AgriLIFE RESEARCH
Texas A&M System

Nutrient Removal Estimates for Major Vegetables in S. Texas

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Fluid Fertilizer Foundation
Solutions for AGRICULTURE

IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

VFIC Foods for Health Vegetable and Fruit Improvement Center

Tessenderlo Group Tessenderlo KERLEY

Tessenderlo Kerley, Inc.

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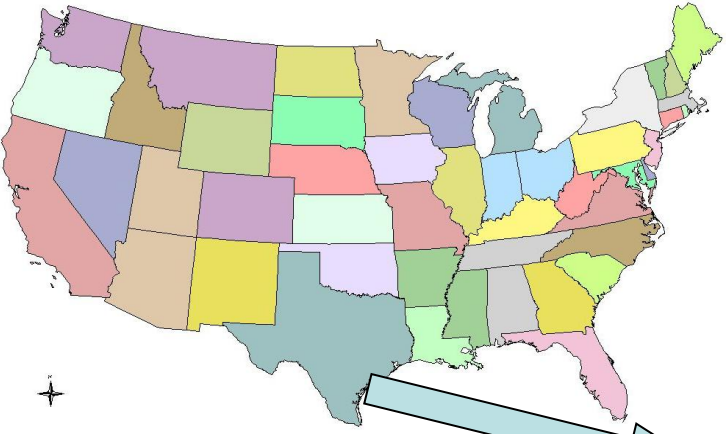


Lower Rio Grande Valley

Focus: Improving quality through (fluid) fertilizer management

Main Crops:

Melons, Watermelons, Onions, Peppers, Citrus (grapefruits & oranges):

- Taste (soluble solids content)
- Texture
- Color
- Nutritional and Health benefits

The Basic Problem:

Nutrient imbalance and uptake limitations

Timing is everything for uptake of quality nutrients

- *Weather conditions; Plant factors; Soil factors*

Soil chemical properties

	pH	NO_3-N	P	K	Ca	Mg
			ppm			
Average	**8.2 0.1**	**64.3 24.2**	**63.8 15.9**	**586.6 81.5**	**9166.7 3739**	**522.4 92.1**
Critical Limits	**6.5**	**-**	**50.0**	**175.0**	**180**	**50**

Others

S	16.2	0.5 ppm
Zn	7.95	0.6 ppm
Mn	110.7	2.1 ppm
B	3.7	0.21 ppm
Cu	16.5	2.1 ppm
Fe	39.0	1.2 ppm
Organic matter:	1.1	0.12 %
CEC:	56.2	0.96 meq/100g

Previous research: improving quality through fertilizer management

- Showed that supplementing soil-derived K with **foliar K applications** during the fruit development/maturation stages can improve fruit quality parameters of muskmelons grown on calcareous soils.

- Fertilizer guidelines for optimizing yield may not be the same as those for produce quality. Highlighted the need to reassess soil K management strategies to improve fruit quality especially on calcareous soils.

- Foliar K feeding was the most practical approach that growers can easily incorporate into existing foliar programs using existing equipment…… compared to soil intervention strategies (e.g. soil pH, etc)

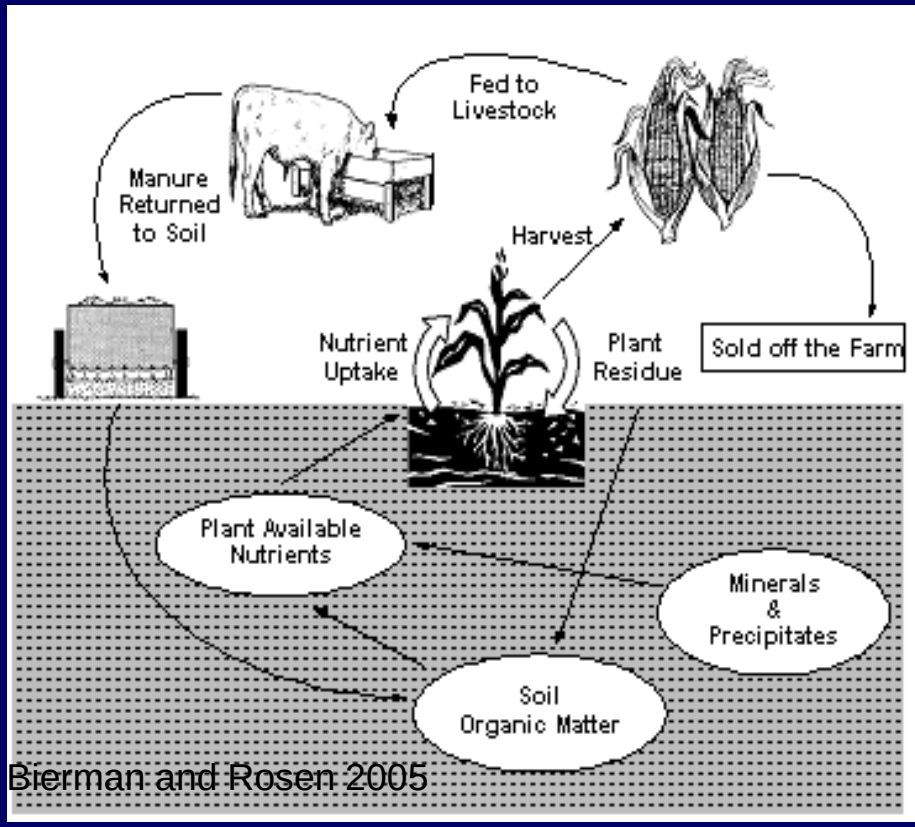
Jifon and Lester (2009)

Questions emerging

- How much K is required to assure minimum quality standards?
- How much is taken off fields with produce?
- Very little information available for vegetable crops.

Basic Plant Nutrient Cycle

- Depending on cultivar, harvestable portion, yield level, location etc, the balance between nutrient inputs and outputs can easily shift in either direction.
- Works well for Yield prediction; quality??
- Well established for major crops – little information on fruits and vegetables.



Bierman and Rosen 2005

Objectives

- How much K and others do plants take up?
- How much is taken off fields with produce?
- Very little information on uptake and removal amounts by vegetable crops.

Near-term:

- Estimate nutrient (N, P, **K**, S, Ca, Mg,) removal amounts in relation to different yield expectations in sites with contrasting soil types (light vs heavy) in S. Texas.

- Characterize timing of nutrient (especially K & Ca) uptake and partitioning among harvested & non-harvested biomass

Long-term:

- Develop nutrient management guidelines to assure produce quality.

Methods - sites

Commercial fields with contrasting soil types:

Locations

Edinburg -	**Brennan fine sandy loam**
Mission -	**Delfina fine sandy loam**
Santa Ana -	**Hidalgo sandy clay loam**
Weslaco -	**Harlingen clay**

Cultural Practices

Raised beds

Plastic mulch

Subsurface drip irrigation

Fluid fertilizers through drip

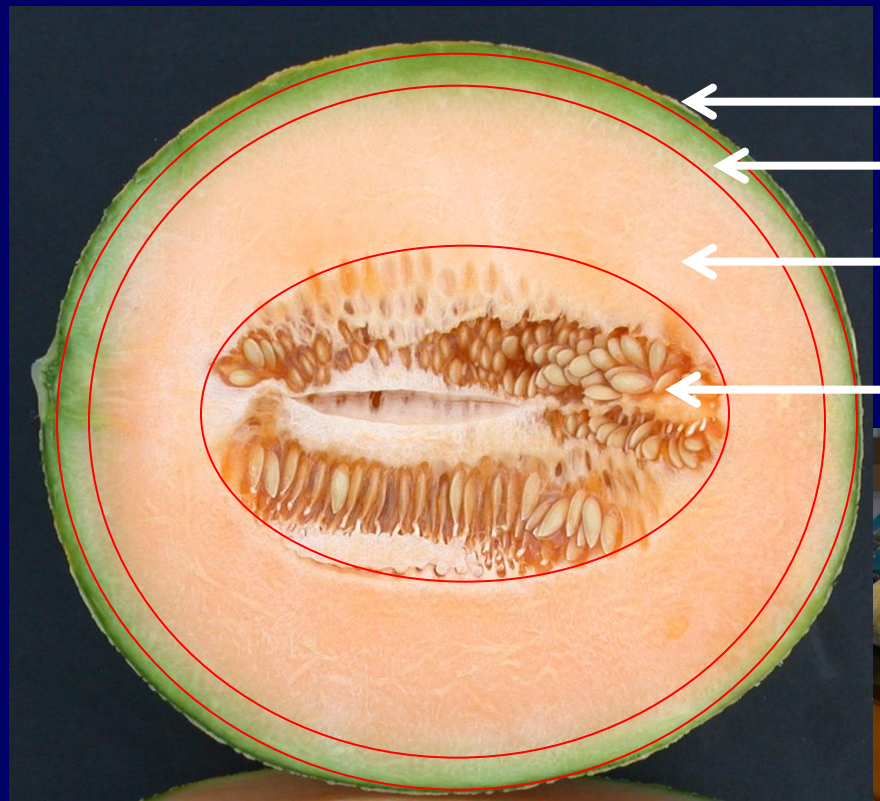
Season: early February – mid May

Methods - measurements

- Pre-plant soil analysis
- Biomass & nutrient partitioning
- Yield estimates

Methods - measurements

- Fruit size (fresh wt)
- Dry matter content/partitioning
- Brix
- Fruit mineral analysis



Pre-plant soil chemical properties

	pH	NO_3-N	P	K	Ca	Mg
				$mg \cdot kg^{-1}$		
Edinburg	8.2	33.4	110.0	**558.5**	2805.6	297.3
Mission	8.1	126.5	39.0	**385.0**	2805.6	537.8
Santa Ana	8.3	19.5	46.5	**779.0**	13807.8	507.3
Weslaco	8.3	78.0	59.8	**624.0**	17247.8	747.3
Critical Limits	**6.5**	**-**	**50**	**175**	**180**	**50**

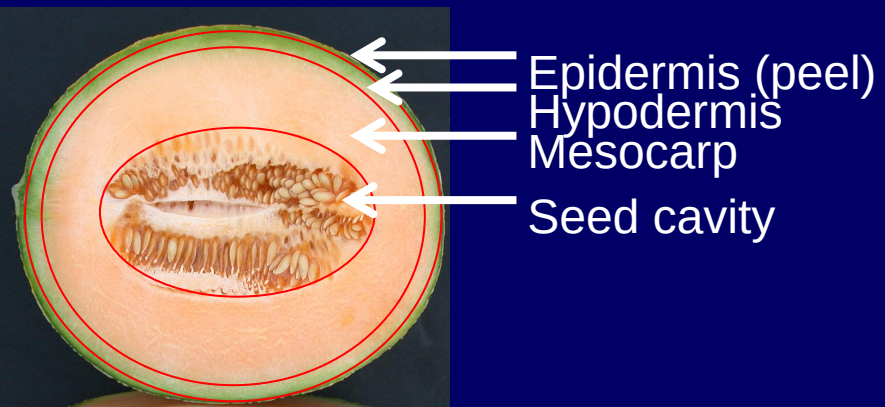
Fruit size, Brix, and mineral contents in edible mesocarp tissue

	Frtwt	Brix	N	P	K	Ca	Mg
	Lbs	%			mg·kg^{-1}		
Edinburg	4.3	9.1	9.0	1.5	17.9	11.8	1.1
Mission	4.2	9.5	10.1	1.7	20.3	12.7	1.3
Santa Ana	4.6	11.5	12.6	2.1	25.2	13.5	1.6
Weslaco	4.6	10.6	11.9	2.0	23.9	14.8	1.5

9s
~6”
40lb-bx

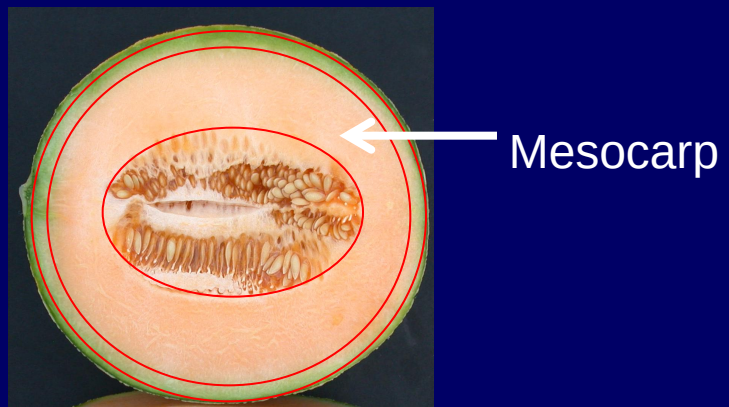
Nutrients removed with fruits

Location	Edinburg	Mission	Santa Ana	Weslaco
Fruit yield level (tons/ac)	**9.5**	**9.78**	**12.4**	**10.2**
	lbs/ac			
N	65.8	71.1	106.3	88.6
P	14.3	16.1	19.3	15.2
K	**141.0**	**142.6**	**223.2**	**190.45**
Ca	**66.1**	**75.8**	**111.3**	**98.1**
Mg	12.3	13.7	24.7	23.9



Nutrients removed in edible mesocarp tissue

Location	Edinburg	Mission	Santa Ana	Weslaco
Fruit yield level (tons/ac)	9.5	9.78	12.4	10.2
	lbs/ac			
N	18.4	21.8	37.7	31.3
P	3.1	3.6	6.3	5.2
K	36.8	43.6	75.4	62.5
Ca	24.7	27.6	40.4	38.9
Mg	2.3	2.7	4.7	3.9



Comparisons with limited available data

	N	P_2O_5	K_2O	Ca
[1]IPNI	80.0	25.0	140.0	
[2]Knott's	95.0	17.0	120.0	
?Europe?	45-107	13-22	45-178	44-64
Edinburg	65.8	14.3	141	66.1
Mission	71.1	16.1	142.6	75.8
Santa Ana	106.3	19.3	223.2	111.3
Weslaco	88.6	15.2	190.45	98.1

[1]IPNI, 2001;
[2]Maynard and Hochmuth, 2007- Knott's Handbook

Summary

- **Removal amounts very variable …. could be due to interacting soil, plant and weather factors**
- **2009 exceptionally dry – data over multiple years under different weather conditions needed**
- [[develop fertilizer guidelines to improve quality]]

Related studies

Foliar K nutrition:

- **Citrus:** Effects of K sources, KTS, K-Metalosate, PeaK,
- Additives (polymers) to improve uptake of foliar K
- Improving P uptake efficiency: Avail; polymers.

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THANK YOU