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Fertilizer Recommendations Guide

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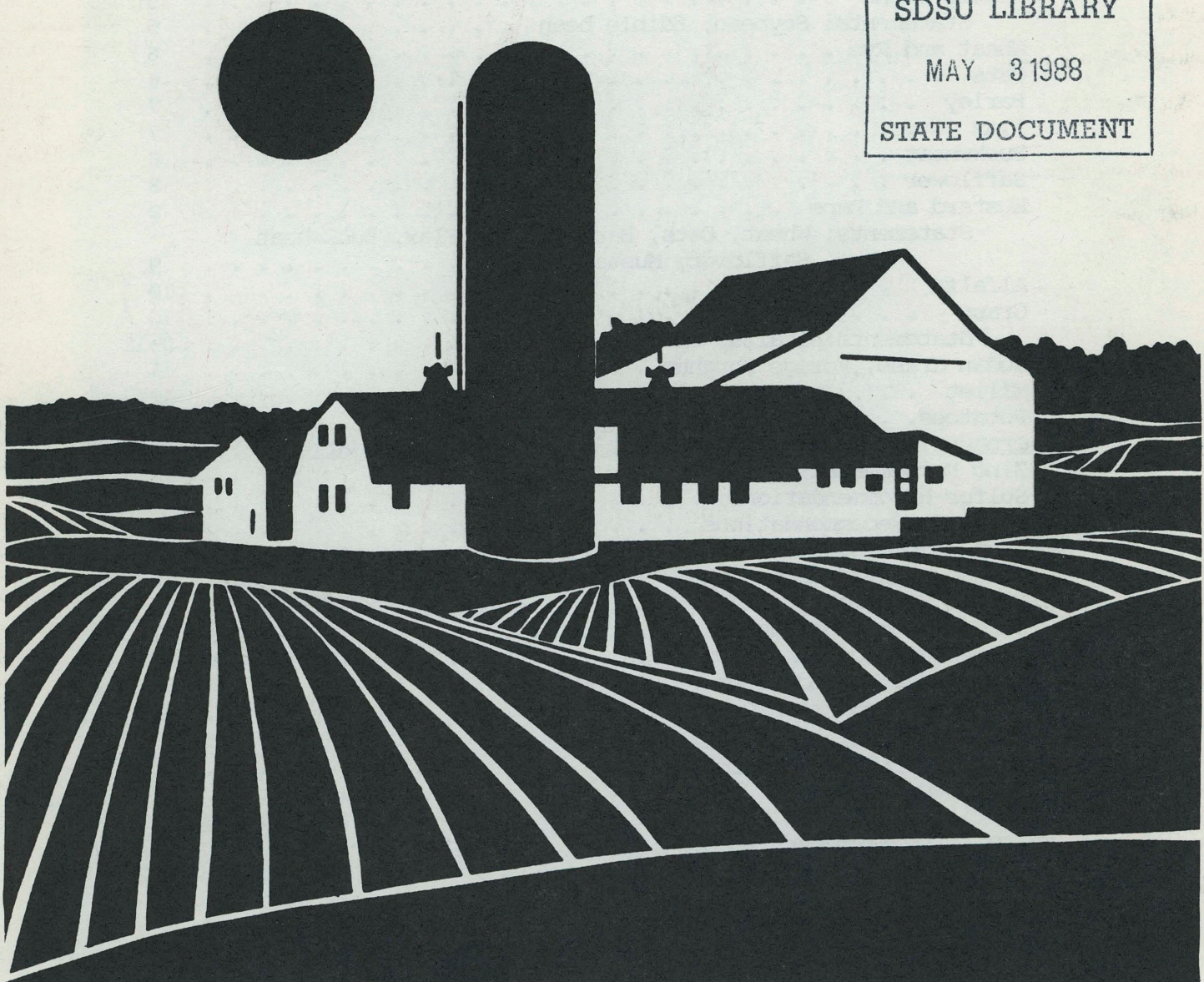
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Fertilizer Recommendations Guide

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FERTILIZER RECOMMENDATIONS GUIDE

South Dakota State University

January, 1988

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Continued research in crop responses to fertilizer has allowed revisions to be made in South Dakota State University's fertilizer recommendations. Those revisions have been included in the following fertilizer guide. In some cases, data in the literature was used because little or no data was available from South Dakota.

The revised recommendations are generated by equations using a microcomputer and therefore vary continuously across yield goals and soil test levels. However, due to space limitations, only the recommendations for selected yield goals and soil test levels have been printed in this guide. When yield goals and/or soil test values are not listed in the tables, recommendations can be determined by interpolating between the nearest two yield goals, soil test levels and recommendations.

In addition to values in the tables, the nitrogen requirement of crops and nitrogen fertilizer recommendations can be calculated using the formulas beginning on page 21.

If a deep (0-2') nitrate nitrogen test was not taken, nitrogen recommendations are made according to footnote 1 at the bottom of each table. This recommendation is based on the average nitrate nitrogen soil test levels measured at the SDSU soil testing lab over the last 5 years. It will not be as accurate as recommendations based on the deep nitrate test and could result in recommendations higher or lower than desirable, depending upon the actual amount of available nitrogen in the soil profile.

Phosphorus and potassium recommendations listed in the tables are for the middle of each soil test range (VL = very low, L = low, M = medium, H = high, VH = very high). In addition to the values in the tables, phosphorus and potassium recommendations can be made using the formulas and tables at the end of this guide.

Special statements which modify and/or add information to the recommendations are listed after the crops or groups of crops (row crops, small grains, etc.). The statements should be considered when making recommendations from this guide as they may alter the recommendation in the tables. The criteria for when each statement will be printed by the computer are listed prior to each statement.

Corn

18100140

South Dakota Corn Nutrient Recommendations

Yield Goal	Soil N Plus Fertilizer N Required ¹	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL	L	M	H	VH	L	M	H	VH
bu/A	lb/A-2'	<6	6-15	16-25	26-40	>40	<100	100-200	201-350	>350
		3	10	20	33	40	50	150	275	350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
60.0	67	34	32	24	0	0	50	35	0	0
80.0	96	47	42	32	11	0	68	47	18	0
100.0	125	59	53	39	14	0	87	59	23	0
120.0	154	72	63	47	18	0	106	72	27	0
140.0	183	84	73	54	21	0	124	84	32	0
160.0	212	97	84	61	25	0	143	96	36	0
180.0	241	109	94	69	29	0	161	109	41	0
200.0	270	122	105	76	32	0	180	121	46	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Corn silage

South Dakota Corn Silage Nutrient Recommendations

Yield Goal	Soil N Plus Fertilizer N Required ¹	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL	L	M	H	VH	L	M	H	VH
ton/A	lb/A-2'	<6	6-15	16-25	26-40	>40	<100	100-200	201-350	>350
		3	10	20	33	40	50	150	275	350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
6.0	50	27	26	20	0	0	38	27	0	0
10.0	96	47	42	32	11	0	68	47	19	0
14.0	142	67	59	44	16	0	98	67	26	0
18.0	189	87	76	55	22	0	128	87	33	0
22.0	235	107	92	67	28	0	157	106	40	0
26.0	282	127	109	79	33	0	187	126	47	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Grain sorghum

South Dakota Grain Sorghum Nutrient Recommendations

Yield Goal bu/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
40.0	44	24	19	13	0	0	31	24	0	0
60.0	66	35	29	20	0	0	47	37	0	0
80.0	88	47	38	26	10	0	64	50	0	0
100.0	110	59	48	32	12	0	80	63	22	0
120.0	132	71	57	39	15	0	97	76	31	0
140.0	154	82	67	45	17	0	113	89	40	0
160.0	176	94	76	52	19	0	129	102	48	0

¹ Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Sunflowers

South Dakota Sunflower Nutrient Recommendations

Yield Goal lb/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
1000.0	50	15	14	10	0	0	32	21	0	0
1400.0	70	20	19	14	0	0	44	29	0	0
1800.0	90	26	24	18	0	0	57	37	0	0
2200.0	110	31	29	22	0	0	69	45	15	0
2600.0	130	36	34	27	11	0	82	53	17	0
3000.0	150	42	39	31	14	0	94	61	20	0

¹ Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

CORN, CORN SILAGE, GRAIN SORGHUM, and SUNFLOWER Statements

1. Corn grain sorghum and sunflowers if fertilizer is recommended.
Nitrogen plus K_2O applications in contact with the seed should be limited to 8 lbs/A for 36 inch rows. Nitrogen as urea, DAP (18-46-0) should NOT be applied in contact with the seed. With cool, wet spring planting conditions or very reduced or no tillage situations, an application of P_2O_5 as a starter can be advantageous. DO NOT apply more than 30 lbs/A of P_2O_5 as a starter.
2. Corn, grain sorghum, and sunflower when very reduced or no-till is used and deep nitrate test is used and nitrogen is recommended.
With very reduced and no-till systems, add 30 lbs/A of nitrogen to the above recommendation.
3. Corn, grain sorghum, and sunflowers when very reduced or no-till is used and no deep nitrate test is used and nitrogen is recommended.
With very reduced and no tillage systems, add 45 lbs/A of nitrogen to the above recommendation.
4. Corn, grain sorghum, and sunflower when soil texture is coarse.
You have a relatively sandy soil. As a result, you should not apply fertilizer in direct contact with the seed.
5. Corn, grain sorghum, and sunflower when the previous "crop" was fallow or potatoes.
The growth of corn, grain sorghum, and sunflowers after fallow or potatoes is sometimes not satisfactory. To correct this, apply 20-30 lb/A of P_2O_5 as a starter.

Soybeans

South Dakota Soybean Nutrient Recommendations

Yield Goal bu/A	NITROGEN lb/A	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		----- lbs P_2O_5 /A -----					----- lbs K_2O /A -----			
20.0	0	27	23	16	0	0	24	22	0	0
30.0	0	37	31	22	0	0	38	32	0	0
40.0	0	46	40	28	11	0	51	42	0	0
50.0	0	56	48	34	14	0	64	52	18	0
60.0	0	66	56	40	18	0	77	62	24	0
70.0	0	76	64	46	21	0	90	72	30	0

Edible beans

South Dakota Edible Bean Nutrient Recommendations

Yield Goal lb/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
1000.0	17	21	19	15	0	0	22	17	0	0
1400.0	29	28	25	19	0	0	29	22	0	0
1800.0	50	35	31	23	0	0	35	26	11	0
2200.0	82	42	36	27	11	0	41	30	12	0
2600.0	123	49	42	31	12	0	47	34	14	0
3000.0	175	56	48	35	14	0	54	39	16	0

¹ Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

SOYBEAN and EDIBLE BEAN Statements

- Soybean or edible bean when P₂O₅ and/or K₂O are recommended.
If the recommended amount of a nutrient is below 20 lb/A it should be applied with a starter attachment. Starter fertilizers should be applied in a band 2 inches beside and 2 inches below the seed. It should not touch the seed. A maximum of 15 lb/a of nitrogen can be included in the starter and the total N + K₂O should not exceed 20 lb/A.
- All soybeans.
Soybeans that have been well inoculated are not likely to respond to additional nitrogen fertilizer.
- 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.

Wheat and rye

South Dakota Wheat and Rye Nutrient Recommendations

Yield Goal bu/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
30.0	72	30	29	23	10	0	40	37	0	0
40.0	96	39	36	28	12	0	54	48	0	0
50.0	120	48	44	34	14	10	69	58	0	0
60.0	144	57	51	39	17	10	83	68	0	0
70.0	168	66	58	44	19	10	97	78	16	0
80.0	192	74	66	50	22	10	111	88	21	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Oats

South Dakota Oats Nutrient Recommendations

Yield Goal bu/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
60.0	78	32	30	24	10	0	59	38	0	0
70.0	91	37	34	27	12	10	69	45	0	0
80.0	104	42	38	30	13	10	79	51	17	0
90.0	117	47	42	33	14	10	89	58	19	0
100.0	130	52	46	35	15	10	99	64	21	0
110.0	143	57	51	38	16	10	109	71	23	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Barley

South Dakota Barley Nutrient Recommendations

Yield Goal bu/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
40.0	60	28	26	20	10	0	39	32	0	0
50.0	75	34	31	24	10	0	50	39	17	0
60.0	90	41	37	28	11	0	60	47	20	0
70.0	105	47	42	31	13	10	71	54	23	0
80.0	120	53	47	35	15	10	81	61	26	0
90.0	135	59	52	39	17	10	92	68	29	0
100.0	150	65	57	43	19	10	103	75	32	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Flax

South Dakota Flax Nutrient Recommendations

Yield Goal bu/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
20.0	60	22	21	16	0	0	39	36	0	0
30.0	90	31	29	22	0	0	60	51	0	0
40.0	120	40	37	29	12	0	81	67	16	0
50.0	150	50	45	35	16	0	102	82	24	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Buckwheat

South Dakota Buckwheat Nutrient Recommendations

Yield Goal bu/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		3	10	20	33	40	50	150	275	350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
24.0	50	22	20	15	0	0	23	20	0	0
32.0	72	32	28	21	0	0	34	29	0	0
40.0	93	42	37	27	11	0	43	36	17	0
48.0	115	52	45	33	14	0	50	41	20	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Safflower

South Dakota Safflower Nutrient Recommendations

Yield Goal lb/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		3	10	20	33	40	50	150	275	350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
800.0	40	18	17	14	0	0	27	19	0	0
1200.0	60	27	25	19	0	0	40	28	0	0
1600.0	80	35	32	24	10	0	53	37	17	0
2000.0	100	44	39	29	12	0	66	46	21	0
2400.0	120	53	46	34	15	0	78	54	24	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

Mustard and rape

South Dakota Mustard and Rape Nutrient Recommendations

Yield Goal lb/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
1000.0	60	29	24	17	0	0	53	35	0	0
1500.0	90	41	35	24	10	0	79	52	18	0
2000.0	120	54	45	32	13	0	104	68	23	0
2500.0	150	67	56	39	17	0	129	84	28	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

WHEAT, OATS, BARLEY, RYE, FLAX, BUCKWHEAT, SAFFLOWER, MUSTARD, and RAPE Statements

- Wheat, barley, rye, oats, flax, rape seed, mustard, safflower and buckwheat when P₂O₅ is recommended.
The P₂O₅ recommendation can be reduced by one third if applying as a starter.
- Wheat, barley, rye, oats, flax, rape, mustard, safflower and buckwheat when very reduced or no-till is used and no deep nitrate test.
With very reduced and no tillage systems, add 30 lbs/A of nitrogen to the above recommendation.
- Wheat, barley, rye, and oats when nitrogen and/or potassium are recommended.
Nitrogen plus K₂O applications in contact with the seed should not exceed 50 lbs/A for moist, medium-fine textured soils. Nitrogen from urea and DAP (18-46-0) fertilizers should be limited to 25 lbs/A when placed in contact with the seed in six 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.
- Flax, rape seed, mustard, safflower, and buckwheat when nitrogen and/or potassium are recommended.
Nitrogen plus K₂O applications in contact with the seed should not exceed 10 lbs/A. Nitrogen from urea, DAP (18-46-0), and ammonium thiosulfate (21-0-0-26) should NOT be placed with the seed.
- Malting barley with no 0-24" nitrate test.
To reduce the risk of high protein, nitrogen recommendations are not made for malting barley unless the amount of soil nitrate-nitrogen is known. As a result, WE ARE MAKING A RECOMMENDATION FOR FEED BARLEY. If you wish a recommendation for malting barley, it will be necessary to take two-foot deep samples for the nitrate-nitrogen tests.

Alfalfa

South Dakota Alfalfa Nutrient Recommendations

Yield Goal ton/A	NITROGEN lb/A	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
2.0	0	30	30	24	0	0	105	57	18	0
3.0	0	42	40	32	12	0	153	89	29	0
4.0	0	54	50	39	16	0	202	121	40	0
5.0	0	66	60	46	19	0	250	153	52	0
6.0	0	79	71	54	23	0	299	185	63	0
7.0	0	91	81	61	26	0	347	217	74	0
8.0	0	103	91	68	30	0	396	249	86	0

Grass

South Dakota Grass Nutrient Recommendations

Yield Goal ton/A	NITROGEN lb/A	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL <6	L 6-15	M 16-25	H 26-40	VH >40	L <100	M 100-200	H 201-350	VH >350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
1.0	25	15	15	15	0	0	46	45	18	0
2.0	50	22	19	15	0	0	99	81	33	0
3.0	75	34	27	15	0	0	151	117	49	0
4.0	100	45	36	20	0	0	204	153	64	0
5.0	125	57	44	24	0	0	256	189	79	0
6.0	150	68	53	28	0	0	309	225	95	0
7.0	175	80	62	33	0	0	362	261	110	0

ALFALFA and GRASS Statements

1. When alfalfa yield goals are greater than 5 tons.
Because of high yield goals, soil nutrient withdrawal will likely be large. Therefore, you should soil test each year.
2. New alfalfa seedlings.
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 for new seedlings.

ALFALFA and GRASS Statements (Cont.)

3. Established alfalfa when fertilizer is recommended.
The above fertilizer is to be applied annually as long as the stand is maintained.
4. When alfalfa grass mixture is listed.
If your alfalfa-grass mixture contains at least 1/3 alfalfa, no additional nitrogen should be needed.
5. Alfalfa and grass when a 0-2' NO₃-N sample was taken.
The nitrate nitrogen test is of little value for perennial crops.
6. 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 lbs/A of nitrogen.
7. 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 grass stands, apply about mid-May.
8. Established grass when yield is greater than 5 tons.
For cool season grass stands, apply half of the nitrogen in late fall or early spring. The remainder should be applied between cuttings or when livestock are rotated.

Sudan grass and forage sorghum

South Dakota Sudan Grass and Forage Sorghum Nutrient Recommendations

Hay Yield Goal ton/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM, lb/A			
		VL	L	M	H	VH	L	M	H	VH
		<6	6-15	16-25	26-40	>40	<100	100-200	201-350	>350
		3	10	20	33	40	50	150	275	350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
3.0	75	32	29	22	0	0	156	82	0	0
4.0	100	41	36	27	10	0	203	114	0	0
5.0	125	49	43	32	12	0	249	147	19	0
6.0	150	57	50	37	15	0	296	179	33	0
7.0	175	65	57	41	17	0	342	211	48	0
8.0	200	73	63	46	19	0	389	244	63	0

¹ Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

SUDAN GRASS Statement

1. Sudan grass when nitrogen is recommended.
The nitrogen should be divided in half; one half being applied at/or prior to seeding time, the other half after the first cutting or after 6 weeks.

Millet

South Dakota Millet Nutrient Recommendations

Yield Goal lb/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
1000.0	40	17	15	12	0	0	22	15	0	0
1400.0	56	22	20	15	0	0	30	20	0	0
1800.0	72	28	24	18	0	0	37	25	0	0
2200.0	88	33	29	21	0	0	45	30	0	0
2600.0	104	39	34	24	0	0	53	35	0	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

MILLET Statement

1. Millet when fertilizer is recommended.

If a drill attachment is used, do not apply more than 20 lbs of N + K₂O in contact with the seed.

Potatoes

South Dakota Potato Nutrient Recommendations

Yield Goal cwt/A	Soil N Plus Fertilizer N Required ¹ lb/A-2'	Soil Test PHOSPHORUS, lb/A					Soil Test POTASSIUM lb/A			
		VL <6 3	L 6-15 10	M 16-25 20	H 26-40 33	VH >40 40	L <100 50	M 100-200 150	H 201-350 275	VH >350 350
		----- lbs P ₂ O ₅ /A -----					----- lbs K ₂ O/A -----			
200.0	80	103	80	50	16	0	151	101	39	0
250.0	105	112	87	54	17	0	188	126	47	0
300.0	130	120	93	59	19	0	225	150	56	0
350.0	155	129	101	63	21	0	262	174	65	0
400.0	180	138	108	69	23	0	299	199	73	0
450.0	205	147	116	74	25	0	336	223	82	0

1 Fertilizer nitrogen to apply is equal to the value in the table minus soil nitrate N to a 2-foot depth. Without a two-ft NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

POTATO Statements

1. If P₂O₅ and/or K₂O are recommended.

The best placement of fertilizer for potatoes has been found to be about 2 inches below and on each side of the seed piece. Avoid placement of fertilizer in contact with the seed piece.

Zinc

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

Management	Zinc soil test (ppm Zn)		
	Low (0-0.50)	Medium (0.51-1.00)	High (>1.00)
--- lbs/A Zn (broadcast basis)* --			
Dryland	5	5	0
Irrigated	10	5	0

*Based on the use of inorganic products as source of zinc.

Zinc Statements

1. Corn, sorghum, soybeans, edible beans, flax, and potatoes when zinc test is below 1.0 ppm.

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 three 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, soybeans, flax, and potatoes when zinc test is below 1.0 ppm.

Experience has shown that only the crops of corn, sorghum, beans, flax, and potatoes respond to added zinc. See fact sheet FS 674 "Zinc Deficiencies".

Sulfur

Sulfur Recommendations

Calculate the total sulfur requirement for a given crop and yield goal using the following table. Subtract from this requirement the sum of the following sulfur sources.

- A) SO₄-S soil test to 2 feet (lb/A)
- B) organic matter level in soil x 3 (lb/A)
- C) 6 lb/A for sulfur from air and rainfall
- D) sulfur in irrigation water (lb/A)

If the sum of these sources of sulfur is less than the calculated sulfur requirement, apply 25 lbs/A broadcast sulfur or apply 10-15 lbs actual sulfur in the row or with the drill.

Example: The farmer has a 5 ton/A alfalfa yield goal and his sulfur test in the top 2-ft of soil is 5 lb/A with an organic matter soil test of 2.0%, then:

$$5 \text{ ton} \times 5.2 \text{ lb/ton} = 26 \text{ lb S requirement}$$

$$\begin{aligned} \text{recommendation: } & 26 \text{ lb} - 5 \text{ lb soil test} - 6 \text{ lb from OM (2 x 3)} - \\ & \quad 6 \text{ lb from precipitation} \\ & = 26 - 17 = 9 \text{ lb} \\ & = 9 \text{ is greater than 0, apply 25 lb sulfur} \end{aligned}$$

Sulfur requirements of crops

Crop	Unit	Sulfur Required per unit lbs
Wheat	bu	0.25 x yield
Oats	bu	0.20 x yield
Barley	bu	0.20 x yield
Rye	bu	0.25 x yield
Flax	bu	0.35 x yield
Corn (grain)	bu	0.18 x yield
Corn (silage)	ton	1.10 x yield
Sorghum	bu	0.18 x yield
Soybeans	bu	0.30 x yield
Sunflowers	cwt	0.80 x yield
Edible Beans	cwt	0.67 x yield
Millet	cwt	0.42 x yield
Rape	cwt	0.50 x yield
Mustard	cwt	0.50 x yield
Potatoes	cwt	0.06 x yield
Alfalfa	ton	5.20 x yield
Grass	ton	5.00 x yield
Sudangrass	ton	3.50 x yield

SULFUR Statements

- 1) When a sulfur recommendation is made.
Apply above sulfur as broadcast or apply 10-15 pounds actual sulfur in the row or with the drill. Sulfate forms of sulfur (gypsum 18% S, Ammonium Sulfate 24% S, and Potassium Sulfate 17% S) are the best sources for immediate effectiveness. However, elemental sulfur (95-98% S) is usually most available from dealers and least expensive. Elemental sulfur requires 3-6 months in the 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") 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.

Example: 35 lb 2 foot chloride soil test
fertilizer Rec. = 60 - 35
= 25 lbs/A chloride recommended

<u>Chloride Soil Test</u>	<u>Relative Level</u>

lb/A 2 ft.	
0-30	Low
31-60	Medium
>60	High

CHLORIDE Statement

- 1) The chloride recommendation is for the crops spring and winter wheat and barley. The spring wheat variety Guard does not respond to added chloride. 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) which is 45% chloride. The amount of this fertilizer to apply is calculated as: lbs/A fertilizer needed = recommended Cl x 2.2.

Iron

Iron Recommendations

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

IRON Statement

- 1) The above iron recommendation 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 and extremely expensive in South Dakota. 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.

Manganese

Manganese Recommendations

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

MANGANESE Statement

- 1) The above manganese recommendation is for a broadcast application of actual manganese. This is equivalent to about 55 pounds of manganese sulfate. A row application of 10 pounds actual manganese is the recommended method since manganese will be fixed on high pH soils. Soybeans, potatoes, oats, wheat, and alfalfa are most likely to show a manganese deficiency. Manganese deficiency has never been confirmed in South Dakota.

Copper

Copper Recommendation

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

COPPER Statement

- 1) The above copper recommendation is for a broadcast application of actual copper. This would be equivalent to about 5 pounds of copper sulfate. In season copper deficiencies may be corrected by foliar applications of copper chelate at labelled rates. Do not apply copper annually because of a possible toxic build-up. Copper deficiency has never been confirmed in South Dakota.

Boron

Boron Recommendations

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

BORON Statement

- 1) The above boron recommendation is for a broadcast recommendation. Never apply boron in direct seed contact (row or drill fertilizers). Alfalfa and clovers are the most sensitive to boron deficiency. Reduce the above recommendation by 1/2 for all other crops. Because of possible toxic over-fertilization with boron, never apply unless a boron soil test has first been taken.

Magnesium

Magnesium Recommendations

<u>Magnesium Soil Test</u> ppm	<u>Interpretation</u>	<u>Magnesium Recommendations</u> lb/A
0-25	Low	50
26-50	Medium	50
>50	High	0

MAGNESIUM Statement

- 1) The above magnesium recommendation is for a broadcast application. Reduce to 10-20 pounds actual magnesium if row applied. Sources such as magnesium sulfate (11% Mg) can be used.

Calcium

Calcium Recommendations

<u>Calcium Soil Test</u> ppm	<u>Interpretation</u>	<u>Calcium Recommendations</u> lb/A
0-250	Low	Lime
251-500	Medium	Lime
>500	High	0

CALCIUM Statement

- 1) The calcium recommendation above 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 never been confirmed in South Dakota.

Lime

Lime Recommendations

- based on single SMP buffer
- SMP run only when pH is 6.0 or lower
- recommendations used to raise pH to 6.0

<u>SMP Buffer Index</u>	<u>Lime Required for 6" plow depth* tons/A</u>
6.8	0
6.7	0
6.6	0
6.5	0
6.4	2.0
6.3	2.0
6.2	2.0
6.1	2.0
6.0	2.5
5.9	2.5
5.8	3.0
5.7	3.0
5.6	3.5

* Rates based on a calcium carbonate equivalent of 90% and a total effectiveness of 70%. One ton of pure CaCO_3 is equivalent to 1.60 tons of such a limestone.

Salts and sodium

Salts and Sodium Statements

<u>Low</u>	<u>#1 Medium</u>	<u>#2 Medium-High</u>	<u>#3 High</u>	<u>#4 Very High</u>
<u>Conductivity = millimhos cm (EC x 105)</u>				
<u><3</u>	<u>3-5</u>	<u>5.1-10.0</u>	<u>10.1-16.0</u>	<u>>16</u>

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 application of crop residues and phosphate fertilizer sometimes increases 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 the 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.

Nitrogen credits for legumes

Nitrogen credits for Legumes

The growth of a legume in the rotation increases the supply of available nitrogen in the soil. Estimating the amount of nitrogen supplied is difficult. The amount of nitrogen supplied through the growth of a legume depends on the stand, the length of time it was on the ground and the amount of growth turned under. You are far better able to judge these factors than anyone else. The information given in the following table is provided to help you make this decision. Any nitrogen made available for the coming crop through the growth of a legume should be subtracted from the rate recommended by soil test.

Suggested Average Nitrogen Credits for Legumes.

<u>Crop</u>	<u>Nitrogen Credit</u> ^{1/} lb/A
Legume or Legume-Grass sods	
More than 50% legume <u>(3 or more plants/sq ft)</u>	100
20-50% legume <u>(1-3 plants/sq ft)</u>	50
Less than 20% legume <u>(less than 1 plant/sq. ft.)</u>	0
Soybeans and Edible Beans for Seed	1 lb for each bu produced (max. of 40 lb)

^{1/} For the second crop year after legumes, divide the credits by 2.

Fertilizer credits for manure

Fertilizer Credits for Manure

The fertilizer value of manure varies with the age and type of animal producing it. Its value is also influenced by how it is handled. Tables 1 and 2 provide a simple method of estimating the plant food credits of manure. Subtract the credits from the fertilizer amount recommended. If a more accurate measurement is desired, a laboratory analysis of the manure is recommended. If the analysis is known, credit 50% of the total nitrogen, 50% of the total phosphate, and 70% of the total potash as available.

Table 1. Nutrient Credits for Solid Manure.

<u>Kind of Manure</u>	<u>Fertilizer Credit</u>		
	<u>N</u>	<u>P₂O₅</u> lb/ton	<u>K₂O</u>
Cattle or Hog	5	3	7
Sheep	15	5	15
Poultry and Turkey	25	25	10

Credits shown in table 1 apply to manure containing enough straw or stalks to have absorbed most of the urine. Excessively "strawy" manure should be credited for K₂O only. Credits shown are equivalent fertilizer values. Manure nitrogen and phosphorus is considered to be 50% available.

Table 2. Nutrient Credits for liquid manure ^{1/}

Animal	Element		
	N	P ₂ O ₅ lb/1000 gal. manure	K ₂ O
Dairy	25	10	32
Beef	27	20	38
Swine	33	25	38
Poultry	72	49	53

^{1/} Assuming no outside contamination or dilution.

It is often difficult to estimate how much manure is hauled. Table 3 gives the load capacity of many of the common manure spreaders sized in both bushels and tons. The number of pounds of plant food elements added per acre can be calculated when you know how many loads of manure are applied to an acre. Multiply the number of loads per acre times the tons per load times the pounds of nutrients per ton given in Table 1.

Table 3. Estimated Tonnage Capacity for Various Manure Spreader Sizes.

Spreader Size	Tons of Manure
60- 80 bushels	1.2
90-110 bushels	1.7
120-140 bushels	2.2
150-170 bushels	2.7

Calculating from equations

Calculating Nitrogen Phosphorus and Potassium Fertilizer Recommendations from Equations

When yield goals and soil test levels are given, the tables in this guide can be used to determine fertilizer recommendations for nitrogen, phosphorus and potassium. The recommendations can also be determined using equations. Determining the nitrogen fertilizer requirement is a relatively simple calculation. However, estimation of fertilizer P₂O₅ and K₂O needs is not a simple process and required numerous calculations. Many individuals, however, have computers or programmable calculators to easily handle these computations. The following formulas are listed to compute the SDSU N, P₂O₅, and K₂O fertilizer recommendations for some common crops.

Nitrogen fertilizer recommendations are made by subtracting the NO₃-N soil test value in the top two feet of soil from the calculated nitrogen requirement for a given yield goal. The nitrogen requirement for crops grown in South Dakota is listed in Table 1.

Table 1. Nitrogen Recommendations Using 2-ft. NO₃-N Test. ^{1/}

Crop	Unit	Nitrogen Required lbs
Wheat	bu	2.4 x yield
Oats	bu	1.3 x yield
Barley	bu	1.5 x yield
Rye	bu	2.4 x yield
Flax	bu	3.0 x yield
Corn (Grain)	bu	(1.45 x yield)-20
Corn (Silage)	ton	(11.6 x yield)-20
Sorghum (Grain)	bu	1.1 x yield
Sorghum, Sudan (hay)	ton	25 x yield
Grass (hay)	ton	25 x yield
Sunflowers	cwt	5.0 x yield
Edible beans	cwt	(7.5 x yield)-75
Millet	cwt	4.0 x yield
Rape	cwt	6.0 x yield
Mustard	cwt	6.0 x yield
Safflower	cwt	5.0 x yield
Buckwheat	bu	(2.73 x yield)-16
Potatoes	cwt	(.5 x yield)-20

^{1/} Fertilizer nitrogen to apply is equal to the nitrogen requirement minus soil NO₃-N to a 2-ft depth.

Example 1: The farmer has a 40 bushel wheat yield goal and his NO₃-N soil test level of 45 lbs/A.
 40 bu x 2.4 lbs N/Bu = 96 lbs N requirement.
 96 - 45 lbs soil test NO₃-N = 51 lbs N fertilizer needed.

Example 2: The farmer has a 100 bushel corn yield goal and his NO₃-N soil test level of 45 lbs/A.
 (100 bu x 1.45 lbs N/Bu)-20 lbs = 125 lb N requirement.
 125 - 45 lbs soil test N = 80 lbs N fertilizer needed.

Without a two-foot NO₃-N test, an assumption of 40 lb/acre residual NO₃-N is made. Therefore, Recommended N = Required Nitrogen (Table 1) - 40. If the previous crop was black fallow, use 75 instead of 40 as the estimated residual 2-ft. NO₃-N level.

During the summer, soils in South Dakota are warm enough to allow bacteria to convert nitrogen in organic matter to available nitrogen. Therefore, samples taken in mid-summer will not measure all the nitrogen which will be available to the next year's crop. To compensate for this nitrogen which is becoming available after sampling, 25 lbs is subtracted from the calculated recommendation if the soil sample was taken between July 1 and August 15 and 15 lbs is subtracted for samples taken between August 15 and September 15.

Phosphorus and potassium recommendations are made from the following formula:

$$\text{P or K recommendation} = A + (B \times \text{yield goal}) + (C \times \text{yield goal} \times \text{yield goal}) + (D \times \text{soil test}) + (E \times \text{yield goal} \times \text{soil test}) + (F \times \text{soil test} \times \text{soil test}).$$

The P or K soil analysis result (lb/A) would be substituted for soil test in the equation. The yield goal would also be substituted into the equation. The coefficients (A, B, C, D, E, or F) are found in Table 2.

Table 2. Phosphorus and potassium coefficients.

Crop	Units	Fertilizer	Coefficient					
			A	B	C	D	E	F
Alfalfa	ton/A	P	2.5751	13.1366	0	0.9519	-0.2903	-0.0298
		K	20.6250	56.7500	0	-0.3000	-0.1650	0.0008
Grass	ton/A	P	-2.2120	12.7633	0	0.5698	-0.4232	-0.0170
		K	-21.0360	60.8479	0	0.3369	-0.1656	-0.0009
Sudan Grass	ton/A	P	4.9692	9.6796	-0.0876	0.3262	-0.1926	-0.0163
		K	32.7413	53.5652	0	-0.3197	-0.1412	0
Corn (grain)	bu/A	P	-5.6669	0.6682	0	0.8715	-0.0148	-0.0248
		K	-8.4452	1.0870	0	0.0510	-0.0031	-0.0001
Corn (silage)	ton/A	P	-5.4883	5.3654	0	0.8454	-0.1194	-0.0231
		K	-8.9646	8.6896	0	0.0576	-0.0250	-0.0001
Sorghum	bu/A	P	0.4714	0.6302	0	0	-0.0155	0
		K	-7.0085	0.9058	0	0.1414	-0.0017	-0.0007
Soybeans	bu/A	P	7.4143	1.0417	0	0	-0.0218	-0.0081
		K	-9.0971	1.4678	0	0.1819	-0.0032	-0.0007
Edible Beans	lb/A	P	1.9097	0.0191	0	0.3669	-0.0005	-0.0112
		K	5.2461	0.0184	0	0.0290	-0.0001	-0.0001
Barley	bu/A	P	2.6804	0.6506	0	0.4895	-0.0139	-0.0177
		K	-9.3500	1.2300	0	0.1360	-0.0034	-0.0003

Table 2. Phosphorus and potassium coefficients (Cont.).

Crop	Units	Fertilizer	Coefficient					
			A	B	C	D	E	F
Wheat & Rye	bu/A	P	1.9874	0.9448	0	0.6754	-0.0206	-0.0215
		K	-17.5399	1.6300	0	0.3664	-0.0042	-0.0013
Oats	bu/A	P	-0.1777	0.5370	0	0.7725	-0.0128	-0.0192
		K	-0.5940	1.1663	0	0	-0.0035	0
Flax	bu/A	P	1.9842	0.9827	0	0.4791	-0.0184	-0.0191
		K	-16.7171	2.3901	0	0.3260	-0.0057	-0.0012
Rape & Mustard	lb/A	P	3.4609	0.0271	0	0	-0.0006	-0.0042
		K	3.1555	0.0592	0	0	-0.0002	0
Millet	lb/A	P	4.0445	0.0122	0	0.2876	-0.0004	-0.0092
		K	5.6175	0.0199	0	-0.0093	-0.0001	0
Potatoes	cwt	P	80.4597	0.1561	0.0001	-2.6221	-0.0047	0.0184
		K	3.1192	0.8655	0	0.0026	-0.0025	0
Sunflowers	cwt	P	0.5014	0.0140	0	0.3920	-0.0002	-0.0214
		K	0.4747	0.0368	0	0	-0.0001	0
Buckwheat	bu/A	P	-10.7073	1.3655	0	0.6765	-0.0313	-0.0129
		K	-26.9067	2.4060	-0.0163	0.1055	-0.0023	-0.0004
Safflower	lb/A	P	-0.0081	0.0229	0	0.4636	-0.0005	-0.0132
		K	1.5826	0.0370	0	0	-0.0001	0

Example 3: The farmer has a 100 bushel corn yield goal. The P soil test is 20 lb/A and the K test is 275 lb/A.

$$\begin{aligned}
 P_2O_5 \text{ rec.} &= -5.6669 + 0.6682 \times 100 + 0 + 0.8715 \times 20 - 0.0148 \times 100 \\
 &\quad \times 20 - 0.0248 \times 20 \times 20 \\
 &= -5.7 + 66.8 + 17.4 - 29.6 - 9.9 = 39 \text{ lb/A } P_2O_5.
 \end{aligned}$$

$$\begin{aligned}
 K_2O \text{ rec.} &= -8.4452 + 1.087 \times 100 + 0 + .051 \times 275 - 0.0031 \times 100 \times \\
 &\quad 275 - .0001 \times 275 \times 275 \\
 &= -8.4 + 108.7 + 14.0 - 85.3 - 7.6 = 22 \text{ lb/A } K_2O.
 \end{aligned}$$