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Fertilizers for Johnsongrass on Calcareous Black Belt Soils

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FERTILIZERS FOR JOHNSONGRASS ON CALCAREOUS BLACK BELT SOILS

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JOHNSONGRASS (*Sorghum halepense* (L.)Pers) is an example of the old adage, "One man's junk is another man's treasure." In row crops this grass is considered a noxious weed. At the other extreme, it is recognized as a valuable hay and temporary grazing crop in the Black Belt region of Alabama where it is widely grown in grassland systems. Persistence of johnsongrass as a weed is deceptive since it is extremely responsive to fertilizers and the stand can be depleted quickly by improper management.[2]

Johnsongrass grows both from seed and from rhizomes produced the previous year. The rhizomes that will produce the next year's crop emerge from the crown beginning about flowering time. If the grass is cut before these new rhizomes are produced there will be no rhizomes for the next year's crop. The rhizomes live for only about 1 year. A common practice for ensuring sufficient rhizomes for the next year's growth is to make the last cutting in August or early September, which leaves sufficient time for new rhizomes to be produced before frost. After frost the dead grass can be grazed or cut for hay without affecting the rhizomes.

There is little published information on fertilizers for johnsongrass. The research reported here was conducted to determine

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[2] BENNETT, HUGH W. AND N. C. MERWINE. 1964. Interplanted Legumes in Johnsongrass. Miss. Agr. Exp. Sta. Bull. 698.

the effects of rates of fertilizer elements on growth of johnsongrass in the Black Belt region of Alabama.

METHODS

The experiments were conducted on Sumter clay soil at the Black Belt Substation. These soils contain 40 to 60 per cent calcium carbonate and have a pH above 7. The soil test values for the experimental locations were low for phosphorus (P) and medium for potassium (K).[3]

All experiments were located on established stands in a johnsongrass meadow. Each location was overseeded when the experiment was begun.

Fertilizers were applied on the soil surface. One-half the nitrogen (N) was applied before growth began in the spring and the remainder after the first harvest. Phosphorus, potassium, and magnesium (Mg) were applied in a single application before growth began in the spring except as indicated for K.

Ammonium nitrate was the source of N unless otherwise stated. Superphosphate was the source of P, muriate of potash was the source of K, and magnesium sulfate was the source of Mg.

Total N in the grass was determined by the Kjeldahl procedure and nitrates by the phenoldisulfonic acid method.

All yields are reported as oven-dried forage. To convert to the approximate hay yields, about 10 per cent should be added to the oven-dry weights. Harvesting was done when the most advanced plots were in the blossom stage. In most years there were four harvests.

COMMERCIAL NITROGEN AND LEGUME NITROGEN, 1958-61

One treatment received no P and K and all others received 108 pounds of P and 196 pounds of K per acre. Rates of N up to 320 pounds per acre were applied both with and without Caley peas (*Lathyrus hirsutus* L.) in a rotation. Where Caley peas were in the rotation, yield of the legume was added to that of johnsongrass. Irrespective of N treatment the Caley peas yielded an average of about ½ ton per year.

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[3] Values for P can be converted to P_2O_5 by multiplying by 2.3 and K to K_2O by multiplying by 1.2.

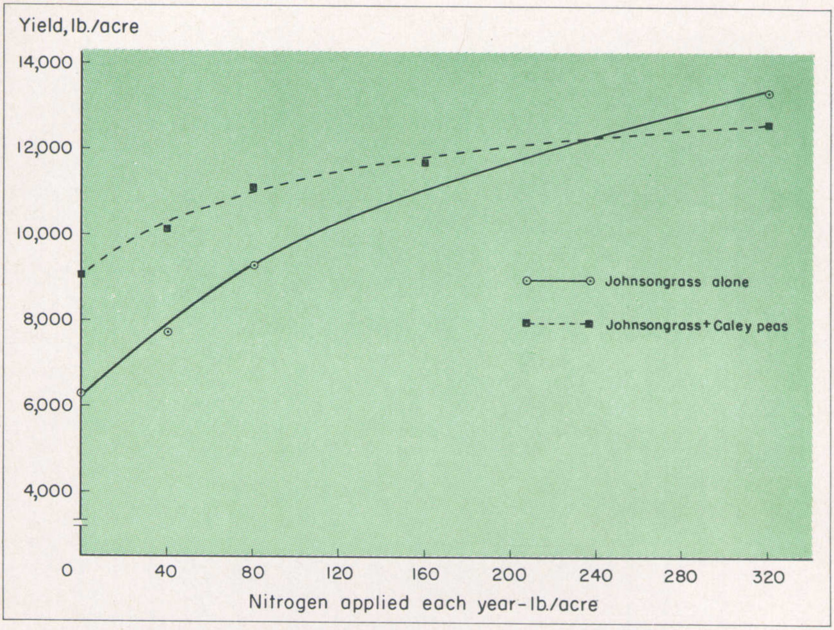


FIG. 1. Effect of nitrogen on yield of johnsongrass alone and johnsongrass plus Caley peas, 1958-61, is illustrated here.

Yields were increased with every increment of N on the grass alone or when grown with Caley peas, Figure 1. The addition of Caley peas resulted in higher yields where less than about 200 pounds of N was applied. The highest yields were about 6½ tons where 320 pounds of N was applied. However, such high rates appear to be uneconomical.

There was a progressive loss of stand each year on plots receiving no PK. This resulted in declining yields when compared to treatments that received the same rate of N (160 pounds per acre) plus P and K, Figure 2. After 4 years of cropping, the stand on the no PK treatment was less than half that of plots receiving a complete fertilizer.

RATES AND SOURCES OF NITROGEN, 1962-66

Ammonium nitrate, ammonium sulfate, sodium nitrate, and urea were compared at N rates of 40, 80, and 120 pounds per acre. There was also a 160- and a 320-pound N rate with ammonium nitrate. Phosphorus and potassium were applied in a single appli-

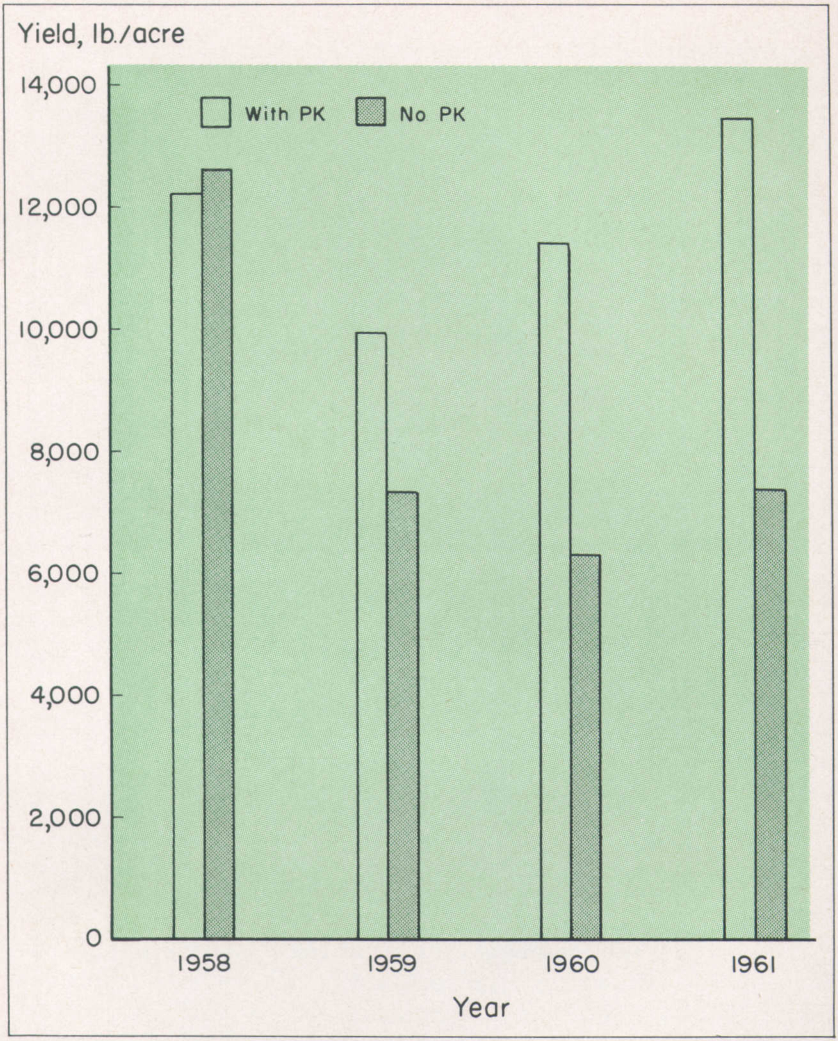


FIG. 2. Yields of johnsongrass plus Caley peas with and without added phosphorus and potassium, 1958-61, are illustrated here.

cation before growth started at the per acre rate of 89 pounds of P and 165 pounds of K.

Five-year average yields show an increase from each increment of N applied from ammonium nitrate, Figure 3. Yields were low as a result of droughty conditions in 1962 and 1963; however, there was a response to each rate of N in every year of the experiment.

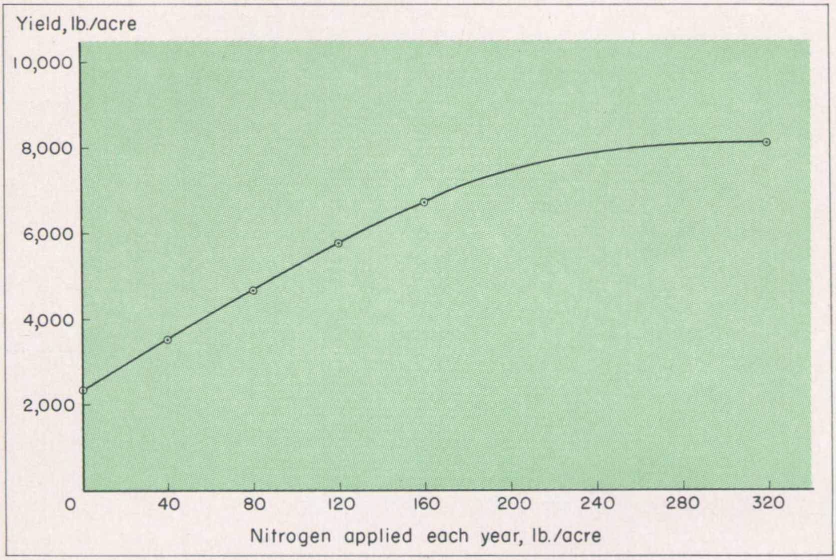


FIG. 3. Effect of nitrogen rate, from ammonium nitrate, on johnsongrass yields, 1962-66, is illustrated here.

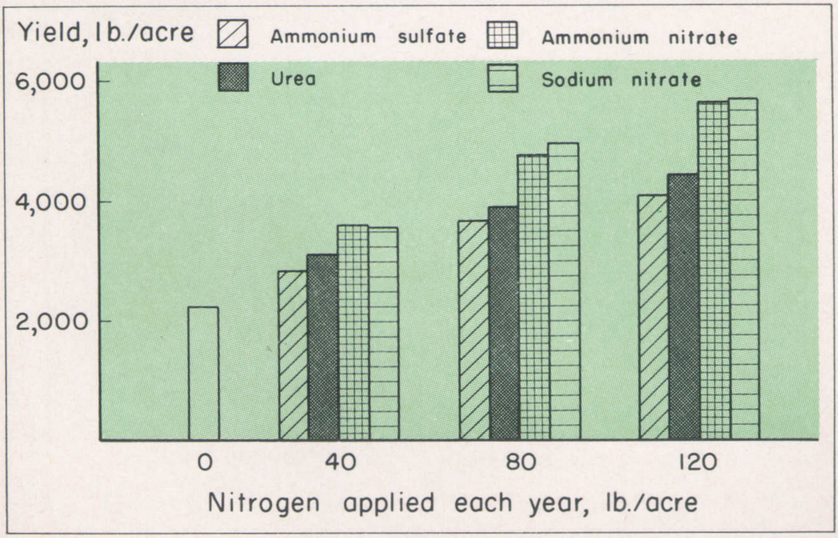


FIG. 4. Average yields of johnsongrass from four sources of nitrogen, 1962-66, are illustrated here.

Yields were similar with ammonium nitrate and sodium nitrate, Figure 4. The yield responses from ammonium sulfate and urea were similar. Ammonium nitrate and sodium nitrate resulted in higher yields than either ammonium sulfate or urea. The lower

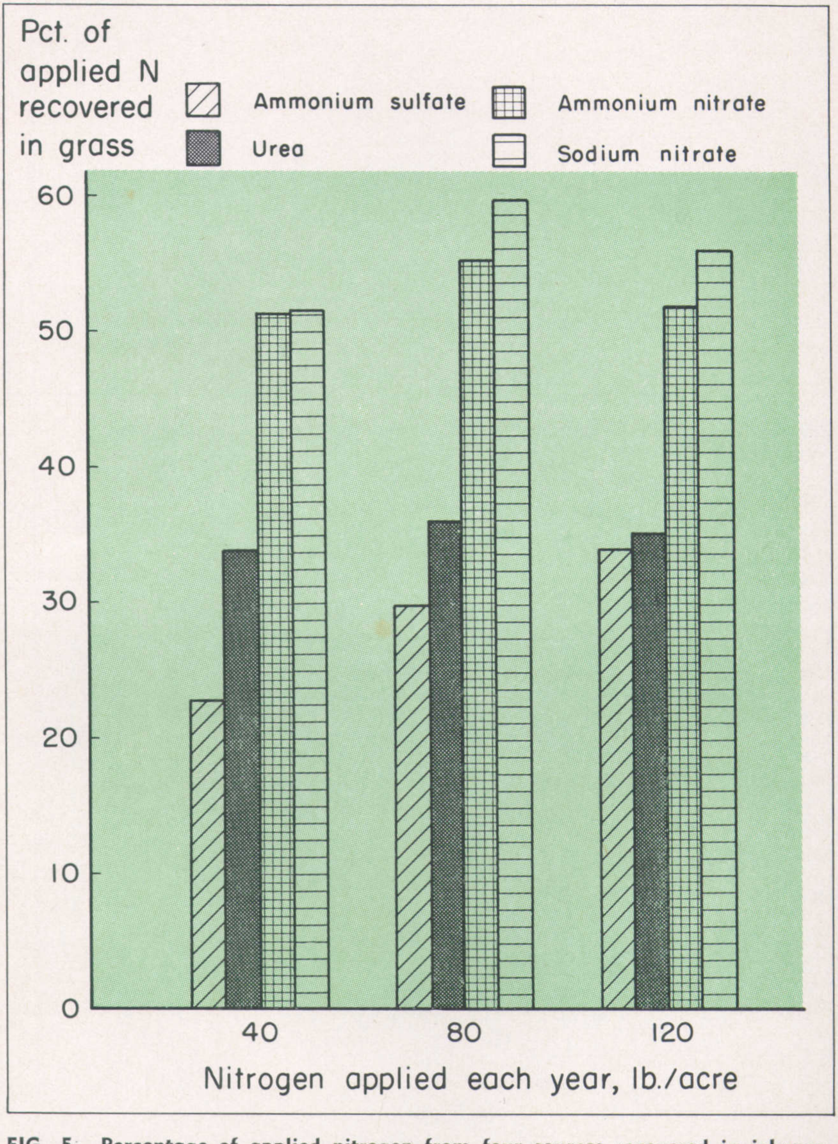


FIG. 5. Percentage of applied nitrogen from four sources recovered in johnsongrass, 1962-66, is illustrated here.

yield from these all-ammonia sources of N was probably the result of loss of ammonia as a gas.

Ammonia producing N sources applied to the surface of calcareous soil, such as Sumter clay, may be subject to losses of ammonia gas. When the soil surface is moist chemical reactions may occur that will release some of the ammonia into the atmosphere. However, if the N material is turned into the soil or rains move the fertilizer below the soil surface, then the ammonia released is not lost since it is held by the soil particles. Laboratory results confirmed the large loss of ammonia gas from these all-ammonia sources of N.

Another measure of the efficiency of N applications is the amount of applied N recovered in the forage. Average N recovery ranged from a low of 22 per cent with ammonium sulfate to a high of 60 per cent with sodium nitrate, Figure 5. This nitrogen recovery graph shows the same trends as the yields in Figure 4.

The N content of the forage increased with rate of applied N from all sources, Figure 6. The average N contents of johnsongrass grown with the 160- and 320-pound rates of N were 1.88 per cent and 2.13 per cent, respectively. These values correspond to crude protein contents of 11.8 per cent and 13.3 per cent.

The stand of johnsongrass was excellent when the experiment was begun in 1958. After 5 years there was a serious stand deple-

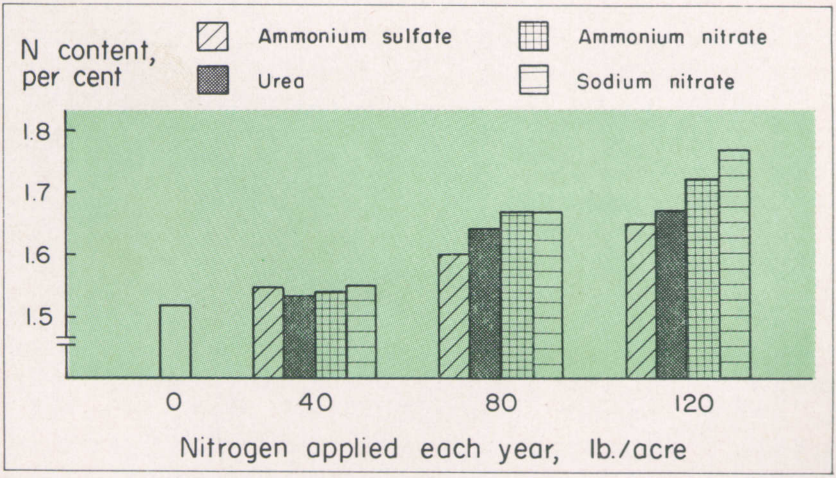


FIG. 6. Effect of rate and source of nitrogen on total nitrogen in johnsongrass, 1962-66, is illustrated here.

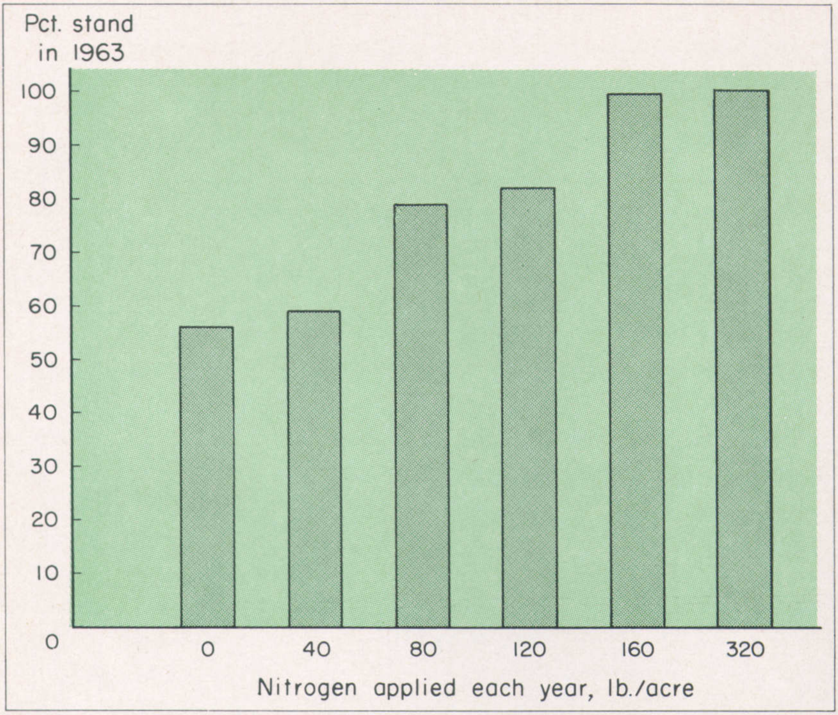


FIG. 7. Effect of nitrogen on johnsongrass stands after application for 5 years, 1959-63, is illustrated here.

tion where low rates of N had been applied, Figure 7. There were no differences among sources of N in their effect on stand. Where the stand was poor, dropseed (*Sporobolus poiretir* (Roem. Schult.) Hitche.) and foxtail (*Setaria lutescens* (Weigel) Hubb.) were the prevalent weeds. The poorer the johnsongrass stand, the greater was the weed population.

Nitrates in Johnsongrass

Johnsongrass along with many other grasses will accumulate nitrate-nitrogen (NO_3-N) under certain environmental conditions, such as drought, when a large amount of nitrate is present in the soil. Forage containing more than 0.2 per cent NO_3-N has been considered potentially toxic to ruminant animals.[4] *However, it*

[4] Bradley, W. B., H. F. Eppson, and O. A. Beath. 1940. Livestock Poisoning by Oat Hay and Other Plants Containing Nitrates. Wyo. Agr. Exp. Sta. Bull. 241.

is not possible to give a definite toxic level since it varies with such factors as condition of the animal and amount of forage consumed.

Generally, nitrates were considerably below the level considered potentially toxic even when the 320-pound rate of N was applied. The highest concentration measured was 0.17 per cent N as nitrate in the July 1963 harvest where 320 pounds of N was applied. Most harvests contained none or only a trace of nitrates regardless of rate or source of N. When nitrates were found in the grass, the content increased slightly with increasing rate of N but was similar for all sources of N.

RATES OF PHOSPHORUS AND POTASSIUM, 1963-67

There was a small increase in yield from 22 pounds of P per acre but none from a higher rate, Figure 8. There was also little or no response to applied K. Apparently the largest response was from the N. Both stand and growth were poor where no fertilizer was added.

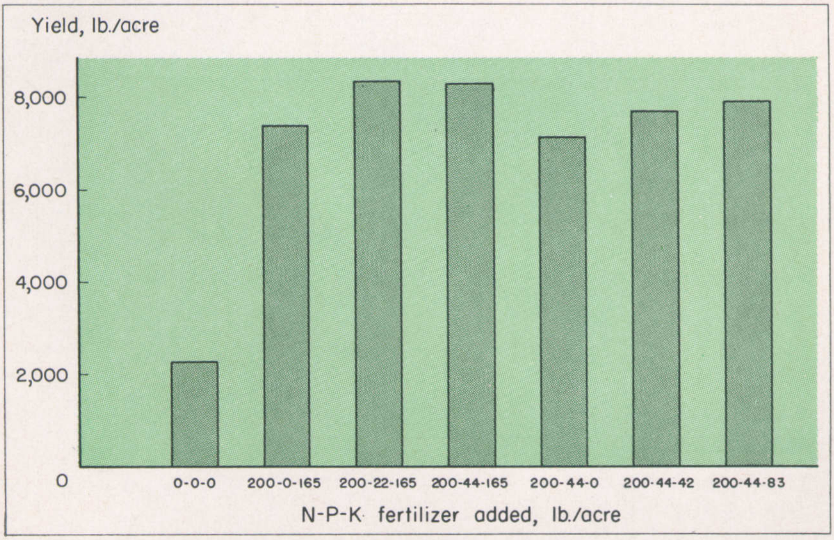


FIG. 8. Effect of nitrogen, phosphorus, and potassium fertilizer on yield of johnsongrass, 1963-67, is illustrated here.

RATES OF NITROGEN, PHOSPHORUS, POTASSIUM, AND MAGNESIUM, 1965-70

Fertilizer treatments and yields are given in the table. Yields are grouped into two 3-year averages since rainfall differences resulted in much higher yields during 1965-67 than in 1968-70.

YIELDS OF JOHNSONGRASS FROM THE RATES OF NITROGEN, PHOSPHORUS, POTASSIUM, AND MAGNESIUM EXPERIMENT, 1965-70

Element added, pounds/acre				Average yields of oven-dried johnsongrass per acre		
N	P	K	Mg	1965-67	1968-70	1965-70
				Lb.	*Lb.*	*Lb.*
0	25	100	0	4,700	3,100	3,900
50	25	0	0	7,200	4,300	5,800
50	25	25	0	7,900	4,500	6,200
50	25	50	0	6,900	4,300	5,600
50	25	100	0	6,800	4,500	5,700
100	25	0	0	9,200	5,500	7,400
100	25	25	0	9,500	5,800	7,700
100	25	50	0	7,800	5,500	6,700
100	25	100	0	9,200	5,700	7,500
200	25	0	0	10,000	5,600	7,800
200	25	25	0	11,000	6,500	8,800
200	25	50	0	11,500	7,100	9,300
200	25	100	0	11,400	6,600	9,000
200	25	200	0	11,800	7,200	9,500
200	0	100	0	11,800	5,600	8,700
200	50	100	0	11,800	7,600	9,700
200	25	100	25	11,300	7,400	9,400
200	25	200	25	12,900	7,600	10,300
200	25	100[1]	0	11,600	7,100	9,400
200	25	200[1]	0	12,500	7,300	9,900

[1] Applied in two equal applications.

There was a response to each increase in rate of N. Nitrogen had a much greater effect on yield than did the other elements applied.

As in the 1963-67 experiment, there was a small increase in yield from P. This increase became progressively larger toward the end of the experiment.

Yield increases from K were both small and erratic. Evidently the soil K was sufficient to preclude a response to more than 25 pounds of K. It made little or no difference whether the K was applied in a single or a split application.

Magnesium had no effect on yield.

Weed infestation measurements made at the end of the 6-year experiment show that the higher the rate of N the lower the weed

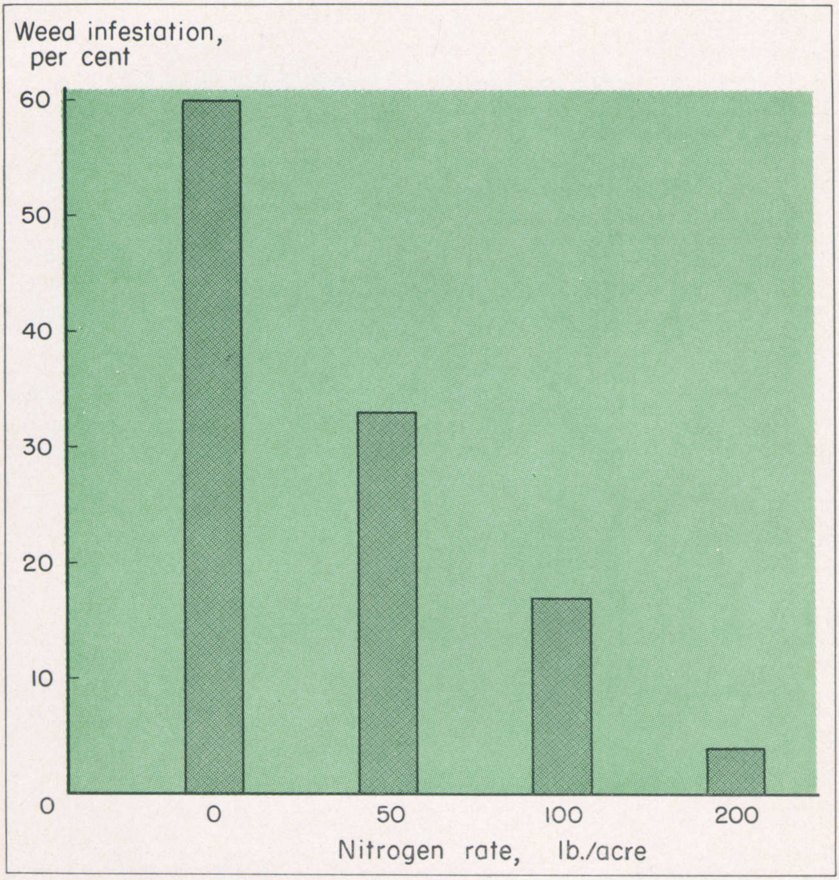


FIG. 9. Effect of applied nitrogen on weed infestation after 6 years, 1965-70, is illustrated here.

population, Figure 9. Apparently N fertilizers produced denser stands and more vigorous growth of the johnsongrass plants, which reduced weed competition.

SUMMARY AND CONCLUSIONS

Conclusions from fertility experiments conducted with johnsongrass on calcareous Sumter clay soil at the Black Belt Substation during 1958-70 are as follows:

1. There were yield increases from each increment of N up to 320 pounds per acre, the highest rate in any of the experiments.

2. Caley peas in rotation with johnsongrass increased total yield where less than about 200 pounds of N was added.

3. Yield responses to P and K were small; however, there was a loss of stand and a greater weed population where no P or K was added.

4. The higher the rate of N the better the johnsongrass stand and the lower the weed population.

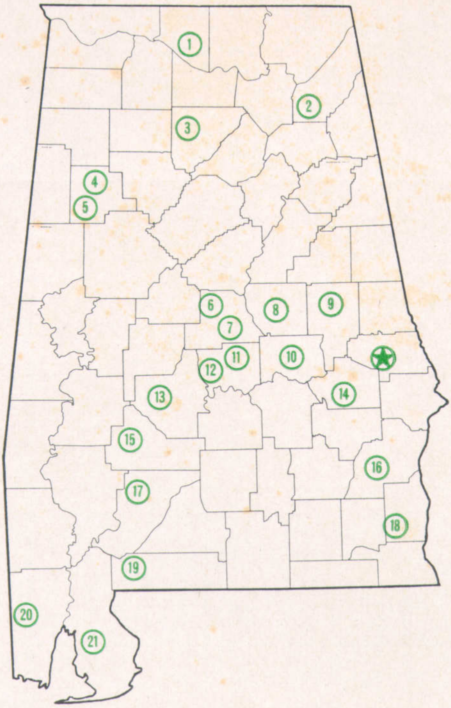
5. Ammonium nitrate and sodium nitrate resulted in higher yields than either ammonium sulfate or urea.

6. The higher the N rate the higher was the N content of johnsongrass.

7. Most harvests of johnsongrass contained none or only a trace of NO_3-N regardless of rate of N applied. When nitrates were present in the grass, the higher the rate of N the higher were the nitrates. The highest level ever measured in a single harvest was 0.17 per cent NO_3-N.

AGRICULTURAL EXPERIMENT STATION SYSTEM OF ALABAMA'S LAND-GRANT UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

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. Thorsby 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. Tuskegee Experiment Field, Tuskegee.
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. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.