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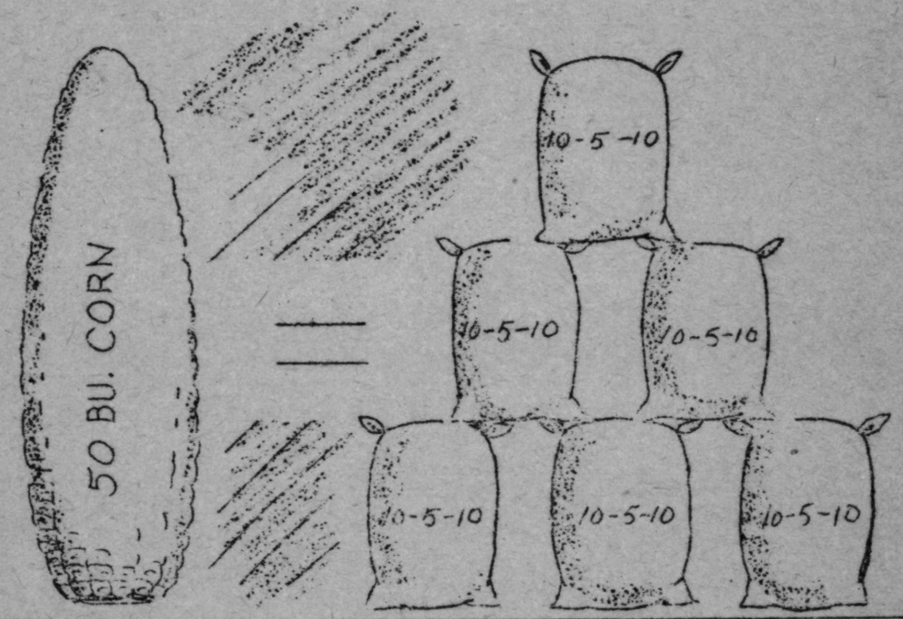
FIELD TRIALS WITH FERTILIZERS IN SOUTH DAKOTA



Plant food removed by crops

Agricultural Experiment Station
South Dakota State College
Brookings, South Dakota

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FIELD TRIALS WITH FERTILIZERS IN SOUTH DAKOTA

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INTRODUCTION

The continuous production of farm crops without the return of a substantial quantity of the plant food removed by the crops will result in a shortage of plant food in the soil. Investigations conducted by the South Dakota Agricultural Experiment Station reveal that our cultivated soils have lost in the past 50 years approximately 40% of their original content of organic matter. Associated with this loss is the loss of 29% of the original nitrogen content of the soil which is a constituent of organic matter. Continuous cropping has also depleted our soils of a considerable portion of other plant food, especially phosphorous. The rate of plant food removal from the soil is proportional to the crop yield. For example, a 50 bushel crop of corn requires 80 pounds of nitrogen, 20 pounds of phosphorous and 55 pounds of potassium. This is equivalent to the plant food in approximately 600 pounds of complete fertilizer. Improved varieties of cereals and hybrid corn which are capable of producing higher crop yields are also increasing the rate at which plant food is removed from the soil. In order for the improved crops to produce maximum yields an adequate amount of plant food must be available to them in the soil. It now appears that it is necessary to give more attention to the soil fertility factor in crop production in South Dakota.

EXPERIMENTAL PROCEDURE

In 1944 field experiments were conducted on private farms in order to study the effect of the application of plant food in the form of fertilizer on the yields of crops. Soil fertility plots were located in the following counties: Brookings, Deuel, Clay, Clark, Codington, Grant, McCook, Moody and Union. The plots were so distributed that the locations would be representative of the major crop and soil areas. County Agents and Soil Conservation Service assisted in locating and making arrangements with the farm cooperators.

These plots were established on private farms by arrangement with the owner of the farm. The entire field including the plot is farmed in the usual manner by the farmer and the plots received no special cultural practices except the application of the fertilizer. The fertilizer applications and the samples of the crop taken for yield were made by members of the Experiment Station staff. From time to time during the growing season the plots were inspected to note the condition of the crop or any damage which may have occurred due to insects, hail or excessive water, etc.

FERTILIZERS AND RATE OF APPLICATION

The plant food elements, nitrogen, phosphorus and potassium are the principal elements which enter into the makeup of commercial fertilizers. These three elements are sometimes called the primary elements of plant food because they are used heavily in crop production and may become deficient in soils. These elements may occur singly or in combination in commercial fertilizers. If all three elements enter into the composition of the fertilizer it is known as a complete fertilizer.

The plant food was applied to the fertilizer test plots in the following forms: nitrogen in ammonium sulphate, phosphorus in treble superphosphate and potassium in muriate of potash. The rates were 100 pounds ammonium sulphate, 100 pounds treble superphosphate and 50 pounds muriate of potash, respectively per acre. The same rates were used whether the fertilizer was applied alone or in combination.

Table I. 1944 Average Acre Yields of Crops Following Fertilizer Treatments For all Locations

Treatment	Corn (5 farms) Bu.	Small Grain (5 farms) Bu.	Pasture (3 farms) Tons of Hay	Potatoes (3 farms) Bu.
1. None	67.6	38.9	.94	142.5
2. Nitrogen	75.7	52.1	1.53	140.8
3. Phosphorous	77.2	48.9	1.28	205.8
4. Potassium	75.3	46.8	1.15	179.5
5. Nitrogen-Phosphorous	80.2	57.0	1.58	197.5
6. Nitrogen-Phosphorous-Potassium	79.6	64.2	1.79	213.8

In Table I is presented the average yields of all crops from all locations.

Results on Corn

The corn plots were located in Clay, McCook, Moody, Brookings and Grant counties. Corn yields are the average from five farms. The yields of corn were increased in every case by fertilizer treatment. The largest yields of corn were obtained when the fertilizer treatment included nitrogen and phosphorous. Nitrogen and phosphorous increased the yield of corn approximately 13 bushels per acre and the complete fertilizer 12 bushels per acre over the untreated or no treatment plots.

Results on Small Grain

The small grain fertility plots were located in Clay, McCook and Day counties.

Oats were grown on three farms and barley on one farm. The small grain yields were influenced the most by the application of nitrogen fertilizer. The yields were increased in every case by all fertilizer treatments. Nitrogen increased the yields of small grain approximately 14 bushels per acre. The complete fertilizer nitrogen, phosphorous and potassium increased the yield of small grain 26 bushels per acre.

Results on Pastures

Pasture fertilizer experiments were conducted in Union, Brookings and Deuel counties. From Table I it may be noted that the application of nitrogen either alone or in combination gave the largest increases in hay yields.

Results on Potatoes

The potato fertilizer trials were located in Codington and Clark counties. The application of phosphorous alone increased the yields of potatoes 63 bushels and potassium alone increased the yield approximately 38 bushels. The complete fertilizer increased the yield approximately 71 bushels per acre.

It is evident from the data that the application of fertilizers gave substantial increases in yield for all crops, but it must be remembered that the results are for the one year (1944) when climate factors especially rainfall were very favorable for crop production.

Methods of applying fertilizer

For closely planted crops such as small grain the fertilizer may be applied broadcast previous to preparing the seed bed and afterwards disked into the soil. Another method of application is by means of a fertilizer attachment on the grain drill which places the fertilizer near the seed.

To the corn crop fertilizer may also be applied broadcast and then plowed under or by means of a fertilizer attachment on the planter which places the fertilizer near each hill. A newer method of application for the corn crop is by means of an attachment on the plow which places the fertilizer in a narrow band in the bottom of the furrow. Placing fertilizer deeper in the soil by plowing under or by the plow attachment may frequently prove to be better than the hill method in seasons when rainfall may be low in midsummer.

Fertilizer Recommendations for 1945

The following general recommendations are made for South Dakota:

Crop	Amount per Acre	Analysis
Small Grain	100 to 150 lbs.	4-24-12
Corn	100 to 200 lbs.	4-24-12
Pasture	100 to 200 lbs.	Ammonium sulphate
Potatoes	300 to 500 lbs.	0-20-10

The recommendations are tentative and will be subject to future modifications depending upon the availability of certain types of fertilizer. Because of war conditions the amount of nitrogen available is extremely limited and for that reason the recommendations are for fertilizers which are relatively low in nitrogen. On soils where the nitrogen content has been fairly well maintained by manure and crop rotations, the use of treble superphosphate at the rate of approximately 100 pounds per acre is advisable.

Determination of a Soil's Need for Fertilizer

The most reliable method for determining the fertilizer needs of a soil is by field tests. Since the growth of crops is influenced by rainfall, drainage, crop rotations, previous soil treatment, varieties grown and other cultural practices it is very difficult to predict on the basis of chemical tests alone just what fertilizer or combination of fertilizers that will give maximum yields of crops on a given soil. Chemical tests are of value in determining the relative quantities of plant food in the soil but cannot be relied upon entirely for making fertilizer recommendations. If these tests are used at all they must be supplemented by actual field trials with fertilizers. For these reasons it is recommended that farmers be guided by fertilizer trials conducted in his vicinity.

Plant symptoms may also be used as a guide in determining the fertilizer needs of a soil. This is especially true for soil nitrogen deficiencies. Plants which are not getting sufficient nitrogen from the soil will be light green to yellow in appearance. The lower or older leaves will usually be first to show these symptoms.