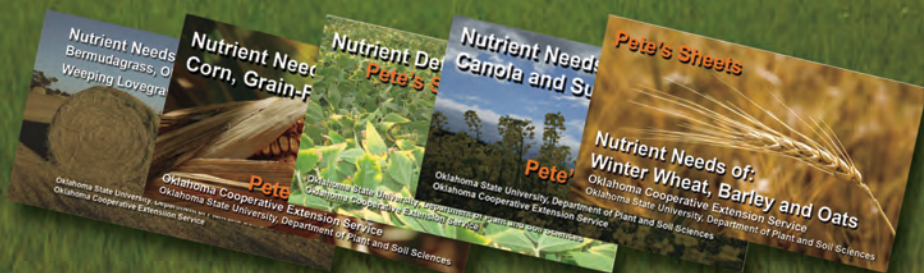


# ***NUTRIENT MANAGEMENT FIELD GUIDE***



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**Oklahoma Cooperative Extension Service  
Oklahoma State University  
Department of Plant and Soil Sciences**

# Nutrient Removal of Grains, Fibers and Forages

## Pete's Sheets



Crop	*Units	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Ca	S	Mg	Fe	Zn	Mn	Cu	B
Canola	lb/bu	1.88	0.4	0.32	0.125	0.7	0.13	0.003	0.001	0.001	0.0001	na
Corn	lb/bu	0.9	0.38	0.3	0.014	0.07	0.06	0.004	0.001	0.0006	0.0004	0.0008
Oats	lb/bu	0.8	0.3	0.2	0.03	0.08	0.05	0.008	0.0006	0.0015	0.0004	na
Sorghum	lb/bu	0.84	0.42	0.22	0.014	0.08	0.07	0.0002	0.0007	0.0006	0.0001	na
Soybean	lb/bu	3.8	0.8	1.4	0.16	0.1	0.16	0.0007	0.0008	0.001	0.0008	0.0002
Sunflower	lb/cwt	1.9	1.5	2.8	0.29	0.2	0.4	0.03	0.042	0.012	0.007	0.023
Wheat												
Grain	lb/bu	1.5	0.5	0.35	0.16	0.18	0.08	0.002	0.0011	0.0003	0.0009	0.0001
Straw	lb/ton	11.2	1	28.2	3.4	3.8	6.4	0.314	0.012	0.082	0.0072	na

\*Units refer to the amount in pounds (lb) of each nutrient removed per unit of harvest such as bushel (bu), hundred weight (cwt), bale, or ton.



Crop	Units	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Ca	Mg	S	Fe	Zn	Mn	Cu	B
Cotton	lb/bale	32	13	16	2	2.5	3.5	0.03	0.48	0.17	0.09	0.015
Peanuts	lb/cwt	3.5	0.55	0.88	0.15	0.25	0.13	0.001	0.006	0.008	0.001	na
Alfalfa	lb/ton	52	12	50	19	3.25	4.5	0.21	0.04	0.06	0.01	0.05
Bermuda	lb/ton	50	11.5	43	6	4	4	0.105	0.06	0.05	0.003	0.02
Corn Silage	lb/ton	10	4.2	10	1.75	1.25	2	0.04	0.02	0.07	0.004	0.007
Fescue	lb/ton	37	12	54	8.6	5.2	3.4	0.264	0.07	0.206	0.056	na
Sorghum Sudan	lb/ton	40	15	58	8	6	6	0.34	0.076	0.153	0.0628	na
Wheat Pasture	lb/ton	60	6.9	60	7.6	5.4	4	0.91	0.06	0.55	0.104	0.006

One cotton bale weighs 480 lbs and contains both cotton seed and lint.  
Forage ton is on a dry weight basis, Silage ton is on a wet weight basis.  
na refers to values that are not available.

Nutrient Removal Values presented in this card only represent that of the harvested plant parts. Within the stover, straw, roots and other residues is an additional amount of minerals and plant nutrients. However, this is not considered in removal or replacement estimates as these materials are cycled through the system. Nutrient removal values were derived from a wide range of resources and publications collected from around the United States. If a nutrient value is not listed in the tables, there was no reputable source found. Of the 16 plant essential nutrients only 11 are presented. H,C,O are not listed as they are not supplied by the soil but are supplied by the atmosphere and water. Cl and Mo have no documentation on concentration in grain, fiber, or forage due to the minute amounts in which they exist.

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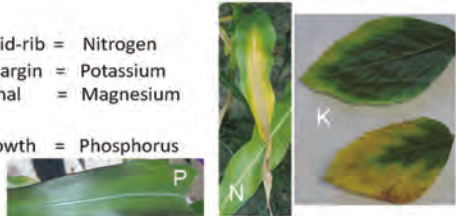


# Nutrient Deficiency ID

## Pete's Sheets

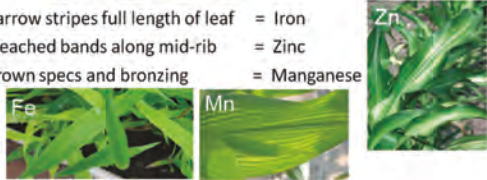
### ↓ Symptom in Old Growth

Chlorosis Yes → [ Along mid-rib = Nitrogen  
Along margin = Potassium  
Interveinal = Magnesium ]  
 No ↓  
Purpling Yes → Stunted growth = Phosphorus



### ↓ Symptom in New Growth

Interveinal Chlorosis Yes → [ Narrow stripes full length of leaf = Iron  
Bleached bands along mid-rib = Zinc  
Brown specs and bronzing = Manganese ]  
 No ↓



Terminal bud is dying Yes → [ Leaves are yellow = Calcium  
Leaves are white/light brown = Boron ]  
 No ↓

General yellowing Yes → [ Leaves & veins pale green/yellow = Sulfur  
Terminal dieback, leaves wilting = Copper ]  
 No ↓

Chlorotic Spots Yes → Wilting of leaves = Chlorine  
 No ↓

Interveinal Mottling Yes → leaves wilt and die along margin = Molybdenum  
 No ↓

Collect Plant and Soil samples for analysis



### Soil factors associated with nutrient deficiencies and the nutrients of concern

Soil pH <5.5	P, Mg, Mo, Zn	Sandy soils prone to leaching N, B, Cl, S, Zn
>7.5	Fe, S, Mn, Zn	

### Other Indicators and notes

Mg: Rust colored specks and purple/reddish hue around margins  
 Mo: Symptoms can be seen throughout the whole plant  
 B: Thick leaves in cotton, redness in legume and canola.  
 Often symptoms that are seen while soils are cold and wet, will likely disappear when soils warm.

### Keywords:

**Chlorosis:** Yellowing of tissue    **Interveinal:** Between veins    **Margin:** Outer edge of leaf  
**Mid-rib:** Central vein    **Mottling:** blotches of color    **Terminal Bud:** Growing point

# Nutrient Needs of: Winter Wheat, Barley and Oats

**Pete's Sheets**

## Nitrogen

Grain Only				Grazing	
Yield Goal in bu/ac			N Needs	Yield Goal	
Wheat	Barley	Oats	lb/ac	Forage tons/ac	N Needs lb/ac
15	20	25	30	0.5	30
20	25	35	40	1.0	60
30	35	55	60	1.5	90
40	50	70	80	2.0	120
50	60	90	100	2.5	150
60	75	105	125	3.0	180
70	90	125	155	3.5	210
80	100	140	185	4.0	240
100	125	175	240		

## Phosphorus

Soil Test Index	Percent Sufficiency	P <sub>2</sub> O <sub>5</sub> lb/ac
0	25	80
10	45	60
20	80	40
40	95	20
65+	100	0

## Potassium

Soil Test Index	Percent Sufficiency	K <sub>2</sub> O lb/ac
0	50	60
75	70	50
125	80	40
200	95	20
250+	100	0

Crop	pH Range	Min pH
Wheat	5.5-7.0	5.4
Barley	6.5-7.0	6.1
Oats	5.8-6.5	5.4

The pH range is the soil pH that crops prefer, the Min pH is the pH at which lime should be applied. (PSS-2229)

**Nitrogen:** The N recommendation is the total amount needed for the entire growing season, based on yield goal, (5 year field avg.) plus 20%. Subtract residual reported in soil test from N rate suggested for the yield goal you have chosen.

**Phosphorus and Potassium:** Both P and K are based on a sufficiency level. Soil tests report P and K values as soil test index. The P and K tables show the corresponding percent sufficiency and recommend the fertilizer rate in pounds of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O /ac.

Yield goals are not the most accurate method to determine N rates.

**Reference Strips** optimize the return on N fertilizer investments by accounting for the temporal and spacial variabilities that exist in all fields.

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# Nutrient Needs of Oil Seeds: Canola and Sunflower



**Pete's Sheets**

## Nitrogen

Canola			Sunflower	
Yld Goal lbs/ac	Yld Goal bu/ac	N Need lbs ac	Yld Goal lbs/ac	N Need lbs/ac
1000	20	50	500	33
1250	25	63	1000	65
1500	30	75	1250	82
1750	35	88	1500	98
2000	40	100	1750	114
2500	50	125	2000	130
3000	60	150	2500	163
3500	70	175	3000	195
4000	80	200	3500	228

## Phosphorus

Soil Test	Canola % P <sub>2</sub> O <sub>5</sub>	Sunflower % P <sub>2</sub> O <sub>5</sub> \$
P	Suf lb/ac	lb/ac
0	25 80	60
10	45 60	50
20	80 40	30
40	90 20	20
65+	100 0	0

## Potassium

Soil Test	Canola % K <sub>2</sub> O	Sunflower % K <sub>2</sub> O\$
K	Suf lb/ac	lb/ac
0	50 60	70
75	70 50	60
125	80 40	35
200	95 20	15
250+	100 0	0

## Sulfur\*

Yld Goal	S Need
bu/ac	lb/ac
20	5
30	7.5
40	10
50	12.5
60	15

\$ Sunflower P and K recs adapted from High Plains Sunflower Production Handbook, No Sulf index available  
 \* Sulfur recommendations for Canola.. Based on 1 lb S per 10 lbs N.

Crop	pH Range	Min pH	The pH range is the soil pH that crops prefer, the Min pH is the pH at which lime should be applied. (PSS-2229)
Canola	5.8-7.0	5.8	
Sunflower	6.0-7.0	6.0	

**Nitrogen and Sulfur:** The N & S recommendation is the total amount needed for the entire growing season, based on yield goal, (5 year field avg.) plus 20%. Subtract residual N & S reported in soil test from N & S rate suggested for the yield goal you have chosen.

**Phosphorus and Potassium:** Both P and K are based on a sufficiency level. Soil tests report P and K values as soil test index. The P and K tables show the corresponding percent sufficiency and recommend the fertilizer rate in pounds of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O /ac.

**Soil Samples:** As both canola and sunflower are tap rooted crops and it is recommended that sub-soil samples (6-18 in) be collected. Both crops are capable of reaching mobile nutrients in the subsoil such as N, B, S, Cl. Metal nutrients may be deficient in high pH soils.

# Nutrient Needs of: Bermudagrass, Old World Bluestem, Weeping Lovegrass, and Cool Season Forages



## Pete's Sheets

### Nitrogen

Yld Goal ton/ac	N Need lbs N/ac			
	Bermuda- grass	Old World Bluestem	Weeping Lovegrass	Cool Season (fescue, rye)
1	50	35	35	60
2	100	70	70	120
3	150	110	110	180
4	200	150	160	240
5	260	200	220	300
6	320			
7	400			

Bermudagrass (BG) Old World Bluestem (OW), Weeping Lovegrass (WL)  
Cool Season grasses: Fescue, Rye, Orchardgrass (CS).

### Phosphorus

Soil Test P	BG		OW&WL		CS	
	%	P <sub>2</sub> O <sub>5</sub>	%	P <sub>2</sub> O <sub>5</sub>	%	P <sub>2</sub> O <sub>5</sub>
	Suf	lb/ac	Suf	lb/ac	Suf	lb/ac
0	50	75	50	60	30	80
10	65	60	70	40	50	60
20	80	40	85	30	70	40
40	95	20	95	20	95	20
>65	100	0	100	0	100	0

### Potassium

Soil Test K	BG		OW&WL		CS	
	%	K <sub>2</sub> O	%	K <sub>2</sub> O	%	K <sub>2</sub> O
	Suf	lb/ac	Suf	lb/ac	Suf	lb/ac
0	50	140	40	80	60	80
75	65	80	65	60	70	60
125	80	50	80	40	80	40
200	95	30	95	20	95	20
>250	100	0	100	0	100	0

### Forage pH Range

Fescue, OW, WL	4.5-7.0
Orchard, Rye	5.5-7.0
Bermudagrass	5.7-7.0

The pH range is the soil pH that crops prefer, lime should be applied if soil pH is below this range.(PSS-2229)

**Nitrogen:** The N recommendation is the total amount needed for the entire growing season, based on yield goal, (5 year field avg.) plus 20%. Subtract residual N reported in soil test from N rate suggested for the yield goal you have chosen.

**Phosphorus and Potassium:** Both P and K are based on a sufficiency level. Soil tests report P and K values as soil test index. The P and K tables show the corresponding percent sufficiency and recommend the fertilizer rate in pounds of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O /ac.

# Nutrient Needs of: Corn, Grain-Forage Sorghums



**Pete's Sheets**

## Nitrogen

Grain Only			Forage and Ensilage		
Yld Goal	bu/ac	N Need	Yld Goal	N Need	
Sorg	Corn	lb/ac	Ensilage	Hay	
44	40	40	tons/ac	tons/ac	lb/ac
54	50	50		1	18
62	60	60	5	1.5	45
76	75	75	10	2.0	90
85	87	90	15	2.5	135
94	100	110	20	3.0	185
118	130	150	25	3.5	240
145	170	200	30	4.0	300
170	200	240			

## Phosphorus

Soil Test	Sorghum % P <sub>2</sub> O <sub>5</sub>	Corn % P <sub>2</sub> O <sub>5</sub>	Forage % P <sub>2</sub> O <sub>5</sub>	
P	Suf	lb/ac	Suf	lb/ac
0	40	60	40	80
10	60	50	65	60
20	80	40	80	45
40	95	20	95	25
65+	100	0	100	0

## Potassium

Soil Test	Sorghum % K <sub>2</sub> O	Corn % K <sub>2</sub> O	Forage % K <sub>2</sub> O	
K	Suf	lb/ac	Suf	lb/ac
0	40	100	40	120
75	65	75	60	80
125	80	50	75	60
200	95	30	90	40
250+	100	0	100	0

Crop	pH Range	Min pH
Sorghum	5.5-7.0	5.4
Corn	6.0-7.0	5.9
Forages	5.5-7.0	5.4

The pH range is the soil pH that crops prefer, the Min pH is the pH at which lime should be applied. (PSS-2229)

**Nitrogen:** The N recommendation is the total amount needed for the entire growing season, based on yield goal, (5 year field avg.) plus 20%. Subtract residual N reported in soil test from N rate suggested for the yield goal you have chosen.

**Phosphorus and Potassium:** Both P and K are based on a sufficiency level. Soil tests report P and K values as soil test index. The P and K tables show the corresponding percent sufficiency and recommend the fertilizer rate in pounds of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O /ac.

Yield goals are not the most accurate method to determine N rates.

**Reference Strips** optimize the return on N fertilizer investments by accounting for the temporal and spatial variabilities that exist in all fields.

# Nitrogen Rich Strip & SBNRC



**Pete's Sheets**

## Application

The N-Rich Strip (NRS) should be at least 10 ft wide by 100 ft long.

Any source of Nitrogen will work.

Apply minimum 50 lbs N per acre above the preplant N rate.

Do not exceed 125% of yield goal recommended total N.

One strip for the entire field applied in a representative area or several strips in different the soil types or yield zones.

Preplant application is the preferred timing.

For wheat and canola, app can be delayed to 30 days after planting.

Strips should be relocated each year. Records need to be kept.

Field should at least receive a starter.

Zero N is not recommended unless soil test NO<sub>3</sub> levels are high.

## Dual Purpose Wheat

Graze strip through the fall. Remove cattle two weeks before sensing.

Or two weeks prior to removing cattle, an area of the N-Rich Strip and adjacent Farmer Practice should be fenced off, hay rings will work.

## Sensing

Sensing should occur within a week of the strip first becoming visible.

### Winter Wheat

Sense prior to hollow stem.

Sensing and N application can take place after hollow stem but response to N decreases as crop nears flag leaf.

Typically 80 plus GDD>0 needed for wheat and canola.

Corn and sorghum from V6-V10 stage

Collect NDVI from as much of the N-Rich Strip as possible and same size area for Farmer Practice (FP).

Avoid sensing over poor areas: wet spots, poor stands, turn rows.

Have planting date, knowledge of the nearest Mesonet Station, and NDVI from NRS and FP ready for the online SBNRC.

Apply top-dress over the strip.

Strips can be utilized late season to evaluate grain protein levels.

Sensor Based Nitrogen Rate Calculator @ [www.nue.okstate.edu](http://www.nue.okstate.edu)

Choose Within Oklahoma in Bottom Left of webpage for Mesonet.

If Outside of Oklahoma, must calculate GDD>0, DFP, or Cum GDD

## Terms

Farmer Practice: Area outside of the N-Rich strip that only received preplant

RI: Response Index, RI of 1.2 means 20% increase in yield with rec N.

GDD>0: Used for Winter crops, number of days that average daily temp was high enough for plant growth.

Cum GDD: Used in Summer crops, measure of total heat units since planting.

DFP: Used in Summer Crops, Days from Planting to Sensing

Yield Potential: Yield possible if all factors remain constant

YP0: Yield without add N, YPN: Yield potential with added N

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# **FERTILIZERS**

**Fertilizer Name, Concentration of N-P2O5-K2O-S**

**\*For the liquid fertilizers only\***

**Lbs of product per gallon, lbs of nutrient per gallon**

Anhydrous Ammonia	82-0-0
Urea	46-0-0
Ammonium Nitrate	34-0-0
Urea Ammonium Nitrate (UAN)	32-0-0
11.1 lbs/gal	3.54 lbs N/gal
Urea Ammonium Nitrate (UAN)	28-0-0
10.67 lbs/gal	2.99 lbs N/gal
Ammonium Sulfate	21-0-0-24
Diammonium Phosphate (DAP)	18-46-0
Ammonium ThioSulfate	12-0-0-26
11.04 lbs/gal	1.32 lb N, 2.87 lb S/gal
Monoammonium Phosphate (MAP)	11-52-0
Ammonium Polyphosphate (APP)	10-34-0
11.2 lbs/gal	1.12 lb N, 3.81 lbs P2O5/gal
Liquid Starter	9-18-9
11.05 lbs/gal	.99 lb N, 1.99 lbs P2O5, .99 lb K2O/gal
Liquid Starter	7-21-7
11.24 lbs/gal	.79 lb N, 2.36 lb P2O5, .79 lb K2O/gal
Triple Super Phosphate	0-46-0
Potash	0-0-60





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