

# General information for nutrient management planning for Nitrogen (N), Phosphorus (P) and Potassium (K) for various crops

## VEGETABLES

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Crop	N Application Rates	Sufficient P Level Bicarbonate/Olsen P unless otherwise noted	Sufficient K Level	Information Source
<b>Broccoli</b>	Crop planted cool season ~180-240 lbs/A total application Crop planted warm season ~160-200 lb/A total application 20 ppm nitrate generally sufficient	50 ppm	150 ppm crop removes ~100-140 lbs/A, manage to avoid depletion	<a href="http://apps.cdfa.ca.gov/frep/docs/Broccoli.html">State of CA Fertility Guidelines Broccoli http://apps.cdfa.ca.gov/frep/docs/Broccoli.html</a>  <a href="http://anrcatalog.ucdavis.edu/pdf/7211.pdf">Broccoli Production in CA UC pub 7211 Broccoli http://anrcatalog.ucdavis.edu/pdf/7211.pdf</a>
<b>Lettuce (Iceberg or Leaf)</b>	150-180 lbs/A for 1st crop of the season; 100-150 lbs/A for following crops 20ppm nitrate generally sufficient	60ppm	150 ppm crop removes ~120 lbs/A, manage to avoid depletion	<a href="http://apps.cdfa.ca.gov/frep/docs/Lettuce.html">State of CA Fertility Guidelines for Lettuce http://apps.cdfa.ca.gov/frep/docs/Lettuce.html</a>  <a href="http://anrcatalog.ucdavis.edu/pdf/7215.pdf">Iceberg Lettuce Production in CA pub 7215 http://anrcatalog.ucdavis.edu/pdf/7215.pdf</a>

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Crop	N Application Rates	Sufficient P Level Bicarbonate/Olsen P unless otherwise noted	Sufficient K Level	Information Source
				<a href="http://anrcatalog.ucdavis.edu/pdf/7216.pdf">Leaf Lettuce Production in CA UC pub 7216 http://anrcatalog.ucdavis.edu/pdf/7216.pdf</a>
<b>Fresh-market Bulb Onions</b>	250 lbs N/A not recommended to apply more than 20-30% preplant	soil P > 30ppm recommended to apply no more than 50 lbs/A P <sub>2</sub> O <sub>5</sub>	150 ppm	<a href="http://anrcatalog.ucdavis.edu/pdf/7242.pdf">Fresh-Market Bulb Onion Production in CA UC pub 7242 State of CA Fertility Guidelines: http://anrcatalog.ucdavis.edu/pdf/7242.pdf</a>
<b>Spinach</b>	20 lbs/A preplant or at planting; 20-30 lbs/A sidedress once for fresh market, twice for freezer spinach (harvested at greater maturity) 20ppm in top 6" generally sufficient	60ppm	120 ppm fresh market removes ~25-55 lbs/A, manage to avoid depletion	<a href="http://anrcatalog.ucdavis.edu/pdf/7212.pdf">Spinach Production in CA UC pub 7212 http://anrcatalog.ucdavis.edu/pdf/7212.pdf</a>

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Crop	N Application Rates	Sufficient P Level Bicarbonate/Olsen P unless otherwise noted	Sufficient K Level	Information Source
<b>Celery</b>	200-275 lbs/A total generally sufficient, applied throughout the season, with higher rates as the crop matures 20 ppm in top 12" generally sufficient	60 ppm	150 ppm, crop removes ~350-450 lbs/A, manage to avoid depletion	<a href="http://anrcatalog.ucdavis.edu/pdf/7220.pdf">Celery Production in CA UC pub 7720 http://anrcatalog.ucdavis.edu/pdf/7220.pdf</a>
<b>Processing Tomatoes</b>	100-150 lbs/A for furrow irrigated	20ppm Consider applying to replace P removed with crop. With a yield of 50 tons/acre, approximately 25-35 lbs P/acre are removed with the tomatoes	135-270 ppm depends on what fruit will be used for as quality parameters vary depending on type of processing <i>see guidance in links</i>	<a href="http://apps.cdafa.ca.gov/frep/docs/Tomato.html">State of CA Fertility Guidelines for Processing Tomatoes http://apps.cdafa.ca.gov/frep/docs/Tomato.html</a>  <a href="http://anrcatalog.ucdavis.edu/pdf/7228.pdf">Processing Tomato Production in CA UC pub 7228 http://anrcatalog.ucdavis.edu/pdf/7228.pdf</a>

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Crop	N Application Rates	Sufficient P Level Bicarbonate/Olsen P unless otherwise noted	Sufficient K Level	Information Source
<b>Asparagus</b>	1st 2-3 years of establishment ~200 lbs/A after establishment ~100-150 lbs/A	15ppm may require modest P application, crop removes ~50 lbs P/A, manage to avoid depletion	150 ppm, crop removes ~50-75 lbs/A, manage to avoid depletion	<a href="http://anrcatalog.ucdavis.edu/pdf/7234.pdf">Asparagus Production in CA UC pub 7234 http://anrcatalog.ucdavis.edu/pdf/7234.pdf</a>
<b>Peppers (Bell)</b>	180-240 lbs/A is normally sufficient	not given	150 ppm	<a href="http://anrcatalog.ucdavis.edu/pdf/7217.pdf">Bell Pepper Production in CA UC pub 7217 http://anrcatalog.ucdavis.edu/pdf/7217.pdf</a>
<b>Beets and Swiss Chard</b>	150-200 lbs/A	no sufficiency level noted guidance is P>50ppm, apply 50-70 lbs/A	225 ppm	<a href="http://anrcatalog.ucdavis.edu/pdf/8096.pdf">Beets and Swiss Chard Production in CA 8096 pub http://anrcatalog.ucdavis.edu/pdf/8096.pdf</a>

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Crop	N Application Rates	Sufficient P Level Bicarbonate/Olsen P unless otherwise noted	Sufficient K Level	Information Source
Carrots	100-250 lbs N/A usually no response to rates over 150 lbs N/A	30 ppm Olsen P 70 ppm Bray P	200 ppm	<a href="http://anrcatalog.ucdavis.edu/pdf/7226.pdf">Carrot Production in CA UC pub 7226 http://anrcatalog.ucdavis.edu/pdf/7226.pdf</a>

## Nutrient Budget Worksheet

**(enter information in white cells, grey cells calculate values)**

### 1. Identifying Information and Site Characteristics

1.1 Today's Date	
1.2 Field/Ranch Location	
1.3 Irrigation Method	
1.4 Planned Crop	
1.5 Expected Yield (include units)	
1.6 Planting Date for Planned Crop	
1.7 Soil type and texture	

### 2. Nutrients Available

2.1 Soil Test Results (date of test)	NOTES	
2.1.1 Nitrate-N ppm		ppm N * 4 is estimate of lbs/A N to 12 inch depth, gray box calculates; note: nitrate is rapidly leached by rain or irrigation
2.1.2 P ppm		pH equal/greater than 6.0 use Olsen/Sodium Bicarbonate, pH less than 6.0 use Bray value
2.1.3 K ppm		Usually listed as NH <sub>4</sub> OAc K
2.1.4 % SOM and expected N release		See assumptions and calculation in guidance document, gray box calculates
2.2 Irrigation Water Test (date of test)		
2.2.1 Irrigation Water NO <sub>3</sub> -N (ppm)		See notes in guidance if test gives nitrate (NO <sub>3</sub> <sup>-</sup> ) and not nitrate-nitrogen (NO <sub>3</sub> <sup>-</sup> -N)
2.2.2 Acre inches water applied		See notes in guidance if not known.
2.2.3 lbs N/A applied with irrigation water		ppm NO <sub>3</sub> <sup>-</sup> -N*0.227=lbs N/acre inch, multiply by acre inches applied for lbs N/A applied with irrigation water, gray box calculates. Note: Consider value in light of actual crop water use, see guidance
2.3 Organic soil amendments Date applied:		
2.3.1 N from amendments (lbs/A)		Carry value over from the <a href="#">Nutrients in Organic Amendments Tab</a>
2.3.2 P <sub>2</sub> O <sub>5</sub> from amendments (lbs/A)		Carry value over from the <a href="#">Nutrients in Organic Amendments Tab</a>
2.3.3 K <sub>2</sub> O from amendments (lbs/A)		Carry value over from the <a href="#">Nutrients in Organic Amendments Tab</a>
2.4 N from cover crop Date killed:		
2.4.1 N from cover crop (lbs/A)		Carry value over from N from <a href="#">Cover Crop Tab</a>
2.5 Other Describe:	Any other materials that add N, P or K. Nutrients from fertilizer can be calculated in the <a href="#">Nutrients from Fertilizer Tab</a> .	
2.5.1 Other N (lbs/A)		
2.5.2 Other P <sub>2</sub> O <sub>5</sub> (lbs/A)		
2.5.3 Other K <sub>2</sub> O (lbs/A)		

### 3. Nutrient Inputs (summed from above calculations)

The numbers below should be seen a total maximum possible. It is critical to consider when samples were collected, how amendments were managed, irrigation efficiency and many other factors to use these values for production management. Actual availability of nutrients depends on many factors. See accompanying documentation for factors to consider when using these numbers in nutrient management planning.

3.1 N lbs/A added	#VALUE!	Adjusted value
3.2 P <sub>2</sub> O <sub>5</sub> lbs/A added	0	Adjusted value
3.3 K <sub>2</sub> O lbs/A added	0	Adjusted value

NOTES AND CONSIDERATIONS:



**Calculating Nitrogen as N, Phosphorus as P<sub>2</sub>O<sub>5</sub> and Potassium as K<sub>2</sub>O  
Added with Fertilizer**

Fertilizer Name	Liquid/ Solid	Guaranteed Analysis			Density (if liquid)	Amount applied/A (lbs or gallons)	Lbs Applied		
	L or S	%N	% P <sub>2</sub> O <sub>5</sub>	%K <sub>2</sub> O			lbs N	lbs P <sub>2</sub> O <sub>5</sub>	lbs K <sub>2</sub> O
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
							0	0	0
<b>TOTAL APPLIED WITH FERTILIZERS:</b>							<b>0</b>	<b>0</b>	<b>0</b>



## Calculating N, P and K added from Fertilizer

By convention, fertilizer analysis is given in the oxide formation for both phosphorus and potassium. The analysis is typically given as N-P-K, but in fact shows a guaranteed analysis by weight of N,  $P_2O_5$  and  $K_2O$ . Thus for example a fertilizer label that reads N-P-K 18-8-13 has the following analysis:

18% N

8%  $P_2O_5$

13%  $K_2O$

If 250 lbs of this fertilizer is applied this would mean that:

$250 * 0.18 = 45$  lbs of N are applied

$250 * 0.08 = 20$  lbs  $P_2O_5$  are applied

$250 * 0.13 = 32.5$  lbs of  $K_2O$  are applied

If the fertilizer is in a liquid formulation, then the calculations must also include consideration of the density of the liquid fertilizer. So using an example with CAN 17 (a liquid fertilizer) with a guaranteed analysis of 17% N, a density of 12.7 lbs/gallon and an application rate of 14 gallons/acre:

Each gallon weighs 12.7 lbs

Each pound of product has 17% N, so  $12.7 * 0.17 = 2.2$  lbs N per gallon

14 gallons has  $14 * 2.2$  lbs = 30.8 lbs N

Sometimes it is helpful to be able to convert back and forth from the oxide to the element form for P and K. It is easily done with the following conversion factors:

$P * 2.3 = P_2O_5$  and  $P_2O_5 * 0.44 = P$

$K * 1.2 = K_2O$  and  $K_2O * 0.83 = K$

## NITROGEN ADDED IN COVER CROPS

Enter values for **green** cells, **blue** cells are calculated using data you entered. Calculations explained below.

*NOTE: Enter percents as whole numbers, for example for 5% enter 5, not 0.05*

Cover Crop Mix Name/Code	% of cover crop that is legume (a)	Estimated height of crop at kill (b)	Estimated biomass at kill (c)	Estimated lbs of N/acre from cover crop	

- a) Estimate the percent of the actual cover crop stand that is legume, not simply the percent of seed that was legume.
- b) Estimate the height at kill in inches
- c) Calculated based on height of crop entered in column C.

**Calculations/assumptions as follows:**

1. Most non-woody legumes contain roughly 2000 lbs dry matter/acre when they are 6" tall, for each additional inch we assume an additional 150 lbs dry matter/acre.
2. Legumes cut before flowering have ~3.5-4% N, after flowering ~3-3.5% N in above ground growth (with younger material at the high end). After flowering the N is quickly transferred to the developing seed. Most cover crops are killed before seed set. We assume a value of 3.5% N as an acceptable estimate for the legume component of a cover crop stand.
3. Multiply biomass (in lbs) by % N to estimate lbs N contributed in cover crop.
4. Non-legume cover crops may also release N, but typically have a C:N ratio that minimizes quick availability of N from decomposing material.

Assumptions based on guidance from *Managing Cover Crops Profitably*, edited by Andy Clark. Sustainable Agriculture Network Handbook Series Book 9, 3rd Edition published 2007 by Sustainable Agriculture Network (SAN). Available for purchase or free download through the SARE website: <http://www.sare.org/Learning-Center/Books>.



## NUTRIENTS ADDED IN ORGANIC AMENDMENTS

**BE SURE TO CHOOSE THE CORRECT SECTION!**

### ANALYSIS BASED ON DRY WEIGHT

Is analysis based on dry weight? If yes, enter the information in the green cells below to calculate estimated N, P and K contributions. If no, enter skip to next section.

*NOTE: Enter percents as whole numbers, for example for 5% enter 5, not 0.05*

Sample ID	lbs of material applied	% moisture (*)	%N	%P <sub>2</sub> O <sub>5</sub>	%K <sub>2</sub> O	lbs N applied	lbs P <sub>2</sub> O <sub>5</sub> applied	lbs K <sub>2</sub> O applied
						0	0	0
						0	0	0
						0	0	0

*\* If you have information re: the percent moisture of the materials you actually applied, use this value, if you do not, assume that the product is the same percent moisture as the product that was analyzed.*

#### The calculations are as follows when analysis is based on dry weight:

First calculate what percent of the materials applied are dry matter by multiplying the lbs applied by the percent dry matter. Percent dry matter is calculated by subtracting percent moisture from 100. The calculation is thus:

Lbs dry material applied = lbs applied x (100-% moisture)/100

Then multiply the lbs of dry material applied by the % of the total dry weight that is N.

lbs of each N, P<sub>2</sub>O<sub>5</sub>, or K<sub>2</sub>O = lbs of dry material applied x (% N, P<sub>2</sub>O<sub>5</sub> or K<sub>2</sub>O/100)

For example, formula in cell G7 is **(B7\*(100-C7)/100)\*(D7/100)**

## ANALYSIS BASED ON MOIST WEIGHT ("AS RECEIVED")

Is the analysis based on moist or "as received" weight? If yes, enter the information in the green cells below to calculate estimated N, P and K contributions. If no, return to above section.

*NOTE: Enter percents as whole numbers, for example for 5% enter 5, not 0.05*

Sample ID	Ibs of material applied	%N	%P <sub>2</sub> O <sub>5</sub>	%K <sub>2</sub> O	Ibs N applied	Ibs P <sub>2</sub> O <sub>5</sub> applied	Ibs K <sub>2</sub> O applied
					0	0	0
					0	0	0
					0	0	0

**The calculations are as follows when analysis is based on moist weight:**

If analysis is based on moist weight, often described "as received", then assuming the moisture content of the applied materials is the same (or similar) to the moisture content of the sample that was analyzed, the calculation does not require a correction for % moisture. Multiply the lbs of moist material applied by the % of the total weight that is N, P<sub>2</sub>O<sub>5</sub> or K<sub>2</sub>O/100 gives lbs of each applied.

**Formula in cell G16 is B16\*(C16/100)**

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## Fruit Crops

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Crop	N Application Rates	Sufficient P Level	Sufficient K Level	Information Source
<b>Strawberries</b>	about 20 lb N/A taken up from planting until late March, about 1 lb N/A/day for the rest of the season	50 ppm combination of soil test information with tissue test results may be more helpful	200 ppm combination of soil test information with tissue test results may be more helpful	<a href="http://cesantacruz.ucanr.edu/files/136230.pdf">Presentation to 2012 Central Coast Strawberry Meeting by Tim Hartz, UC,  http://cesantacruz.ucanr.edu/files/136230.pdf</a>
<b>Caneberries (blackberries, raspberries)</b>	1st year plantings and florican bearing varieties: 10 lbs N/A/month from February to end of harvest in fall  2nd year or older primocane-bearing varieties in coastal areas w/long fruiting season: 20 lbs N/A/month	40 ppm combination of soil test information with tissue test results may be more helpful	200 ppm combination of soil test information with tissue test results may be more helpful	<a href="http://anrcatalog.ucdavis.edu/items/3525.aspx">Fresh Market Caneberry Production Manual UC ANR Publication 3525 2012 available for purchase (\$25):  http://anrcatalog.ucdavis.edu/items/3525.aspx</a>
<b>Wine Grapes</b>	<b>COMING SOON! :)</b>			
