



Soil Test Interpretations For Vegetable Crops

Lynn Brandenberger

Extension/Research Vegetable Crops

Warren Roberts

Research/Extension Vegetable Crops

Hailin Zhang

Director, Soil, Water, and Forage Analytical Laboratory

Soil test interpretation is an important part of nutrient management for crop production. The following tables include soil test interpretations for nitrogen (N), phosphorus (P), and potassium (K) the three most commonly deficient plant nutrients used by vegetable crops. The suggested interpretations are valid for results from the OSU Soil, Water, and Forage Analytical Laboratory, but should not be utilized directly for interpreting results tested with different methods by other soil testing laboratories. Nitrogen requirements are based on crops and yield goals. The actual amount of N needed is the N requirement minus soil nitrate-N. Requirements for P and K are based on soil test values. Keep in mind that vegetable crop yield goals are based on the potential yield achievable in the state. Actual yield may vary due to other conditions.

Determining Fertilizer Needs by Soil Testing

The starting point for vegetable crop fertilization is determining the residual fertility available in the soil by soil testing. Soil tests are only as good as the soil sample that represents the field and proper sampling is a key part of obtaining reliable soil test results. Extension Fact Sheet PSS-2207 explains proper soil sampling techniques.

County Extension offices throughout Oklahoma have guidelines and materials for collecting and sending soil samples to the OSU Soil Testing Laboratory. The standard soil test includes soil reaction (pH), and levels of plant available N, P, and K. Micronutrients, secondary nutrients, soil organic matter, soil salinity and soil textural classification can also be determined by the soil testing lab for additional charges.

Soil pH

Soil pH is a measure of the acidity/alkalinity of the soil. The pH ranges from 0 to 14 with 7.0 being neutral, less than 7.0 is considered acidic and greater than 7.0 is alkaline. The main influence of soil pH is the availability of nutrients in the soil. A majority of plant nutrients are most available in mildly acidic soils ranging from 6.0 to 7.0. Agricultural soils have a tendency to become more acidic over time. Excess acidity is corrected through the application of lime to the soil, with each soil varying in the amount of lime required to increase

Oklahoma Cooperative Extension Fact Sheets
are also available on our website at:
<http://osufacts.okstate.edu>

soil pH. Buffer index (BI) is a measure of the soil's ability to resist changes in pH and will be listed on the OSU soil test report. Lime is applied according to the Buffer Index (Table 1) which is further explained in fact sheet PSS-2229. Vegetable crops differ in their ability to take up nutrients at a given pH. Matching crops to soils with the appropriate pH is important because vegetable crops have different tolerance levels to soil pH (Table 2).

Vegetable fertilizer recommendations

Nitrogen, phosphorous, and potassium fertilizer recommendations are given on the soil test report. The recommendations are in pounds of N, P₂O₅, and K₂O per acre as listed on a fertilizer analysis. Soil test interpretations for various vegetable crops are given in Tables 3 through 7. Table 8 provides timing suggestions for nitrogen fertilization of various vegetable crops. Crop requirements for nitrogen will vary due to differences in plant populations i.e. where higher population plantings will require more nitrogen than lower plant populations. Phosphorus and potassium are generally applied pre-plant or at planting.

Table 1. Tons of ECCE* lime required to raise soil pH of a 6-7 inch furrow slice to pH 6.8.

<i>Buffer index</i>	<i>Lime required pH 6.8</i>
Over 7.1	None
7.1	0.5
7.0	0.7
6.9	1.0
6.8	1.2
6.7	1.4
6.6	1.9
6.5	2.5
6.4	3.1
6.3	3.7
6.2	4.2

*Effective calcium carbonate equivalent guaranteed by lime supplier.

Tons lime material needed = Tons ECCE required/percent ECCE x 100

Table 2. Soil pH preference of selected vegetable crops*.

<i>pH 6.0-6.8</i>	<i>pH 5.8-6.8**</i>	<i>pH 5.5-6.8</i>
Asparagus	Bean, snap	Potato
Beet	Bean, Lima	Rhubarb
Broccoli	Brussels sprouts	Sweet potato
Cabbage	Carrot	Watermelon
Cantaloupe	Collard	
Cauliflower	Cucumber	
Celery	Eggplant	
Chinese cabbage	Garlic	
Lettuce	Kale	
Okra	Kohlrabi	
Onion	Mustard	
Spinach	Parsley	
	Pea	
	Pepper	
	Pumpkin	
	Radish	
	Squash	
	Sweet corn	
	Tomato	
	Turnip	

* Adapted from Knott's handbook for vegetable growers.

** Although crops can tolerate lower pH, they will be more successfully grown at soil pH's between 6.0-6.8.

Table 3. Primary Nutrient Recommendations for Brassica Head Crops Including: Broccoli, Brussels sprouts, Cabbage, and Cauliflower; Leafy Greens Crops including: Lettuce, Cilantro, Collard, Kale, Mustard, Spinach, and Turnip.

Nitrogen Requirements (lbs N/Acre)		
N ¹	Brassica Head Crops ²	Leafy Greens ³
	175 (lbs/Acre)	120 (lbs/Acre)

Phosphorous Requirements (P ₂ O ₅ lbs/Acre)		
P soil test	Brassica Head Crops ²	Leafy Greens ³
0	150	150
10	125	125
20	100	100
40	55	55
>65	0	0

Potassium Requirements (lbs K ₂ O/Acre)		
K soil test	Brassica Head Crops ²	Leafy Greens ³
0	150	150
75	125	125
125	100	100
200	50	50
>250	0	0

¹ The amount of fertilizer N needed equals the N requirement minus the available N from a soil test. Recommended nitrogen should be split into several applications, such as pre-plant and side-dress applications.

² Brassica head crops include: Broccoli, Brussels sprouts, Cabbage, Cauliflower, and Lettuce.

³ Leafy Greens include: Cilantro, Collard, Kale, Mustard, Spinach, and Turnip.

Table 4. Primary Nutrient Recommendations for Asparagus, Okra, Sweet Corn, and Bulb crops including: Garlic, and Onion.

Nitrogen Requirements (lbs/Acre)					
N*	Asparagus**	Okra	Sweet Corn	Garlic	Onion
	70-80	80	200	175	150

Phosphorous Requirements (lbs P ₂ O ₅ /Acre)					
P soil test index	Asparagus	Okra	Sweet Corn	Garlic	Onion
0	200	150	150	150	150
10	170	125	125	125	125
20	140	100	100	100	100
40	80	55	55	55	55
>65	0	0	0	0	0

Potassium Requirements (lbs K ₂ O /Acre)					
K soil test index	Asparagus	Okra	Sweet Corn	Garlic	Onion
0	200	150	150	150	150
75	155	125	125	125	125
125	120	100	100	100	100
200	50	50	50	50	50
>250	0	0	0	0	0

* The amount of fertilizer N needed equals the N requirement minus the available N from a soil test. Recommended nitrogen should be split into several applications, such as pre-plant and side-dress applications.

** Asparagus rates are based on established plantings, for establishment purposes phosphorous and potassium rates will need to be increased 1.3 to 2 times while nitrogen rates will be 50% of that recommended for established plantings.

Table 5. Primary Nutrient Recommendations for Cucurbit Crops including: Cucumber, Melons, Pumpkin, Squash, and Watermelon.

Nitrogen Requirements (lbs/Acre)					
N*	Cucumber 150	Melons 125	Pumpkin 150	Squash 150	Watermelon 150
Phosphorous Requirements (lbs P ₂ O ₅ /Acre)					
P soil test index					
0	120	150	120	120	150
10	100	125	100	100	125
20	80	100	80	80	100
40	45	55	45	45	55
>65	0	0	0	0	0
Potassium Requirements (lbs K ₂ O /Acre)					
K soil test index					
0	120	150	120	120	150
75	100	125	100	100	125
125	80	100	80	80	100
200	40	50	40	40	50
>250	0	0	0	0	0

* The amount of fertilizer N needed equals the N requirement minus the available N from a soil test. Recommended nitrogen should be split into several applications, such as pre-plant and side-dress applications.

Table 6. Primary Nutrient Recommendations for Fruiting Vegetable Crops including: Eggplant, Pepper, Tomato, and Legume Vegetable Crops including: Bean, Cowpea, and Garden Pea.

Nitrogen Requirements (lbs/Acre)						
N*	Eggplant 100	Pepper 100	Tomato 100	Bean 75	Cowpea 50	Garden Pea 60
Phosphorous Requirements (lbs P ₂ O ₅ /Acre)						
P soil test index						
0	150	150	150	120	80	80
10	125	125	125	100	70	70
20	100	100	100	80	55	55
40	55	55	55	45	30	30
>65	0	0	0	0	0	0
Potassium Requirements (lbs K ₂ O /Acre)						
K soil test index						
0	150	200	225	120	80	80
75	125	155	165	100	70	70
125	100	120	120	80	55	55
200	50	50	50	40	25	25
>250	0	0	0	0	0	0

*The amount of fertilizer N needed equals the N requirement minus the available N from a soil test. Recommended nitrogen should be split into several applications, such as pre-plant and side-dress applications.

Table 7. Primary Nutrient Recommendations for Root and Tuber Vegetable Crops including: Beet, Carrot, Potato, Radish, Sweet Potato, Turnip.

Nitrogen Requirements (lbs/Acre)						
N*	Beet	Carrot	Potato	Radish	Sweet Potato	Turnip
	120	175	200	80	60	80
Phosphorous Requirements (lbs P ₂ O ₅ /Acre)						
P soil test index	Beet	Carrot	Potato	Radish	Sweet Potato	Turnip
0	120	150	120	120	120	150
10	100	125	100	100	100	125
20	80	100	80	80	80	100
40	45	55	45	45	45	55
>65	0	0	0	0	0	0
Potassium Requirements (lbs K ₂ O /Acre)						
K soil test index	Beet	Carrot	Potato	Radish	Sweet Potato	Turnip
0	120	150	300	120	120	150
75	100	125	250	100	100	125
125	80	100	200	80	80	100
200	40	50	100	40	40	50
>250	0	0	0	0	0	0

*The amount of fertilizer N needed equals the N requirement minus the available N from a soil test. Recommended nitrogen should be split into several applications, such as pre-plant and side-dress applications.

Table 8. Timing of nitrogen fertilization for vegetable crops.

Crop	Total N lbs/acre*	N preplant lbs/acre	1 st N	2 nd N	3 rd N
			side/top-dress lbs/acre	side/top-dress lbs/acre	side/top-dress lbs/acre
Asparagus**	70-80	50	30-70	NA***	NA
Bean	75	25	50	NA	NA
Beet	120	55	65	NA	NA
Broccoli	175	40	65	70	NA
Brussels sprouts	175	40	65	70	NA
Cabbage	175	40	65	70	NA
Carrot	175	50	65	60	NA
Cauliflower	175	40	65	70	NA
Cilantro	120	70	50	NA	NA
Collard	120	70	50	NA	NA
Cowpea	50	30	20	NA	NA
Cucumber	150	50	50	50	NA
Eggplant	100	25	25	25	25
Garden pea	60	30	30	NA	NA
Garlic	175	50	65	60	NA
Kale	120	70	50	NA	NA
Lettuce	120	70	50	NA	NA
Melons	125	50	50	25	NA
Mustard	120	70	50	NA	NA
Okra	80	40	20	20	NA
Onion	150	50	55	45	NA
Pepper	100	25	25	25	25
Potato	200	55	75	70	NA
Pumpkin	150	50	60	40	NA
Radish	80	40	40	NA	NA
Spinach	120	70	50	NA	NA
Squash	150	50	60	40	NA
Sweet corn	200	40	80	80	NA
Sweet potato	60	30	30	NA	NA
Tomato	100	25	25	25	25
Turnip (roots)	80	40	40	NA	NA
Turnip (tops)	120	70	50	NA	NA
Watermelon	150	50	60	40	NA

* Attention should be paid to nitrogen applications in light of the fact that nitrogen is easily leached from soil by excessive rainfall.
 ** Asparagus is a perennial crop and fertility rates will vary according to establishment year vs. years following establishment. Establishment year apply 50 lbs N preplant and 30 lbs N as a sidedress 2 months after establishment. Years following establishment apply 70 lbs N near end of harvest season.
 *** NA = Not Applicable.

Oklahoma State University, in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices, or procedures. This includes but is not limited to admissions, employment, financial aid, and educational services.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 1009 GH.