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THE RELATIVE EFFICIENCY OF DIFFERENT FORMS OF NITROGEN IN FLUE-CURED TOBACCO PRODUCTION

by

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CIRCULAR 14 MAY, 1949

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INTRODUCTION

Nitrogen is one of the more important fertilizer elements in the production of tobacco. The amount to be applied for efficient production varies with the type of soil and type of tobacco. Data indicate that approximately 30 pounds of nitrogen per acre are sufficient for flue-cured tobacco production. Fertilizer recommendations for flue-cured tobacco state that the nitrogen should be derived from more than one source. Since the cost per unit of nitrogen (20 pounds N) and the relative availability for plant assimilation differ so much in the various forms of nitrogen, it is desirable to know the yields and dollar returns on tobacco from these various forms of nitrogen in tobacco fertilizer so as to use the most efficient and profitable source for production.

Numerous experiments have been run on nitrogen sources at this and other Experiment Stations during the past thirty years, but the question always arises as to the possible influence of the elements associated with the various forms of nitrogen. This experiment was designed to evaluate the influence of the various forms of nitrogen separated from the elements associated with these forms. To do this, rates of phosphorus, potash, calcium, magnesium, sulphur, and chlorine were kept constant on all treatments. By keeping these values constant, comparisons were made of the relative values of nitrogen from ammoniacal ($(NH_4)_2SO_4$), nitrate ($NaNO_3$ and KNO_3), urea ($CO(NH_2)_2$), and cottonseed meal forms, as well as a mixture with one-fourth of the nitrogen derived from each of the four forms. A fertilizer with no nitrogen was used as a check.

REVIEW OF LITERATURE

Relative cost per unit of nitrogen: During the early part of the century there was little difference in the cost per unit of nitrogen (20 pounds N) from the various soluble and insoluble sources. A higher percentage of the nitrogen used as fertilizer during the 1910-1914 period was from natural organic sources because of supply, physical condition of the mixtures having high organic content, and custom. With the increase in facilities for the production of water soluble sources of nitrogen and the increase in demand for vegetable oil meals and packinghouse by-products as a feed for livestock, soluble sources of nitrogen are at present more widely used. There has been very little change in the price per unit of nitrogen from the soluble sources of nitrogen considered in

(1) Cooperative investigation by Georgia Coastal Plain Experiment Station, the State College of Agriculture of the University System of Georgia, and U. S. D. A., Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration.

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this discussion since the early part of the century, whereas the price per unit of nitrogen from the insoluble source (cottonseed meal) has increased threefold (Table 1).

TABLE 1.

PRICE OF THE FOUR FORMS OF NITROGEN PER UNIT OF NITROGEN (20 POUNDS N) FOR 1910-1914 PERIOD AND 1949

Nitrogen Source	Wholesale Price (1)		Retail Price (2)
	1910-1914	Jan. 1949	April 1, 1949
Ammonium sulphate	$2.85	$ 2.23	$3.00
Nitrate of soda	2.68	3.15	4.06
Cottonseed meal	3.50	10.29	9.84
Urea	(3)	(3)	2.57

(1) Better Crops with Plant Food. February 1949. pp. 34-35.
(2) Retail price, Tifton, Georgia. April 1, 1949.
(3) Information not available.

Relative availability of different forms of nitrogen:

In Lysimeter experiments (7) in which the applied nitrogen recovered from nitrate of soda was given a value of 100, 81.0 percent of the applied nitrogen was recovered from urea, 76.4 percent from sulphate of ammonia, and 58.0 percent from cottonseed meal.

Experiments (6) covering a period of twenty years on limed soil show that the percentage of applied nitrogen recovered by crops was 41.9 percent from sulphate of ammonia, 33.4 percent from nitrate of soda, 26.6 percent from dried blood, and 25.5 percent from tankage.

Results from studies of forty-eight commercial fertilizer mixtures in North Carolina (3) show that the average efficiency of the insoluble nitrogen in one-fourth of the mixtures included in the highest classification would not exceed about 70 percent of the value of nitrogen supplied by sulphate of ammonia. These studies also show that three-fourths of the mixtures would release for crop growth 35 percent or less of their insoluble nitrogen in a single season.

Results from experiments with flue-cured tobacco in Virginia (4) and Georgia (1), and with cotton in North Carolina (10) show that higher yields were obtained from water soluble sources of nitrogen than from insoluble sources. Data on sources of nitrogen (2) in tobacco plant production show that tankage as a source of insoluble nitrogen was equal to or better than nitrate of soda, ammonium sulphate, and urea when used as a single source of nitrogen at the rate of two pounds per square yard of 4-8-3. However, approximately 30 percent more plants were produced when the nitrogen was derived equally from the four sources named. Other data (8) on sources of nitrogen in tobacco plant production show that with 1.5 pounds or more of insoluble nitrogen (cottonseed meal) per hundred square yards of bed area there was a reduction of plant stand and total plants produced.

In experiments with shade-grown cigar wrapper tobacco at Attapulgus, Georgia (5), good results were obtained with 56 percent or more of the nitrogen derived from insoluble source (cottonseed meal). It should be pointed out that the recommended amount of nitrogen for this type of tobacco is 200 pounds nitrogen per acre compared to 30 pounds for flue-cured tobacco. Results from experiments in Connecticut (9) with oil seed meals including cottonseed meal, castor pomace, and soybean meal show that, as a source of nitrogen in tobacco production, castor pomace was at least 20 percent and soybean meal was 10 percent to 15 percent more efficient than cottonseed meal.

MATERIAL AND METHOD

This experiment covered a 5-year period (1940-1944 inclusive) and was located twelve miles south of Tifton, Georgia, on a Norfolk sandy loam soil. The tobacco was in a 3-year rotation of Spanish peanuts harvested, oats followed by natural weed growth, and tobacco the third year. No fertilizer was applied to either the peanuts or the oats.

Six treatments in a randomized block with four replications were used on which 1000 pounds per acre of a 3-8-12 fertilizer were applied. Each treatment consisted of six rows 68 feet long and spaced four feet apart. Tobacco plants were spaced two feet in the drill. Data were taken from the four inside rows or 1/40 acre.

The fertilizer in each treatment (Table 2) contained 8 percent phosphoric acid (P_2O_5), 12 percent potash (K_2O), 6 percent calcium (CaO), 2 percent magnesium (MgO), 12 percent sulphur (SO_3), and 2 percent chlorine (Cl). The mixtures contained 3 percent nitrogen in all treatments except one in which there was no nitrogen and were derived as follows: (1) sulphate of ammonia, (2) nitrate of soda and potassium nitrate, (3) cottonseed meal, (4) urea, (5) one-fourth of the nitrogen from each of the above forms, and (6) no nitrogen. The only inconsistency was that the nitrate treatment received 46 pounds sodium per acre. No way could be found to eliminate sodium without upsetting the balance of some of the other elements.

TABLE 2
MATERIALS USED TO SUPPLY PLANTFOOD

Material	Treatment No. and Lbs. per Acre					
	1	2	3	4	5	6
DiCalcium phosphate	200	200	180	200	195	200
Sulphate of ammonia	150				37.5	
Muriate of potash	43	43	43	43	43	43
Magnesium sulphate	125	125	100	125	120	125
Potassium carbonate*	165			10	5	10
Nitrate of soda (Arc.)		175				
Potassium nitrate		15			58	
Sulphate of potash		200	200	200	150	200
Cottonseed meal (7%)			430		107	
Gypsum			22		5	
Urea				66	16.5	

* ALL CARBONATE OF POTASH APPLIED AS A SEPARATE APPLICATION DUE TO ITS INCOMPATIBILITY WITH OTHER FERTILIZER MATERIALS.

Values per acre were determined by separating each harvesting into as many grades as were necessary to obtain uniformity within grades. Each grade