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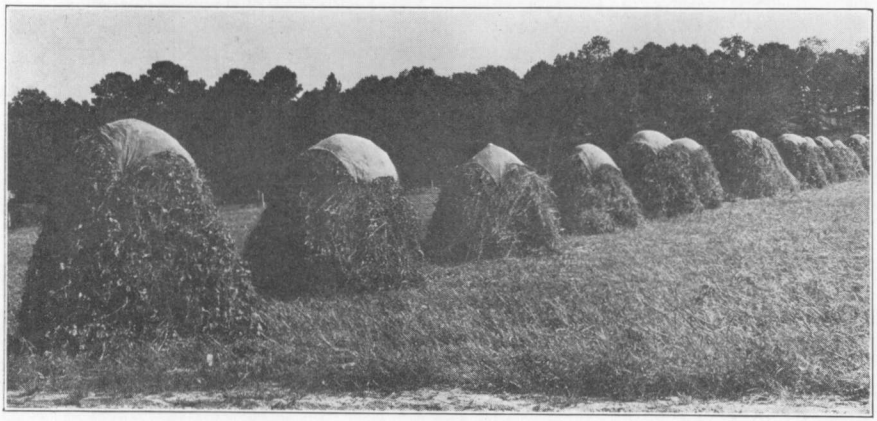
EXPERIMENTS WITH HAY CROPS IN ALABAMA

By
D. G. STURKIE AND R. Y. BAILEY



AGRICULTURAL EXPERIMENT STATION
OF THE
ALABAMA POLYTECHNIC INSTITUTE

M. J. FUNCHESS, Director
AUBURN

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Experiments With Hay Crops In Alabama

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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 1100 pounds to one 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 yield 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 seven-year period, 1923-1929, inclusive. The table also shows the number of days between the dates of planting and cutting for hay. 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	7-year average yield 1923-1929		
	Days from planting to time to cut for hay	Hay	Seed
		Lbs. per acre	Bus. per acre
Virginia	84	1,432	6.8
Arlington	93	1,833	8.0
Otootan	121	2,519	5.4
Biloxi	125	2,564	6.5
Laredo	107	1,979	6.5
Mammoth Yellow	104	2,371	6.3
Tarheel Black	110	2,368	7.1
Southern Prolific	88	1,748	5.7
Dixie	88	1,611*	9.0*
Wilson	87	1,526*	6.1*

*5-Year average.

The results presented in Table 4 show that Biloxi, Otootan, Mammoth Yellow, Tarheel Black, and Laredo, in the order named, produced the largest yields of hay. Of these varieties Biloxi and Mammoth Yellow are coarse-stemmed and are not recommended for hay. Otootan, and Laredo are fine-stemmed and

make hay of excellent quality with a low percentage of waste in feeding.

The Virginia, Dixie, and Arlington varieties made moderate yields of both hay and seed. These varieties mature early and, consequently, are suitable for early grazing; Mammoth Yellow and Biloxi may be used for later grazing. If these varieties are planted early in the spring they will supply grazing from about July 15 until frost.

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; no fertilizers have been used since. Oats and Austrian winter peas were planted broadcast in this experiment each fall, and Ootootan soybeans were planted in 30-inch rows each spring after the fall-planted crop was harvested. All crops were harvested for hay. The fertilizer treatments, annual yields, and four-year average yields are given in Table 5.

Table 5.—Influence of Lime and Phosphate on Yields of Oats, Austrian Winter Peas, and Soybeans.

Plot No.	Treatment*		Yields of hay						
	Material	Pounds per acre	1927	1928	1929	1930	4-year average 1927-1930		
							Oats and Austrian winter peas	Soybeans	Total
1	None	None	4,273	5,380	3,115	2,892	2,096	1,819	3,915
2	Superphosphate Lime	1,100 3,500	7,756	6,642	4,244	2,401	2,723	2,568	5,292
3	Lime	4,000	6,084	8,045	3,495	2,510	2,557	2,476	5,033
4	Basic slag	2,000	7,454	5,800	3,835	2,845	2,482	2,501	4,983

*All of the fertilizer was applied in 1926.

The data presented in Table 5 show that Plot 2, which received superphosphate and lime, produced 1377 pounds of hay per acre more than Plot 1, which was unfertilized, 259 pounds more than Plot 3, which received lime alone, and 309 pounds more than Plot 4 on which basic slag was used. These results indicate that lime was a more important factor than phosphate in the growth of the crops used in this experiment. The fact that basic slag contains both lime and phosphate makes it a valuable fertilizer for crops which respond to both of these materials.

The yields in 1929 and 1930 were reduced by disease injury to Austrian winter peas and by drouth which seriously affected the yield of soybean 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 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. If the high production of the first two years had been maintained, enough hay would have been made on an acre to feed two mules. 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. The fertilizer treatments 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.

Table 6 shows 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 decrease in yield was the result of

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

the acid condition of the soil on Plot 4 caused by the continued use of ammonium sulfate. Sudan grass, sorghum and soybeans suffered more serious injury than other crops. These three crops also gave more response to calcium cynamid than the other crops used. Since calcium cyanamid contains a high percentage of lime, the response of these crops to this fertilizer further emphasizes the fact that they are not well adapted to acid soils and are benefitted by lime.

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.

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	Per cent protein	Yield per acre	Per cent protein	Yield per acre	Per cent 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

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 2300 pounds per acre, with an average increase of 1200 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.

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	by	900
9	P K N Oats*	3,780	6,645	10,425	grass	cold	1,350
10	P K Hop clover		2,290	2,290	failed		2,350
11	0		2,015	2,015	to		600
12	P K N Oats and vetch*	3,720	7,235	10,955	come back		1,600
13	P K		1,765	1,765	on		2,950
14	0		1,730	1,730	some of		1,350
15	P K L Black Medic		3,430	3,430	the		2,900
16	P K Austrian peas plowed in		4,245	4,245	plots		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

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.

Johnson grass and growing a winter crop on Plots 9 to 16, inclusive. The results for 1930 are presented in Table 9 .

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, 1000 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

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	Root-stocks	No. cuttings	Hay	Root-Stocks	No. cuttings	Hay*	Root-stocks	No. cuttings	Hay	Root-stocks	No. cuttings	Hay	Root-stocks
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.

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 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.

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 two or more tons of hay per acre, as compared with one-half to one 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. Biloxi, Otootan, Mammoth Yellow, Tarheel Black, and Laredo in the order named 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 increased the yields of hay from oats, Austrian winter peas, and Otootan soybeans more than did phosphate.

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 each year 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 yields of Johnson grass hay were made when the plants were cut when seed were in the late milk stage. Cutting prior to this stage reduced the yields and thinned the stand.

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