John Jifon

Nutrient Removal by Vegetable Crops: s. Texas

John Jifon

Texas AgriLife Research, Texas A&M System, Weslaco, TX jljifon@ag.tamu.edu

AgriLIFE RESEARCH
Texas A&M System

Nutrient Removal by Vegetable Crops: s. Texas

Fluid Fertilizer Foundation — Solutions for Agriculture

IPNI — International Plant Nutrition Institute

VFIC Foods for Health — Vegetable and Fruit Improvement Center

Tessenderlo Kerley

John Jifon

jljifon@ag.tamu.edu

The Problem

- The role of fertilizers on quality and functional properties has not been well researched. Quality & functional properties - major determinants of consumer preference.

- Fertilizer recommendations for many fruits and vegetables have not changed over decades. Improper fertilizer management practices account for some of the production limitations of the new high-yielding & specialty varieties

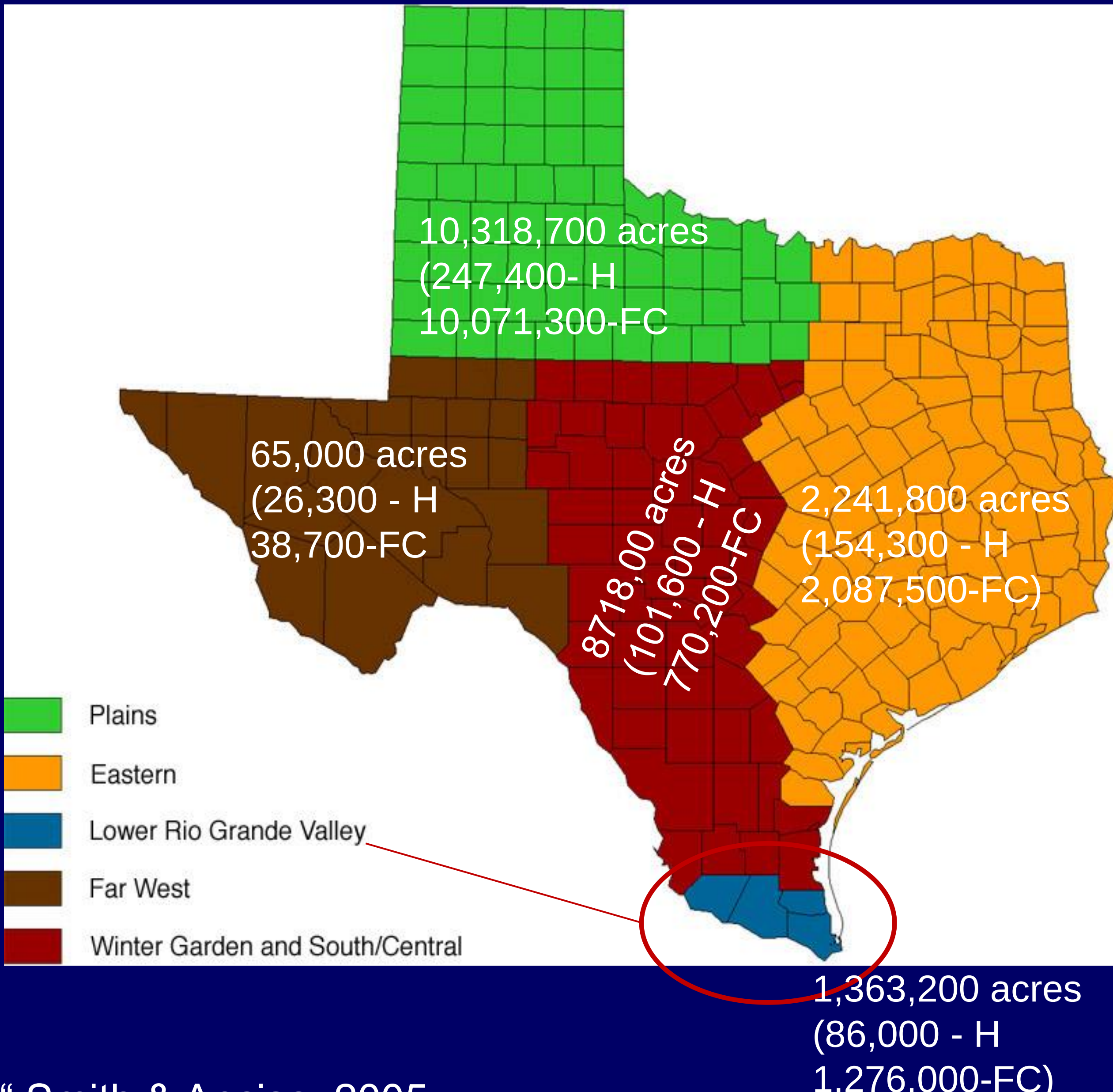
Production Regions

AgriLIFE RESEARCH
Texas A&M System

<u>Lower Rio Grande Valley</u>

The most intense horticultural production within 4 Counties:

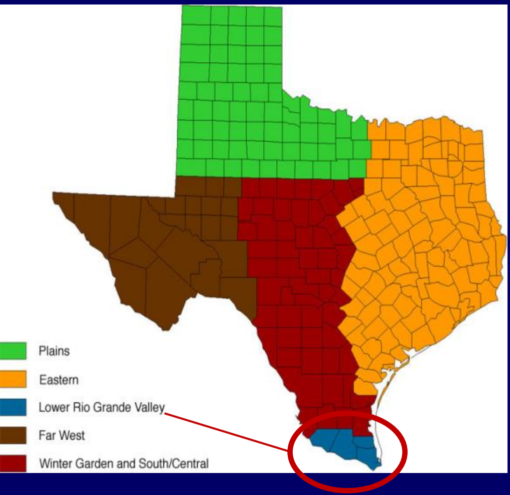
- **Cameron,**
- **Hidalgo,**
- **Willacy,**
- **Starr**



"The Crops of Texas" Smith & Anciso, 2005

AgriLIFE RESEARCH
Texas A&M System

Major Vegetable Crops



Cucurbits/Melon Crops: (84,000) 19,000 acres

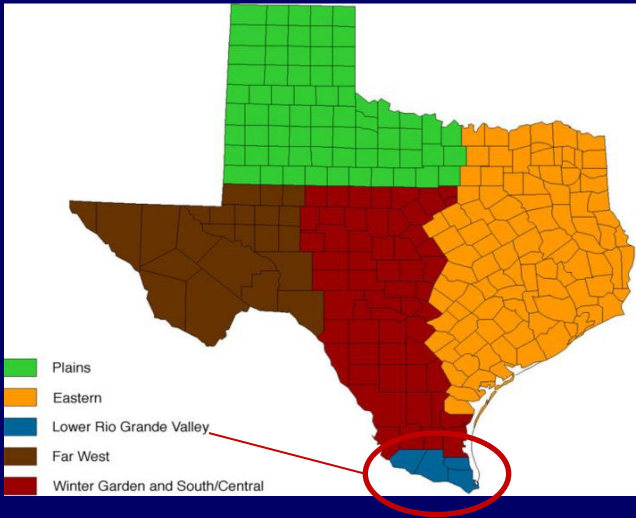
Fruiting Vegetable Crops: (34,000) 6,000 acres

Cole Crops 7,300 acres

Bulb Crops: (17,000) 11,000 acres

Root and Tuber Crops: (34,000) 6,000 acres

Major Field Crops



Sorghum
900,000 acres

Cotton
250,000 acres

Corn
80,000 acres

Citrus
28,000 acres

Sugarcane
44,000 acres

Previous research:
Improving quality through fertilizer management

- Supplemental foliar K during fruit development can improve quality traits
  - Sugar content
  - Nutritional & Health Promoting properties (Phytonutrients)
  - Texture & shelf life
- Four aspects:
  - ✓ Timing – Post-flowering
  - ✓ Source – K_2SO_4, KTS, K-Metalosate
  - ✓ Placement – soil vs foliar
  - ❑ Rate??

Previous research:
Improving fruit quality through fertilizer management

- 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.
    - Consumer Preference Traits: Sugar content
    - Nutritional & Health Promoting properties (Phytonutrients)
    - Retail Traits: fruit texture & shelf life
- Four aspects:
    - TIMING – Post-flowering
    - SOURCE – K2SO4, KTS, K-Metalosate
    - Placement – soil vs foliar
    - Rate??
- Fertilizer guidelines for optimizing yield may not be the same as those for produce quality. Need to reassess soil K management strategies to improve fruit quality especially on calcareous soils.
    - ±Zn + source (Zn SO4, Zn-EDTA) effects on grain yield vs quality (Dr. I. Cakmak)
    - Foliar K studies: K_2SO_4, KTS, K-Metalosate

Emerging Questions

- **How much K is required to assure minimum quality standards?**

- **How much is taken off fields with produce?**
  - ✓ Timing – Post-flowering
  - ✓ Source – K_2SO_4, KTS, K-Metalosate
  - ✓ Placement – soil vs foliar
  - Rate??

- **Little information available for nutrient removal by vegetable crops.**

Objectives

Near-term Objectives:

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

- Timing of nutrient uptake and distribution among harvested & non-harvested biomass

Long-term Objective:

- Enhance produce quality though fertilizer management.

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
- Growing season: early February – mid May

General Soil Chemical Properties

	pH	NO_3-N	P	K	Ca	Mg
			ppm			
Average	8.2	64.3	63.8	~586.6	~10,166.7	~522.4
Critical Limits	6.5-7.0	-	50.0	175	180	50

Procedures

- Pre-plant soil analysis
- Tissue mineral analyses
- Fruit Yield & Quality (fruit size, dry matter, Brix)
- Nutrient removal estimates



Pre-plant soil properties

	Soil Texture	Soil Organic Matter (%)	pH	NO_3-N	P	K	Ca	Mg
				(mg·kg^{-1})				
				2009				
Edinburg	light	0.89	8.2	33.4	22	558	2805.6	297.3
Mission	light	0.97	8.1	126.5	39	385	2805.6	537.8
Santa Ana	heavy	1.21	8.3	19.5	46.5	779	13807.8	507.3
Weslaco	heavy	2.01	8.3	78	59.8	624	17247.8	747.3
				2010				
Edinburg	light	0.96	7.1	37.2	56.1	410.6	2524.3	307.1
Mission	light	1.08	6.9	19.8	44.3	463.1	2915.3	601.3
Santa Ana	heavy	2.03	8.1	64.2	78.6	801.6	12602.7	584.2
Weslaco	heavy	1.13	7.9	45.7	86.2	719.4	17834.9	699.2
Critical limit			6.5	-	50	175	180	50

Tissue (leaf) characteristics

Nutrient	Unit	Edinburg 12" vine	Edinburg Pre-harvest	Weslaco 12" vine	Weslaco Pre-harvest	Sufficiency range
N	(%)	4.2	2.3*	5.1	2.9*	2-5
P	(%)	0.39	0.21*	0.56	0.29*	0.3-0.5
K	(%)	4.3	1.1*	4.9	1.3*	2-5
Ca	(%)	3.5	3.2	4.1	3.8	2-5
Mg	(%)	0.32	0.49	0.42	0.43	0.3-0.5
S	(%)	0.33	0.35	0.42	0.48*	0.2-0.5
Fe	ppm	136	152	185	179	40-100
Mn	ppm	42.8	44.2	35.7	66.3*	20-100
Zn	ppm	26.4	28.5	44.6	58.2*	20-60
B	ppm	26.1	27.3	38.7	51.3*	20-80
Cu	ppm	6.8	7.1	7.3	8.4*	5-10

Fruit yield & quality

	Fruit Yield tons/ac	Fruit TSS %
2009		
Edinburg	9.5b	8.9b
Mission	9.8b	9.6b
SantaAna	12.4a	11.2a
Weslaco	10.2a	11.9a
2010		
Edinburg	10.5a	9.7a
Mission	11.7a	10.8a
SantaAna	12.6a	12.2a
Weslaco	12.2a	11.1a

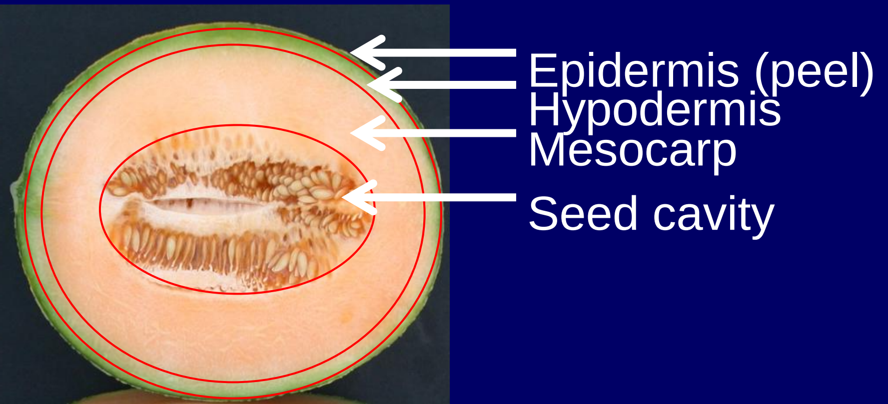
Nutrient removal estimates

	Fruit Yield tons/ac	N	P	K lbs/ac	Ca	Mg
				2009		
Edinburg	**9.5b**	18.4c	7.0c	44.1c	24.7b	2.3b
Mission	**9.8b**	21.8bc	8.3bc	52.3bc	27.6b	2.7b
SantaAna	**12.4a**	37.7a	14.4a	90.5a	40.4a	4.7a
Weslaco	**10.2a**	31.3ab	11.9b	75.0b	38.9a	3.9a
				2010		
Edinburg	**10.5a**	**47.0b**	**9.2b**	**72.3c**	**27.1b**	**2.5b**
Mission	**11.7a**	**55.8b**	**10.9b**	**85.8b**	**30.6b**	**2.9b**
SantaAna	**12.6a**	**73.5a**	**14.4a**	**113.1a**	**44.4a**	**5.0a**
Weslaco	**12.2a**	**72.7a**	**14.2a**	**111.8a**	**42.4a**	**4.3ab**

Comparison with 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	47.0b	9.2b	72.3c	27.1b
Mission	55.8b	10.9b	85.8b	30.6b
Santa Ana	73.5a	14.4a	113.1a	44.4a
Weslaco	72.7a	14.2a	111.8a	42.4a

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



Removal Estimates: Spinach & Sweet Onions

Crop	Location	Soil texture	Yield tons/ac	N	P lbs/ac	K
Sweet Onion	Weslaco	Heavy	18 a	87 a	26a	109a
	La Feria	Light	15 a	76 a	16b	95ab
Spinach	Weslaco-1	Light	8 a	68 b	9c	88b
	Weslaco-2	Heavy	11 a	72 ab	14b	96a

Summary

- Removal amounts vary by year and site ….interactions between soil, plant and weather factors

- Related to yield level ….higher yields higher removal amounts

- The current removal data are higher than those available in the literature…

  …. higher yield expectations

Related studies

- Supplemental Foliar K - Pink Grapefruit
- Use of polymer additives to improve uptake of foliar K
- Improving P uptake efficiency: AVAIL™

THANK YOU

Schuster Farms, Inc.
San Juan, TX

J&D Produce
Edinburg, TX

A&W Produce

Fluid Fertilizer Foundation

Tessenderlo Group
Tessenderlo Kerley

vfic Foods for Health
Vegetable and Fruit Improvement Center

IPNI
International Plant Nutrition Institute