrate of soda.

The data presented in Table 9 show that the yield of Sudan grass hay was more than doubled by the application of nitrogen, but was not influenced much by other fertilizers. These results further emphasize the fact that large yields of hay may be obtained by growing both winter and summer hay crops.

INFLUENCE OF TIME OF CUTTING ON THE YIELD OF JOHNSON GRASS HAY AND ROOT STOCKS

Johnson grass has been considered a pest under some conditions and a valuable forage plant under others. In a test started in 1927 to study methods of eradicating and managing Johnson grass, the effect of cutting treatments on hay yields and rootstock development was studied. The land used in this experiment was a moderately productive Norfolk sandy loam. Each plot received 2 tons of ground limestone, 1,000 pounds of superphosphate, 500 pounds of kainit, and 200 pounds of nitrate of soda per acre before planting. Nitrate of soda at the rate of 200 pounds per acre was added when the plants showed signs of nitrogen hunger by a paling of the green color. The average annual application of nitrate of soda was 600 to 800 pounds per acre. The seed was sown at the rate of 50 pounds per acre.

Plots 4 feet by 5 feet separated by two-foot alleys were used in this experiment and the plants were harvested by hand, leaving stubble one inch in height. There were 6 plots in each treatment. Three plots in each treatment were dug in the fall of 1927 to determine the amount of rootstock development. The three remaining plots were left to be cut for hay in 1928. The rootstocks on these were dug in the fall of 1928.

The experiment was divided into three series. In Series 1 the cutting treatments were started as soon as the plants reached the stages indicated in Table 10 and were cut thereafter as often as they reached these stages. In Series 2 the plants were permitted to mature a crop of seed in the summer of 1927 before the cutting treatments were started. When the plants reached maturity in 1927 the tops were harvested; during the remainder of 1927 and during 1928 the plants were cut as often as they reached the indicated stages. In Series 3 the plants were permitted to grow during the summer of 1927 without cutting. They were harvested as often as they reached the proper stage during the summer of 1928. The cutting treatments and yields of hay and rootstocks are recorded in Table 10. The yields were larger than could be expected in common farm practice because of the conditions under which the experiment was conducted.

The results of this experiment show that the largest yield of hay was produced when the plants were cut when the seed was in the late milk stage. Cutting as late as this stage did not reduce the yield the following year, while cutting prior to this stage did. Cutting at this late stage does not produce the best quality of hay. In order to produce the best quality of hay, and

TABLE 10.—Effect of Stage of Cutting on the Yield of Hay and Rootstocks of Johnson Grass.

Treatment No.	Stage cut	Series 1. Cut continuously. Results lbs. per acre dry weight**						Series 2. Permitted to mature a crop of seed before starting cutting. Results lbs. per acre dry weight**						Series 3. Permitted to grow for one year before starting cutting. Results lbs. per acre dry weight**		
		1927			1928			1927			1928			1928		
		No. cuttings	Hay	Rootstocks	No. cuttings	Hay	Rootstocks	No. cuttings	Hay*	Rootstocks	No. cuttings	Hay	Rootstocks	No. cuttings	Hay	Rootstocks
1	1 foot high	5	4,450	619	8	2,051	48	3	9,996	3,132	7	2,237	52	9	6,007	214
2	2 feet high	4	7,159	1,247	5	3,580	242	3	10,191	2,894	5	3,903	357	6	7,835	523
3	Booting	3	7,492	1,528	4	6,045	662	2	10,043	2,875	4	4,303	352	4	11,248	1,823
4	Blooming	3	9,605	1,942	3	8,606	876	2	9,934	3,675	3	7,192	909	3	12,267	2,280
5	Seed in late milk	2	10,552	2,803	3	11,709	2,356	2	10,886	4,194	3	11,405	1,642	3	16,203	3,803
6	Seed mature	2	11,071	3,684	2	9,087	3,518	2	11,071	3,684	2	9,087	3,518	2	12,614	3,818
7	At end of growing season	1	5,812	5,616	1	7,987	6,098	1	5,812	5,616	1	7,987	6,098	1	7,987	6,098
8	Dug when seed mature (August 2, 1927)	----	----------	--------	----	----------	--------	1	8,620	5,022	----	----------	--------	----	----------	--------
9	Booting until middle of season (July 5)	----	----------	--------	----	----------	--------	----	----------	--------	----	----------	--------	2	5,712	2,504

*The yields include the cutting made when the seed reached maturity. This cutting yielded 8,620 pounds.
**All yields are on an oven-dry basis.

at the same time not reduce the yield and thin out the stand, it is necessary either to let the plants develop a system of rootstocks (which contains the food reserve for the next year's plants) or reseed the land frequently. The plants will develop a system of rootstocks if they are not cut the latter half of the summer, or if cut only every other year.

The results of this experiment show that any cutting treatment reduces the rootstock development, and the more frequently the cuttings are made the greater is the reduction. Frequent cutting will greatly assist in eradicating Johnson grass. To be most effective, cutting should be done during the latter half of the summer as Johnson grass can develop a good system of rootstocks after the middle of the season. For this reason it often remains as a pest in cultivated fields in spite of attempts to eradicate it by cultivation early in the season. The main efforts at eradication should be spent from July until frost.

The results of the test reported above indicated that the yield of Johnson grass would decrease if it were cut for several years. In order to study this, a test was begun on Norfolk soil in the spring of 1929 in which various frequencies of cutting were made. In this test all plots were limed and received an application of 1,600 pounds per acre of a 6-10-4 fertilizer each year. The results are reported in Table 11.

TABLE 11.—Effect of Frequency of Cutting on the Yield of Johnson Grass Hay.

Frequency of Cutting	Yield[1] Per Acre	
	1933	5-Year Average 1929-1933
	Pounds	
Cut continuously	3,463	4,618
Cut until middle of summer	3,691	3,672
Cut every other year[2]	6,343	5,275

[1]Studies were made with cutting in three stages of growth viz. booting, blooming and late milk; the yields reported are the average for the three stages.

[2]The yield reported is the yield for the year the crop was harvested. Two plots were used; one was cut one year and the other the next. To obtain the average yield per plot per year, the yield should be divided by two.

These results show that cutting continuously each year greatly reduced the yield. The plots that were cut every other year made in 1933 nearly double the yield of those cut continuously. Also in 1933 the plot cut until the middle of the summer each year made a larger yield than the one cut continuously. The average for the five years shows that the largest yield was obtained by cutting every other year and the next largest yield by cutting continuously. If an area is to be used permanently as a Johnson grass meadow, it will be desirable to stop cutting in the middle of the summer or to cut every other year or to plow up the area every few years and plant to corn or other crop and thus let the plants develop a system of rootstocks.

INFLUENCE OF STAGE OF CUTTING JOHNSON AND SUDAN GRASS ON THE YIELD AND COMPOSITION OF HAY

In 1929 a test was begun to study the effect of cutting Johnson and Sudan grasses in various stages of growth on the yield and composition of hay. The soil used was a Norfolk sandy loam. All plots were limed and fertilized at the rate of 1,600 pounds per acre of a 6-10-4 fertilizer each year. The results of this experiment are reported in Table 12.

The results show that the largest yield of Sudan grass was obtained by cutting when the seed were in the late milk stage. The largest yield of Johnson grass per year was obtained by cutting in the blooming stage. The largest yield of Johnson grass per cutting was obtained in the late milk stage, but fewer cuttings per year were obtained than when the plants were cut in the blooming stage so that the total yield was less.

There was only a slight difference in the composition of the hay cut in the various stages. The protein content of the hay was higher when the plants were cut early, but the carbohydrate content was approximately the same in all stages.

These results show that Johnson and Sudan grasses should be cut in the blooming stage or at least by the time the seed are in the milk stage.

TABLE 12.—Effect of Stage of Cutting on Yield and Composition of Johnson and Sudan Grass Hay. 5-Year Average 1929-1933.

Stage cut	Yield per acre	Per cent moisture	Per cent ash	Per cent protein	Per cent fat	Per cent fiber	Per cent carbohydrates
			Johnson Grass				
Booting	3,854	8.6	4.6	8.1	1.9	31.0	45.8
Blooming	5,314	8.3	3.9	8.0	1.7	32.0	46.1
Late milk	4,526	8.2	3.7	7.8	1.9	32.2	46.2
			Sudan Grass				
Booting	3,926	7.8	4.2	8.0	1.9	28.0	47.8
Blooming	4,742	7.7	3.7	6.9	1.9	31.9	47.9
Late milk	5,190	7.5	3.5	6.9	1.8	32.9	47.4

DISCUSSION AND RECOMMENDATIONS

Results reported show that when cowpeas, soybeans, sorghum, or Sudan grass were planted after oats and were not fertilized, the yields of hay were low. The yields of hay were frequently limited by a lack of rain during the summer. Farmers who have followed this plan, although they have produced some satisfactory crops, have made small average yields. This may explain why hay production in Alabama has been below the needs of the State. Larger yields must be made if Alabama farmers are to produce an adequate supply of hay.

It should be remembered that the results herein reported were obtained on poor land, and, therefore, were lower than the yields on some of the better soils of Alabama. However, a large percentage of the land in Alabama is no better than that used in these experiments. In many cases farmers who have good land have produced large yields of hay by planting a summer hay crop after oats. Results of experiments indicate that even those farmers who produce large yields of hay after oats could double their annual yields by following the plan outlined below.

Based on the results of experiments reported in this circular, the following recommendations are made:

(1) Plant late in September or early in October a mixture composed of 2 bushels of oats or 1 bushel of wheat, and either 20 pounds of vetch or 40 pounds of Austrian winter peas.

(2) After this crop is harvested plant cowpeas, soybeans, sorghum, or Sudan grass, or a mixture of these on the same land.

(3) Fertilize the fall-planted crop with 400 to 600 pounds of basic slag per acre. Basic slag supplies both lime and phosphate, which experiments have shown to be essential to the maximum growth of these crops. Apply 100 to 200 pounds of nitrate of soda per acre late in February or early in March.

(4) Apply 400 to 600 pounds of basic slag for summer legumes at planting time. Top dress sorghum or Sudan grass with 100 to 200 pounds of nitrate of soda per acre as soon as the plants are up.

(5) Results of experiments show that by following this plan it is possible to produce 2 or more tons of hay per acre, as compared with one-half to 1 ton when only an unfertilized summer crop planted after oats is used.

SUMMARY

(1) Cowpeas made more hay than soybeans in both drilled and broadcast plantings.

(2) Mixtures of either summer or winter crops usually produced larger yields than single plantings.

(3) A mixture of oats and Austrian winter peas made the largest yield of any winter crops used.

(4) Otootan and Biloxi made the largest yields of hay in soybean variety tests.

(5) Otootan and Laredo are fine-stemmed and make hay of excellent quality.

(6) Lime and phosphate increased the yields of hay from oats, Austrian winter peas, and Otootan soybeans.

(7) Basic slag produced large increases in the yields of these crops.

(8) Sudan grass, sorghum, and soybeans were injured more by soil acidity than corn or cowpeas.

(9) The yield and protein content of Sudan grass hay were increased by an application of nitrate of soda.

(10) The most profitable rate of applying nitrate of soda was 100 to 200 pounds per acre.

(11) It was found that nitrate of soda should be applied soon after the grass was up.

(12) Large annual yields of hay were made by following a winter hay crop with a summer crop.

(13) It was necessary to reseed Johnson grass frequently on sandy land.

(14) Winter legumes should be cut for hay rather than turned for Johnson grass.

(15) Johnson grass responded remarkably to nitrogen and lime.

(16) The largest yield of Sudan grass hay was obtained when the plants were cut when the seed were in the late milk stage. The largest yield of Johnson grass was obtained when the plants were cut in the blooming stage. Cutting prior to these stages reduced the yield and thinned the stand.

(17) The protein content of the hay was higher when the plants were cut early but the carbohydrate content was approximately the same for all cutting stages.

(18) Frequent cutting during the latter half of the growing season will reduce the development of rootstocks and assist in eradicating Johnson grass.

(19) To produce high yields of Johnson grass hay, it will be necessary to let the plants develop a large system of rootstocks. This may be accomplished by not cutting for a year or by stopping cutting in the middle of the summer or by plowing the land and planting to corn or other crop.