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Recommended Citation

Puhr, Leo; Shubeck, Fred; Ladd, Leonard; and Switzer, Merle, "Fertilizer Recommendations for S.D. Crops" (1954). *SDSU Extension Circulars*. 703.

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Extension Circular 505

February 1954

Fertilizer Recommendations for S. D. Crops



Agricultural Extension Service
SOUTH DAKOTA STATE COLLEGE
U.S. DEPARTMENT OF AGRICULTURE

Fertilizer Recommendations For South Dakota Crops

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The use of fertilizer is rapidly becoming recognized as an essential part of a good soil management program. Fertilizers, however, are not a substitute for other well established soil management practices. A good rotation is the foundation of a sound fertility and soil building program. Commercial fertilizer should be used to correct the plant food deficiencies that normally occur under our best soil management systems. It should be emphasized that the fullest use be made of legumes and grasses, crop residues and manure to maintain the organic matter supply of the soil and to reduce the amount of fertilizer required for maximum crop production.

For the present time, most South Dakota soils have the capacity to supply all the essential elements required for general crop production except nitrogen and phosphorus. These two elements are required in large amounts by crops and therefore are deficient in many soils. Potassium is also required in large quantities by crops, but South Dakota soils are usually capable of furnishing sufficient amounts of this element.

These recommendations are based on information obtained from soil fertility experiments, fertilizer field trials on private farms, and observations under field conditions.

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Fertilizer Facts and Terms

Fertilizers are carriers of the plant food elements in an available and concentrated form. The principal plant food elements in commercial fertilizers are nitrogen, phosphorous and potassium. These elements are removed in large quantities by crops and are commonly deficient in soils.

The composition or analysis of a fertilizer is expressed by means of a formula which is always printed on the bag or label. The first figure of the formula refers to the percentage of available nitrogen (N), the second figure to the percentage of available phosphoric acid (P_2O_5), and the third to the percentage of potassium oxide (K_2O). For example, a mixed fertilizer having the formula 4-24-12 would have 4% N, and 24% P_2O_5 , and 12% K_2O . Not all fertilizers have all three elements. For example a fertilizer having the formula 33-0-0 would have 33% nitrogen and no phosphorus and no potassium.

When purchasing fertilizer it should be emphasized that it is the total amount of plant food indicated by the analysis that is important, rather than the total weight of the bag and its contents. The value of a fertilizer should be based on the cost per pound of each of the available plant food elements in the container and not the total weight. This applies to all types of fertilizer no matter if they are sold or applied to the soil as a liquid, solid, or a gas.

Determining Plant

Food Deficiencies

One of the most important reasons for low crop yields is a lack of sufficient plant food. The cropping history of a farm gives important information on the present state of its soil fertility. Soils heavily cropped with small grains and corn without the return of barnyard manure, green manure, or crop residues, are usually low in organic matter and deficient in nitrogen. Nitrogen deficiencies are very easily observed in small grains and corn. The need for more nitrogen is indicated by a light green to yellow appearance of the leaves, by a retarded rate of growth, and by a reduced plant size.

Phosphorus deficiency symptoms on small grain and corn are not so easily detected. Stunted plant growth and delayed maturity are common symptoms of phosphate starvation. The need for more phosphate on alfalfa

is indicated by short stunted plants, yellowish color of lower leaves, and premature browning of the plants in the fall.

Potash deficiencies are seldom found in South Dakota because the soils are well supplied with this element.

An individual farmer may try fertilizers in an experimental way and determine the kinds of fertilizer and rates of application which are most beneficial for his particular soil and soil management system.

Chemical soil tests are also a means of determining plant food deficiencies. These tests measure the available plant nutrient supply in the soil and from the interpretation of these tests, fertilizer recommendations are made. A soil testing laboratory is maintained at South Dakota State College. Further information on soil testing may be obtained from the county extension agents office or by writing the Soil Testing Laboratory, Department of Agronomy, College Station, South Dakota.



Fig. 1. A combination grain-fertilizer drill is the most effective method of applying fertilizer to small grains.

Use of Fertilizers For Farm Crops

The specific recommendations for each crop are discussed separately. Included in this discussion is the effect of soil and management practices on the use of fertilizer, the effect of method of application on utilization of fertilizer, and the effect of nitrogen and phosphate on crop yields. The recommended fertilizer grades and rates of application for the various crops are presented in table form.

Fertilizers for Corn

Nitrogen is usually the most deficient plant food element for corn production. This is especially true for soils which have been continuously planted to soil depleting crops. Nitrogen fertilizer will usually increase corn yields except when the nitrogen requirements have been supplied by a legume in the rotation or by applications of manure. The type of soil also influences the response to nitrogen. For example, the well drained rolling upland soils are more responsive to nitrogen than the nearly level deep dark moderately well drained soils.

The lack of phosphorus frequently reduces yields and retards maturity of corn. Phosphorus is most efficiently used when applied with nitrogen or in association with a legume rotation.

A fertilizer attachment on the corn planter appears to be the best method to apply small quantities of mixed nitrogen and phosphate fertilizers. Large quantities of mixed fertilizer or straight phosphate may be applied by broadcasting and then disked or plowed under. Straight nitrogen may be applied before planting by broadcasting and plowing under or by broadcasting after plowing and disking in. Straight nitrogen may also be applied by side-dressing with an attachment on the cultivator at the time of second cultivation. A recent practice is to broadcast nitrogen on corn at the time of the second cultivation. This appears to be a practical method of applying nitrogen, but the fertilizer should be dropped between the rows and kept off the corn plants. In the drier parts of the corn producing area, the plowing under of all fertilizer generally gives the best results.

Recommended Fertilizer Grades and Rates of Application for Corn

Explanation of fertilizer use on corn	Fertilizer grades	Rates of application, lbs. per acre
a) These fertilizers supply only nitrogen. In the eastern part of the state, the application of phosphorus with nitrogen will usually give larger yields and earlier maturing corn.	82-0-0	40-80
	43-0-0	75-150
	33-0-0	100-200
	20-0-0	150-300
b) These mixed fertilizers may be used on soils that are fairly well supplied with nitrogen but also need phosphorus. When these fertilizers are used on soils which are very deficient in nitrogen, an additional quantity of nitrogen should be supplied with the fertilizers listed in paragraph a).	16-20-0	50-100
	11-48-0	50-100
	10-20-0	50-150
	8-32-0	50-150

- | | | |
|---|--------|---------|
| c) Straight phosphate should be used only when the nitrogen supply has been maintained by use of legumes, by applications of manure, or by application of high nitrogen fertilizers listed in paragraph a). | 0-45-0 | 50-150 |
| | 0-20-0 | 100-200 |



Fig. 2. The height of wheat on this marker shows its response to fertilizer treatment.

Fertilizers for Spring Wheat

Nitrogen is the most deficient plant food element in the soil throughout the spring wheat belt. Wheat does not usually give a profitable response to nitrogen when grown on land following a legume, or a recent application of manure, or after summer fallow.

Phosphorus deficiencies do occur, but they are not as widespread or prevalent as nitrogen deficiencies. When applied alone, phosphorus seldom gives satisfactory yield increases. A mixed fertilizer containing both nitrogen and phosphorus sometimes gives yield increases greater than from nitrogen alone. This is

especially true for the eastern part of the spring and winter wheat area. Straight phosphorus fertilizers are best utilized by wheat when used in conjunction with a legume rotation.

A fertilizer attachment on the grain drill is the most effective device for the application of fertilizer to small grains. Fertilizer may be applied by broadcasting on the surface previous to planting, followed by light disking or harrowing, or it may be broadcast just after planting followed by harrowing. Straight nitrogen fertilizer may be broadcast as a top dressing to winter wheat and rye early in the spring.

Recommended Fertilizer Grades and Rates of Application for
Spring Wheat, Winter Wheat, and Rye

Explanation of fertilizer use on spring wheat, winter wheat and rye	Fertilizer grades	Rates of application, lbs. per acre
Straight nitrogen fertilizers are more adapted to the central and western part of South Dakota where soil phosphorus is generally adequate.	82-0-0	25-50
	43-0-0	50-100
	33-0-0	75-150
	20-0-0	100-200
Mixed fertilizers containing both nitrogen and phosphorus can be used anywhere in the wheat area but the most profitable use will be obtained in the more humid parts where phosphorus is more often a limiting factor for wheat production.	20-20-0	75-150
	16-20-0	100-200
	15-15-0	100-200
	13-39-0	150-200
	10-20-0	100-200
Straight phosphate is recommended for wheat only when the nitrogen requirements are supplied by legumes, summer fallow or commercial nitrogen fertilizer.	0-45-0	50-100
	0-20-0	100-200

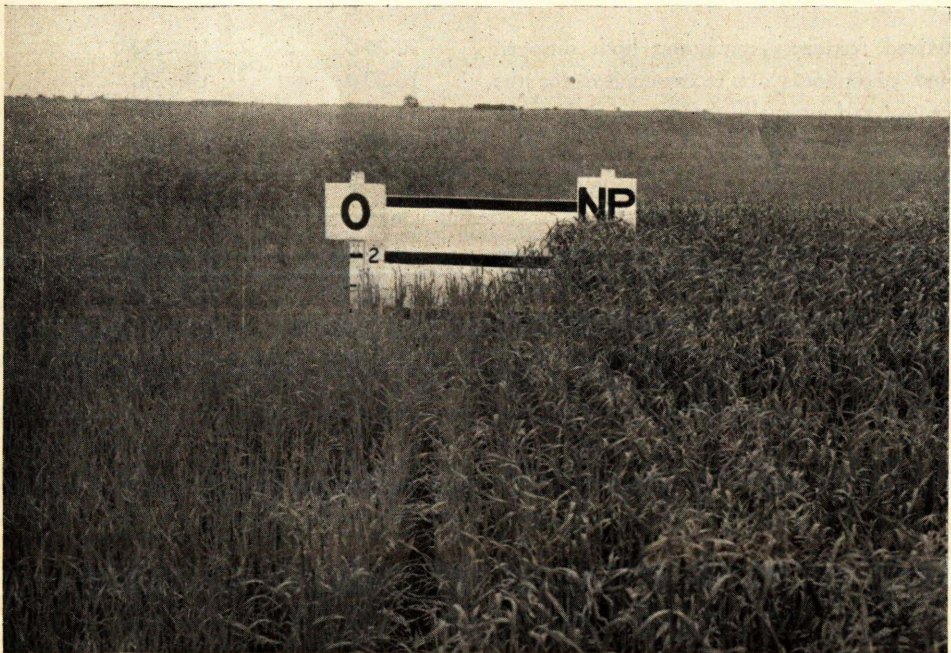


Fig. 3. This picture demonstrates the response of oats to fertilizer treatment.

Fertilizers for Oats

In the major oat producing area of eastern South Dakota, nitrogen and phosphorus are the primary deficient nutrients. The nitrogen deficiencies are more pronounced and more easily observed than those of phosphorus. The fertilizer recommendations for oats are influenced by soil fertility conditions and past management practices in the same manner as those mentioned for corn and wheat.

When a legume is planted with the oats, a lower rate of nitrogen should be applied (not to exceed 20 to 25 pounds of total nitrogen

per acre). It is possible to decrease the stand of legumes when they are planted with oats which have been heavily fertilized with nitrogen.

The occurrence of widespread nitrogen deficiencies in oats, as indicated by the pale yellowish-green color and associated low yields, emphasizes the general lack of nitrogen in the soil for this crop. When nitrogen fertilizer is applied, however, it is generally advisable to include some phosphorus in the mixture.

Methods of fertilizer application for oats are similar to those methods discussed for wheat.

Recommended Fertilizer Grades and Rates of Application for Oats

Explanation of fertilizer used for oats	Fertilizer grades	Rates of application, lbs. per acre
Nitrogen alone can be used more profitably in the western part of the state than in the central or eastern parts.	82-0-0	25-50
	43-0-0	50-100
	33-0-0	60-120
	20-0-0	100-200
Mixed fertilizers containing both nitrogen and phosphorus are recommended for the central and especially the eastern part of the state where phosphorus is more often deficient.	20-20-0	100-150
	16-20-0	100-200
	15-15-0	100-200
	13-39-0	150-200
	10-20-0	150-250
Straight phosphate fertilizer should be used only when the nitrogen already in the soil is adequate, or it may be applied with straight nitrogen when there is a need for both elements.	0-45-0	50-100
	0-20-0	100-200

Fertilizers for Barley

The soil conditions and past management practices which influence the fertilizer recommendations for barley are similar to those for oats. Barley, however, is more responsive to phosphorus than the other small grains and is more susceptible to lodging from excess nitrogen.

For barley, straight phosphate fertilizers should be used only when soils are well supplied with available nitrogen. The application of nitrogen alone will increase barley yields, but larger yields and better quality grain usually will be obtained when phosphorus is applied with the nitrogen.

Recommended Fertilizer Grades and Rates of Application for Barley

Explanation of fertilizer use for barley	Fertilizer grades	Rates of application, lbs. per acre
For best results, apply 50-100 lbs. of 0-45-0 or 100-200 lbs. of 0-20-0 with the nitrogen. This applies especially to the eastern and central part of the state.	82-0-0	25-50
	43-0-0	50-100
	33-0-0	60-120
	20-0-0	100-200
These mixed fertilizers are especially adapted to soils of average fertility which need both nitrogen and phosphorus.	20-20-0	100-150
	16-20-0	100-200
	15-15-0	100-200
	13-39-0	150-200
	10-20-0	150-250
Straight phosphate is recommended for use only on those soils which are well supplied with available nitrogen.	0-45-0	50-100
	0-20-0	100-200

Fertilizers for Flax

Flax grown on soils two or more years after legumes or after applications of manure, may respond to nitrogen. Fertilizer will stimulate weed growth, therefore the use of nitrogen should be restricted to soils that are rela-

tively free of weeds.

On most soils phosphorus fertilizer has not increased yields of flax.

The plow under method of application is recommended in preference to surface application because the latter method stimulates more weed growth.

Recommended Fertilizer Grades and Rates of Application for Flax

Explanation of fertilizer use for flax	Fertilizer grades	Rates of application, lbs. per acre
Flax is more responsive to nitrogen than to phosphate and for this reason only nitrogen is recommended.	43-0-0	50-100
	33-0-0	75-150
	20-0-0	100-200

Fertilizers for Legumes

Phosphorus is the only fertilizer element that should be applied on legumes. The response of legumes to phosphate is greater in the eastern than in the central and western parts of the state.

New seedings of legumes may be fertilized with a drill attachment at the time of seeding, by broadcasting the fertilizer on the surface and working lightly into the soil before seeding, or by plowing the fertilizer under before seeding. Established stands may be successfully fertilized by broadcasting the phosphate fertilizer on the surface with no subsequent tillage.

The best time of application on established stands is in late fall or early spring. In areas of higher rainfall, the rates of application should be equivalent to 100 lbs. of 0-43-0 each year or 200 lbs. every two years. In the areas of lower rainfall the response to phosphate is more variable and for this reason phosphorus should be applied on a limited area for trial before extensive applications are made. If the yield of hay is increased, the same rates of application should be used as those recommended for the higher rainfall areas.

Rock phosphate and colloidal phosphate which contain a very low percentage of available phosphorus are not recommended for application on legumes.

Recommended Fertilizer Grades and Rates of Application for Alfalfa, Red Clover, Sweet Clover and Other Legumes

Explanation of fertilizer use on legumes	Fertilizer grades	Rates of application, lbs. per acre
The higher rates of application are recommended for the more responsive areas. Where phosphate fertilizer increases the yield, it also increases the feeding value and the quality of forage.	0-45-0	100-200
	0-20-0	200-400

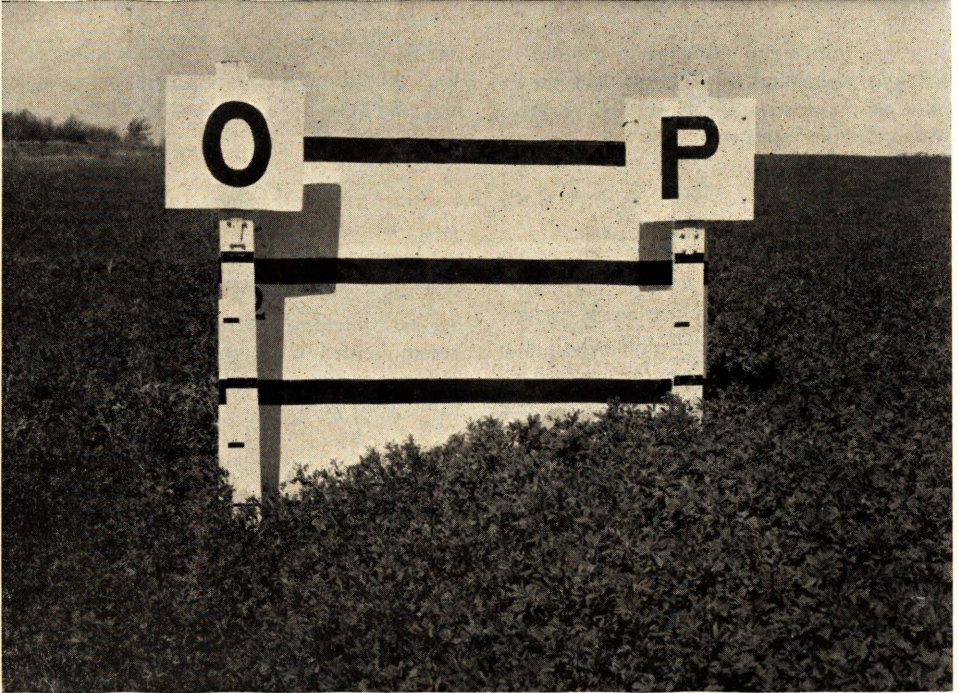


Fig. 4. Alfalfa needs an abundant supply of phosphorus. The first cutting in this field yielded 2.7 tons per acre where phosphate fertilizer was applied and 1.1 tons per acre where none was used.

Fertilizers for Grasses

Grasses are very responsive to nitrogen fertilizer. On most soils, very substantial yield increases of both forage and seed will be obtained by the application of nitrogen alone.

Phosphorus may give some increases when applied with nitrogen. This is especially true of some bottomland soils which are high in lime, and on some upland soils which have been eroded.

Grass legume mixtures need only phosphate fertilizer because the legume will usually supply adequate nitrogen.

Established stands of grasses should be fertilized by broadcasting on the surface early in the spring or late fall. Because of the weed hazard, the rate of application of nitrogen for new seedings of grasses should not exceed 20 to 30 pounds of nitrogen per acre. In general, fertilizer will increase the yields of bromegrass, Ree Wheatgrass and tall wheatgrass more than the native grasses.

Recommended Fertilizer Grades and Rates of Application for Grasses

Explanation of fertilizer use on grasses	Fertilizer grades	Rates of application, lbs. per acre
Grasses require large quantities of nitrogen for maximum yields of forage and seed. The application of a small quantity of phosphorus (100 lbs. of 0-43-0 or its equivalent) with the nitrogen will often increase the yield and quality of forage.	82-0-0	40-80
	43-0-0	100-150
	33-0-0	100-200
	20-0-0	150-300
For grasses, straight phosphate is recommended only on grass-legume mixtures.	0-43-0	100-150
	0-20-0	150-250

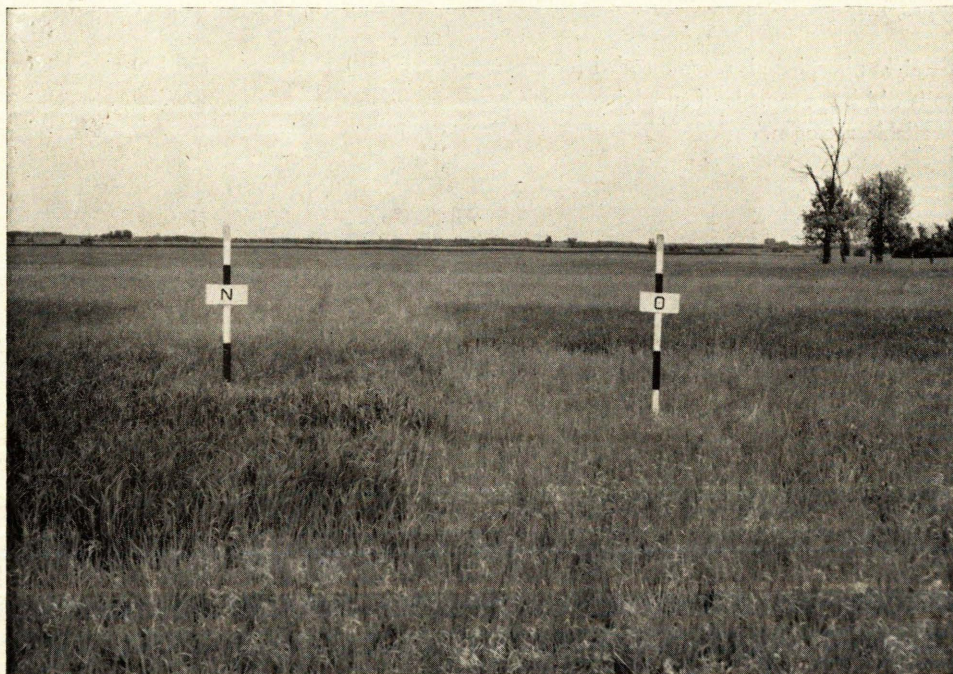


Fig. 5. Grasses are responsive to nitrogen fertilizer. On most soils both forage and seed yields can be boosted with application of nitrogen alone.

Fertilizers for Potatoes

Potatoes are most responsive to nitrogen and phosphorus but potassium may give some increase in yield especially on sandy soils. Soils which have been heavily cropped

and have not had a legume in the rotation need a fertilizer high in nitrogen. When potatoes follow a legume, phosphorus alone is recommended.

The recommended method of application is by means of a planter attachment, but the plow under method gives satisfactory results.

Recommended Fertilizer Grades and Rates of Application for Potatoes

Explanation of fertilizer use on potatoes	Fertilizer grades	Rates of application, lbs. per acre
These fertilizers are recommended for use on soils of average fertility. For soils low in nitrogen a fertilizer should be selected like 16-20-0 rather than 6-24-0.	16-20-0	200-300
	10-20-0	200-300
	6-24-0	200-300
Mixed fertilizers containing potash are included in the recommended list because potatoes require large amounts of potash. Most soils have the capacity to supply sufficient potash but some soils, especially the sandier types, may give some response.	10-20-10	200-300
	4-24-12	200-300
Straight phosphate is recommended for those soils which are capable of supplying sufficient available nitrogen.	0-43-0	100-150
	0-20-0	200-300

EXTENSION SERVICE, SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND
MECHANIC ARTS, BROOKINGS, SOUTH DAKOTA

Published and distributed under Acts of Congress, May 8 and June 30, 1914, by the Agricultural Extension Service of the South Dakota State College of Agriculture and Mechanic Arts, Brookings, George I. Gilbertson, Director. U. S. Department of Agriculture cooperating.