NUTRIENT GUIDELINES FOR VEGETABLES

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TABLE OF CONTENTS

No	te	1
Ac	knowledgments	1
1.	Introduction	2
2.	Nitrogen Guidelines	2
3.	Phosphorus Guidelines	5
4.	Potassium Guidelines	7
5.	Lime Guidelines	9
6.	Extension References	14
Ap	pendix A: Soil management groups for New York State agricultural soils	15

NOTE

For nutrient applications, Concentrated Animal Feeding Operations (CAFOs) in New York State are required to follow the USDA-NRCS Nutrient Management Standard (Code 590), which in turn requires the use of Cornell University Guidelines for nitrogen (N) and phosphorus (P), nutrients that can have a direct impact on the environment. When fields in vegetable production are part of a CAFO operation and receive manure, litter, or process wastewater, the comprehensive nutrient management plan must include those fields and be created using these guidelines.

ACKNOWLEDGMENTS

The vegetable N, P, potassium (K), and lime guidelines contained in this document have been provided by Dr. Stephen Reiners, Section of Horticulture in the School of Integrated Plant Sciences at Cornell University. The potato guidelines are based on recommendations from Dr. Donald Halseth, Emeritus of the Section of Horticulture. The guidelines are also documented in the Cornell Integrated Crop and Pest Management Guidelines for Vegetable Crops, a copy of which can be purchased from Cornell Cooperative Extension at: <u>https://cropandpestguides.cce.cornell.edu/</u>. Reviewed by the NMSP internal advisory committee.

1. INTRODUCTION

Three-letter crop codes are used to identify vegetables crops for which the N, P, K, and lime guidelines are documented in this bulletin (Table 1).

Code	Description	Code	Description
ASP	Asparagus	MML	Muskmelon
BDR	Beans - Dry	MUS	Mustard
BNL	Beans - Lima	ONS	Onion-Seeded
BNS	Beans - Snap	ONP	Onion-Transplant
BET	Beet	PSL	Parsley
BRS	Broccoli-Seeded	PSN	Parsnips
BRP	Broccoli-Transplanted	PEA	Pea
BUS	Brussels Sprouts	PEP	Peppers
CBS	Cabbage - Seeded	POP	Popcorn
CBP	Cabbage-Trans	POT	Potato
CAR	Carrots	PUM	Pumpkins
CFS	Cauliflower - Seeded	RAD	Radishes
CFP	Cauliflower - Transplanted	RHU	Rhubarb
CEL	Celery	RUT	Rutabagas
CRD	Chard	SPF	Spinach-Fall
CHC	Chinese Cabbage	SPS	Spinach-Spring
CKS	Cucumber - Seeded	SQS	Squash-Summer
СКР	Cucumber - Transplanted	SQW	Squash-Winter
EGG	Eggplant	SWC	Sweet Corn
END	Endive	SWP	Sweet Potatoes
GAR	Garlic	TOM	Tomato
LET	Lettuce	TUR	Turnips
MIX	Mixed Vegetables	WAT	Watermelon

Table 1: Vegetable crops and their Cornell crop codes.

2. NITROGEN GUIDELINES

Nitrogen guidelines for the 46 vegetables listed in Table 1 are shown in lbs of N per acre in Table 2. Celery, onions, potatoes, and spinach have varying N guidelines depending on the soil management group (SMG) designation of the field in which these crops are grown in. See Appendix A to identify the SMG of a specific soil type. Muck type soils are classified as soil management group 6. Perennial vegetables such as asparagus and rhubarb have different N guidelines in the planting (establishment) year and subsequent (established) years.

Table	2.	Cornell	nitrogen	(N)	guidelines	for	vegetables	in	lbs	Ν	per	acre.	Gross
require	eme	ents do no	ot take int	o acc	ount residua	al N	from manur	e or	sod	cre	dits.		

Crop description	Crop Code	Gross N guideline
		lbs N/acre
Asparagus – Established	ASP	50
Asparagus – New Planting	ASP	50
Beans – Dry	BDR	30
Beans – Lima	BNL	40
Beans – Snap	BNS	40
Beet	BET	175
Broccoli-Transplanted	BRP	120
Broccoli-Seeded	BRS	120
Brussels Sprouts	BUS	120
Cabbage – Seeded	CBS	120
Cabbage-Transplanted	CBP	120
Carrots	CAR	90
Cauliflower – Transplanted	CFP	120
Cauliflower – Seeded	CFS	120
Celery, $SMG = 1$ to 5	CEL	180
Celery, $SMG = 6$	CEL	140
Chinese Cabbage	CHC	120
Chard	CRD	100
Cucumber – Transplanted	СКР	100
Cucumber – Seeded	CKS	100
Eggplant	EGG	130
Endive	END	100
Garlic	GAR	100
Lettuce	LET	100
Mixed Vegetables	MIX	120
Muskmelon	MML	100
Mustard	MUS	100
Onion-Transplant, $SMG = 1$ to 5	ONP	120
Onion-Transplant, SMG = 6	ONP	100
Onion-Seeded, $SMG = 1$ to 5	ONS	120
Onion-Seeded, $SMG = 6$	ONS	100
Parsley	PSL	100
Parsnips	PSN	150
Pea	PEA	50
Peppers	PEP	150
Popcorn	POP	*
Potato, $SMG = 1$ to 5	РОТ	150
Potato, $SMG = 6$	РОТ	100
Pumpkins	PUM	100

Crop description	Crop Code	Gross N guideline
		lbs N/acre
Rhubarb – Established	RHU	80
Rhubarb – New Planting	RHU	100
Radishes	RAD	50
Rutabagas	RUT	60
Spinach-Spring, SMG = 1-5	SPS	125
Spinach-Spring, SMG = 6	SPS	100
Spinach-Fall, SMG = 1-5	SPF	125
Spinach-Fall, SMG = 6	SPF	100
Squash-Summer	SQS	100
Squash-Winter	SQW	100
Sweet Corn	SWC	140
Sweet Potatoes	SWP	75
Tomato	TOM	100
Turnips	TUR	60
Watermelon	WAT	100

*Popcorn N guidelines are the same as for field corn (COG, COS). See the Cornell Guide for Integrated Field Crop Management, a copy of which can be purchased from Cornell Cooperative Extension at: <u>https://cropandpestguides.cce.cornell.edu/</u>, or Nitrogen Guidelines for Field Crops in New York, which can be downloaded from the Nutrient Management Spear Program (NMSP) website at: <u>http://nmsp.cals.cornell.edu/publications/extension/Ndoc2003.pdf</u>.

Residual N from sod (alfalfa/grass) fields in rotation with vegetables should be taken into account. Total N required is the difference between the gross N guideline in Table 2 and residual N credits from a sod. Three years of N credits from sod fields are taken into account, in addition to the percent legume in the sod. See Agronomy Factsheet #21 (<u>http://nmsp.cals.cornell.edu/publications/factsheets/factsheet21.pdf</u>) for more detailed information on estimating N credits from sod in rotation.

Residual manure N is the portion of the organic N from the past two years of manure applications available to the plants in the current plan year. Total N required is the difference between gross N required and residual manure N. See Agronomy Factsheet #4 (<u>http://nmsp.cals.cornell.edu/publications/factsheets/factsheet4.pdf</u>) for more information on estimating N credits from manure.

The remaining N needs of a crop after accounting for sod and past manure or compost credits, can be met with fertilizer N, manure/compost, or a combination of both. However, for vegetables a starter fertilizer N application of up to 25 lbs N per acre is recommended for all direct seeded, non-legume, vegetable crops.

Popcorn N guidelines are the same as field corn (COG, COS). See the Cornell Guide for Integrated Field Crop Management, a copy of which can be purchased from Cornell Cooperative Extension at: <u>https://cropandpestguides.cce.cornell.edu/</u>, or Nitrogen Guidelines for Field Crops in New York, downloadable from the NMSP website: <u>http://nmsp.cals.cornell.edu/publications/extension/Ndoc2003.pdf</u>.

3. PHOSPHORUS GUIDELINES

The P guidelines for vegetables depend on the soil test phosphorus (STP) level as measured by the (modified) Morgan extraction method. Carrots, celery, endive, lettuce, onions, potatoes, and spinach have different P guidelines when grown on mineral soil (SMG 1 to 5) and muck soils (SMG 6). Vegetable P guidelines in lbs of P₂O₅ per acre for mineral soils and muck soils are shown in Tables 3 and 4, respectively. Popcorn P guidelines are the same as for field corn (COG, COS). See the Cornell Guide for Integrated Field Crop Management, a copy of which can be purchased from Cornell Cooperative Extension: <u>https://cropandpestguides.cce.cornell.edu/</u>, or Phosphorus Guidelines for Field Crops in New York: <u>http://nmsp.cals.cornell.edu/publications/extension/Pdoc2003.pdf</u>.

(son management groups 1-5) in los of 1205 per acre.									
		Cornell P guideline							
		lbs P ₂ O ₅ /acre							
Crop description	Code	Morgan Soil Test P (lbs P/acre)							
		<3	3-5	6-12	13-39	40+			
Asparagus (new)	ASP	160	110	60	30	20			
Asparagus (established)	ASP	100	75	60	25	0			
Beans - Dry	BDR	100	80	60	40	20			
Beans - Lima	BNL	100	80	60	40	20			
Beans - Snap	BNS	100	80	60	40	20			
Beet	BET	200	150	100	50	20			
Broccoli-Transplanted	BRP	160	120	80	40	20			
Broccoli-Seeded	BRS	160	120	80	40	20			
Brussels Sprouts	BUS	160	120	80	40	20			
Cabbage - Seeded	CBS	160	120	80	40	20			
Cabbage-Transplanted	CBP	160	120	80	40	0			
Carrots	CAR	160	120	80	40	20			
Cauliflower - Transplanted	CFP	160	120	80	40	20			
Cauliflower - Seeded	CFS	160	120	80	40	20			
Celery	CEL	200	150	100	50	20			
Chinese Cabbage	CHC	160	120	80	40	20			
Chard	CRD	160	120	80	40	20			
Cucumber - Transplanted	СКР	160	120	80	40	20			
Cucumber - Seeded	CKS	160	120	80	40	20			
Eggplant	EGG	200	150	100	50	20			
Endive	END	160	120	80	40	20			
Garlic	GAR	200	150	100	50	20			
Lettuce	LET	160	120	80	40	20			
Mixed Vegetables	MIX	160	120	80	40	20			
Muskmelon	MML	160	120	80	40	20			
Mustard	MUS	160	120	80	40	20			

Table 3. Phosphorus (P) guidelines for selected vegetable crops grown on mineral soils (soil management groups 1-5) in lbs of P_2O_5 per acre.

			Cornell P guideline					
				lbs P ₂ O ₅ /a	cre			
Crop description	Code	M	lorgan Soil	Test P (lb	s P/acre)			
		<3	3-5	6-12	13-39	40+		
Onion-Transplant	ONP	200	150	100	50	20		
Onion- Seeded	ONS	200	150	100	50	20		
Parsley	PSL	160	120	80	40	20		
Parsnips	PSN	160	120	80	40	20		
Pea	PEA	120	100	75	50	20		
Peppers	PEP	200	150	100	50	20		
Popcorn	POP	*	*	*	*	*		
Pumpkins	PUM	160	120	80	40	20		
Rhubarb - New Planting	RHU	160	110	60	30	20		
Rhubarb - Established	RHU	100	75	50	25	0		
Radishes	RAD	125	100	75	50	20		
Rutabagas	RUT	125	100	75	50	20		
Spinach-Spring	SPS	170	140	110	80	50		
Spinach-Fall	SPF	170	140	110	80	50		
Squash-Summer	SQS	160	120	80	40	20		
Squash-Winter	SQW	160	120	80	40	20		
Sweet Corn	SWC	160	120	80	40	20		
Sweet Potatoes	SWP	300	200	100	50	0		
Tomato	TOM	200	150	100	50	20		
Turnips	TUR	125	100	75	50	20		
Watermelon	WAT	160	120	80	40	20		

*See the Cornell Guide for Integrated Field Crop Management, a copy of which can be purchased from Cornell Cooperative Extension at: <u>https://cropandpestguides.cce.cornell.edu/</u>, or <u>Phosphorus Guidelines for</u> Field Crops in New York, which can be downloaded for free from the NMSP website at: <u>http://nmsp.cals.cornell.edu/publications/extension/Pdoc2003.pdf</u>.

		Cornell P guideline						
Crop description	Code	N	Morgan Soil Test P (lbs P/acre)					
	Coue	<- 40	101gan 501	101 160	161 220	221		
Compto	CAD	160	120	101-100	101-220	221+		
Carrots	CAR	160	120	80	40	0		
Celery	CEL	200	150	100	50	0		
Endive	END	160	120	80	40	0		
Garlic	GAR	200	150	100	50	0		
Lettuce	LET	160	120	80	40	0		
Onion-Transplant	ONP	200	150	100	50	0		
Onion- Seeded	ONS	200	150	100	50	0		
Spinach-Spring	SPS	170	140	110	80	0		
Spinach-Fall	SPF	170	140	110	80	0		

Table 4. Phosphorus (P) guidelines for selected vegetable crops grown on muck soils (soil management group 6) in lbs of P_2O_5 per acre.

Potato P guidelines depend on county, (modified) Morgan STP, soil test iron (Fe), soil test aluminum (Al) and pH:

For potatoes (POT) grown in Suffolk County, New York: If STP < 40, P guideline = 240 lbs P₂O₅/acre If STP \ge 40, and (Al + Fe) \le 200, P guideline = 150 lbs P₂O₅/acre If STP \ge 40, and (Al + Fe) \ge 200, P guideline = 240 lbs P₂O₅/acre

For potatoes (POT) grown in Upstate New York: If STP < 20, P guideline = 240 lbs P_2O_5 /acre If STP ≥ 20 , and (Al + Fe) < 100, P guideline = 120 lbs P_2O_5 /acre If STP ≥ 20 , and (Al + Fe) ≥ 100 and ≤ 200 , P guideline = 150 lbs P_2O_5 /acre If STP ≥ 20 , and (Al + Fe) > 200, P guideline = 240 lbs P_2O_5 /acre

For potatoes (POT) grown in Upstate New York if soil test Al and Fe are <u>not</u> available: If STP < 20, P guideline = 240 lbs P_2O_5 /acre If STP ≥ 20 , and pH ≤ 5.2 , P guideline = 240 lbs P_2O_5 /acre If STP ≥ 20 , and pH > 5.2 and ≤ 5.6 , P guideline = 150 lbs P_2O_5 /acre If STP ≥ 20 , and pH > 5.6, P guideline = 120 lbs P_2O_5 /acre

4. POTASSIUM GUIDELINES

The potassium (K) guideline for vegetables depend on the soil test potassium (STK) level as measured by the (modified) Morgan extraction method. Carrots, celery, endive, lettuce, onions, potatoes, and spinach have different K guidelines when grown on mineral soils (SMG 1 to 5) and muck soils (SMG 6). Vegetable K guidelines are listed in pounds of K₂O per acre in Tables 5 and 6. Popcorn K guidelines are the same as field corn (COG, COS). See the Cornell Guide for Integrated Field Crop Management, a copy of which can purchased from Cornell Cooperative Extension be at: https://cropandpestguides.cce.cornell.edu/, or Potassium Guidelines for Field Crops in New York, which can be downloaded for free from the NMSP website at: http://nmsp.cals.cornell.edu/publications/extension/Kdoc2003.pdf. Guidelines for K for potatoes depend on the STK and the SMG. Appendix A shows the SMG of each of the soil types in New York.

The K guidelines for potatoes (POT) depend on STK and constants associated with the soil type. The minimum recommended K₂O application is 50 lbs per acre. The maximum rate is 300 lbs/acre for potatoes grown in SMGs 1, 2, 3 and 4. The maximum rate is 350 lbs/acre for production in SMGs 5 and 6. Between the minimum and maximum rates, the following equation is used to calculate the K rate: K guideline (lbs K₂O /acre) = (400-STK) * A - 50, where A is 0.75 for SMG 1 and 2, 0.85 for SMG 3, 1.00 for SMG 4, and 1.15 for SMG 5 and 6.

		Cornell K guideline						
		lbs K ₂ O/acre						
Crop description	Code	N	Morgan Soil Test K (lbs K/acre)					
		< 50	50-99	100-199	200-299	300+		
Asparagus (new)	ASP	200	150	100	50	0		
Asparagus (established)	ASP	100	80	60	40	0		
Beans - Dry	BDR	80	60	40	20	0		
Beans - Lima	BNL	80	60	40	20	0		
Beans - Snap	BNS	80	60	40	20	0		
Beet	BET	400	300	200	100	50		
Broccoli-Transplanted	BRP	200	160	120	60	0		
Broccoli-Seeded	BRS	200	160	120	60	0		
Brussels Sprouts	BUS	200	160	120	60	0		
Cabbage - Seeded	CBS	200	160	120	60	0		
Cabbage-Transplanted	CBP	200	160	120	60	0		
Carrots	CAR	200	160	120	60	0		
Cauliflower - Transplanted	CFP	200	160	120	60	0		
Cauliflower - Seeded	CFS	200	160	120	60	0		
Celery	CEL	300	240	180	120	60		
Chinese Cabbage	CHC	200	160	120	60	0		
Chard	CRD	200	150	100	50	0		
Cucumber - Transplanted	СКР	160	120	80	40	0		
Cucumber - Seeded	CKS	160	120	80	40	0		
Eggplant	EGG	200	150	100	50	0		
Endive	END	200	150	100	50	0		
Garlic	GAR	200	150	100	50	0		
Lettuce	LET	200	150	100	50	0		
Mixed Vegetables	MIX	160	120	80	40	0		
Muskmelon	MML	160	120	80	40	0		
Mustard	MUS	200	150	100	50	0		
Onion-Transplant	ONP	200	150	100	50	0		
Onion- Seeded	ONS	200	150	100	50	0		
Parsley	PSL	200	150	100	50	0		
Parsnips	PSN	200	160	120	60	0		
Pea	PEA	160	120	80	40	0		
Peppers	PEP	200	150	100	50	0		
Popcorn	POP	*	*	*	*	*		
Pumpkins	PUM	160	120	80	40	0		
Rhubarb - New Planting	RHU	200	150	100	50	0		
Rhubarb - Established	RHU	100	80	60	40	0		
Radishes	RAD	200	150	100	50	0		
Rutabagas	RUT	200	150	100	50	0		
Spinach-Spring	SPS	200	150	100	50	0		

Table 5. Potassium (K) guidelines for selected vegetable crops grown on mineral soils (soil management groups 1-5) in lbs of $K_2O/acre$.

			Cornell K guideline				
				lbs K ₂ O/a	cre		
Crop description	Code	N	lorgan Soi	l Test K (l	bs K/acre)		
		< 50	< 50 50-99 100-199 200-299 300+				
Spinach-Fall	SPF	200	150	100	50	0	
Squash-Summer	SQS	160	120	80	40	0	
Squash-Winter	SQW	160	120	80	40	0	
Sweet Corn	SWC	160	120	80	40	0	
Sweet Potatoes	SWP	350	300	200	100	0	
Tomato	TOM	240	180	120	60	0	
Turnips	TUR	200	150	100	50	0	
Watermelon	WAT	160	120	80	40	0	

*Popcorn K guidelines are the same as field corn (COG, COS). See the Cornell Guide for Integrated Field Crop Management, a copy of which can be purchased from Cornell Cooperative Extension at: <u>https://cropandpestguides.cce.cornell.edu/</u>, or Potassium Guidelines for Field Crops in New York, which can be downloaded from the NMSP website: <u>http://nmsp.cals.cornell.edu/publications/extension/Kdoc2003.pdf</u>. Guidelines for K for potatoes depend on the soil test K (STK, [modified] Morgan, and the soil management group [SMG]).

		Cornell K guideline					
				lbs K ₂ O/a	cre		
Crop description	Code	N	Morgan Soil Test K (lbs P/acre)				
		≤ 220	220-370	371-520	521-670	>670	
Carrots	CAR	200	160	120	60	0	
Celery	CEL	300	240	180	120	0	
Endive	END	200	150	100	50	0	
Garlic	GAR	200	150	100	50	0	
Lettuce	LET	200	150	100	50	0	
Onion-Transplant	ONP	200	150	100	50	0	
Onion- Seeded	ONS	200	150	100	50	0	
Spinach-Spring	SPS	200	150	100	50	0	
Spinach-Fall	SPF	200	150	100	50	0	

Table 6. Potassium (K) guidelines for selected vegetable crops grown on muck soils (soil management group 6) in lbs of $K_2O/acre$.

5. LIME GUIDELINES

Lime is recommended if the soil pH is below the optimum range for the crops in the rotation, where the minimum pH of the rotation is determined by the crop with highest desired pH. Table 7 indicates the minimum and desired soil pH levels for vegetables.

A pH measurement can only tell us whether or not liming of the soil should be considered. We need a measure of the soil's "buffer capacity" or ability to counteract a pH change upon lime addition to determine how much lime is needed. Guidelines for pH management are based on the modified Mehlich buffer (which contains CaCl₂ instead of

BaCl₂). No lime is recommended if the soil pH is above the desired pH. No lime is recommended if the soil pH is below the desired pH but above the minimum pH as applications would not be economical (but test the soil again in 2-3 years). If the soil pH is lower than the minimum rotation pH, lime addition is recommended.

The recommended lime rate can be read from Table 8 using the soil's buffer pH and the desired rotation pH. For example, if the buffer pH is 5.5 and desired rotation pH is 6.5, 4.5 tons/acre lime is recommended. The recommendations listed in Table 8 assume a 6 to 7 inch tillage depth. For an 8-inch tillage depth, multiply the rates listed in Table 2 by 1.33. For a 10+ inch tillage depth, multiply the rate listed in Table 2 by 1.67.

Lime rates in Table 8 also assume liming material with 100% Effective Neutralizing Value (ENV). To adjust for specific materials, divide the recommended lime rate by the percent ENV reported for the lime source. For example, if the recommended lime rate is 4.5 tons/acre and the lime source available is 75% ENV, 4.5 / 0.75 = 6 tons of this liming material should be applied per acre.

Сгор	Crop	Desired	Minimum
Description	Code	pH	рH
Asparagus	ASP	7.0	6.8
Beans – Dry	BDR	6.4	6.0
Beans – Lima	BNL	6.4	6.0
Beans – Snap	BNS	6.4	6.2
Beet	BET	6.5	6.2
Broccoli-Seeded	BRS	6.5	6.2
Broccoli-Transplanted	BRP	6.5	6.2
Brussels Sprouts	BUS	6.5	6.2
Cabbage – Transplanted	CBP	6.5	6.2
Cabbage – Seeded	CBS	6.5	6.2
Carrots	CAR	6.4	6.0
Carrots (SMG=6)	CAR	5.5	5.5
Cauliflower – Transplanted	CFP	6.5	6.2
Cauliflower – Seeded	CFS	6.5	6.2
Celery	CEL	6.4	6.0
Celery (SMG = 6)	CEL	5.5	5.5
Chard	CRD	6.5	6.2
Chinese Cabbage	CHC	6.5	6.2
Cucumber – Seeded	CKS	6.4	6.0
Cucumber – Transplanted	СКР	6.4	6.0
Eggplant	EGG	6.4	6.0
Endive	END	6.5	6.2
Endive (SMG=6)	END	5.6	5.6
Garlic	GAR	6.4	6.0
Lettuce	LET	6.5	6.2
Lettuce (SMG=6)	LET	5.6	5.6

Table 7. Desired and minimum crop pH levels for vegetables.

Crop	Crop	Desired	Minimum
Mixed Vegetables	MIX	6.4	6.0
Muskmelon	MML	6.4	6.0
Mustard	MUS	6.5	6.2
Onion-Seeded	ONS	6.4	6.0
Onion-Seeded (SMG=6)	ONS	5.2	5.2
Onion-Transplant	ONP	6.4	6.0
Onion-Transplant (SMG=6)	ONP	5.2	5.2
Parsley	PSL	6.5	6.0
Parsnips	PSN	6.4	6.0
Pea	PEA	6.5	6.2
Peppers	PEP	6.4	6.0
Popcorn	POP	6.2	6.0
Potato (consult CCE)	POT	-	-
Pumpkins	PUM	6.4	6.0
Radishes	RAD	6.4	6.0
Rhubarb	RHU	6.5	6.2
Rutabagas	RUT	6.4	6.0
Spinach-Fall	SPF	6.7	6.5
Spinach-Fall (SMG=6)	SPF	5.6	5.6
Spinach-Spring	SPS	6.7	6.5
Spinach-Spring (SMG=6)	SPS	5.6	5.6
Squash-Summer	SQS	6.4	6.0
Squash-Winter	SQW	6.4	6.0
Sweet Corn	SWC	6.5	6.2
Tomato	TOM	6.4	6.0
Turnips	TUR	6.4	6.0
Watermelon	WAT	6.4	6.0

Table 9 provides a guideline for lime recommendations given the incidence of potato scab for the location and the resistance associated with the variety. There are limitations on rate and sequence of lime applications. This includes:

Continuous Potatoes:

- 1. Maximum of 0.5 ton/acre per year (even in rye year). Rye-potato rotation is considered to be the same as continuous potatoes.
- 2. If the total lime requirement cannot be met with 0.5 ton/acre per year, apply recommended amount and resample at end of the listed rotation.

Rotation:

- 1. Maximum of 0.5 ton/acre per year in the potato year.
- 2. Maximum of 4.0 tons/acre per year can be applied on the non-potato year, except for cole crops where the maximum is 1.0 ton/acre per year. If the total lime requirement can be met for a 3-year rotation by application on the non-potato year, all lime may be applied on the non-potato year.

- 3. If the lime recommendation is greater than 2.0 ton/acre per split lime rate; plow in half, work rest in seed zone before planting.
- 4. If lime recommendation is not satisfied for rotation options 1 and 2, the overall lime requirement for the potato rotation was not satisfied and it is recommended to resample at the end of listed rotation.

Anytime lime is recommended, use a limestone containing magnesium unless soil magnesium level is very high, in which case a low magnesium limestone is recommended. If soil test for Mg is less than 100 or pH less than 5.0: apply 30 lbs of magnesium (50 pounds of magnesium oxide) per acre to address the magnesium deficiency. This is independent of soil pH.

Modified Mehlich	Desired rotation pH (minimum pH)			
Buffer pH	7.0 (6.7)	6.8 (6.6)	6.5 (6.4)	6.2 (6.0)
	tons/acre (100% Effective N	Neutralizing Valu	e [ENV])
5.0	11.0	10.0	8.5	6.5
5.1	10.0	9.0	7.5	6.0
5.2	9.0	8.0	7.0	5.5
5.3	8.0	7.5	6.0	5.0
5.4	7.5	6.5	5.5	4.0
5.5	6.5	6.0	4.5	3.5
5.6	5.5	5.0	4.0	3.0
5.7	4.5	4.0	3.0	2.5
5.8	4.0	3.5	2.5	1.5
5.9	3.0	2.5	2.0	1.0
6.0	2.0	1.5	1.0	0.5
6.1	1.0	1.0	0.5	0.5
6.2	1.0	0.5	0.5	0.5
6.3	1.0	0.5	0.5	0.5
6.4	1.0	0.5	0.5	0.5
6.5	1.0	0.5	0.5	0.5
6.6	1.0	0.5	0.5	0.5

Table 8: Lime guidelines for soil with a pH less than the minimum pH for the rotation.

Sc	cab	Scab	res	istant	Minimum	Desired	
incie	lence	variet	ty g	grown	pН	pН	
No	Minor	Yes		No		_	
	to						Comments
	severe						
Contin	uous po	tatoes					
X		X	or	X	5.3	5.5	1. If rye for grain is the only crop in rotation with potatoes, lime as if continuous potatoes.
	Х	X	or	Х	5.0	5.2	2. Use of a scab resistant variety recommended.
Potato	bes in ro	tation					
X		X	or	X	5.3	5.6	3. Rotation with clover, grasses, wheat, barley, oats, buckwheat, corn, millet, sorghum and sudangrass (for Suffolk Co. only, include cabbage, Brussels sprouts, broccoli and cauliflower). Use of a scab resistant variety recommended.
Х		X			5.8	6.0	4. Rotation with all other crops not listed in comment #3.
X				X	5.8	6.0	5. Rotation with all other crops not listed in comment #3. For this rotational sequence, a scab resistant variety is recommended.
	X	Х			5.3	5.6	6. Same as comment #3.
	X			X	5.3	5.6	7. Same as comment #3. Use of a scab resistant variety is recommended.
	X	X			5.8	6.0	8. Rotation with crops other than those listed in comment #3: <u>CAUTION</u> - because of scab problem, rotation needs to be reviewed. Consult Cooperative Extension.
	X			X	5.8	6.0	 Rotation with crops other than those listed in comment #3. Use of a scab resistant variety is recommended". <u>CAUTION</u> – because of scab problem, rotation needs to be reviewed. Consult Cooperative Extension.

Table 9: Lime recommendations for potatoes.

6. EXTENSION REFERENCES

Vegetable guidelines:

• Cornell Integrated Crop and Pest Management Guidelines for Vegetable Crops. Order at: <u>https://cropandpestguides.cce.cornell.edu/.</u>

Field crops fertility guidelines:

- Cornell Guide for Integrated Field Crop Management. Order at: <u>https://cropandpestguides.cce.cornell.edu/.</u>
- Nitrogen Guidelines for Field Crops in New York. Downloadable from: <u>http://nmsp.cals.cornell.edu/publications/extension/Ndoc2003.pdf</u>.
- Phosphorus Guidelines for Field Crops in New York. Downloadable from: <u>http://nmsp.cals.cornell.edu/publications/extension/Pdoc2003.pdf</u>.
- Potassium Guidelines for Field Crops in New York. Downloadable from: <u>http://nmsp.cals.cornell.edu/publications/extension/Kdoc2003.pdf</u>.

Lime guidelines and management:

- Buffer pH to Derive Lime Guidelines. Agronomy Factsheet #48. Downloadable from: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet48.pdf
- Liming Materials. Agronomy Factsheet #7. Downloadable from: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet7.pdf.

APPENDIX A: SOIL MANAGEMENT GROUPS FOR NEW YORK STATE AGRICULTURAL SOILS

Potassium recommendations for field crops in New York depend on soil management group. The soil management group is a measure of the potassium supplying power of the soil. It is dependent upon the clay content, the soil rooting depth and the soil structure. A clayey of silty clay loam soil with deep rooting would have a soil management group of 1 and a sandy soil would be a group 5. Most of the silt loam soils of the central plains are group 2's and the silt loam soils of the southern tier are groups 3's.

Soil Management Group (SMG)	General Description
1	Fine-textured soils developed from clayey lake sediments and medium- to fine-textured soils developed from lake sediments.
2	Medium- to fine-textured soils developed from calcareous glacial till and medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale and medium-textured soils developed in recent alluvium.
3	Moderately course textured soil developed from glacial outwash and recent alluvium and medium-textured acid soil developed on glacial till.
4	Course- to medium-textured soils formed from glacial till or glacial outwash.
5	Course- to very course-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas.
6	Organic or muck soils with more than 80% organic matter.

Table A1: General descriptions of soil management groups.

Modified from: Cornell Field Crops & Soils Handbook, Cornell Cooperative Extension, 1987).

Soil Type	SMG
Acton	4
Adams	5
Adirondack	4
Adjidaumo	1
Adrian	6
Agawam	4
Albia	3
Albrights	2
Alden	3
Allagash	5
Allard	3
Allendale	3
Allis	3
Alluvial Land	3
Almond	3
Alps	3
Altmar	5
Alton	5
Amboy	4
Amenia	4
Angola	2
Appleton	2
Arkport	4
Armagh	2
Arnot	3
Ashville	3
Atherton	3
Atkins	3
Atsion	5
Au Gres	5
Aurelie	3
Aurora	2
Barbour	3
Barcelona	3
Barre	1
Bash	3
Basher	3
Bath	3
Becket	4
Becraft	3
Belgrade	3
Benson	4
Berkshire	5

Soil Type	SMG
Bernardston	4
Berrien	5
Berryland	5
Beseman	6
Bice	5
Biddeford	2
Birdsall	3
Blasdell	3
Bombay	4
Bonaparte	4
Bono	1
Boots	6
Borosaprists	6
Boynton	3
Braceville	4
Brayton	4
Bridge-Hampton	3
Bridport	2
Briggs	4
Brinkerton	2
Broadalbin	4
Brockport	1
Brookfield	3
Buckland	3
Bucksport	6
Budd	4
Burdett	2
Burnham	3
Busti	3
Buxton	2
Cambria	2
Cambridge	3
Camillus	3
Camroden	3
Canaan	4
Canaan-Rock	4
Outcrop	4
Canadice	2
Canandaigua	3
Canaseraga	3
Canastota	2
Caneadea	2
Canfield	3

Soil Type	SMG
Canton	4
Carbondale	6
Carlisle	6
Carrollton	3
Carver	5
Carver-Plymouth	5
Castile	4
Cathro	6
Cathro-Greenwoo	6
Cattaraugus	3
Cavode	2
Cayuga	2
Cazenovia	2
Ceresco	3
Chadakoin	3
Chagrin	3
Champlain	5
Charles	3
Charlton	4
Chatfield (E)	4
Chatfield (WE)	4
Chaumont	1
Chautauqua	3
Cheektowaga	5
Chenango	3
Cheshire	4
Chippeny	6
Chippewa	3
Churchville	2
Cicero	2
Clarkson	2
Claverack	4
Clymer	4
Cohoctah	4
Collamer	3
Colonie	5
Colosse	4
Colrain	4
Colton	5
Colwood	3
Conesus	2
Conotton	3
Constable	5

Table A2: Soil management groups for New York soil types.

Soil Type	SMG
Cook	5
Copake	4
Cornish	3
Cosad	4
Cossayuna	4
Covert	4
Coveytown	4
Covington	1
Crary	4
Croghan	5
Culvers	3
Dalbo	3
Dalton	3
Danley	2
Dannemora	4
Darien	2
Dawson	6
Deerfield	5
Deford	4
Dekalb	4
Depeyster	3
Deposit	3
Derb	3
Dixmont	5
Dorval	6
Dover	4
Duane	4
Dunkirk	3
Dutchess	4
Duxbury	4
Edwards	6
Eel	2
Eelweir	4
Elka	4
Ellery	3
Elmridge	5
Elmwood	4
Elnora	5
Empeyville	4
Enfield	3
Ensley	3
Erie	3
Ernest	3

Soil Type	SMG
Essex	5
Fahey	5
Farmington	3
Farnham	4
Fernlake	4
Flackville	4
Fonda	2
Franklinville	4
Fredon	4
Freetown	6
Fremont	2
Frenchtown	3
Frewsburg	3
Fryeburg	3
Fulton	1
Gage	3
Galen	4
Galestown	5
Galoo	4
Galoo-Rock	4
Outcrop	4
Galway	4
Genesee	2
Georgia	4
Getzville	3
Gilpen	3
Gilpin	3
Glebe	4
Glebe-Saddleback	4
Glendora	4
Glenfield	3
Gloucester	4
Glover	4
Gougeville	5
Granby	5
Grattan	5
Greene	3
Greenwood	6
Grenville	4
Gretor	3
Groton	4
Groveton	4
Guff	1

Soil Type	SMG
Guffin	1
Gulf	4
Hadley	3
Haights	3
Haights-Gulf	3
Hailesboro	3
Halcott	2
Halsey	4
Hamlin	2
Hamplain	2
Hannawa	4
Hartland	4
Haven	4
Hawksnest	3
Hempstead	4
Henrietta	6
Herkimer	3
Hermon	4
Hero	4
Heuvelton	2
Hilton	2
Hinckley	5
Hinesburg	4
Hogansburg	4
Hogback	5
Hogback-Ricker	5
Holderton	3
Hollis	4
Holly	2
Holyoke	3
Holyoke-Rock	2
Outcrop	3
Homer	2
Honeoye	2
Hoosic	4
Hornell	2
Hornellsville	3
Houghtonville	5
Houghtonville-	F
Rawson	5
Houseville	2
Howard	3
Hudson	2

Soil Type	SMG
Hulberton	2
Ilion	2
Insula	4
Ipswich	6
Ira	4
Ischua	3
Ivory	2
Jebavy	5
Joliet	4
Junius	5
Kalurah	4
Kanona	2
Kars	4
Kearsarge	3
Kendaia	2
Kibbie	3
Kingsbury	1
Kinzua	3
Knicker-bocker	5
Lackawanna	3
Lagross	3
Lagross-Haights	3
Lairdsville	2
Lakemont	1
Lakewood	5
Lamson	4
Lanesboro	3
Langford	3
Lansing	2
Leck Kill	3
Leicester	4
Leon	5
Lewbath	3
Lewbeach	3
Leyden	2
Lima	2
Limerick	3
Linden	4
Linlithgo	3
Livingston	1
Lobdell	3
Lockport	2
Lorain	1

Soil Type	SMG
Lordstown	3
Lovewell	2
Lowville	4
Loxley	6
Lucas	2
Ludlow	4
Lupton	6
Lyman	4
Lyman-Becket-	1
Berkshire	4
Lyme	5
Lyons	2
Machias	4
Macomber	4
Macomber-	1
Taconic	4
Madalin	1
Madawaska	5
Madrid	4
Malone	4
Manahawkin	6
Mandy	3
Manheim	2
Manhoning	2
Manlius	3
Mansfield	3
Maplecrest	2
Marcy	3
Mardin	3
Marilla	3
Markey	6
Marlow	4
Martisco	6
Massena	4
Matoon	1
Matunuck	6
Medihemists	6
Medina	3
Medomak	3
Melrose	4
Menlo	4
Mentor	4
Merrimac	4

Soil Type	SMG
Middlebrook	3
Middlebrook-	3
Mongaup	5
Middlebury	3
Millis	4
Millsite	4
Mineola	4
Miner	1
Mino	4
Minoa	4
Mohawk	2
Moira	4
Monadnock	4
Monarda	4
Mongaup	3
Montauk	4
Mooers	5
Morocco	4
Morris	3
Mosherville	4
Muck	6
Muck-Peat	6
Mundal	4
Mundalite	3
Mundalite-	2
Rawsonville	3
Munson	2
Munuscong	4
Muskego	6
Muskellunge	3
Napoleon	6
Napoli	3
Nassau	4
Naumburg	5
Nehasne	4
Nellis	4
Neversink	4
Newfane	4
Newstead	4
Newton	5
Niagara	3
Nicholville	4
Ninigret	4

Soil Type	SMG
Norchip	3
Norwell	5
Norwich	3
Nunda	2
Oakville	5
Occum	4
Odessa	2
Ogdensburg	4
Olean	2
Ondawa	4
Oneida	4
Onoville	3
Ontario	2
Onteora	3
Ontusia	3
Oquaga	3
Oramel	2
Organic	6
Orpark	2
Orwell	2
Ossipee	6
Otego	2
Otisville	4
Ottawa	5
Ovid	2
Palatine	2
Palms	6
Palmyra	3
Panton	1
Papakating	2
Parishville	4
Parsippany	1
Patchin	3
Pawcatuck	6
Pawling	4
Paxton	4
Peacham	3
Peat	6
Peat-Muck	6
Peru	4
Petoskey	4
Phelps	3
Philo	3

Soil Type	SMG
Pillsbury	4
Pinckney	3
Pipestone	5
Pittsfield	4
Pittstown	4
Plainbo	5
Plainfield	5
Plessis	3
Plymouth	4
Podunk	4
Poland	2
Pompton	4
Pootatuck	4
Pope	4
Potsdam	4
Poygan	1
Punsit	3
Pyrities	4
Quetico	4
Quetico-Rock	4
Outcrop	4
Raquette	4
Rawsonville	5
Rawsonville-	5
Beseman-	5
Rayne	3
Raynham	3
Raypol	3
Red Hook	4
Redwater	3
Remsen	2
Retsof	2
Rexford	4
Rhinebeck	2
Ricker	4
Ricker-Lyman	4
Ridgebury	4
Rifle	6
Riga	2
Rippowam	4
Riverhead	4
Rockaway	2
Romulus	2

Soil Type	SMG
Ross	2
Roundabout	3
Rumney	2
Runeberg	4
Ruse	4
Rushford	3
Saco	3
Salamanca	3
Salmon	4
Saprists	6
Saugatuck	5
Scantic	2
Scarboro	4
Schoharie	1
Schroon	5
Schuyler	3
Scio	3
Scituate	4
Scriba	4
Searsport	4
Shaker	2
Shoreham	2
Sisk	4
Skerry	5
Sloan	3
Sodus	4
Somerset	5
St Johns	4
Staatsburg	3
Stafford	4
Steamburg	3
Stetson	5
Stissing	4
Stockbridge	3
Stockholm	5
Stowe	4
Sudbury	4
Suffield	2
Summerville	4
Sun	4
Sunapee	4
Suncook	5
Suny	4

Soil Type	SMG
Surplus	4
Surplus-Sisk	4
Sutton	4
Swanton	4
Swartswood	4
Swormville	1
Taconic	3
Taconic-	2
Macomber	5
Tawas	6
Teel	2
Tioga	3
Toledo	2
Tonawanda	2
Tor	4
Torull	3
Towerville	3
Trestle	3
Trout River	5
Troy	3
Trumbull	1
Tughill	4
Tuller	3
Tunbridge	4
Tunbridge-	4
Adirondack	4
Tunkhannock	3
Turin	2
Tuscarora	4
Unadilla	3
Valois	3

Soil Type	SMG
Varick	2
Varysburg	2
Venango	3
Vergennes	1
Vly	3
Volusia	3
Waddington	4
Wainola	5
Wakeland	3
Wakeville	3
Wallace	5
Wallington	3
Wallkill	3
Walpole	4
Walton	3
Wampsville	3
Wappinger	3
Wareham	5
Warners	3
Wassaic	4
Watchaug	4
Waumbeck	4
Wayland	2
Weaver	3
Wegatchie	3
Wellsboro	3
Wenonah	4
Westbury	4
Westland	2
Wethersfield	4
Wharton	2

Soil Type	SMG
Whately	4
Whippany	2
Whitelaw	4
Whitman	4
Wilbraham	4
Willdin	3
Willette	6
Williamson	4
Willowemoc	3
Wilmington	4
Wilpoint	1
Windsor	5
Winooski	4
Wolcottsburg	1
Wonsqueak	6
Woodbridge	4
Woodlawn	4
Woodstock	4
Woodstock-Rock	4
Outcrop	4
Wooster	3
Woostern	3
Woostern-Bath-	3
Valois	3
Worden	4
Worth	4
Wurtsboro	4
Wyalusing	3
Yalesville	4
Yorkshire	3