

# The Role of Calcium in Potatoes

*By: John P. Taberna- Soil Scientist*

Calcium, when taken up by the potato is soluble in the xylem and will be transported to the leaf. Phloem is the living vein that transports nutrients and sugars to the tuber. In the tuber, the sugars are converted to starch.

Calcium does not transport to the tuber because Calcium will not move more than four inches downward in the phloem.

Potato leaves have much higher transpiration (water loss) than the tuber. The tuber has very low transpiration because it is living in a moist environment.

Dr. Palta at the University of Wisconsin found that a small amount of Calcium is provided to the tuber by the leaf. He also found that most Calcium can only be provided to the tubers by the roots growing from the stolon joints. There is xylem in the stolon's, which is the transport mechanism for Calcium to the tuber.

Calcium reduces the incidence of internal brown spots (IBS), hollow heart (HH), storage rot, pressure bruise and black spot. Calcium gives cell wall rigidity allowing the storage of potatoes in the cellar to be piled 18 feet high. Dr. Palta also observed that at harvest the potato peel needs to be at least 200 parts per million (ppm) Calcium for maximum storage and for sprouting in potato seed.

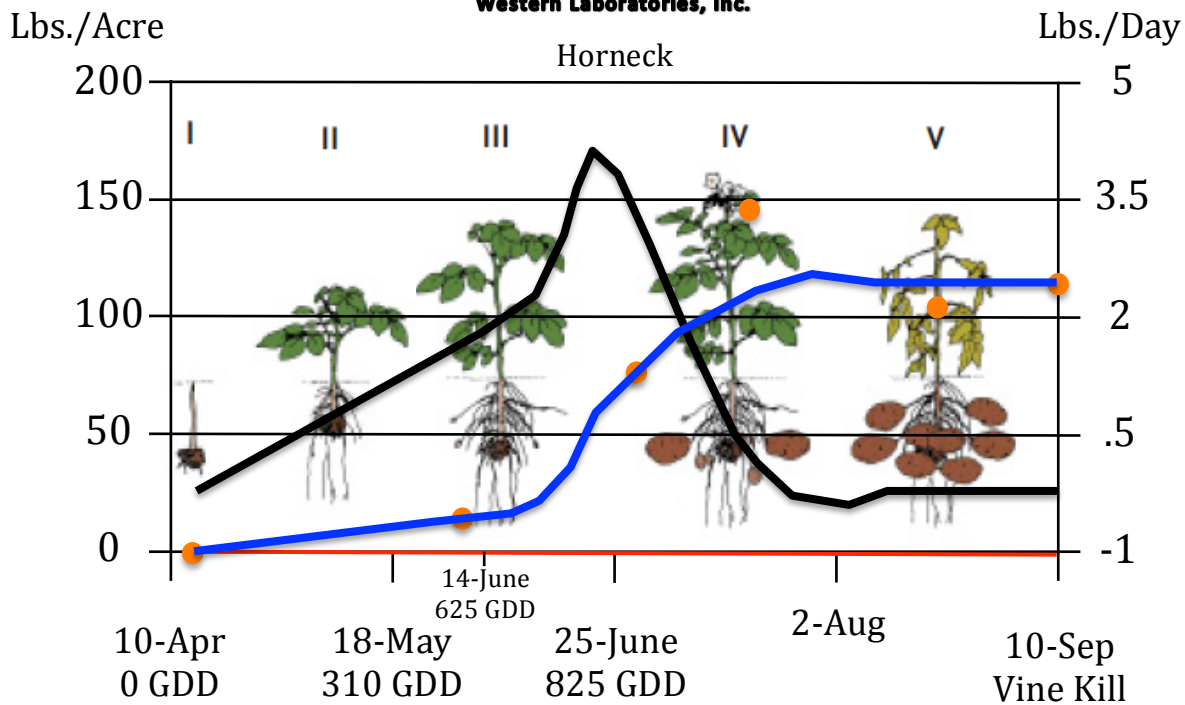
The demand for Calcium begins at tuberization initiation and continues through growth stage four. Calcium is the only nutrient that is not provided to the tuber by phloem. **YOU NEED 5 LBS. OF CALCIUM IN THE SOIL SOLUTION FROM TUBERIZATION INITIATION THROUGH BULKING.**

Our Soil Solution testing is the only one of this kind in the United States. The Soil Solution test emulates the exudates that plant roots release to stimulate bacteria and fungi to release nutrients from extractable nutrients.

Dr. Don Horneck (deceased) of Oregon State established numbers for all nutrients needed on a daily basis to maintain a bulking rate of 1000 lbs. potatoes per acre, per day during growth stage four.

# Seasonable Ca, lbs./ac

Western Laboratories, Inc.



WL Tissue: 0.45 % → 2.0 %

Soil Solution: 5 lbs. →

- Ca uptake lbs./day
- Ca uptake lbs./ac

## TISSUE CALCIUM GENERALLY INCREASES WITH PLANT AGE.

Dr. Hornick found that the plant required approximately four lbs. of Calcium at its peak demand. He analyzed the entire plant on a regular basis without counting for the physiological demands of Calcium in the tuber.

In 1969 I started working with Soil Solution. Plant roots give off exudates into the rhizosphere to stimulate the release of nutrients for plant uptake. After Dr. Horneck's work, I was able to focus on nutrients that the plant roots can obtain. After nutrients are taken-in, a ZONE OF DEPLETION is created around the root and migration through diffusion and mass flow must meet the daily requirement for tubers to bulk at 1000 lbs. per acre per day.

Several university trials have been performed for our soil solution and they have outperformed all other analytical methods.

**Western Laboratories.com**

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Methods: [www.westernlaboratories.com/soil-](http://www.westernlaboratories.com/soil-)

**AGRICULTURAL SOIL REPORT**



Dealer:

Reported:

Test #:

Grower:

Field ID:

Lab #:
15106

ELEMENT	ANSWER	INTERP	SHOULD BE	ELEMENT	ANSWER	INTERP	SHOULD BE
pH-Soil	7.1	Neutral	Soil	Sulfur-ppm	8	Very Low	20 +
pH-SMP				Calcium-ppm	2535	Optimum	1,800 +
Soluble Salts	0.19	Optimum	< 1.5	Magnesium-ppm	403	Optimum	250 +
% Lime	L	1.5 to 3.0 % lime		Sodium-ppm	93	Optimum	< 225
% Organic Matter	1.88	Low		Zinc-ppm	0.8	Low	1.0 - 3.0
Nitrates-ppm	10	Low	10 - 35	Copper-ppm	1.0	Optimum	0.8 - 2.5
Ammonium-ppm	1	Low	5 +	Manganese-ppm	6	Low	6 - 30
Phosphorus-ppm	6	Very Low	25 - 40	Iron-ppm	29	High	7 +
Phos-ppm-Bray			50 - 100	Boron-ppm	0.2	Very Low	0.7 - 1.5
Potassium-ppm	201	Low	300 +	TBS%	100		
Texture	Loamy Sand		Water Holding Capacity/foot	0.96	Bulk Density	1.6	
Cation Exchange Capacity - CEC	7		P Index	53	Fertilizer Suggestions in Pounds per Acre for the whole season		
Percent Base Saturation	242				Crop	R. Burbank	Umatilla
BASES		IDEAL	YOURS	NO3 ppm	NH4 ppm		
Calcium-% of CEC	65-80	181	1 Ft	10	1	Yield Goal	500 CWT 40 Tons
Magnesium-% of CEC	10-20	48	2 Ft			Past Crop	SWS Wheat
Potassium-% of CEC	2-6	7	3 Ft			Acres	
Sodium-% of CEC (ESP)	< 5	6	Total N PPM		11	Nitrogen	242 307
Hydrogen-% of CEC	< 15		Lbs N / Acre		33	Phosphate	291 528
Ratio	Ideal	Yours	Evaluation	Recommendations			
Ca:Mg	6-20:1	6 :1	OK				
Ca:K pH >7	15:1	13 :1	OK				
Ca:K pH <7	10:1	:1					
Ca:P pH >7	100:1	423:1	High	Watch P			
Ca:P pH <7	40:1	:1					
P:Zn	15:1	8 :1	OK				
P:Mn	4:1	1:1	OK				
P:Cu	25:1	6 :1	OK				
Zn:Cu	3:1	1 :1	OK				
Mn:Zn	3:1	8 :1	High	Watch Zn			
Mn:Cu	7:1	6 :1	High	Watch Cu			
K:B	200:1	1005 :1	High	Watch B			
Mg:K	2:1	2 :1	Ok				
Add Phos for P INDEX					79		
Potash					299	479	
P.F. Sulfur					25	45	
Elemental Sulfur					94		
Gypsum							
Lime							
Dolomite					0		
Magnesium							
Zinc					8	10	
Manganese					1	8	
Copper					1	4	
Boron					3	3	

Split apply Nitrogen. Nitrogen, sulfur and boron recs are made for this year. All other nutrient recs can be split over a two-year program. Tissue and soil test in-season gives the best results.

P.F. Sulfur = Plant Food Sulfur

Elemental Sulfur = Reclamation Sulfur

*"Always practice the laws of Agronomy"*  
John P. Taberna, Soil Scientist

This is a typical soil report using Western University extracting procedures. Notice the free lime... for every 1% lime there is approximately 35 thousand pounds per acre-foot.

There is approximately 10 thousand pounds for extractable Calcium on this soil report. 2,535ppm of extractable Calcium multiplied by 4 is 10,140 lbs. Yet, only 3 lbs. of Calcium is in the Soil Solution.



Lab #:
15106

EXTRACTABLE NUTRIENTS					SOIL SOLUTION TEST**			
ELEMENT	ANSWER	SHOULD BE	RECS	PRE-PLANT SUGGESTIONS	ELEMENT	ANSWER	SHOULD BE	ADD WEEKLY
			LBS	LBS			LBS / DAY	LBS
Phosphorus-ppm	6	25 - 40	291	192	P-lbs	0.6	2	5.0
Potassium-ppm	201	300 +	299	150	K-lbs	7	8	17
Calcium-ppm	2535	1,800 +	*	see 1	Ca-lbs	3	5	*
Magnesium-ppm	403	250 +			Mg-lbs	9	1	
			LBS	LBS			grams / DAY	OZ
Zinc-ppm	0.8	1.0 - 3.0	8	4	Zn-grams	18	26	0.2
Copper-ppm	1.0	0.8 - 2.5	1	1	Cu-grams	21	14	
Manganese-ppm	6	6 - 30	1	1	Mn-grams	16	28	0.4
Boron-ppm	0.2	0.7 - 1.5	3	3	B-grams	13	28	0.5

**\* Refer to soil report for Calcium recommendations, if needed.**

All chelating products can be used if the zinc, copper and magnesium are adequate. When the levels are below the should be levels, you need to use the elements in the sulfate forms. Disease suppressions are caused by the elements in their metallic forms. Chelates are an excellent sources for plant and production needs.

**PRE-PLANT:**

For disease suppression add 1/2 of the weekly recommendations for all micro nutrients in a sulfate form on calcareous soils.

For plant needs and maximum bulking add the other 1/2 in chelate form by using the SV (Secret Vault) program to monitor weekly requirements.

1. If calcium is over 1800 and there is free lime, use acid residue fertilizer and elemental sulfur to form gypsum from free lime .
2. If no lime and calcium is less than 1800 and soil solution is less than “should be” add 250 lbs. of gypsum pre-plant.
3. If Soil Solution calcium is less than 5, add 250 lbs. gypsum per acre

If phosphate, potash and magnesium in soil solution are less than requires consider putting filed on the SV Program to monitor it. If you are using the SV program and the phosphate, potash, and magnesium “should be” levels in the soil solution are higher than results on the SV Program, it is because the sample is taken with out the influence of the root system. In season results are lower because plant root gives off carbonaceous exodates.

\*\*Our soil solution test emulates the exudates that plant roots release to stimulate bacteria and fungi to release nutrients from the extractable nutrients.

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The analysis on the left side is transferred from the soil test on the previous page. The answers on the right side are the Soil Solution test. This test has been performed for the past 15 years and the numbers are giving you a heads-up as to the problems you may encounter in the upcoming growing season.

# Western Laboratories

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Dealer: 11-111

Grower: Western Laboratories

Variety: R. Burbank

SV No:

**10053**

Acres **62** GDD nematodes **1,717**

Field id: 77

## SECRET VAULT 2017

WEEK			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
LABORATORY NO			279	559	1032	1969	3042	4151	5352	6545	7557	8467
DATE			6/14	6/21	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15
	IDEAL	YOURS	YOURS	YOURS	YOURS	YOURS	YOURS	YOURS	YOURS	YOURS	YOURS	YOURS
PLANT	Nitrates-ppm	> -24961	23769	20601	19617	20365	24380	24538	19329	16187	18512	16669
SOIL SOL'N	Nitrogen-lbs	> 2.0	13	11	9	8	8	6	5	6	6	6
PLANT	Phosphorus-%	> 0.20	0.47	0.53	0.4	0.37	0.3	0.3	0.3	0.23	0.34	0.31
SOIL SOL'N	Phosphorus-lbs	> 0.60	4.80	3.90	3.60	3.90	3.80	3.00	1.50	0.80	1.20	0.80
PLANT	Potassium-%	> 7.5	10.3	12.7	14.3	16.2	13.6	10.3	11.5	10.0	11.3	10.6
SOIL SOL'N	Potassium-lbs	> 7.0	9.4	7.8	8.6	8.4	7.6	9.4	9.8	7.5	6.2	5.0
PLANT	Sulfur-%	> .2	0.3	0.24	0.25	0.27	0.21	0.22	0.2	0.23	0.26	0.28
SOIL SOL'N	Sulfur-lbs	> 2.0	2.5	3.0	2.6	2.7	2.9	3.7	3.9	2.7	1.9	1.3
PLANT	Calcium-%	> .45	1.31	0.91	0.83	0.71	0.79	0.94	0.81	0.99	1.13	1.13
SOIL SOL'N	Calcium-lbs	> 5.0	2.9	3.4	3.6	3.1	2.9	3.1	4.0	3.9	5.1	4.8
PLANT	Magnesium-%	> .4	0.5	0.41	0.4	0.42	0.48	0.44	0.39	0.46	0.51	0.46
SOIL SOL'N	Magnesium-lbs	> 1.0	9.7	8.1	6.5	5.2	5.6	6.8	6.3	5.2	6.5	6.2
PLANT	Zinc-ppm	> 23	121	116	108	103	97	82	75	71	61	55
SOIL SOL'N	Zinc-grams	> 56	177	138	138	141	132	147	174	144	102	84
PLANT	Manganese-ppm	> 33	106	117	114	94	91	85	103	75	85	92
SOIL SOL'N	Manganese-grams	> 40	51	42	36	36	39	30	36	33	39	45
PLANT	Copper-ppm	> 5	13	12	10	12	10	9	10	8	9	11
SOIL SOL'N	Copper-grams	> 28	33	30	24	18	24	30	39	30	36	33
PLANT	Boron-ppm	> 21	32	27	32	33	40	42	31	37	36	30
SOIL SOL'N	Boron-grams	> 28	38	45	38	32	36	38	39	33	30	27

The tissue test sufficiency is adequate throughout the growing season. But, the Soil Solution test indicates there is not enough Calcium available for the tubers. There maybe physiological problems and these tubers may not do well in storage.

Soil Solution testing is done every week with the tissue testing. The original numbers were intended for maximum bulking per acre per day. Dr. Don Horneck's testing was based on complete plant analysis. I originally had 3 pounds of Calcium required in the soil solution to meet plant needs, but it wasn't until Dr. Palta's work at Wisconsin that raised the bar on the tuber needs.

*Footnote:* In the past many crop advisors felt that brown center and hollow heart was a Boron deficiency or a physiological disorder. Boron deficiencies show up in other crops but isn't prone to be a problem on alkaline soils where most potatoes are raised. There is a Ca:B ratio in plants 100:1 and I have a Ca:B ratio of 175:1. Boron compliments Calcium for cell permeability of nutrients and solutes. Boron aids Potassium in translocating carbohydrates from the leaves to the tubers. If your Boron levels are low, it is best to start injecting small amounts beginning at two weeks prior to tuberization initiation.

To prevent physiological disorders in the tubers, you must have five lbs. of Calcium and 13 grams of Boron in the Soil Solution at all times from tuberization initiation to maturation.

*For further questions, please feel free to email John at [john@westernlaboratories.com](mailto:john@westernlaboratories.com)*