Use of Nitrogen Fertilizers

by F. W. PARKER

WAR LIVES on nitrogen. All explosives except the atomic bomb are nitrogen compounds. War increases the need for nitrogen fertilizers for growing more food and fiber. To meet increased wartime needs, the United States more than doubled its capacity to produce fixed nitrogen compounds, by building 10 new synthetic nitrogen plants. As a result, our Army and Navy had plenty of ammunition, and American farmers used more fertilizer nitrogen than they had ever used before—in fact, 10 times the 62 thousand tons they used in 1900. But even this record supply was not all they wanted or could well have used.

Nitrogen for fertilizers comes from natural organic materials like dried blood, tankage, and cottonseed meal, or from chemical compounds like ammonium sulfate, sodium nitrate, ammonia solutions, and ammonium nitrate. A sharp cut in the price of chemical nitrogen between 1925 and 1935 followed the development of synthetic nitrogen processes, stimulated the use of nitrogen, and caused a trend away from the higher priced natural organics.

Farmers in some States use a great deal of nitrogen. Others use very little. In Maine, Florida, and Ohio mixed fertilizers supply most of the nitrogen. In California, Mississippi, and South Carolina most of the nitrogen is used as nitrogen fertilizer materials unmixed with phosphate and potash. Seven States along the South Atlantic and Gulf coasts use 53 percent of the fertilizer nitrogen; Iowa and Minnesota and the great wheat-producing States use little nitrogen. Why?

Several factors are involved, among them the nitrogen content of the soil, rainfall, cropping or farming system, and the value of the crop per acre. In the Southeast, where rainfall and mean annual temperature are relatively high, the soils are low in nitrogen and farmers use a large

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The use of nitrogen fertilizers by American farmers has increased tenfold since 1900. As consumption increased, the proportion of nitrogen in the form of ammonium sulfate, sodium nitrate, cyanamide, ammonia solutions, and ammonium nitrate has increased. Much of the change from natural organics has been due to price changes in favor of chemical nitrogen, prices of which dropped sharply from 1925 to 1935 because of improved synthetic processes for making it. Here are significant facts

Year	Nitrogen consumption	Percentage of fertilizer investment chargeable to nitrogen	Part supplied as chemical nitrogen	Average wholesale price of 20 pounds of nitrogen as—		Percentage of total plant food supplied as nitrogen
				Natural organics	Chemical nitrogen	
	Tons	*Percent*	*Percent*	*Dollars*	*Dollars*	*Percent*
1900.....	62,000	35	12	2.57	2.42	15.7
1910.....	145,900	41	46	3.63	2.76	16.1
1920.....	227,800	40	66	8.71	4.26	19.9
1930.....	376,600	45	84	4.50	2.14	24.7
1940.....	419,100	43	88	3.55	1.42	23.7
1944.....	626,200	40	94	4.82	1.40	24.9

quantity of fertilizers. In the Corn Belt the soils are higher in nitrogen, and less is applied as fertilizer.

Difference in rainfall is an important factor. Generally speaking, rainfall in the States west of Minnesota, Iowa, Missouri, and Arkansas is so low that water, rather than nitrogen, limits crop yields except on irrigated land. There is some evidence that nitrogen fertilizers may be profitably used for the production of grass seed and wheat under certain conditions in parts of the West, but for the most part the use of nitrogen is limited to irrigated crops.

A third factor is the farming system. In a good livestock system legumes are grown and much of the nitrogen is returned to the land in farm manure. In a cash crop system a higher proportion of the nitrogen is sold. In eight Southeastern States, 75 to 85 percent of the farm income is from the sale of crops. In the Corn Belt States only 20 to 40 percent of the farm income is from the sale of crops, whereas 60 to 80 percent is from livestock. Differences in farming systems as well as differences in soils and rainfall are important.

The value of the crop being grown also is a factor. High-value crops, such as citrus, tobacco, potatoes, and vegetables, usually are heavily fertilized. Cotton, one of the higher valued field crops, receives moderate fertilization. Lower valued crops generally are fertilized at lower rates.

Large quantities of nitrogen are required for high yields of most crops. A 60-bushel corn crop contains about 95 pounds of nitrogen, 57 pounds in the grain and 38 pounds in the stover. This nitrogen must come from the soil, legumes that have been turned under, manure, or fertilizers.

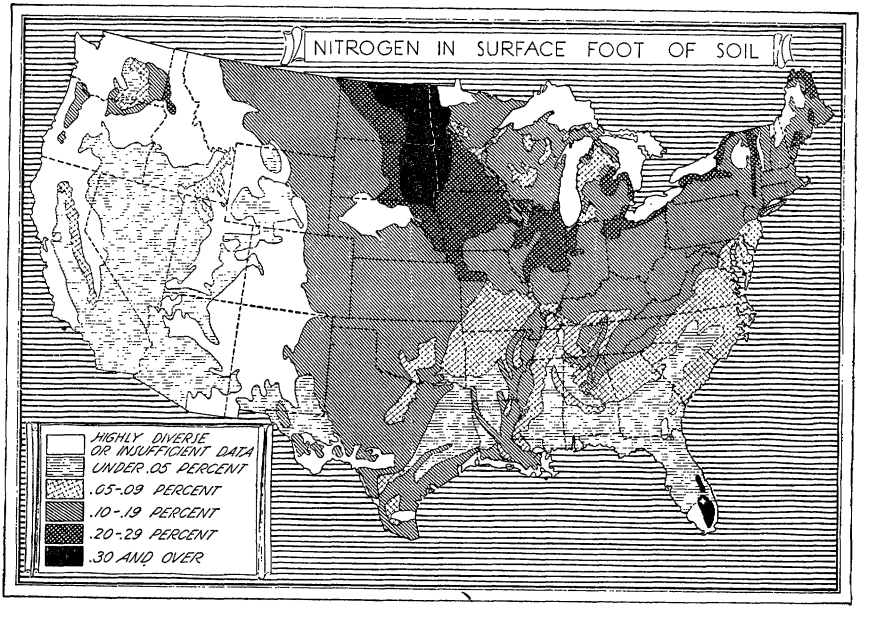
The time when the crop needs nitrogen corresponds with its rate of growth. Little nitrogen is needed in the seedling stage, but that little is highly essential. The demand is greater when growth is quite rapid. Usually this is in midsummer for spring-planted crops. Corn planted on

May 22 in Ohio needed only 12 pounds of nitrogen before July 1. Between July 10 and August 10 the crop absorbed 81 pounds of nitrogen—almost 60 percent of the nitrogen required for the 117-bushel crop. These figures indicate the corn crop needs most of its nitrogen during the 1 month of maximum growth.

The nitrogen may be supplied in a mixed fertilizer, one containing nitrogen, phosphoric acid, and potash, or as a fertilizer containing only nitrogen. One point is important. The crop should be well fertilized with phosphate and potash if they are needed. Nitrogen fertilization will not give good results if there is a deficiency of other nutrients, insufficient water, or other factors unfavorable to growth. Ordinarily when other nutrients are needed, all or part of the nitrogen required is included with them in the application of a mixed fertilizer. This is an efficient and convenient method under many conditions.

Where large quantities of nitrogen are to be applied or in regions of high rainfall and light soils, a common practice is to apply a part of the nitrogen in mixed fertilizer at planting and the rest as a side dressing along the row. This is the general practice with cotton and corn in the South. On some soils nitrogen is the only fertilizer that gives profitable returns. Examples are the soils of the Mississippi Delta and certain soils in California.

Row crops are usually fertilized somewhat as has been indicated for corn; namely, all or a part of the nitrogen is applied in a mixed fertilizer at planting. Supplementary nitrogen may be applied as a side-dressing shortly after the crop is well established and is making good growth.



This table, taken from the March 1940 issue of Better Crops With Plant Food, shows the nitrogen content of some common nonlegume crops. Potatoes rank very high

Crop	Yield per acre	Nitrogen content	Crop	Yield per acre	Nitrogen content
		Pounds			*Pounds*
Cotton	1 bale	65	Potatoes	300 bushels	125
Tobacco	1,500 pounds	80	Tomatoes	10 tons	100
Corn	60 bushels	95	Cabbage	15 tons	100
Wheat	30 bushels	50	Apples	400 bushels	30
Oats	50 bushels	50	Peaches	500 bushels	85
Timothy	1.5 tons	40	Oranges	600 boxes	90

Wheat in the Midwest is usually fertilized at planting in the fall with a complete fertilizer containing 2 to 4 percent nitrogen. Additional nitrogen may be applied as a top dressing in the spring, but that is not a well established practice. In the South, a spring top dressing of nitrogen fertilizer on small grains is a general practice.

Details of fertilization vary so much with soil, crop, and climatic conditions that it is advisable for farmers to consult local and State authorities for specific recommendations.

The selection of a satisfactory nitrogen fertilizer is not difficult. All of the nitrogen fertilizers on the market give good results when used properly. In general, there are no great differences in their efficiency.

A few facts should be understood regarding differences in the properties of various forms of nitrogen:

Both ammonium and nitrate nitrogen are readily absorbed by plants in the early as well as later stages of growth. Nitrate nitrogen moves with the soil water and may be leached from the soil by heavy rainfall. Ammonium and related forms of nitrogen are not readily leached from the soil.

Sodium nitrate and cyanamide are slightly basic in residual reaction. Their continued use tends to reduce slightly the soil acidity.

Ammonium sulfate is quite acid in its action on the soil. It requires about 1 pound of limestone to correct the acidity from 1 pound of ammonium sulfate. Ammonium nitrate and uramon produce only one-third as much acid as an equivalent amount of ammonium sulfate.

The physical properties of nitrogenous fertilizers, found in the market, range from fair to excellent. Granular materials free of dust are easier to handle and are generally preferred by farmers.

Since equivalent amounts of the different nitrogen fertilizers give substantially the same results for most crops, their relative cost is an important consideration. They should be purchased on the basis of cost per unit of nitrogen, with small allowances for differences in some of the properties indicated, if those properties are important considerations under the conditions of use. Comparative unit costs are calculated by dividing the ton price by the percentage of nitrogen (N) in the fertilizer. At any given location and time the price relationships shown in the table

This table shows the relative retail price of nitrogen in different fertilizers. Prices are based on the average OPA ceiling for March 1946 for three regions

Fertilizer	Nitrogen content	Relative retail price of nitrogen (ammonium sulfate = 100)		
		Southeast	Midwest	New England
	Percent			
Ammonium sulfate	20. 5	100	100	100
Sodium nitrate	16. 0	133	144	128
Ammonium nitrate	32. 5	98	85	84
Cyanamide	21. 0	128	124	119
Cal-nitro	20. 5	107	119	111
Uramon	42. 0	86	88	79

above may not hold. Buyers, therefore, should calculate unit costs from the guaranteed analysis and price data furnished by the dealer or salesman.

The final selection of a nitrogen fertilizer can therefore be made on the basis of cost per unit of nitrogen, physical properties, and their influence on the chemical and physical properties of the soil.

The crop returns from the use of nitrogen fertilizer depend on many factors other than the kind of fertilizer selected and how it is used. Nitrogen fertilizers give best results when their use is combined with other good soil and crop management practices. The soil should be limed when needed, have a good supply of available phosphate and potash, be in good tilth, and have a satisfactory supply of moisture. The crop should be an improved variety with date of planting, rate of seeding, and cultural methods best adapted for local conditions. What returns can be expected from nitrogen fertilizers when a farmer does all this?

Extensive field experiments, many of them in cooperation with farmers, indicate that the approximate increase from the use of 10 pounds of nitrogen on crops will be about as follows:

Cotton, 100 to 140 pounds of seed cotton; corn, 3 to 5 bushels; wheat (Ohio, Indiana), 2 to 3 bushels; oats (South), 6 to 8 bushels; timothy or Sudan grass hay, 300 to 400 pounds; potatoes (Eastern States), 6 to 8 bushels; apples, 30 to 90 bushels; peaches, 20 to 60 bushels.

The data are representative of returns obtained in States east of the Mississippi River at normal to good rates of fertilization—30 to 60 pounds of nitrogen to the acre in most cases. They show that where nitrogen fertilization is needed it gives good returns.

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