MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA
AGRICULTURE

Fertilizer Recommendations For Agronomic Crops In Minnesota

by

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INTRODUCTION

This publication provides a summary of the fertilizer recommendations for agronomic crops grown in Minnesota. The recommendations are in tables. By using these tables, it should be possible to use analytical results from other soil testing laboratories and generate University of Minnesota fertilizer recommendations.

The recommendations are listed by crop (see Table of Contents). There are not recommendations for all nutrients for each crop. The absence of a recommendation for a specific nutrient implies that the crop in question does not respond to the application of that nutrient.

Nutrient management information (timing, source, placement, etc.) is not provided in this publication. This information is provided in detail in extension folders that describe fertilizer practices for the major crops.

When using the recommendations in this publication, there are some general statements that should be remembered. These are:

- A good stand of alfalfa is 5 or more plants/ft^2. This information is useful when making nitrogen recommendations that are based on previous crop and yield goal.

- It may not be practical to broadcast relatively low rates of either phosphate or potash. An alternative practice would be to double the suggested rates and broadcast on alternate years.

- If the soil test level for P is very low (0-5 ppm), use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

- If the soil test level for K is very low (0-40 ppm for corn; 0-50 ppm for small grain), use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill rate and broadcast the remainder.

- Sulfur recommendations are made for sandy soils only.

- Do not apply urea, thiosulfate, or boron in contact with the seed.

Table 1. Phosphate recommendations for alfalfa production.

Yield Goal	Soil Test P (ppm) 0-5	6-10	11-15	15-20	21-25	25+
ton/acre	- - - - - - - P_2O_5 to apply (lb./acre) - - - - - - -					
3 or less	70	50	30	0	0	0
4	85	65	40	20	0	0
5	100	80	55	30	0	0
6	115	95	70	45	20	0
7	130	110	85	60	30	0
more than 7	150	125	100	75	50	0

Table 2. Potash recommendations for alfalfa production.

Yield Goal	Soil Test K (ppm) 0 - 40 F-M	0 - 40 C*	41 - 80 F-M	41 - 80 C	81 - 120 F-M	81 - 120 C	121 - 160 F-M	121 - 160 C	160 + F-M	160 + C
ton/acre	- - - - - - - - - - - K_2O to apply (lb./acre) - - - - - - - - - - -									
3 or less	140	150	80	90	40	50	0	0	0	0
4	180	190	130	140	80	90	30	40	0	0
5	220	240	160	190	120	140	70	90	0	0
6	260	290	210	240	160	190	110	140	0	0
7	300	340	240	280	180	220	120	160	0	0
more than 7	340	390	270	320	200	250	130	180	0	0

* F-M refers to fine to medium textured soils. These are: loam, silt loam, silty clay loam, silty clay, and clay textures: C refers to coarse textured soils. These are: sand, loamy sand, and sandy loam textures.

Table 3. Sulfur recommendations for alfalfa production.

Soil Test For Sulfur	Sulfur to Apply
ppm	- - lb./acre - -
0 - 6	25 each year
7 - 12	25 each year (trial basis only)
13 +	0

Table 4. Boron recommendations for alfalfa production.

Soil Test For Boron	Boron to Apply
ppm	- - lb./acre - -
less than 1.0	2 - 4
1.0 and higher	0

Table 5. Phosphate recommendations for alsike clover, birdsfoot trefoil, red clover, grass-legume hay and grass-legume pastures.

	Soil Test P (ppm)			
Yield Goal	0 - 5	6 - 10	11 - 15	16 +
ton/acre	- - - - - P_2O_5 to apply (lb./acre) - - - - -			
2 or less	40	40	0	0
3	60	40	40	0
4	80	60	40	0
5 or more	100	80	60	0

Table 6. Potash recommendations for alsike clover, birdsfoot trefoil, red clover, grass-legume hay and grass-legume pastures.

	Soil Test K (ppm)			
Yield Goal	0 - 50	51 - 100	101 - 150	151 +
ton/acre	- - - - - - K_2O to apply (lb./acre) - - - - -			
2 or less	120	40	0	0
3	160	80	0	0
4	200	120	40	0
5 or more	240	160	80	0

Table 7. Nitrogen suggestions for barley grown for feed when the soil nitrate test is used.

Yield Goal	Soil nitrate - N (0-2 ft.) + fertilizer N needed*
bu./acre	lb./acre
less than 50	85
50 - 69	100
70 - 89	135
90 - 109	170
more than 109	185

* For specific yield goals, the equation is:

$N_{Rec} = (YG \times 1.67) - ST_N$

N_{Rec} = suggested amount of N to use in lb./acre

YG = yield goal in bu./acre

ST_N = residual NO_3-N in top 2 ft. of root zone measured as lb./acre

Table 8. Nitrogen suggestions for malting barley when the soil nitrate test is used.

Yield Goal	Soil nitrate - N (0-2 ft.) + fertilizer N needed*
bu./acre	lb./acre
less than 50	75
50 - 69	90
70 - 89	120
90 - 109	150
more than 109	165

* For specific yield goals, the equation is:

$N_{Rec} = (YG \times 1.5) - ST_N$

N_{Rec} = suggested amount of N to use in lb./acre

YG = yield goal in bu./acre

ST_N = residual NO_3-N in top 2 ft. of root zone measured as lb./acre

Table 9. Suggested rates of fertilizer N for all barley production when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
bu./acre	N to apply (lb./acre)								
less than 50	0	0	25	-	0	0	55	35	0
50 - 69	0	0	40	20	25	0	70	50	0
70 - 89	0	0	75	55	60	40	105	85	0
90 - 109	50	30	110	90	95	75	140	120	30
more than 109	65	45	125	105	110	90	155	135	45

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley
buckwheat
canola
corn
edible beans
flax
grass hay
grass pasture
millet
mustard
oats
potatoes
rye
sorghum-sudan
sugarbeets
sunflowers
sweet corn
triticale
wheat
vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 10. Suggested rates of phosphate fertilizer for barley production.

Yield Goal	Soil Test P (ppm) 0 - 5		6 - 10		11 - 15		16 - 20		21 +	
	Bdcst	or Drill	Bdcst	or Drill	Bdcst	or Drill	Bdcst	or Drill	Bdcst	or Drill
bu./acre	- - - - - - - - - - - - - - P_2O_5 to apply (lb./acre) - - - - - - - - - - - - - -									
less than 50	50	30	30	15	20	10	0	10	0	0
50 - 69	60	30	40	20	20	10	0	10	0	0
70 - 89	70	30	50	25	30	15	0	10	0	0
90 - 109	80	30	60	30	40	20	0	10	0	0
more than	90	30	70	35	50	25	0	10	0	0

Table 11. Suggested rates of potash fertilizer for barley production.

Yield Goal	Soil Test K (ppm) 0 - 50		51 - 100		101 - 150		151 +	
	Bdcst	or Drill	Bdcst	or Drill	Bdcst	or Drill	Bdcst	or Drill
bu./acre	- - - - - - - - - - - K_2O to apply (lb./acre) - - - - - - - - - - -							
less than 50	60	35	20	10	20	10	0	0
50 - 69	80	35	40	20	20	10	0	0
70 - 89	100	35	60	30	20	10	0	0
90 - 109	120	35	80	40	40	20	0	0
more than 109	140	35	100	40	60	30	0	0

Table 12. Nitrogen recommendations for buckwheat and millet production when the soil nitrate test is used.

Yield Goal	Soil nitrate-N (0-2 ft.) + fertilizer N
lb./acre	- - - - lb./acre - - - -
less than 1400	60
1500 - 1900	70
2000 - 2400	80
2400 - 2900	100
3000 or more	120

Table 13. Nitrogen recommendations for buckwheat and millet production when the soil nitrate is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -1/		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
lb./acre	- - - - - - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - - - - - -								
less than 1400	0	0	30	20	20	0	40	20	0
1500 - 1900	0	0	40	20	30	0	50	30	0
2000 - 2400	20	0	50	30	40	20	60	40	20
2500 - 2900	40	20	60	40	60	40	80	60	20
3000 or more	60	40	80	60	80	60	100	80	20

* CROPS IN GROUP 1
alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley	grass hay	sorghum-sudan
buckwheat	grass pasture	sugarbeets
canola	millet	sunflowers
corn	mustard	sweet corn
edible beans	oats	triticale
flax	potatoes	wheat
	rye	vegetables

1/ low to medium = less than 4.5%; high = more than 4.5%

Table 14. Phosphate recommendations for buckwheat and millet production.

Soil Test P	P_2O_5 to Apply
- ppm -	lb./acre
0 - 5	60
6 - 10	40
11 - 15	20
16 +	0

Table 15. Potash recommendations for buckwheat and millet production.

Soil Test K	K_2O to Apply
- ppm -	lb./acre
0 - 50	90
51 - 100	60
101 - 150	30
151 +	0

Table 16. Nitrogen recommendations for canola (rape) and mustard production when the soil nitrate test is used.

Yield Goal	Soil nitrate-N (0-2 ft.) + fertilizer N
lb./acre	- - - - lb./acre - - - -
less than 1,000	60
1100 - 1300	70
1400 - 1600	80
1700 - 1900	100
2000 or more	120

Table 17. Nitrogen recommendations for canola (rape) and mustard production when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1/]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
lb./acre	- - - - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - - - -								
less than 1000	0	0	30	20	20	0	40	20	0
1100 - 1300	0	0	40	20	30	0	50	30	0
1400 - 1600	20	0	50	30	40	20	60	40	20
1700 - 1900	40	20	60	40	60	40	80	60	20
2000 or more	60	30	80	60	80	60	100	80	20

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley, buckwheat, canola, corn, edible beans, flax, grass hay, grass pasture, millet, mustard, oats, potatoes, rye, sorghum-sudan, sugarbeets, sunflowers, sweet corn, triticale, wheat, vegetables

1/ low to medium = less than 4.5%; high = more than 4.5%

Table 18. Phosphate recommendations for canola (rape) and mustard production.

Soil Test P	P_2O_5 to Apply
- ppm -	lb./acre
0 - 5	60
6 - 10	40
11 - 15	20
16 +	0

Table 19. Potash recommendations for canola (rape) and mustard production.

Soil Test K	K_2O to Apply
- ppm -	lb./acre
0 - 50	90
51 - 100	60
101 - 150	30
151 +	0

Table 20. Nitrogen recommendations for corn when the soil nitrate test is not used.

Yield Goal		Previous crop and organic matter level							
		alfalfa[1] (good stand)		soybeans, field peas		any crop in group 1*		any crop in group 2*	
		- - O.M. - -[3]		- - O.M. - -		- - O.M. - -		- - O.M. - -	
		low to[2] medium	high	low to medium	high	low to medium	high	low to medium	high
Grain	Silage								
bu./acre	ton/acre	- - - - - - - - - - N to apply (lb./acre) - - - - - - - - - -							
75 or less	10 or less	0	0	50	40	0	0	60	40
76 - 95	10 - 12	0	0	70	50	15	0	90	70
96 - 115	13 - 15	0	0	100	70	45	0	120	100
116 - 135	16 - 18	0	0	120	90	75	45	150	120
136 - 155	19 - 21	30	0	150	120	105	75	180	150
156 - 175	22 - 24	50	20	160	130	125	95	200	170
more than 175	more than 24	70	40	180	150	145	115	220	190

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley	grass hay	sorghum-sudan
buckwheat	grass pasture	sugarbeets
canola	millet	sunflowers
corn	mustard	sweet corn
edible beans	oats	triticale
flax	potatoes	wheat
	rye	vegetables

1/ For second-year corn after a good stand of alfalfa on fine and medium textured soil, apply the N rate suggested for a previous crop of clover.

2/ The well drained silt loam soils in Southeastern Minnesota receive the N recommendations for soils with a high organic matter content. All irrigated soils are included in the low to medium organic matter category.

3/ Low to medium - less than 4.5%; high - more than 4.5%.

Table 21. Phosphate recommendations for corn production.

Yield Goal		Soil Test P (ppm)									
		0 - 5		6 - 10		11 - 15		16 - 20		21+[1]	
Grain	Silage	Bdcst	Row	Bdcst	Row	Bdcst	Row	Bdcst	Row	Bdcst	Row
bu./acre	ton/acre	P_2O_5 to apply (lb./acre)									
75 or less	10 or less	80	40	50	25	20	15	10	10 - 15	0	10 - 15
76 - 95	10 - 12	85	40	55	25	25	15	10	10 - 15	0	10 - 15
96 - 115	13 - 15	90	40	60	30	30	20	10	10 - 15	0	10 - 15
116 - 135	16 - 18	95	40	65	30	35	20	10	10 - 15	0	10 - 15
136 - 155	19 - 21	100	40	70	35	40	20	10	10 - 15	0	10 - 15
156 - 175	22 - 24	105	40	75	35	45	25	10	10 - 15	0	10 - 15
more than 175	more than 24	110	40	80	40	50	25	20	10 - 15	0	10 - 15

[1] No phosphate fertilizer is suggested for corn planted with conventional tillage systems if the soil test for P is 25 ppm or higher.

Table 22. Potash recommendations for corn production.

Yield Goal		Soil Test K (ppm)									
		0 - 40		41 - 80		81 - 120		121 - 160		161 +[1]	
Grain	Silage	Bdcst	Row	Bdcst	Row	Bdcst	Row	Bdcst	Row	Bdcst	Row
bu./acre	ton/acre	K_2O to apply (lb./acre)									
75 or less	10 or less	80	40	30	25	30	15	20	10 - 15	0	10 - 15
76 - 95	10 - 12	100	40	50	30	30	20	20	10 - 15	0	10 - 15
96 - 115	13 - 15	120	40	70	30	30	20	20	10 - 15	0	10 - 15
116 - 135	16 - 18	140	40	90	30	40	20	30	10 - 15	0	10 - 15
136 - 155	19 - 21	160	40	110	35	60	25	30	10 - 15	0	10 - 15
156 - 175	22 - 24	180	40	130	80	80	25	30	10 - 15	0	10 - 15
more than 175	more than 24	200	40	150	40	100	30	30	10 - 15	0	10 - 15

[1] No potash fertilizer is suggested for corn planted with conventional tillage systems if the soil test for K is 180 ppm or higher.

Table 23. Suggestions for zinc use for corn.

Zinc Soil Test	Relative Level	Zinc to Apply Starter or Broadcast
- ppm -		- - - lb./acre - - -
0 - .5	low	2 10-12
.6 - 1.0	marginal	1 5-10
1.1 +	adequate	0 0

Table 24. Sulfur suggestions for corn production on sandy soils.

Soil Test Value for S	Sulfur to Apply Starter or Broadcast
ppm	- - - lb./acre - - - -
0 - 6	12 25
7 or more	0 0

Table 25. Suggestions for magnesium use for corn production on sandy soils.

Magnesium Soil Test	Relative Level	Magnesium to Apply Starter or Broadcast
ppm		- - - lb./acre - - -
0 - 50	low	10-20 50 - 100
51 - 150	medium	trial[1/] 0
151 +	adequate	0 0

1/ Apply 10-20 lb. Mg/acre in a starter only if a Mg deficiency is suspected or if a Mg deficiency has been confirmed by plant analysis.

Table 26. Nitrogen recommendations for edible bean production when the soil nitrate test is used.

Yield Goal	Soil nitrate-N (0-2 ft.) + fertilizer N
lb./acre	- - - - lb./acre - - - -
less than 1400	60
1500 - 1900	80
2000 - 2400	100
2500 - 2900	120
3000 or more	140

Table 27. Nitrogen recommendations for edible bean production when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
lb./acre	- - - - - - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - - - - - -								
less than 1400	0	0	40	30	0	0	40	30	0
1500 - 1900	0	0	40	30	25	0	60	40	0
2000 - 2400	0	0	60	40	35	0	80	50	0
2500 - 2900	30	0	80	50	65	35	100	70	0
3000 or more	50	0	100	70	85	55	120	90	0

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley
buckwheat
canola
corn
edible beans
flax
grass hay
grass pasture
millet
mustard
oats
potatoes
rye
sorghum-sudan
sugarbeets
sunflowers
sweet corn
triticale
wheat
vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 28. Phosphate recommendations for edible bean production.

Yield Goal	Soil Test P (ppm) 0 - 5	6 - 10	11 - 15	16 +
lb./acre	- - - - - P_2O_5 to apply (lb./acre) - - - - -			
less than 1400	40	30	0	0
1500 - 1900	50	30	30	0
2000 - 2400	60	40	30	0
2500 - 2900	70	50	40	0
3000 or more	80	60	40	0

Table 29. Potash recommendations for edible bean production.

Yield Goal	Soil Test K (ppm) 0 - 50	51 - 100	101 - 150	151 +
lb./acre	- - - - - - K_2O to apply (lb./acre) - - - - -			
less than 1400	60	30	0	0
1500 - 1900	70	40	0	0
2000 - 2400	80	50	30	0
2500 - 2900	100	70	40	0
3000 or more	120	90	50	0

Table 30. Zinc recommendations for edible bean production.

Zinc Soil Test	Zinc to Apply Starter or Broadcast
ppm	- - - lb./acre - - -
0 - .5	2 10 - 12
.6 - 1.0	1 5 - 10
1.1 +	0 0

Table 31. Nitrogen recommendations for flax production when the soil nitrate test is used.

Yield Goal	Soil nitrate-N (0-2 ft.) + fertilizer N
bu./acre	lb./acre
less than 20	60
20 - 24	70
25 - 29	80
30 - 34	100
35 or more	120

Table 32. Nitrogen recommendations for flax production where the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
bu./acre	- - - - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - - - -								
less than 20	0	0	30	20	20	0	40	20	0
20 - 24	0	0	40	20	30	0	50	30	0
25 - 29	20	0	50	30	40	20	60	45	20
30 - 34	40	20	60	40	60	40	80	60	20
35 or more	60	40	80	60	80	60	100	80	20

* CROPS IN GROUP 1
alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2
barley, buckwheat, canola, corn, edible beans, flax, grass hay, grass pasture, millet, mustard, oats, potatoes, rye, sorghum-sudan, sugarbeets, sunflowers, sweet corn, triticale, wheat, vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 33. Phosphate recommendations for flax production.

Soil Test P	P_2O_5 to apply
ppm	lb./acre
0 - 5	40
6 - 10	30
11 - 15	20
16 +	0

Table 34. Potash recommendations for flax production.

Soil Test K	K_2O to apply
ppm	lb./acre
0 - 50	80
51 - 100	40
101 - 150	20
150 +	0

Table 35. Nitrogen recommendations for grass hay, grass pastures, native grasses, and sorghum sudan.

Management Situation	N to Apply
	lb./acre
rotational grazing as hay with adequate rainfall	150*
continuous grazing with adequate rainfall	100*
grazing or hay with limited soil moisture on fine textured soils	50
grazing or hay on sandy soils or soils with steep slopes	30
grazing or hay on organic soils	50

* This recommended rate of N should be split and applied in two applications (early April, late August) for best utilization by the plant and more uniform growth throughout the season.

Table 36. Phosphate recommendations for grass hay, grass pastures, native grasses and sorghum sudan.

Soil Test P	P_2O_5 to Apply
- ppm -	- lb./acre -
0 - 5	60
6 - 10	40
11 - 15	20
16 +	0

Table 37. Potash recommendations for grass hay, grass pastures, native grasses, and sorghum sudan.

Soil Test K	K_2O to Apply
- ppm -	- lb./acre -
0 - 50	80
51 - 100	60
101 - 150	40
151 +	0

Table 38. Nitrogen recommendations for grass seed production (bluegrass, timothy, reed canary, orchardgrass).

Status of Field	N to Apply	
	Mineral Soils	Organic Soils
	- - - - - - - lb./acre - - - - - - -	
new seeding	30	0
established stands	100	40

Table 39. Phosphate recommendations for grass seed production (bluegrass, timothy, reed canary, orchardgrass).

Soil Test P	P_2O_5 to Apply
- ppm -	- lb./acre -
0 - 5	60
6 - 10	40
11 - 25	30
26 +	0

Table 40. Potash recommendations for grass seed production (bluegrass, timothy, reed canary, orchardgrass).

Soil Test K	K_2O to Apply
- ppm -	- lb./acre -
0 - 50	60
51 - 100	30
101 - 150	20
151 +	0

Table 41. Fertilizer nitrogen suggestions for oats production when the soil nitrate test is used.

Yield Goal	Soil nitrate - N (0-2 ft.) + fertilizer N needed
bu./acre	lb./acre
less than 60	80
60 - 89	100
90 - 119	140
120 or more	160

$N_{Rec} = (YG \times 1.35) - ST_N$

N_{Rec} = suggested amount of N to use in lb./acre

YG = yield goal in bu./acre

ST_N = residual NO_3-N expressed as lb./acre in top 2 ft. of root zone

Table 42. Suggested rates of fertilizer N for oats production when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
bu./acre	N to apply (lb./acre)								
less than 60	0	0	0	0	0	0	40	30	0
60 - 89	0	0	30	20	30	20	60	50	0
90 - 119	20	0	50	30	50	30	80	60	0
120 or more	30	0	60	40	60	40	90	70	0

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley
buckwheat
canola
corn
edible beans
flax
grass hay
grass pasture
millet
mustard
oats
potatoes
rye
sorghum-sudan
sugarbeets
sunflowers
sweet corn
triticale
wheat
vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 43. Suggested rates of phosphate fertilizer for oats production.

Yield Goal	Phosphorus (P) Soil Test P (ppm) 0 - 5 Bdcst	0 - 5 Drill	6 - 10 Bdcst	6 - 10 Drill	11 - 15 Bdcst	11 - 15 Drill	16 - 20 Bdcst	16 - 20 Drill
bu./acre	- - - - - - - - - - - - P_2O_5 to apply (lb./acre) - - - - - - - - - - - -							
less than 60	40	20	20	10	20	10	0	10
60 - 89	50	25	30	15	20	10	0	10
90 - 119	60	30	40	20	20	10	0	10
120 or more	70	30	50	25	30	15	0	10

Table 44. Suggested rates of potash fertilizer for oats production.

Yield Goal	Potassium (K) Soil Test (ppm) 0 - 50 Bdcst	0 - 50 Drill	51 - 100 Bdcst	51 - 100 Drill	101 - 150 Bdcst	101 - 150 Drill	151 + Bdcst	151 + Drill
bu./acre	- - - - - - - - - - - - K_2O to apply (lb./acre) - - - - - - - - - - - -							
less than 60	40	30	30	20	0	10	0	0
60 - 89	60	30	40	20	20	10	0	0
90 - 119	80	30	50	25	20	10	0	0
120 or more	100	30	60	30	30	15	0	0

Table 45. Nitrogen recommendations for rye and triticale for situations where the soil nitrate test is used.

Yield Goal	Soil nitrate-N (0-2 feet) + fertilizer N needed
bu./acre	- - - - lb./acre - - - -
less than 40	85
40 - 49	110
50 - 59	135
60 - 69	160
70 - 79	185
80 or more	200

N_{Rec} = (YG x 2.5) - ST_N

N_{Rec} = suggested amount of fertilizer N to use in lb./acre

YG = yield goal in bu./acre

ST_N = residual NO_3-N expressed as lb./acre in top 2 feet of the root zone

Table 46. Nitrogen recommendations for rye and triticale when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
bu./acre	- - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - -								
less than 40	0	0	35	-	0	0	55	35	0
40 - 49	0	0	60	40	25	0	80	60	0
50 - 59	0	0	85	65	55	35	105	85	0
60 - 69	30	10	110	90	80	60	130	110	30
70 - 79	55	35	135	115	105	85	155	135	35
80 or more	70	50	150	130	120	100	170	150	50

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley
buckwheat
canola
corn
edible beans
flax
grass hay
grass pasture
millet
mustard
oats
potatoes
rye
sorghum-sudan
sugarbeets
sunflowers
sweet corn
triticale
wheat
vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 47. Phosphate recommendations for rye and triticale.

Yield Goal	Soil Test P (ppm) 0 - 5		6 - 10		11 - 15		16 - 20	
	Bdcst	Drill	Bdcst	Drill	Bdcst	Drill	Bdcst	Drill
bu./acre	P_2O_5 to apply (lb./acre)							
less than 40	40	20	20	10	20	10	0	10
40 - 49	50	25	30	15	20	10	0	10
50 - 59	60	30	40	20	20	10	0	10
60 - 69	70	30	50	25	30	15	0	10
70 - 79	80	30	60	30	40	20	0	10
80 or more	90	30	70	30	50	25	0	10

Table 48. Potash recommendations for rye and triticale.

Yield Goal	Soil Test K (ppm) 0 - 50		51 - 100		101 - 150		151 +	
	Bdcst	Drill	Bdcst	Drill	Bdcst	Drill	Bdcst	Drill
bu./acre	K_2O to apply (lb./acre)							
less than 40	50	20	20	10	20	10	0	0
40 - 49	60	30	30	15	20	10	0	0
50 - 59	80	35	40	20	20	10	0	0
60 - 69	100	35	50	25	30	15	0	0
70 - 79	120	35	60	30	40	20	0	0
80 or more	140	35	80	35	60	30	0	0

Table 49. Phosphate recommendations for soybeans.

Yield Goal	0 - 5	6 - 10	11 - 15	16 +
bu./acre	- - - - - P_2O_5 to apply (lb./acre) - - - - - -			
less than 30	50	30	20	0
30 - 39	60	40	20	0
40 - 49	70	50	30	0
50 or more	80	60	40	0

Table 50. Potash recommendations for soybeans.

	Soil Test K (ppm)				
Yield Goal	0 - 40	41 - 80	81 - 120	121 - 160	161 +
bu./acre	- - - - - - K_2O to apply (lb./acre) - - - - - -				
less than 30	60	40	20	0	0
30 - 39	80	60	20	0	0
40 - 49	100	80	40	20	0
50 or more	120	100	60	20	0

Table 51. Nitrogen recommendations for sugarbeets.

Yield Goal	Soil N plus fertilizer N needed*
ton/acre	lb/acre to 2 feet
16	95
17	100
18	110
19	115
20	120
21	125
22	130

*Subtract the amount of NO_3-N in top 2 feet of soil from these figures to determine the amount of fertilizer N to apply.

Equation:

$N_{Rec} = (6)\ (YG) - N_{st}$

N_{st} = NO_3-N to 2 feet in lb./acre

YG - yield goal in ton/acre

Table 52. Phosphate recommendations for sugarbeets.

Yield Goal	Phosphorus (P) Soil Test (ppm)			
	0 - 5	6 - 10	11 - 15	16+
ton/acre	- - - - - P_2O_5 to apply (lb./acre) - - - -			
16	60	35	10	0
17	60	35	10	0
18	65	40	15	0
19	70	40	15	0
20	75	45	15	0
22	80	50	15	0

Table 53. Potash recommendations for sugarbeets.

Yield Goal	Potassium (K) Soil Test (ppm)			
	0 - 50	51 - 100	101 - 150	151+
ton/acre	- - - - - K_2O to apply (lb./acre) - - - -			
16	85	50	15	0
17	90	55	20	0
18	95	55	20	0
19	100	60	20	0
20	105	65	20	0
22	115	70	25	0

Table 54. Nitrogen recommendations for sunflowers when the soil nitrate test is used.

Yield Goal	Soil nitrate (0-2 ft.) + fertilizer N
lb./acre	- - - - lb./acre - - -
1400 or less	60
1500 - 1900	80
2000 - 2400	100
2500 - 2900	120
3000 or more	140

Table 55. Nitrogen recommendations for sunflowers when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
lb./acre	- - - - - - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - - - - - -								
less than 1400	0	0	30	0	0	0	50	30	0
1500 - 1900	0	0	50	30	0	0	70	40	0
2000 - 2400	30	0	70	40	35	0	90	60	20
2500 - 2900	40	0	90	60	75	45	110	80	30
3000 or more	60	30	110	80	95	65	130	100	40

* CROPS IN GROUP 1

alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2

barley
buckwheat
canola
corn
edible beans
flax
grass hay
grass pasture
millet
mustard
oats
potatoes
rye
sorghum-sudan
sugarbeets
sunflowers
sweet corn
triticale
wheat
vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 56. Phosphate recommendations for sunflowers.

Yield Goal	Soil Test P (ppm) 0 - 5	6 - 10	11 - 15	16 +
lb./acre	- - - - - P_2O_5 to apply (lb./acre) - - - - -			
1400 or less	40	30	0	0
1500 - 1900	40	30	0	0
2000 - 2400	50	40	30	0
2500 - 2900	60	40	30	0
3000 or more	70	50	30	0

Table 57. Potash recommendations for sunflowers.

Yield Goal	Soil Test K (ppm) 0 - 50	51 - 100	101 - 150	151 +
lb./acre	- - - - - K_2O to apply (lb./acre) - - - - -			
1400 or less	60	40	0	0
1500 - 1900	80	40	0	0
2000 - 2400	100	60	0	0
2500 - 2900	120	80	40	0
3000 or more	140	100	60	0

Table 58. Nitrogen recommendations for wheat for situations where the soil nitrate test is used.

Yield Goal	Soil nitrate-N (0-2 feet) + fertilizer N needed
bu./acre	- - - - lb./acre - - - -
less than 40	85
40 - 49	110
50 - 59	135
60 - 69	160
70 - 79	185
80 or more	200

N_{Rec} = (YG x 2.5) - ST_N

N_{Rec} = suggested amount of fertilizer N to use in lb./acre

YG = yield goal in bu./acre

ST_N = residual NO_3-N expressed as lb./acre in top 2 feet of the root zone

Table 59. Nitrogen recommendations for wheat when the soil nitrate test is not used.

	Previous crop and organic matter level								
	alfalfa (good stand) - O.M. -[1]		field peas, soybeans - O.M. -		any crop in group 1* - O.M. -		any crop in group 2* - O.M. -		organic soil
Yield Goal	low to medium	high	low to medium	high	low to medium	high	low to medium	high	
bu./acre	- - - - - - - - - - - - - - - - N to apply (lb./acre) - - - - - - - - - - - - - - - -								
less than 40	0	0	35	-	0	0	55	35	0
40 - 49	0	0	60	40	25	0	80	60	0
50 - 59	0	0	85	65	55	35	105	85	0
60 - 69	30	10	110	90	80	60	130	110	30
70 - 79	55	35	135	115	105	85	155	135	35
80 or more	70	50	150	130	120	100	170	150	50

* CROPS IN GROUP 1
alfalfa (poor stand)
alsike clover
birdsfoot trefoil
grass-legume hay
grass-legume pasture
red clover

CROPS IN GROUP 2
barley, buckwheat, canola, corn, edible beans, flax, grass hay, grass pasture, millet, mustard, oats, potatoes, rye, sorghum-sudan, sugarbeets, sunflowers, sweet corn, triticale, wheat, vegetables

[1] low to medium = less than 4.5%; high = more than 4.5%

Table 60. Phosphate recommendations for wheat.

Yield Goal	Soil Test P (ppm) 0 - 5 Bdcst or Drill		6 - 10 Bdcst or Drill		11 - 15 Bdcst or Drill		16 - 20 Bdcst or Drill	
bu./acre	- - - - - - - - - - - - P_2O_5 to apply (lb./acre) - - - - - - - - - - - -							
less than 40	40	20	20	10	20	10	0	10
40 - 49	50	25	30	15	20	10	0	10
50 - 59	60	30	40	20	20	10	0	10
60 - 69	70	30	50	25	30	15	0	10
70 - 79	80	30	60	30	40	20	0	10
80 or more	90	30	70	30	50	25	0	10

Table 61. Potash recommendations for wheat.

Yield Goal	Soil Test K (ppm) 0 - 50 Bdcst or Drill		51 - 100 Bdcst or Drill		101 - 150 Bdcst or Drill		151 + Bdcst or Drill	
bu./acre	- - - - - - - - - - - - K_2O to apply (lb./acre) - - - - - - - - - - - -							
less than 40	50	20	20	10	20	10	0	0
40 - 49	60	30	30	15	20	10	0	0
50 - 59	80	35	40	20	20	10	0	0
60 - 69	100	35	50	25	30	15	0	0
70 - 79	120	35	60	30	40	20	0	0
80 or more	140	35	80	35	60	30	0	0

Table 62. Nitrogen recommendations for wild rice.

Status of Paddy	Annual N to Apply*			
	Mineral Soils		Organic Soils	
	Incorporated	Not Incorporated	Incorporated	Not Incorporated
	lb./acre			
1st year only	70	80	25	30
2nd year and older	70	80	50	60

* The ammonium form of nitrogen is superior to the nitrate form as a source of N. Excessive N can result in increased lodging and incidence of disease. Preplant N should be incorporated to 3 to 4 inches during seedbed preparation. Nitrogen topdressing should be made at jointing when the internodes of the plant start to elongate.

Table 63. Phosphate recommendations for wild rice.

Soil Test P	P_2O_5 to apply
- ppm -	lb./acre
0 - 7	40
8 - 15	20
16 +	0

Table 64. Potash recommendations for wild rice.

Soil Test K	K_2O to apply
- ppm -	lb./acre
0 - 50	60
51 - 100	40
101 - 150	20
151 +	0

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