

Fertilizer Recommendations Guide

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**South Dakota
Fertilizer
Recommendations
Guide**

September 2005

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Fertilizer Recommendation Guide

September 2005

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South Dakota State University Soil Testing Lab fertilizer recommendations are based on field research in South Dakota and neighboring states. However, information from outside this region is used where only limited local data was available. The tables were developed as part of continuing cooperation between these states to standardize recommendations across the three-state area.

The recommendations in the tables are generated by equations and, therefore, change consistently across yield goals and soil test levels. Due to space limitations, only the recommendations for selected yield goals and the soil test level at the center of each soil test range (very low, low, medium, high, and very high) have been printed in this guide.

Where specific yield goals and/or soil test values are not listed in the table, recommendations can be determined by interpolating between the nearest two yield goals and soil test levels. In addition, recommendations for nitrogen, phosphorus, and potassium also can be calculated using the equations at the bottom of each table. These equations are summarized in Table 3. Recommendations reported by the SDSU Soil Testing Lab are rounded off to the nearest 5 lb per acre.

The abbreviations used in the tables are as follows:

YG = yield goal
STN = soil test nitrogen (2-foot nitrate nitrogen, lb/a)
STP = soil test phosphorus (ppm)
STK = soil test potassium (ppm)
LC = legume credit, lb/a

Statements that clarify or modify the recommendations are listed after the tables. The criterion used by the SDSU Soil Testing Lab to determine when to print any individual statement is listed (in boldface) prior to the statement.

SOIL TEST CATEGORIES

Soil test levels for all nutrients in the tables except nitrate nitrogen have been put into categories labeled very low (VL), low (L), medium (M), high (H), and very high (VH). These categories represent a decreasing probability of a yield response to broadcast fertilizer ranging from more than an 80% chance of a response at the very low soil test level to less than a 20% chance when soil tests are in the very high range. The probability of a yield response to fertilizer in the medium soil test range is estimated at between 40 and 60%.

Soil test categories are listed in Table 1. Categories for the nitrate nitrogen test are not given because calibration of the nitrate nitrogen test depends on yield goal and crop to be grown. Categories listed for iron, manganese, copper, boron, calcium, and magnesium are not based entirely from calibration studies in this area because response to these nutrients is extremely limited in South Dakota. Manganese, copper, boron, calcium, and magnesium deficiencies have not been confirmed in South Dakota.

NITROGEN

The “soil N plus fertilizer N required” column in the tables is not the amount of fertilizer N to apply. Nitrogen credits must be subtract-

Table 1. Soil Test Calibration Levels Used in South Dakota.

Nutrient	Soil Test	Categories				
		Very Low	Low	Medium	High	Very High
..... ppm extractable (0-6 inch samples)						
Phosphorus	Bray P-1	0-5	6-10	11-15	16-20	21+
Phosphorus	Olsen	0-3	4-7	8-11	12-15	16+
Potassium	NH ₄ Ac	0-40	41-80	81-120	121-160	161+
Zinc (1)	DTPA	0-.25	.26-.50	.51-.75	.76-1.00	1.01+
Iron (2)	DTPA	---	0-2.5	2.6-4.5	4.5+	---
Manganese (3)	DTPA	---	0-0.50	0.51-1.00	1.00+	---
Copper (3)	DTPA	---	0-0.10	0.11-0.20	0.20+	---
Boron (3)	Hot H ₂ O	---	0-0.25	0.26-0.50	0.50+	---
Magnesium (3)	NH ₄ Ac	0-10	11-20	21-30	31-40	41+
Calcium (3)	NH ₄ Ac	0-100	101-200	201-300	301-400	401+
..... lb/acre 2 ft						
Sulfur	500 ppm P	0-9	10-19	20-29	30-39	40+
Chloride (4)	0.01M Ca(NO ₃)	0-15	16-30	31-45	46-60	61+

(1) Calibration only for corn, sorghum, flax, potatoes, and edible beans

(2) pH is a better indicator to predict iron deficiency

(3) Deficiencies have not been confirmed in South Dakota

(4) Calibration only for wheat, barley, and rye

ed from this requirement, and the remainder is the N fertilizer recommendation. Nitrogen credits include:

a) **Deep Nitrate Soil Test:** If a 2-foot nitrate soil test is not available, then long-term average soil tests of 40 lb/a for re-cropped fields and 75 lb/a for fallow fields should be used when making an N recommendation. If a 2- to 4-foot-deep nitrate test is available and it is more than 30 lb/a, then reduce the nitrogen recommendation by 4 lb for each 5-lb increment above 30 lb. For example, if there are 50 lb of NO₃-N in the 2-4-foot depth, credit 16 lb (80% of 20 lb).

b) **Legume credits:** Legume credits used in South Dakota are listed in Table 2 and on the back of the SDSU Soil Testing Lab Report forms.

c) **Manure:** The fertilizer value of manure varies with age, type of animal, storage, and application procedures. The only accurate method of determining manure nutrient credits is with a manure analysis. Manure analysis should include both inorganic (ammonia) nitrogen and organic nitrogen. Credit 35% of the organic nitrogen in manure. Credit 98% of the inorganic nitrogen if liquid manure is injected below the soil surface. If manure is broadcast on the surface and incorporated within 24

Table 2. Legume N Credits

<i>Previous Crop</i>	<i>Nitrogen Credit</i>
	<i>lb/a</i>
Soybeans, edible beans, peas, lentils and other annual legumes	40
Alfalfa and legume green manure crops (sweet clover, red clover, etc) (1) (2)	
plants/sq ft > 5	150
3 - 5	100
1 - 2	50
< 1	0

- (1) When no-tilling into alfalfa and legume green manure crops, use half credit.
 (2) For 2nd year following alfalfa and legume green manure crops, use half credit.

hours, credit 90% of the inorganic N. If it is not incorporated until 5 days after application or later, credit only 20% of the inorganic N since most inorganic N may have volatilized as manure dries.

Estimates for the nutrient content of manures can be found in Midwest Plan Service -18, Manure Characteristics (MWPS-18, section 1, 2nd edition, 2004). It is available from MWPS South Dakota representative at 605-688-5667.

The SDSU Soil Testing Lab includes credits for the nitrate soil test and for annual legumes such as soybeans, peas, and lentils when making nitrogen fertilizer recommendations. Nitrogen credits for alfalfa and green manure crops and credit for manure are not included in the recommendations; therefore, recommendations should be adjusted if these credits are available.

The SDSU Soil Testing Lab increases the nitrogen recommendation by 30 lb when no-till or strip-till is used. These tillage systems result in slower breakdown of organic nitrogen, requiring higher nitrogen fertilizer recommendations. If the no-till or strip-till box is checked on the SDSU sample information sheet, 30 lb nitrogen will be added to the recommendation and a statement is printed indicating the additional nitrogen has been included in the recommendation.

The equations used to calculate nitrogen recommendations are included in Table 3.

The following are two nitrogen recommendation examples:

Example 1

145 bu corn yield goal, 35 lb 2-foot NO₃-N soil test, and soybeans as a previous crop:
 145 bu x 1.2 lb N/bu = 174 lb N requirement.
 174 lb N requirement – 35 lb soil nitrate N – 40 lb legume credit = 99 lb N/a recommended.

Example 2

50 bushel wheat yield goal in no-till, 40 lb 2-foot NO₃-N soil test:
 50 bu X 2.5 lb N/bu = 125 lb N requirement.
 125 lb N requirement – 40 lb soil nitrate N + 30 lb N for no-till = 115 lb fertilizer N recommended.

PHOSPHORUS AND POTASSIUM

Phosphorus and potassium soil test results in this guide are stated in parts per million (ppm) and not pounds per acre.

Interpretation for both the Olsen and Bray phosphorus soil test procedures are listed in this guide. The SDSU Soil Testing Lab uses the Olsen procedure for routine phosphorus tests. The equations used to calculate phosphorus and potassium recommendations are listed in Table 3 and at the bottom of each crop recommendation table.

Phosphorus and potassium recommendations in the tables are the amounts to be applied as a broadcast application. Banding P and K near the seed as a starter frequently results in more efficient use of these fertilizers. Therefore, when starter phosphorus and potassium are used, rates can sometimes be reduced by one-third or more and still reach maximum yield. However, when rates are reduced, application may be below maintenance levels, resulting in a soil test level decline with time, especially with phosphorus.

Table 3. Nutrient Recommendation Equations Used by the Soil Testing Laboratory at South Dakota State University, September 2005

<i>Code, Crop, Yield Unit</i>	<i>Nitrogen Recommendation</i>	<i>P₂O₅ Recommendation Olsen test</i>	<i>K₂O Recommendation</i>
01, Alfalfa, ton	none	= (18.57 - 1.16 x STP) x YG	= (55.71 - 0.38 x STK) x YG
02, Alfalfa-Grass, ton	none	= (18.57 - 1.16 x STP) x YG	= (55.71 - 0.38 x STK) x YG
03, Alfalfa(new seeding), ton	none	= (18.57 - 1.16 x STP) x YG	= (55.71 - 0.38 x STK) x YG
04, Grass, ton	= 25 x YG	= 45.0 - 3.45 x STP	= 80.0 - 0.53 x STK
08, Sudan grass, ton	= 25 x YG - STN - LC	= (11.0 - 0.7 x STP) x YG	= (43.0 - 0.3 x STK) x YG
09, Grass (new seeding),ton	= 25 x YG	= 45.0 - 3.45 x STP	= 80.0 - 0.53 x STK
10, Corn (grain), bu	= 1.2 x YG - STN - LC	= (0.700 - 0.044 x STP) x YG	= (1.1660 - 0.0073 x STK) x YG ⁽¹⁾
11, Corn (silage), ton	= 10.4 x YG - STN - LC	= (5.62 - 0.35 x STP) x YG	= (9.50 - 0.06 x STK) x YG ⁽¹⁾
12, Sorghum, bu	= 1.1 x YG - STN - LC	= (0.666 - 0.041 x STP) x YG	= (0.875 - 0.0058 x STK) x YG
14, Soybean, bu	none	= (1.55 - 0.14 x STK) x YG	= (2.2 - 0.0183 x STK) x YG
15, Edible Beans, lb	= 0.05 x YG - STN - LC	= (0.0231 - 0.0014 x STP) x YG	= (0.0346 - 0.00021 x STK) x YG
16, Barley (feed), bu	= 1.7 x YG - STN - LC	= (0.785 - 0.05 x STP) x YG	= (1.286 - 0.0085 x STK) x YG
17, Barley (malting), bu	= 1.5 x YG - STN - LC	= (0.785 - 0.05 x STP) x YG	= (1.286 - 0.0085 x STK) x YG
18, Wheat (winter), bu	= 2.5 x YG - STN - LC	= (1.071 - 0.067 x STP) x YG	= (2.71 - 0.017 x STK) x YG
19, Wheat (spring), bu	= 2.5 x YG - STN - LC	= (1.071 - 0.067 x STP) x YG	= (2.71 - 0.017 x STK) x YG
20, Rye, bu	= 2.5 x YG - STN - LC	= (1.071 - 0.067 x STP) x YG	= (2.71 - 0.017 x STK) x YG
21, Oats, bu	= 1.3 x YG - STN - LC	= (0.644 - 0.041 x STP) x YG	= (1.277 - 0.0086 x STK) x YG
22, Flax, bu	= 3.0 x YG - STN - LC	= (1.17 - 0.073 x STP) x YG	= (2.2 - 0.014 x STK) x YG
23, Rape Seed, Canola, cwt	= 6.5 x YG - STN - LC	= (3.6 - 0.22 x STP) x YG	= (5.4 - 0.034 x STK) x YG
24, Mustard, cwt	= 6.5 x YG - STN - LC	= (3.6 - 0.22 x STP) x YG	= (5.4 - 0.034 x STK) x YG
25, Millet, lb	= 0.035 x YG - STN - LC	= (0.0171 - 0.00114 x STP) x YG	= (0.03 - 0.00018 x STK) x YG
26, Potatoes, cwt	= 0.4 x YG - STN - LC	= (0.5 - 0.034 x STP) x YG	= (0.85 - 0.0057 x STK) x YG
27, Sunflowers, lb	= 0.05 x YG - STN - LC	= (0.0225 - 0.0014 x STP) x YG	= (0.041 - 0.00027 x STK) x YG
28, Garden	= 3.5 - 0.03 x STN	= 3.6 - 0.23 x STP	= 5.4 - 0.03 x STK
29, Fallow	none	none	none
30, Buckwheat, bu	= 2.2 x YG - STN - LC	= (1.32 - 0.083 x STP) x YG	= (1.86 - 0.0116 x STK) x YG
31, Lawn	= 4.0 - 0.4 x STN	= 2.5 - 0.16 x STP	= 5.0 - 0.286 x STK
32, Lawn (new seeding)	= 2.0 - 0.25 x STN	= 5.0 - 0.32 x STP	= 5.0 - 0.286 x STK
33, Safflower, lb	= 0.05 x YG - STN - LC	= (0.027 - 0.0017 x STP) x YG	= (0.048 - 0.0003 x STK) x YG
36, Field Pea, Lentil, Chickpea, lb	none	= (0.0171 - 0.0011 x STP) x YG	= (0.03 - 0.00018 x STK) x YG

Abbreviations: YG = yield goal; STN = soil test nitrogen (0-2 ft), lb/a; STP = soil test Olsen phosphorus (ppm); STK = soil test potassium (ppm); LC = legume credit (lb/a)

(1) 60-lb minimum K₂O recommendation when potassium is recommended for corn.

SEED PLACED FERTILIZER

Fertilizer placed in contact with the seed (starter fertilizer) can often be very efficiently used by the plant. However, fertilizer placed in contact with the seed can also cause seed injury or death. To minimize potential injury, fertilizer rates placed with the seed, especially nitrogen and potassium, need to be kept low.

It is difficult to predict the exact rate which will cause seed injury since it is dependent on soil and environmental conditions. Injury from

any given fertilizer is much more likely when soil is dry or sandy compared to wet or heavy textured. Row width also makes a large difference in acceptable rate per acre since narrower rows mean there are more feet of row per acre than wider rows. In general, seed injury is caused by too much "salt" per acre. However, nitrogen fertilizers such as urea that form ammonia in soil can cause severe injury, as can thiosulfate. Table 4 lists suggested fertilizer rates to limit seed placed fertilizer injury from common fertilizers. For crops not listed in the table, see statements after the crop N P K recommendations tables.

Table 4. Suggested Guidelines¹ for Seed Placed Fertilizer to Minimize Seed Injury

Corn in 30-inch rows
-up to 10 lb/a N + K ₂ O
-no urea or UAN
Soybean and Sunflower in 30-inch rows
-no fertilizer with the seed
Soybean in 7.5-inch rows
-up to 10 lb/a N + K ₂ O
-no urea or UAN
Wheat, Oats, Barley, Rye in 7-inch rows
-up to 25 lb/a N + K ₂ O

¹ Reduce rate 50% for dry or sandy soil. Change rate proportionately for other row widths. Do not put thiosulfate with the seed.

CORN nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	21-160	161 +
			0-3	4-7	8-11	12-15	16 +					
bu/a	lb/acre-2'		.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
80	96		51	37	23	10	0	82	60	60	60	0
100	120		63	46	28	11	0	102	73	60	60	0
120	144		76	55	34	13	0	122	87	60	60	0
140	168		89	64	39	15	0	143	102	61	60	0
160	192		101	73	45	17	0	163	116	70	60	0
180	216		114	82	51	19	0	184	131	78	60	0
200	240		127	92	56	21	0	204	146	87	60	0

Nitrogen recommendation = 1.2 x YG - STN - LC

Bray-1 P recommendation = (0.700 - 0.035 x STP) x YG

Olsen P recommendation = (0.700 - 0.044 x STP) x YG

Potassium recommendation = (1.1660 - 0.0073 x STK) x YG (60-lb minimum when K is recommended)

CORN SILAGE nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	21-160	161 +
			0-3	4-7	8-11	12-15	16 +					
ton/a	lb/acre-2'		.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
6	62		31	22	14	0	0	50	35	21	10	0
10	104		51	37	23	10	0	83	59	35	11	0
14	146		71	52	32	13	0	116	83	49	15	0
18	187		92	67	41	16	0	149	106	63	20	0
22	229		112	81	50	20	0	183	130	77	24	0
26	270		132	96	60	23	0	216	153	91	29	0

Nitrogen recommendation = 10.4 x YG - STN - LC

Bray-1 P recommendation = (5.62 - 0.28 x STP) x YG

Olsen P recommendation = (5.62 - 0.35 x STP) x YG

Potassium recommendation = (9.50 - 0.06 x STK) x YG (60-lb minimum when K is recommended)

SORGHUM nutrient recommendations

Yield goal bu/a	Soil N plus fertilizer N Bray-1 Olsen lb/acre-2'	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
		VL	L	M	H	VH	VL	L	M	H	VH
		0-5 0-3	6-10 4-7	11-15 8-11	16-20 12-15	21 + 16 +	0-40	41-80	81-120	121-160	161 +
		.....lb P ₂ O ₅ /acre .....					.....lb K ₂ O/acre				
60	66	36	26	17	10	0	46	32	18	0	0
80	88	48	35	22	10	0	61	42	24	0	0
100	110	60	44	28	11	0	76	53	30	10	0
120	132	73	53	33	14	0	91	63	35	10	0
140	154	85	62	39	16	0	106	74	41	10	0
160	176	97	70	44	18	0	121	84	47	10	0

Nitrogen recommendation = $1.1 \times YG - STN - LC$
 Bray-1 P recommendation = $(0.666 - 0.033 \times STP) \times YG$
 Olsen P recommendation = $(0.666 - 0.041 \times STP) \times YG$
 Potassium recommendation = $(0.875 - 0.0058 \times STK) \times YG$

SUNFLOWERS nutrient recommendations

Yield goal lb/a	Soil N plus fertilizer N Bray-1 Olsen lb/acre-2'	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
		VL	L	M	H	VH	VL	L	M	H	VH
		0-5 0-3	6-10 4-7	11-15 8-11	16-20 12-15	21 + 16 +	0-40	41-80	81-120	121-160	161 +
		.....lb P ₂ O ₅ /acre .....					.....lb K ₂ O/acre				
1000	50	20	15	10	0	0	36	25	14	0	0
1400	70	29	21	13	0	0	50	35	20	0	0
1800	90	37	27	17	10	0	64	45	25	10	0
2200	110	45	33	20	10	0	78	55	31	10	0
2600	130	53	38	24	10	0	93	64	36	10	0
3000	150	61	42	27	10	0	107	74	42	10	0

Nitrogen recommendation = $0.05 \times YG - STN - LC$
 Bray-1 P recommendation = $(0.0225 - 0.0011 \times STP) \times YG$
 Olsen P recommendation = $(0.0225 - 0.0014 \times STP) \times YG$
 Potassium recommendation = $(0.041 - 0.00027 \times STK) \times YG$

SOYBEAN nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
bu/a	lb/acre-2'		0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
30	0		40	23	10	0	0	55	33	11	0	0
40	0		54	31	10	0	0	73	44	15	0	0
50	0		67	39	11	0	0	92	55	19	0	0
60	0		80	47	13	0	0	110	66	22	0	0
70	0		94	55	15	0	0	128	77	26	0	0
80	0		107	62	18	0	0	147	88	30	0	0

Bray-1 P recommendation = (1.55 - 0.10 x STP) x YG
 Olsen P recommendation = (1.55 - 0.14 x STK) x YG
 Potassium recommendation = (2.2 - 0.0183 x STK) x YG

EDIBLE BEANS nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
lb/a	lb/acre-2'		0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
1000	50		21	15	10	0	0	30	22	14	10	0
1400	70		29	22	14	10	0	43	31	19	10	0
1800	90		38	28	18	10	0	55	40	24	10	0
2200	110		46	34	22	10	0	67	48	30	11	0
2600	130		55	40	25	11	0	79	57	35	14	0
3000	150		63	46	29	13	0	91	30	41	16	0

Nitrogen recommendation = 0.05 x YG - STN - LC
 Bray-1 P recommendation = (0.0231 - 0.0011 x STP) x YG
 Olsen P recommendation = (0.0231 - 0.0014 x STP) x YG
 Potassium recommendation = (0.0346 - 0.00021 x STK) x YG

Field Pea, Lentil, and Chickpea (Garbanzo Bean) nutrient recommendations

Yield goal lb/a	Soil N plus fertilizer N required lb/acre-2'	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21 + 16 +	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161 +
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
1400	0 (1)		22	15	9	3	0	37	27	17	7	0
1800	0		28	20	12	4	0	48	35	22	9	0
2200	0		34	24	15	5	0	58	42	26	11	0
2600	0		40	29	17	6	0	69	50	31	13	0

Bray-1 P recommendation = (0.0171 - 0.00085 x STP) x YG

Olsen P recommendation = (0.0171 - 0.0011 x STP) x YG

Potassium recommendation = (0.03 - 0.00018 x STK) x YG

(1) Inoculation is necessary with proper *Bradyrhizobium* culture.

CORN, GRAIN SORGHUM, SUNFLOWER, SOYBEAN, AND EDIBLE BEAN STATEMENTS

1. Corn and grain sorghum if fertilizer is recommended.

Nitrogen plus K₂O application in contact with the seed should be limited to 10 lb/a for 30-inch rows. Nitrogen as urea, UAN, and ammonium thiosulfate (12-0-0-26) should not be in contact with the seed.

Reduce seed-placed fertilizer rate by 50% when soil conditions are dry or sandy.

2. Soybean, edible beans, field peas, and lentils when fertilizer is recommended.

When planted in 30-inch rows, do not apply fertilizer in contact with the seed. When planted in 7.5-inch rows, limit seed placed N + K₂O to 10 lb/a but do not use urea or UAN.

3. Corn, grain sorghum, sunflower, and edible beans when no-till or strip-till is used.

Because of your very reduced or no tillage system, 30 lb/a of additional nitrogen has been considered in the above N recommendation.

4. Corn, grain sorghum, and sunflower when the previous "crop" was fallow or potatoes.

The growth of corn, sorghum, and sunflowers after fallow or potatoes is sometimes not satisfactory. To correct this, apply 20-30 lb/a of P₂O₅ as a starter.

5. Soybeans.

Soybeans that have been well inoculated are not likely to respond to additional nitrogen fertilizer.

6. Edible beans when nitrogen is recommended.

Edible beans are legumes which respond to nitrogen fertilizer. If nitrogen is applied as a starter, it should not touch the seed.

7. Sunflowers when fertilizer is recommended.

When planted in 30-inch rows or wider, do not apply fertilizer with the seed. When planted in 15-inch rows, limit seed placed N + K₂O to 5 lb/a but do not use urea or UAN.

WHEAT and RYE nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
bu/a	lb/acre-2'		.....lb P ₂ O ₅ /acre .....					.....lb K ₂ O/acre				
30	75		29	21	13	0	0	71	51	30	10	0
40	100		39	28	17	10	0	95	68	40	13	0
50	125		49	35	22	10	0	119	85	50	16	0
60	150		58	42	26	10	0	142	101	61	20	0
70	175		68	49	30	12	0	166	118	71	23	0
80	200		78	56	35	13	0	190	135	81	26	0
90	225		85	63	39	15	0	213	152	91	30	0
100	250		97	70	43	17	0	237	169	101	33	0

Nitrogen recommendation = 2.5 x YG - STN - LC
 Bray-1 P recommendation = (1.071 - 0.054 x STP) x YG
 Olsen P recommendation = (1.071 - 0.067 x STP) x YG
 Potassium recommendation = (2.71 - 0.017 x STK) x YG

OATS nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
bu/a	lb/acre-2'		.....lb P ₂ O ₅ /acre .....					.....lb K ₂ O/acre				
60	78		35	25	15	0	0	66	46	25	0	0
70	91		41	29	18	10	0	77	53	29	0	0
80	104		47	33	20	10	0	88	61	33	10	0
90	117		52	38	23	10	0	99	68	38	10	0
100	130		58	42	25	10	0	111	76	42	10	0
110	143		64	46	28	10	0	122	84	46	10	0

Nitrogen recommendation = 1.3 x YG - STN - LC
 Bray-1 P recommendation = (0.644 - 0.032 x STP) x YG
 Olsen P recommendation = (0.644 - 0.041 x STP) x YG
 Potassium recommendation = (1.277 - 0.0086 x STK) x YG

FEED BARLEY nutrient recommendations

Yield goal bu/a	Soil N plus fertilizer N required lb/acre-2'	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5 0-3	6-10 4-7	11-15 8-11	16-20 12-15	21+ 16+	0-40	41-80	81-120	121-160	161+
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
40	68		28	20	12	0	0	45	31	17	0	0
50	85		36	26	16	0	0	56	39	22	0	0
60	102		43	31	19	10	0	67	47	26	10	0
70	119		50	36	22	10	0	78	54	31	10	0
80	136		57	41	25	10	0	89	62	35	10	0
90	153		64	46	28	10	0	100	70	39	10	0
100	170		71	51	31	11	0	112	78	44	10	0

Nitrogen recommendation = $1.7 \times YG - STN - LC$
 Bray-1 P recommendation = $(0.785 - 0.039 \times STP) \times YG$
 Olsen P recommendation = $(0.785 - 0.05 \times STP) \times YG$
 Potassium recommendation = $(1.286 - 0.0085 \times STK) \times YG$

MALTING BARLEY nutrient recommendations

Yield goal bu/a	Soil N plus fertilizer N required lb/acre-2'	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5 0-3	6-10 4-7	11-15 8-11	16-20 12-15	21+ 16+	0-40	41-80	81-120	121-160	161+
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
40	60		28	20	12	0	0	45	31	17	0	0
50	75		36	26	16	0	0	56	39	22	0	0
60	90		43	31	19	10	0	67	47	26	10	0
70	105		50	36	22	10	0	78	54	31	10	0
80	120		57	41	25	10	0	89	62	35	10	0
90	135		64	46	28	10	0	100	70	39	10	0
100	150		71	51	31	11	0	112	78	44	10	0

Nitrogen recommendation = $1.5 \times YG - STN - LC$
 Bray-1 P recommendation = $(0.785 - 0.039 \times STP) \times YG$
 Olsen P recommendation = $(0.785 - 0.05 \times STP) \times YG$
 Potassium recommendation = $(1.286 - 0.0085 \times STK) \times YG$

BUCKWHEAT nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
bu/a	lb/acre-2'		0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
24	53		29	21	13	0	0	39	28	17	10	0
32	70		38	28	17	10	0	52	37	22	10	0
40	88		48	35	21	10	0	65	47	28	10	0
48	106		57	41	26	10	0	78	56	34	11	0

Nitrogen recommendation = $2.2 \times YG - STN - LC$
 Bray-1 P recommendation = $(1.32 - 0.066 \times STP) \times YG$
 Olsen P recommendation = $(1.32 - 0.083 \times STP) \times YG$
 Potassium recommendation = $(1.86 - 0.0116 \times STK) \times YG$

SAFFLOWER nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
lb/a	lb/acre-2'		0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
800	40		20	14	10	0	0	34	24	14	0	0
1200	60		29	21	13	0	0	50	36	22	10	0
1600	80		39	28	17	10	0	67	48	29	10	0
2000	100		49	35	22	10	0	84	60	36	12	0
2400	120		59	42	26	10	0	101	72	43	14	0

Nitrogen recommendation = $0.05 \times YG - STN - LC$
 Bray-1 P recommendation = $(0.027 - 0.0014 \times STP) \times YG$
 Olsen P recommendation = $(0.027 - 0.0017 \times STP) \times YG$
 Potassium recommendation = $(0.048 - 0.0003 \times STK) \times YG$

MUSTARD, RAPESEED and CANOLA

nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
bu/a	lb/acre-2'		.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
10	65		33	24	15	10	0	47	34	20	10	0
15	97		49	36	23	10	0	71	50	30	10	0
20	130		65	48	30	13	0	94	67	40	13	0
25	162		82	60	38	16	0	118	84	50	16	0

Nitrogen recommendation = $6.5 \times \text{YG} - \text{STN} - \text{LC}$
 Bray-1 P recommendation = $(3.6 - 0.17 \times \text{STP}) \times \text{YG}$
 Olsen P recommendation = $(3.6 - 0.22 \times \text{STP}) \times \text{YG}$
 Potassium recommendation = $(5.4 - 0.034 \times \text{STK}) \times \text{YG}$

FLAX nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
bu/a	lb/acre-2'		.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
20	60		21	15	10	0	0	38	27	16	0	0
30	90		32	23	14	10	0	58	41	24	10	0
40	120		42	31	19	10	0	77	54	32	10	0
50	150		53	38	24	10	0	96	68	40	12	0

Nitrogen recommendation = $3.0 \times \text{YG} - \text{STN} - \text{LC}$
 Bray-1 P recommendation = $(1.17 - 0.058 \times \text{STP}) \times \text{YG}$
 Olsen P recommendation = $(1.17 - 0.073 \times \text{STP}) \times \text{YG}$
 Potassium recommendation = $(2.2 - 0.014 \times \text{STK}) \times \text{YG}$

WHEAT, RYE, OATS, BARLEY, BUCKWHEAT, SAFFLOWER, MUSTARD, RAPESEED, CANOLA, AND FLAX STATEMENTS

1. Wheat, rye, oats, barley, buckwheat, safflower, mustard, rapeseed, canola, and flax when P₂O₅ is recommended.

The P₂O₅ recommendation can be reduced by one-third if applying as a starter. If reduced by one-third, soil test levels may be lowered over time.

2. Wheat, rye, oats, barley, buckwheat, safflower, mustard, rapeseed, canola, and flax with no-till and strip-till.

Because of your very reduced or no tillage system, 30 lb/a of additional nitrogen has been considered in the above N recommendation.

3. Wheat, barley, rye, and oats when nitrogen and/or potassium are recommended.

Nitrogen plus K₂O fertilizers should be limited to 25 lb/a when placed in contact with the seed in 6- or 7-inch rows. Reduce these values correspondingly for wider row width. Reduce these amounts by half for dry or coarse textured soils. DO NOT place thiosulfate in direct contact with the seed.

4. Flax, rapeseed, canola, mustard, safflower, and buckwheat when nitrogen and/or potassium are recommended.

Nitrogen plus K₂O applications in contact with the seed should not exceed 10 lb/a in 6- or 7-inch rows. Nitrogen from urea, DAP (18-46-0), and ammonium thiosulfate (21-0-0-26) should NOT be placed with the seed.

5. Malting barley with no 0-24-inch nitrate test.

To increase the probability of obtaining malting barley grade, a 2-foot deep sample for the nitrate nitrogen test should be taken.

ALFALFA nutrient recommendations

Yield goal ton/a	Soil N plus fertilizer N required lb/acre-2'	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm						
			VL	L	M	H	VH	VL	L	M	H	VH		
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +		
			0-3	4-7	8-11	12-15	16 +							
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
2.0	0		34	24	15	10	0	96	66	35	0	0		
3.0	0		50	37	23	10	0	144	99	53	10	0		
4.0	0		67	49	30	12	0	192	132	71	10	0		
5.0	0		84	61	38	15	0	241	165	89	13	0		
6.0	0		101	73	45	17	0	289	197	106	15	0		
7.0	0		118	85	53	20	0	337	230	124	18	0		
8.0	0		135	98	60	23	0	385	263	142	20	0		

Bray-1 P recommendation = (18.57 - 0.93 x STP) x YG
 Olsen P recommendation = (18.57 - 1.16 x STP) x YG
 Potassium recommendation = (55.71 - 0.38 x STK) x YG

GRASS nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
			0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
ton/a	lb/acre-2'		.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
1.0	25		40	26	12	0	0	69	48	27	10	0
2.0	50		40	26	12	0	0	69	48	27	10	0
3.0	75		40	26	12	0	0	69	48	27	10	0
4.0	100		40	26	12	0	0	69	48	27	10	0
5.0	125		40	26	12	0	0	69	48	27	10	0
6.0	150		40	26	12	0	0	69	48	27	10	0
7.0	175		40	26	12	0	0	69	48	27	10	0

Nitrogen recommendation = 25 x YG
 Bray-1 P recommendation = 45.0 - 2.5 x STP
 Olsen P recommendation = 45.0 - 3.45 x STP
 Potassium recommendation = 80.0 - 0.53 x STK

ALFALFA AND GRASS STATEMENTS

- When alfalfa yield goals are greater than 5 ton.**
 Because of high yield goals, soil nutrient withdrawal will likely be large. Therefore, you should soil test each year.
- New alfalfa seeding.**
 If using a cover crop when establishing a legume, only apply the fertilizer for the new seeding. Additional nitrogen fertilizer may cause too much competition from the cover crop for new seedlings.
- Established alfalfa when fertilizer is recommended.**
 The above fertilizer is to be applied annually as long as the stand is maintained.
- When alfalfa grass mixture is listed.**
 If your alfalfa-grass mixture contains at least one-third alfalfa, no additional nitrogen should be needed.
- Alfalfa and grass when a 0-2 ft NO₃-N sample was taken.**
 The nitrate nitrogen test is of little value for perennial crops unless manure has been applied.
- For all new-seeding grass.**
 The above recommendation is for the seeding year and each year thereafter. For the seeding year, do not apply more than 20 lb/a of nitrogen.
- Established grass when fertilizer is recommended.**
 The above recommendation may be applied for cool season grasses in the late fall or early spring. For warm-season grasses, apply about mid-May.

SUDAN GRASS and FORAGE SORGHUM

nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
ton/a	lb/acre-2'		0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
3.0	75		30	21	13	0	0	111	75	39	0	0
4.0	100		40	29	17	10	0	148	100	52	0	0
5.0	125		50	36	22	10	0	185	125	65	0	0
6.0	150		60	43	26	10	0	222	150	78	10	0
7.0	175		70	50	30	11	0	259	175	91	10	0
8.0	200		80	57	35	12	0	296	200	104	10	0

Nitrogen recommendation = 25 x YG - STN - LC
 Bray-1 P recommendation = (11.0 - 0.533 x STP) x YG
 Olsen P recommendation = (11.0 - 0.7 x STP) x YG
 Potassium recommendation = (43.0 - 0.3 x STK) x YG

MILLET nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
lb/a	lb/acre-2'		0-5	6-10	11-15	16-20	21 +	0-40	41-80	81-120	121-160	161 +
			0-3	4-7	8-11	12-15	16 +					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
1000	35		15	11	10	0	0	26	19	12	0	0
1400	49		22	15	10	0	0	37	27	17	10	0
1800	63		28	19	11	0	0	48	35	22	10	0
2200	77		34	24	14	0	0	58	42	26	11	0
2600	91		40	28	16	0	0	69	50	31	12	0

Nitrogen recommendation = 0.035 x YG - STN - LC
 Bray-1 P recommendation = (0.0171 - 0.00085 x STP) x YG
 Olsen P recommendation = (0.0171 - 0.00114 x STP) x YG
 Potassium recommendation = (0.03 - 0.00018 x STK) x YG

SUDAN GRASS AND MILLET STATEMENTS

1. Sudan grass when nitrogen is recommended.

The nitrogen should be divided in half if more than 100 lb N is recommended, one half being applied at/or prior to seeding time, and the other half after the first cutting.

2. Millet when fertilizer is recommended.

If drilled in 6-7-inch rows, do not apply more than 20 lb of N + K₂O in contact with the seed. For wider rows, reduce rate with seed proportionately.

POTATOES nutrient recommendations

Yield goal	Soil N plus fertilizer N required	Bray-1 Olsen	Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
			VL	L	M	H	VH	VL	L	M	H	VH
cwt/a	lb/acre-2'		0-5	6-10	11-15	16-20	21+	0-40	41-80	81-120	121-160	161+
			0-3	4-7	8-11	12-15	16+					
			.....lb P ₂ O ₅ /acre.....					.....lb K ₂ O/acre.....				
200	80		90	63	35	10	0	147	102	56	10	0
250	100		112	78	44	10	0	184	127	70	13	0
300	120		135	94	53	12	0	221	152	84	16	0
350	140		157	110	62	14	0	258	178	98	18	0
400	160		180	125	71	16	0	294	203	112	21	0
450	180		202	141	80	18	0	331	229	112	23	0

Nitrogen recommendation = $0.4 \times YG - STN - LC$
 Bray-1 P recommendation = $(0.5 - 0.026 \times STP) \times YG$
 Olsen P recommendation = $(0.5 - 0.034 \times STP) \times YG$
 Potassium recommendation = $(0.85 - 0.0057 \times STK) \times YG$

POTATO STATEMENT

1. If P₂O₅ and/or K₂O are recommended.

The best placement of P and/or K fertilizer for potatoes on very low-testing soils is 2 inches below and 2 inches on each side of the seed piece. Avoid placement of fertilizer in contact with the seed piece.

Zinc Recommendations for Corn, Sorghum, Flax, Potatoes and Edible Beans

Zinc Soil Test	Interpretation	Zinc Recommendations
ppm		lb/acre ¹
0 - .25	Very low	10
.26 - .50	Low	10
.51 - .75	Medium	5
.76 - 1.00	High	0
1.01 +	Very high	0

¹ Based on inorganic products as source of zinc such as zinc sulfate

ZINC STATEMENTS

1. Corn, sorghum, edible beans, flax, and potatoes when zinc test is equal to or below 0.75 ppm.

Zinc recommendations are made for the use of inorganic products such as zinc sulfate. One application of broadcast and incorporated zinc should be effective for 2-4 years. If banded, one-third to one-half the recommended amount should be applied each year for 3 years to distribute zinc throughout the soil. Chelates may be used at about one-third the rate of inorganic products.

2. All crops except corn, sorghum, edible beans, flax and potatoes when zinc test is equal to or below 0.75 ppm.

Experience has shown that only the crops of corn, sorghum, edible beans, flax, and potatoes respond to added zinc.

SULFUR

Sulfur Recommendations

Sulfur Soil Test	Relative Level	Soil Texture			
		Coarse		Medium/Fine	
		Tilled ¹	Strip-till or no-till	Tilled	Strip-till or no-till
<i>lb/acre 2 feet</i>		<i>.....lb/acre sulfur recommended.....</i>			
0 - 9	Very low	25	25	25	25
10 - 19	Low	25	25	15	25
20 - 29	Medium	15	25	0	15
30 - 39	High	15	15	0	15
> = 40	Very high	0	0	0	0

¹ Conventional tillage

SULFUR STATEMENTS

1. When sulfur is recommended.

Apply above sulfur as broadcast or apply 10-15 lb actual sulfur in the row or with the drill. Sulfate forms of sulfur (ammonium sulfate 24% S, gypsum 18% S, and potassium sulfate 17% S) are the best sources for immediate effectiveness. However, elemental sulfur (95-98% S) is usually available from dealers and least expensive. Elemental sulfur requires 1-3 months in warm soil before it is completely available.

2. When no deep (0-2 ft) soil analysis is available and a sulfur recommendation would result using the topsoil analysis.

A deep (6-24 inch) sample should be taken to evaluate the sulfur status of your soil.

CHLORIDE

Chloride Recommendations. Chloride recommendations are made by subtracting the 2-foot-deep chloride soil test level from 60, with a minimum recommendation of 15 lb chloride.

<i>Chloride Soil Test</i> <i>lb/acre 2 feet</i>	<i>Relative Level</i>
0 - 15	Very low
16 - 30	Low
31 - 45	Medium
46 - 60	High
> 60	Very High

MAGNESIUM

Magnesium Recommendations

<i>Magnesium Soil Test</i> <i>ppm</i>	<i>Interpretation</i>	<i>Magnesium Recommendations</i> <i>lb/acre</i>
0 - 10	Very low	50
11 - 20	Low	50
21 - 30	Medium	25
31 - 40	High	0
> 40	Very high	0

CHLORIDE STATEMENTS

1. **Wheat and barley when chloride is recommended.**

The recommendation should be applied as a broadcast application. Seed placement of chloride has shown no advantage over a broadcast application. Higher rates of chloride with the seed can cause seedling injury. Chloride is most economically applied by using muriate of potash (0-0-60) that is 45% chloride. The amount of KCl fertilizer to apply is calculated as: lb/a fertilizer needed = recommended Cl X 2.2.

2. **Chloride test done for crops other than wheat or barley.**

The chloride test has only been calibrated for wheat and barley. However, corn, soybean, and oats have not responded to chloride. Therefore no recommendation is given. If wheat or barley is grown, the chloride recommendation would be: 60 - chloride test (lb/a, 2 feet) = recommended chloride (lb/a).

3. **Chloride test is done and soil sample depth is less than 18 inches.**

A deep (24 inch) sample should be taken to evaluate the chloride status of your soil.

MAGNESIUM STATEMENT

1. The magnesium recommendation is for a broadcast application. Reduce to 10-20 lb actual magnesium if row applied. Sources such as magnesium sulfate (11% Mg) can be used. Magnesium deficiency has not been confirmed in South Dakota.

CALCIUM

Calcium Recommendation

<i>Calcium Soil Test</i> <i>ppm</i>	<i>Interpretation</i>	<i>Calcium Recommendation</i>
0 - 100	Very low	lime
101 - 200	Low	lime
201 - 300	Medium	0
301 - 400	High	0
> 400	Very low	0

CALCIUM STATEMENT

1. The calcium recommendation should be based on a buffer pH lime test. Calcium deficiency has only been observed on very acid, sandy soils (pH less than 5.0). Calcium deficiency has not been confirmed in South Dakota.

IRON

Iron Recommendation

<i>Iron Soil Test</i> <i>ppm</i>	<i>Interpretation</i>	<i>Iron Recommendations</i> <i>lb/acre</i>
0 - 2.5	Low	0.15
2.6 - 4.5	Medium	0.15
> 4.5	High	0

IRON STATEMENT

1. The iron test can not be adequately calibrated in our area. High pH (greater than 7.5) will likely be a better indication of potential iron deficiencies in susceptible crops. Research in other areas has shown that an iron soil test above 4.5 ppm is sufficient for crop needs. If the test is below this level, 0.15 lb/a of iron should be applied as a foliar application when iron deficiency symptoms are first observed. Use a chelated form of iron, such as EDDHA. Soil application of iron is generally not effective in South Dakota and extremely expensive. Iron is recommended only for sensitive crops such as sorghum, beans, corn, flax, sudan, and potatoes. Deficiencies are often more severe when soils are wet and cold and may disappear as the soil dries down and warms up.

BORON

Boron Recommendation

<i>Boron Soil Test</i>	<i>Interpretation</i>	<i>Boron Recommendations</i>
<i>ppm</i>		<i>lb/acre</i>
0 - 0.25	Low	2
0.26 - 0.50	Medium	2
> 0.50	High	0

BORON STATEMENT

1. The boron soil test has not been adequately calibrated for our area. Research in other areas has shown that a boron soil test above 0.50 ppm is adequate for crop needs. A boron application should always be broadcast applied and never applied in direct seed contact (row or drill fertilizers). Alfalfa and clovers are the most sensitive to boron deficiency. Because of possible toxic over-fertilization with boron, never apply unless a boron soil test has first been taken. Boron deficiency has not been confirmed in South Dakota.

COPPER

Copper Recommendation

<i>Copper Soil Test</i>	<i>Interpretation</i>	<i>Copper Recommendations</i>
<i>ppm</i>		<i>lb/acre</i>
0 - 0.10	Low	2
0.11 - 0.20	Medium	2
> 0.20	High	0

COPPER STATEMENT

1. The copper soil test has not been adequately calibrated for our area. Research in other areas has shown that a copper soil test above 0.20 ppm is adequate for crop needs. If the test is below this level, 2 lb/a copper should be applied. Copper deficiency has never been confirmed in South Dakota.

MANGANESE

Manganese Recommendation

<i>Manganese Soil Test</i>	<i>Interpretation</i>	<i>Manganese Recommendations</i>
<i>ppm</i>		<i>lb/acre</i>
0.50	Low	20
0.51 - 1.0	Medium	20
> 1.0	High	0

MANGANESE STATEMENT

1. The manganese soil test has not been adequately calibrated for our area. Research in other areas has shown that a manganese soil test above 1.0 ppm is adequate for crop needs. If the test is below this level, apply 20 lb/a manganese. Manganese deficiency has never been confirmed in South Dakota.

LIME

Lime Recommendation

<i>Buffer index</i> ⁽¹⁾	<i>Lime required</i> ⁽²⁾ <i>for 6" soil depth</i> <i>tons/acre</i>
6.8 – 6.5	0
6.4 – 6.1	2.0
6.0 – 5.9	2.5
5.8 – 5.7	3.0
5.6 or less	3.5

(1) This is not soil pH but is the SMP buffer.

(2) Rates based on a calcium carbonate equivalent of 90% and a total effectiveness of 70%. One ton of pure CaCO₃ is equivalent to 1.60 tons of such a limestone.

LIME STATEMENT

(buffer test is run when water pH is below 5.6)

- 1. Buffer test (index) is run and is 6.5 or higher.**
No lime is recommended based on this buffer index test.
- 2. Buffer test (index) is 6.1-6.4.**
Apply 2 tons of lime per 6 inch of soil depth. This rate is based on a calcium carbonate equivalent of 90% and a total effectiveness of 70%. One ton of pure CaCO₃ is equivalent to 1.6 tons of such a limestone. Lime recommendations are based on the buffer test (index) and not directly on soil pH. The buffer index is run when the soil pH is below 5.6 or when requested. Lime recommendations are based on raising soil pH to 6.0.
- 3. Buffer test (index) is 5.9-6.0.**
Apply 2.5 tons of lime per 6 inch of soil depth. This rate is based on a calcium carbonate equivalent of 90% and a total effectiveness of 70%. One ton of pure CaCO₃ is equivalent to 1.6 tons of such a limestone. Lime recommendations are based on the buffer test (index) and not directly on soil pH. The buffer index is run when the soil pH is below 5.6 or when requested. Lime recommendations are based on raising soil pH to 6.0.
- 4. Buffer test (index) is 5.7-5.8.**
Apply 3 tons of lime per 6 inch of depth. This rate is based on a calcium carbonate equivalent of 90% and a total effectiveness of 70%. One ton of pure CaCO₃ is equivalent to 1.6 tons of such a limestone. Lime recommendations are based on the buffer test (index) and not directly on soil pH. The buffer index is run when the soil pH is below 5.6 or when requested. Lime recommendations are based on raising soil pH to 6.0.
- 5. Buffer test (index) is 5.6 or less.**
Apply 3.5 tons of lime per 6 inch of soil depth. This rate is based on a calcium carbonate equivalent of 90% and a total effectiveness of 70%. One ton of pure CaCO₃ is equivalent to 1.6 tons of such a limestone. Lime recommendations are based on the buffer test (index) and not directly on soil pH. The buffer index is run when the soil pH is below 5.6 or when requested. Lime recommendations are based on raising soil pH to 6.0.

SALTS AND SODIUM

Salt Level in Soil, Electrical Conductivity (EC)

<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Very High</i>
.....millimhos(mmhos)/cm.....			
< 3	3 - 5	5.1 - 10.0	> 10

Sodium Level in Soil, Exchangeable Sodium Percentage (ESP)

<i>Low</i>	<i>Medium</i>	<i>High</i>
.....Exchangeable sodium percentage (ESP).....		
< 9	9 - 13	> 13

SALTS AND SODIUM STATEMENTS

1. Soluble salts greater than 3.0 mmhos/cm.

Excessive salts are usually associated with poor drainage either past or present. Frequently, these areas are relatively small in relation to the rest of the field. Little can be done to increase their productivity unless the internal drainage can be improved. This is often impossible or uneconomical. Heavy applications of crop residues and phosphate fertilizer sometimes increase the productivity of these soils.

2. Soluble salts in 3.1-5.0 mmhos/cm range.

The soluble salt content of this soil is higher than considered desirable. Only salt sensitive crops such as corn, soybeans, flax, potatoes,

field beans, sunflower, and new alfalfa seedlings may be affected and then only when soil moisture is in short supply. Phosphorus should be maintained at a medium to high level.

3. Soluble salts in 5.1-10.0 mmhos/cm range.

The total soluble salts are at such a level that normal growth of crops such as corn, soybean, flax, potatoes, field bean, sunflower, and new alfalfa seedlings can be expected only in relatively wet years. You should consider growth of small grain or grass on this land. Grass or legume establishment may be difficult.

4. Soluble salts in 10.1-16.0 mmhos/cm range.

The total soluble salts are at such a level that the growth of only salt-tolerant crops such as rye, millet, barley, and grasses such as western wheatgrass, crested wheatgrass, and tall wheatgrass should be considered. Grass establishment may be difficult.

5. Soluble salts greater than 16 mmhos/cm.

The total soluble salts are at such a level that the growth of only the extremely salt-tolerant crops should be attempted. Tall and western wheatgrasses are the most tolerant. Grass establishment may be difficult.

6. When ESP is in the 9.0-13.0 range.

The soluble sodium content of this soil is high enough so that a dispersed soil condition may now or soon will exist.

7. When ESP is greater than 13.0.

The sodium hazard of this soil is high. Correction of this problem is often not practical.

LAWN and GARDEN nutrient recommendations

Recommendations

Nitrogen					Phosphorus					Potassium				
Soil Test Nitrogen lb/6 inches					Soil Test Phosphorus ¹ , ppm					Soil Test Potassium, ppm				
0	25	50	75	100	2	6	10	14	16+	20	60	100	140	161+
lb N/1000 sq. ft.					lb P ₂ O ₅ /1000 sq. ft.					lb K ₂ O/1000 sq. ft.				
Garden														
3.5	3.0	2.0	1.5	0.5	3.0	2.0	1.5	0.5	0	5.0	3.5	2.5	1.0	0
Established Lawn														
4.0	3.0	2.0	1.0	0.0	2.0	1.5	1.0	0.5	0	4.5	3.5	2.0	1.0	0
New Lawn														
2.0	1.5	1.0	0	0	4.0	3.0	2.0	1.0	0	4.5	3.5	2.0	1.0	0

¹ Olsen (sodium bicarbonate) phosphorus soil test.

LAWN, NEW LAWN, TREE AND SHRUBS, AND GARDEN STATEMENTS

1. Garden when fertilizer is recommended.

For vegetable gardens, any P or K recommended should be broadcast on the surface and worked in during seedbed preparation. If recommended N is 1.5 lb/1000 sq ft or greater, split application with one-third applied during seedbed preparation and the remainder when vine crops, potatoes, and tomatoes have set fruit. If recommended N is less than 1.5 lb/1000 sq ft, delay N application until vine crops have set fruit. For flower gardens apply recommended fertilizer in spring.

2. Garden when fertilizer is recommended.

To supply the above nutrients, this formula is used to determine the quantity of a fertilizer material you need to apply: (pounds of element recommended ÷ percent of that element in the fertilizer) x 100 = lb of fertilizer needed per 1000 sq ft. Repeat this calculation for each element that is recommended. Application of P₂O₅ or K₂O in amounts greater than recommended will not be harmful to growth. Avoid broadcasting more nitrogen than recommended.

3. Garden, lawn, new lawn, trees, and shrubs and no fertilizer is recommended and soluble salt is less than 3.0 mmhos.

Fertility is high; no fertilizer is recommended. If you are encountering poor growth, it is probably due to factors other than soil fertility such as available moisture, shade, compaction, drainage, insects, etc.

4. Garden when salt is 3.0-6.0 mmhos.

Soluble salt content of this soil is higher than considered desirable. Only crops (radish, celery, and green beans) that are sensitive to excessive salts will be affected and then only when moisture is in short supply. Tomato, cabbage, lettuce, potatoes, cucumber, beets, kale, asparagus, and spinach are somewhat more tolerant to the excessive salts.

5. Garden when salt is 6.1-10.0 mmhos.

Total soluble salts are at such a level that successful growth of radish, celery, and green beans can be expected only under the most favorable conditions. Tomatoes, cabbage, lettuce, potatoes, cucumbers, and beets will also be affected by the excessive salts.

6. Garden when salt is greater than 10.0 mmhos.

The soluble salt level of the sample tested is at such a level that the growth of only tolerant crops such as beets, kale, asparagus, and spinach are likely to be successful. Under very favorable weather conditions, some of the crops may produce a partial crop.

7. Lawn, new lawn, garden, trees, and shrubs when no fertilizer is recommended and salt is less than 3.0 mmhos.

Fertility is high; no fertilizer is recommended. If you are encountering poor growth, it is probably due to factors other than soil fertility, such as available moisture, shade, compaction, drainage, insects, etc.

8. Lawn when fertilizer is recommended.

The above nutrients should be broadcast on the surface as evenly as possible per 1,000 sq ft (**NOT** lb/a). If 3 or more lb nitrogen is recommended, split the application into three and apply in early May, early August, and mid-September. If less than 3 lb nitrogen is recommended, apply half each in early May and mid-September.

9. Lawn and new lawn when fertilizer is recommended.

To supply the above nutrients, this formula is used to determine the quantity of a fertilizer material you need to apply: (pounds of element ÷ percent of that element in the fertilizer) x 100 = lb of fertilizer needed per 1,000 sq ft. Repeat this calculation for each element that is recommended. Application of P₂O₅ or K₂O in amounts greater than recommended will not be harmful to growth. For additional information refer to the fertilizing section of the publication FS 715, Lawn Care.

10. New lawn when fertilizer is recommended.

The above nutrients should be broadcast on the surface and worked into the soil before seeding. The above nutrients are per 1,000 sq ft.

11. New lawn when salt is greater than 3.0 mmhos.

The soluble salt level of this sample is at such a high level that difficulty in turf growth or establishing a lawn may result. If you have had difficulty, try seeding Fairway crested wheatgrass. Watering with softened water may have caused this problem. Improving internal or surface drainage may help. Correction of this problem is often not practical.

12. Lawn when salt is greater than 10.0 mmhos.

The soluble salt level is at such a high level that poor growth may result. Correction of this problem is often not practical.

13. Lawn and new lawn when pH is 7.6 or higher.

Your pH is high. This could lead to iron chlorosis symptoms on your grass. This condition is characterized by bright yellow, irregular patches of grass scattered throughout the lawn. If you have these symptoms, obtain an iron fertilizer product from your garden center and apply according to label directions.

14. Trees or shrubs and pH is 7.6 or higher.

Your pH is high. This could lead to iron chlorosis symptoms on your trees or shrubs. This condition is typically characterized by pale yellow leaves with green veins. If you have these symptoms, follow the enclosed fact sheet for correcting the problem.