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Explanation of Soil Test Recommendation

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Explanation of Soil Test Recommendation

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1. Soil Test

Soil tests provide information about your soil which will help in planning and maintaining a good soil management program. Soil tests are not the entire answer to the fertility problems. They merely point out where problems exist. With this additional information a soil management program can be initiated which will secure higher yields of better quality crops.

2. Fertilizers

The use of commercial fertilizer is comparatively new in South Dakota. When properly used it can increase the yields of most crops. Thus it is important that the place of fertilizer in the soil management system be clearly understood. A commercial fertilizer is a material that contains plant food elements in a concentrated form. The plant food elements, nitrogen, phosphorus and potassium are the principle elements in commercial fertilizers and are used to supplement the natural plant food supplies in the soil. Fertilizers are not a substitute for good soil management practices such as crop rotation, growth of legumes, return of barnyard manures, return of crop residues and erosion control.

3. Fertilizer Grades

Fertilizers are either sold as straight goods, that is, fertilizer containing only one plant food element or as mixed fertilizers, those that contain 2 or more plant food elements.

The amount of plant food that a fertilizer contains is printed on the fertilizer tag or bag. It is customarily printed as a grade, such as 4-12-8. The percentage of nitrogen is always given first. The nitrogen content of the fertilizer in the example is 4 percent. The percentage of available phosphorus (P_2O_5) is always given second while that of potash (K_2O) is given third. In the example above the percentage of available phosphorus is 12 while that of potash is 8.

The grade of fertilizer recommended usually is only one of several that can be used. Any other grade of fertilizer that supplies the plant foods in the proportion (ratio) needed is satisfactory provided enough of it is used to supply the pounds of plant foods needed. Please note the recommended pounds of plant food nutrients per acre (N, P_2O_5 and K_2O) on the sheet listing the soil test results.

The table No. 1 gives a few examples of other grades that are equivalent to 100 pounds of suggested grade:

4. Fertilizer Forms

Fertilizers are available in liquid or solid forms. Some of the liquids such as anhydrous ammonia change into a gas when released from the container. However, some of the liquids available today develop little or no pressure at normal temperatures. When applying fertilizer, it is important to apply the plant foods needed by the plant. Except under special conditions, the form (solid, liquid, or gas) of the fertilizer is of little importance.

5. Nitrogen

A lack of available nitrogen limits the crop yields in South Dakota more than any other plant food. Nitrogen may be supplied by the growth of a legume in the rotation. In many instances it is profitable to apply nitrogen fertilizer. Some of the common nitrogen fertilizers are ammonium nitrate, ammonium sulfate, urea, N-32 and anhydrous ammonia. The table No. 2 lists some of the nitrogen fertilizers available and the amount of the fertilizer to be applied to supply a given amount of nitrogen.

Table No. 1

For each 100 pounds of this suggested grade	You may substitute					
	Grade	Lbs.	Grade	Lbs.	Grade	Lbs.
33-0-0	45-0-0	73	82-0-0	40	20-0-0	165
0-20-0	0-45-0	45	0-62-0	32		
10-20-0	8-16-0	125	15-30-0	75	21-53-0	40
11-48-0	6-24-0	200	8-32-0	150	9-36-0	135
20-20-0	10-10-0	200	15-15-0	150	17-17-0	118
10-10-10	8-8-8	125	12-12-12	85		

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Table No. 2 for changing pounds of nitrogen (N) to be applied, to pounds of nitrogen fertilizer

Fertilizer to be used	Pounds of nitrogen (N) to be applied per acre								
	10	20	30	40	50	60	70	80	100
Ammonium nitrate 33.5-0-0	30	60	90	119	149	179	209	239	298
Ammonium sulfate 20.5-0-0	49	98	146	195	244	293	342	390	490
Urea 42-0-0	24	48	71	95	119	143	167	190	240
Urea 45-0-0	22	44	67	89	111	133	156	178	222
Anhydrous ammonia 82-0-0	12	24	37	49	61	73	85	98	120
N-32 32-0-0	31	62	94	125	156	187	219	250	310
41-0-0	24	48	73	97	122	146	171	195	240

6. Phosphorus

An insufficient supply of available phosphorus is found to limit crop yields in many cases. This is especially true in the eastern one-third of the state and the irrigated land in the Black Hills area. Alfalfa and barley are two crops that require a relatively large supply of available phosphorus if maximum yields are to be obtained. There are two phosphatic fertilizers (0-20-0) and (0-45-0) which are commonly found on the market in South Dakota. However, other fertilizers that contain phosphorus are available. The table No. 3 lists some of the common phosphate fertilizers and the amount of the fertilizer to be applied to supply a given amount of available phosphorus (P_2O_5).

Rock phosphate and colloidal phosphate are frequently offered for sale in South Dakota. These materials contain up to 30 percent total phosphorus pentoxide but the amount of phosphorus readily available to plants from these materials is seldom over three percent. For this reason these fertilizers are not recommended for use in South Dakota.

7. Potash

The amount of total potash in South Dakota soils is very high. For this reason a lack of available potash seldom limits crop yields.

8. Minor Elements

During the past few years considerable interest has developed in the need for minor elements in the growth of plants. The application of these elements as a fertilizer to crops has received much publicity. Experiments conducted in South Dakota on soils considered most likely to need these elements have not given a profitable yield increase from their application.

9. Deficiency Symptoms

The color and growth of a plant frequently indicate what plant food element is needed to increase its growth and the resulting yield. These deviations from the normal crop growth are called deficiency symptoms. These symptoms are largely associated with plant food elements. However, plant diseases, insect injury, weather conditions or more than one limiting element may make the symptoms difficult to interpret and understand. It should also be pointed out that when a plant shows nutrient deficiency symptoms it is extremely deficient in that element.

Nitrogen: Plants that do not have enough nitrogen usually are light yellowish-green in color and do not grow as rapidly as they should. In small grains a lack of available nitrogen limits stooling. In corn a lack of nitrogen causes firing or drying up of the lower leaves. This drying begins at the tip and follows the mid-rib of the leaf.

Phosphorus: An insufficient supply of available phosphorus causes stunted slow growth and delayed maturity. Corn 6-18 inches high may develop a purpling on the leaves because of a lack of available phosphorus. The reddening of the corn plant after tasseling is usually due to some cause other than phosphorus deficiency.

Potassium: The browning of the outer edges of corn leaves beginning with the lower leaves is a characteristic symptom of potassium deficiency. This condition is seldom found in South Dakota.

10. Corn

High corn yields are the result of the use of good cultural practices, good soil management and sound planning. It is necessary to have large amounts of available plant food elements present to produce high yields. The supply of available nitrogen is especially important during the silking through ear formation stage of growth.

When the soil fertility is capable of producing a high yield it is necessary to have a plant population high enough to take full advantage of this productivity. Enough plants should be present to take full advantage of the fertility and weather conditions during any particular growing season. In South Dakota where moisture conditions vary greatly from one season to another and from one area to another it is impossible to recommend a definite number of plants per acre. In the areas of the state where the supply of available moisture is more likely to be adequate a plant population up to 14,000 plants per acre is frequently desireable. When the moisture supply can be controlled by irrigation it is desireable to have 16,000 or more plants per acre to take full advantage of the investment in fertility and irrigation. Where a lack of available moisture is more likely to limit yields plant populations of 8,000 to 11,000 plants per acre are more desireable.

Other factors are also important in planning for high corn yields, some of these are the use of adapted hybrid seed (see current South Dakota Corn Performance Test Circular) control of weeds and control of harmful worms and insects.

(10a) Nitrogen for Corn

Corn requires large amounts of nitrogen, especially during the period of maximum growth (silking through ear formation). Few soils are able to supply adequate amounts of nitrogen during this period of growth unless a legume has recently been grown or large amounts of manure applied. Another means of increasing the supply of

Table No. 3 for changing P_2O_5 (Phosphate) to pounds of phosphate fertilizer

Fertilizer to be used.	Pounds of phosphorus (P_2O_5)* to be applied per acre.					
	20	40	60	80	100	120
Super phosphate 0-20-0	100	200	300	400	500	600
Triple or double super phosphate 0-45-0	44	89	133	178	222	267
Calcium Metaphosphate 0-62-0	32	65	98	129	161	194
Rock phosphate 0-3-0	670	1330	2000	2670	3340	4000

*P_2O_5 is phosphorus pentoxide and is frequently referred to as phosphorus, phosphate or phosphoric acid. The amount of phosphorus in fertilizers is expressed as phosphorus pentoxide (P_2O_5). Example: 0-20-0 contains 20 lbs. of available P_2O_5 in each 100 pounds of fertilizer.

available nitrogen in the soil is through the addition of a nitrogenous fertilizer. The fertilizer can be broadcast on the surface before plowing, or it can be applied at the time of the second cultivation with a cultivator equipped with a fertilizer attachment.

(10b) Plow Down Fertilizer for Corn

It is necessary for corn to grow throughout the entire growing season to produce a crop. This means that it grows during July and August when the supply of available moisture may not be adequate. This increases the risk involved in investing money in fertilizer for this crop. It has been found that a plant which has an adequate supply of plant foods will make more efficient use of the moisture available. In areas more subject to these dry periods it is suggested that the nitrogen be broadcast on the surface before plowing. This places the fertilizer in that part of the soil where it is less likely to be dry.

(10c) Starter Fertilizers for Corn

The application of a starter fertilizer will get the corn off to a fast start, hasten maturity and supply additional phosphorus where needed. It may or may not increase the yield. The fertilizer should be applied at the time of planting with a planter equipped with a fertilizer attachment. The attachment should be set, if possible, so it places the fertilizer beside and below the seed. The **fertilizer must not contact** the seed. If it does, it may damage germination. The use of a starter fertilizer should be restricted to the eastern and southeastern parts of the state unless the supply of moisture is controlled through irrigation.

11. Small Grain

The fertilizer recommended for small grains should be applied with a grain drill equipped with a fertilizer attachment unless otherwise stated. The grain drill attachment places the fertilizer close to the seed. This gives the small grain preference over other plants (such as weeds) for these plant foods. It should be pointed out that the advantage mentioned above is primarily for phosphorus. This is because phosphorus is less soluble in water than either nitrogen or potassium. When nitrogen alone is being applied it will save time to broadcast the fertilizer as suggested below in paragraph No. 12.

Under unfavorable weather conditions, fertilizers in contact with the seed can damage germination. This is especially true of fertilizers containing large amounts of nitrogen. If the seed and fertilizer can be separated by a thin layer of soil the danger of damage to germination is not very great. This thin layer of soil between the seed and fertilizer can be attained by dropping the fertilizer and seed down separate spouts.

12. Top Dressing Small Grain

When nitrogen is the only plant food element needed it can be applied by broadcasting on the surface either before or after seeding. Since nitrogen fertilizers will dissolve in water there is little or no advantage to applying it with a grain drill equipped with a fertilizer attachment. (Nitrogen fertilizers should not be applied after the head begins to form in the shoot or boot. Plants are usually 5″ high before this stage is reached). If the fertilizer is applied after the seeding has been made, it should be applied as soon as possible. The smaller the plants are when the fertilizer is applied the better chance of receiving a profitable yield increase from the fertilizer. The plants should not be damp or wet when the fertilizer is applied.

In the drier areas of the state, top dressing spring small grain after it is up is quite risky because of the drought hazard.

The top dressing of winter small grain (rye and wheat) is profitable where the nitrogen supply is limited. Experimental work in the western part of the state has shown that this fertilizer should be applied in the fall rather than in the spring. When applying the fertilizer in the fall it should be applied either at the time of planting or soon thereafter.

13. Flax Fertilization

The use of commercial fertilizer on flax is generally not recommended. The application of fertilizer to flax usually increases the weed growth to such an extent that the yield of flax is lowered rather than increased. One of the best ways to supply additional available plant foods for flax is through the growth of a deep rooted legume in the rotation. Flax is an excellent crop to plant the first year after alfalfa.

14. Legumes

Legumes (alfalfa, sweet clover, red clover, birdsfoot trefoil, etc.) are used for hay, pasture, seed production and green manure. For these purposes the legumes are seeded separately, as mixtures of legumes or mixture of legumes and grasses. The fertilizer for these legumes or legume grass mixtures can be applied before or after seeding. In either case the fertilizer should be broadcast on the surface. The application of the fertilizer just before seeding aids in the establishment of the stand as well as increasing the yields of hay or pasture. Where the legume is being grown for hay it is suggested that a grass such as Brome, Ree wheat or Crested wheat be seeded with it. The grass will increase the amount of hay produced per acre and will not lower the quality of hay providing the hay is cut before the legume reaches full bloom. The grass will fill in where the legume kills out giving a continuous stand of hay. This practice will reduce the weed problem.

15. Soybeans

The fertilization of soybeans has not proved to be profitable except in special instances. It is suggested that the soybean seed be inoculated with nitrogen fixing bacteria before planting. Inoculation enables the soybean plant to derive a substantial proportion of its nitrogen from the air and may add several bushels per acre to the yield.

16. Fertilizing Established Stands of Grass

Nitrogen usually is the plant food element needed to increase the growth of grasses. The nitrogen can be broadcast on the surface either in the fall or in the early spring. When fertilizing grass in the spring the fertilizer should be applied before April 15th if at all possible. It has been found that the solid forms of fertilizer such as 33-0-0 or a liquid solution such as N-32 which can be applied to the surface are more satisfastory for the fertilization of grasses than other types of nitrogenous fertilizers. The addition of phosphorus to grass seldom increases the yields, but when the supply of available phosphorus in the soil is low, added phosphorus in addition to the needed nitrogen will improve the quality of the forage produced.

The application of nitrogen fertilizer to the so-called tame grasses (Brome, Ree wheat and Crested wheat) will result in a greater yield increase than an equal amount of nitrogen applied to the so-called native grasses (such as Blue stem, Western wheat, Blue grass, Side-oats grama, etc.). When fertilizing a grass you should make sure it is a species capable of making efficient use of added fertility.

17. Alkali Soils

Soils containing excessive soluble salts are frequently called alkali. These soils present a difficult management problem. The excessive salts are caused by poor internal drainage. Improved drainage, if possible, is the only corrective measure that will afford any permanent improvement in their productivity. Improved drainage is often impossible or impractical. The addition of large amounts of organic matter (manure and crop residues) will help counteract the effect of the salts. Added phosphorus frequently increases the yield of crops grown on areas of this type.

The crop grown on these areas greatly influences the return received. Corn is es-

pecially sensitive to excessive soluble salts and does not grow well in their presence. Small grains other than flax grow fairly well if the concentration of salts is not too high and the supply of available phosphorus is adequate.

The phosphorus should be applied with a grain drill equipped with a fertilizer attachment, if at all possible. After the seedling stage, alfalfa will tolerate large amounts of salts but it is necessary that the drainage be good. Alfalfa does not grow where the drainage is poor. Grasses will tolerate a higher concentration of soluble salts than other crops.

Western wheatgrass is the most tolerant of the grasses commonly grown in South Dakota. A grass (Tall wheatgrass) recently introduced from Palestine will tolerate a higher concentration of salts than any other desireable grass known.

18. pH

For convenience, numbers are used to express the degree of acidity or alkalinity. These numbers are called pH numbers and range from 0 through 14. A pH of 7.0 indicates a neutral soil. A pH below 7.0 indicates acidity, while one above 7.0 indicates alkalinity. It is important to know whether the soil is sweet (alkaline) or sour (acid) because some crops grow better at one pH while others prefer a different pH. The table No. 4 lists some crops and their pH tolerances.

19. Lime

Many of the surface soils in South Dakota are slightly acid in reaction. This is desireable because it causes the phosphorus in the soil to be more readily available: Periodic testing of acid soils from various areas of the state have not shown any need for lime. Most soils that are acid on the surface have free Calcium Carbonate (lime) within 48 inches of the surface. Experiments are being conducted on soils in the more acid areas of the state to further evaluate the need for lime.

20. Droughty Soils

When sand or gravel is present beneath the surface of a soil it may cause the soil to be drouthy. If this is true, a lack of available moisture may limit crop yields more than a lack of available plant foods. However, it should be pointed out that a crop that is well supplied with available plant foods can make more effcient use of the moisture that is available than one that is not so well supplied.

Table No. 4

Highly tolerant to acidity	Moderately tolerant to acidity	Very sensitive to acidity	Growth indicates the absence of harmful quantities of alkali	Moderately tolerant to alkali	Very tolerant to alkali
rye	alsike clover	alfalfa	corn	alfalfa	timothy
buckwheat	red clover	sweet clover	potatoes	sweet clover	western wheat grass
	soybeans	sugar beets	apples		millet
	vetch	beans	pears	Reed canary grass	rye
	barley	rutabagas	bluegrass	sorghum	tall wheat grass
	wheat	cauliflower	sagebrush	wheat	
	oats			barley	
	corn			oats	
				sugar beets	
				Brome grass	

21. Summer Fallowing

The practice of summer fallowing provides 2 years supply of available plant foods for one years crop in addition to storing some moisture for that crop. One of the chief values of fallow is the increased nitrogen supply. When fallowing it may be well to consider the use of a modified system of fallow. The modified system requires the seeding of a legume with small grain the year before fallowing. Then turning under the legume in mid-June the year of fallowing and fallow for the remainder of the summer. This practice will supply much more available nitrogen to the grain crops than straight fallowing. A word of caution should always be included when fallowing is mentioned. Fallowing is not practical unless you are able to control the soil erosion that is likely to result. You should be able to protect this soil from both wind and water erosion.

22. Manure

Manure is the most valuable by-product produced on the farm. It is also one of the most perishable products. Even under the better systems of management, 50 percent or more of its value may be lost. Research in other states indicates that the most benefit from the manure is attained when it is applied to row crops. It has also been found that more benefit is obtained from a light application made frequently than a heavy application made less frequently.