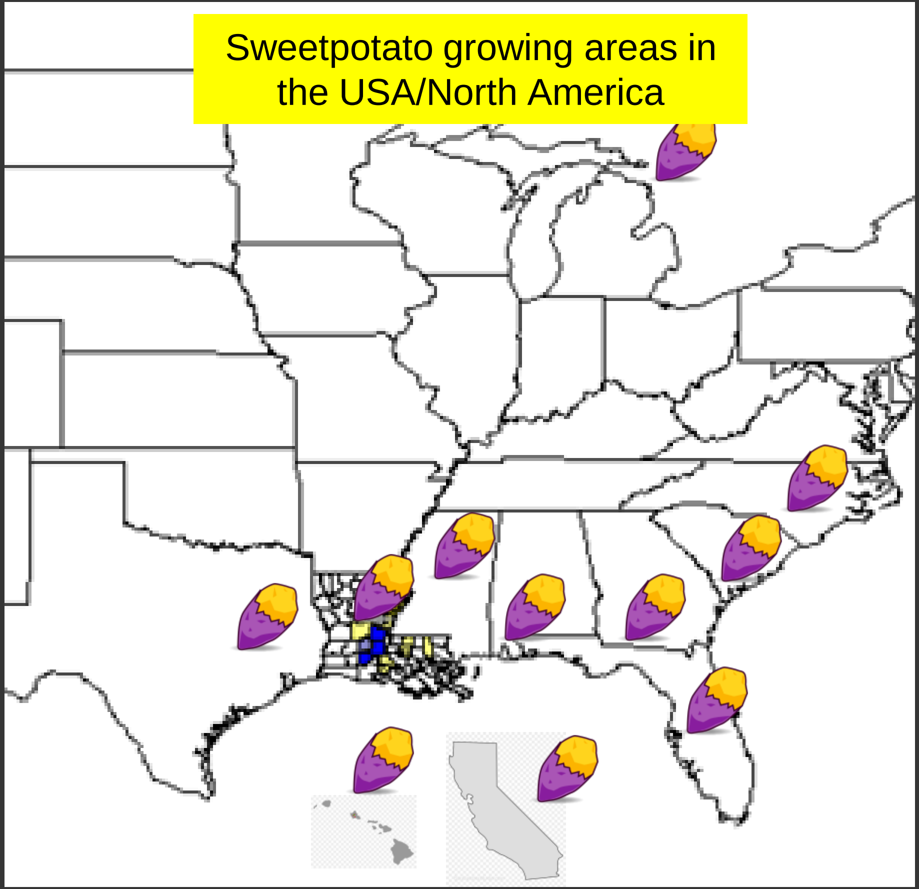
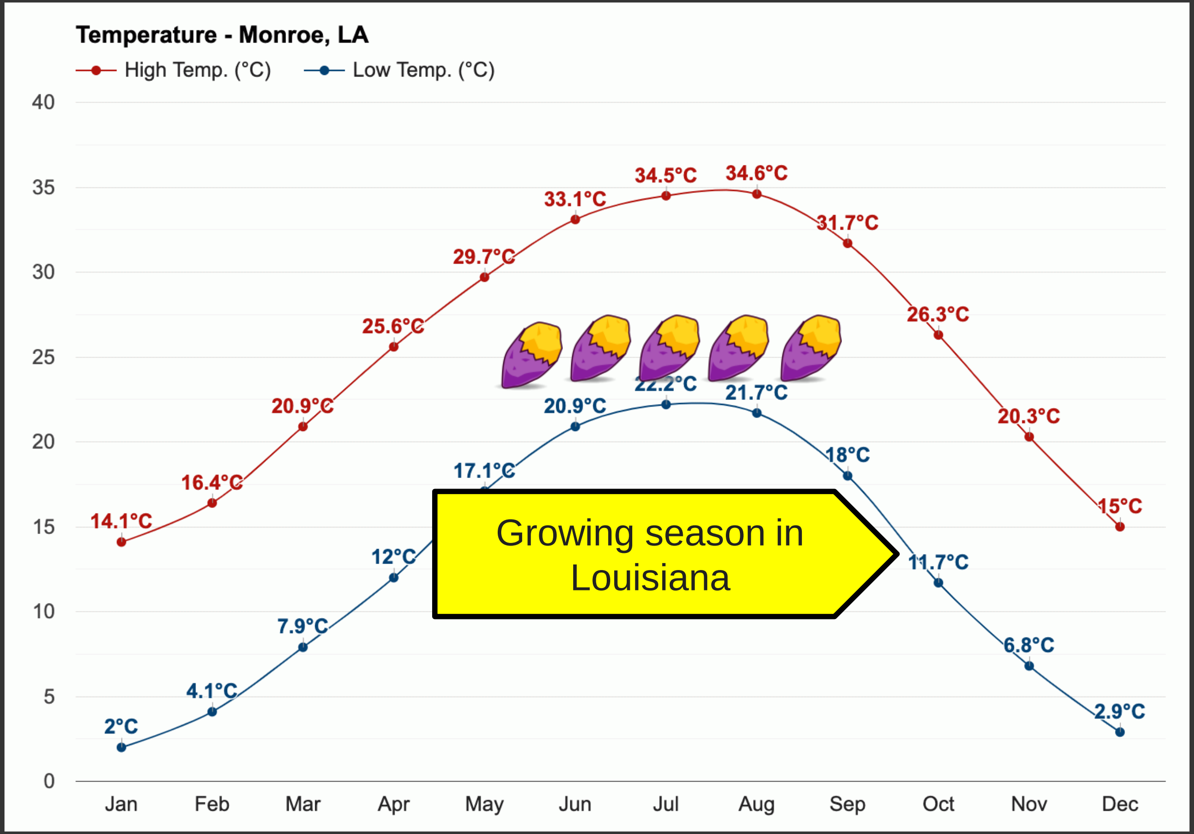
Where I’m based:



Greetings from the
Louisiana State University Agricultural Center,
Sweet Potato Research Station,
Chase, Louisiana

:

Frost-free days: our growing season



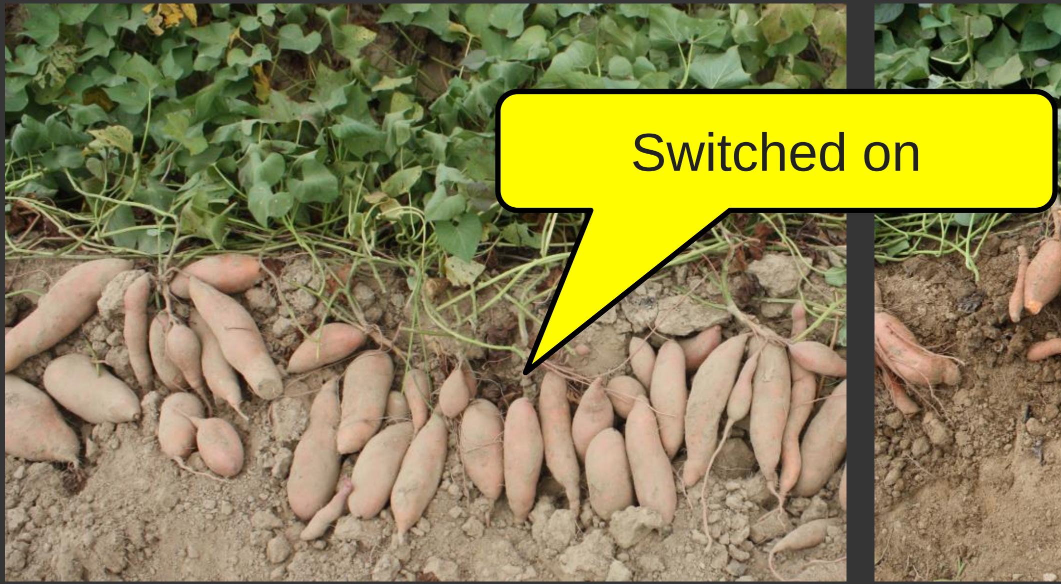
14-15 November 2018

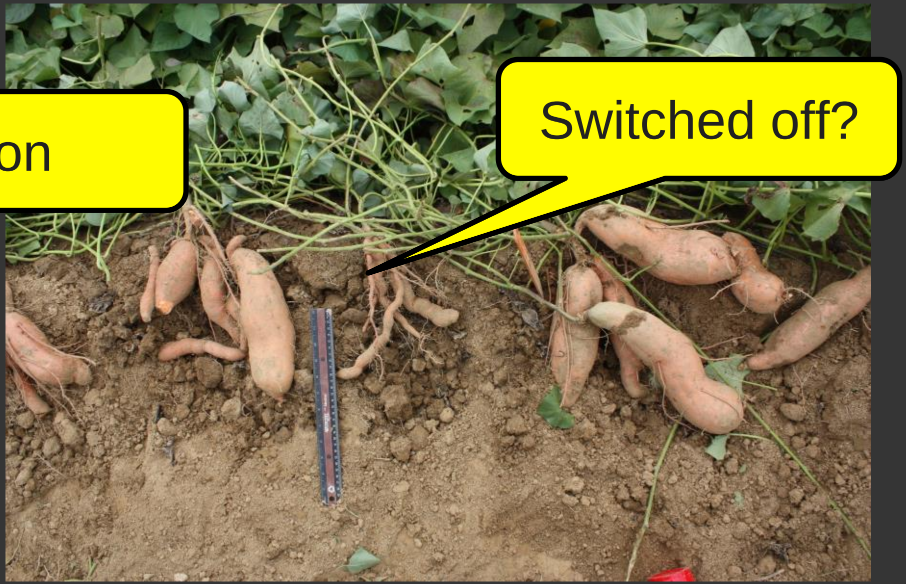
Size uniformity = desirable attribute for fresh market and processing

Over a year ago, during the great panic buying of 2020

My job description:

1. How does storage root formation work?
2. Translate knowledge to practice





Key development stages

Establishment 3-10 days (SR1) | Storage root formation 13-20 days (SR2) | Initial bulking 30-40 days (SR3) | Mid-season 55-65 days (MS) | Harvest 110-130 days (LS)

Figure 1. Key developmental stages in sweetpotatoes grown under optimum conditions.

The number of storage roots is determined

The size and shape of storage roots are determined

Seed System (USA)

In the 1980s and 1990s

- Evidence was building for role of viruses in reducing yield and quality

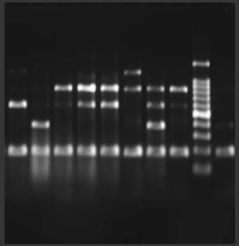
Seed System (USA)

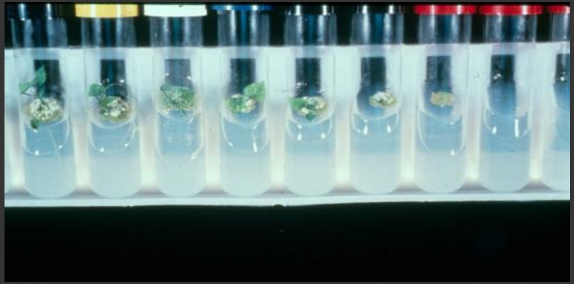
Virus-tested

Virus infected

Benefits of virus-tested foundation seed: Quality

Seed System (USA)





Hill selection

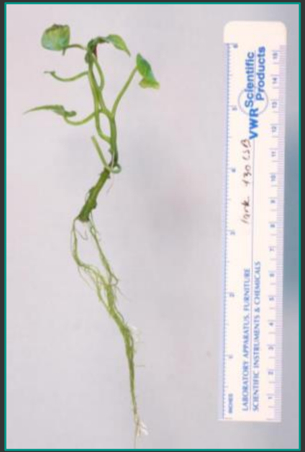
Virus testing

Virus tested (VT) plants
are used for
propagation

Seed System (USA)

Virus tested “mother plants” are maintained long term in vitro

Seed System (USA)



November to May

- VT plants grown in greenhouses

Seed System (USA)

May to October

- VT greenhouse plants grown in field

Seed System (USA)

Harvest: August to November

- VT foundation seed is harvested

Seed System (USA)

Curing: 29 C,
85% RH

Storage: 15C,
85% RH

Seed System (USA)

Farmers pick up VT foundation seed starting in February

Production – Producing quality plants

Plant production starts in March for commercial production

Production – Producing quality plants

Storage roots produce sprouts starting at 15 days with temperatures > 20C and higher

Production – Producing quality plants

Seed and plant increase: near Merced, California April 2017

Production – Producing quality plants

Plants are ready to be cut after 45 days, starting as early as May

Production – Producing quality plants

Production – Producing quality plants

Good quality plants that are uniform as essential for productivity

Production – Producing quality plants

"The best plants are 20 to 30 cm long and have eight or more leaves"

Production – Producing quality plants

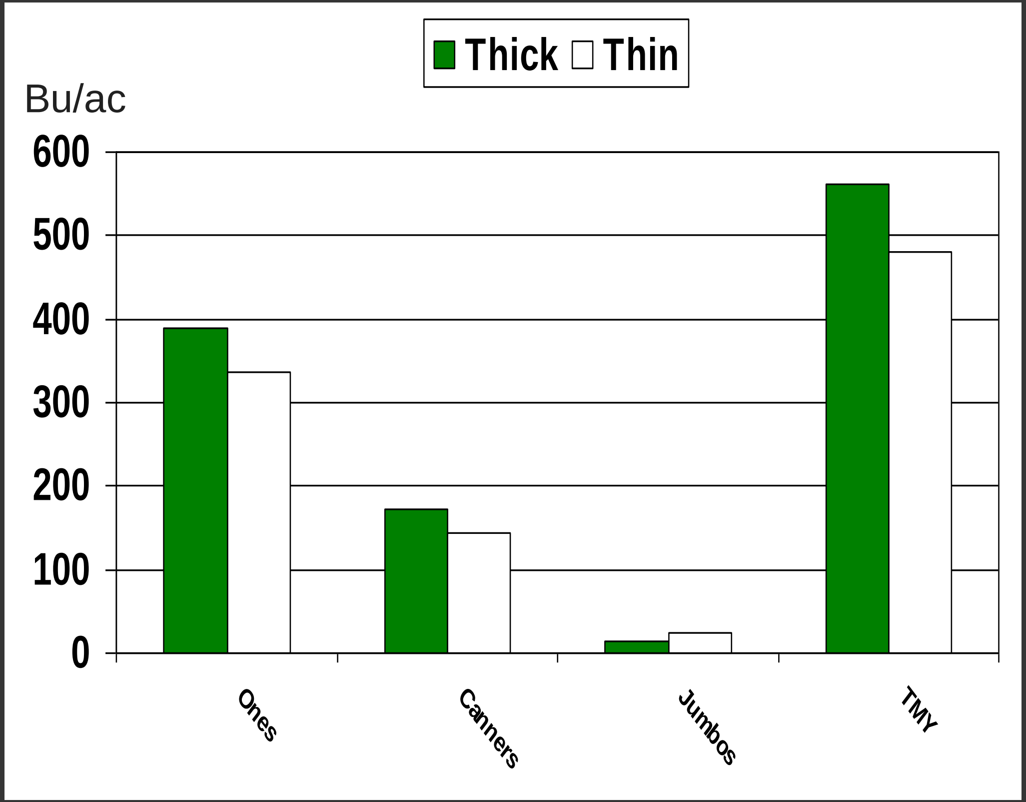
Transplant survivability & stand study (Chase, La, 2005)

Production – Producing quality plants

Transplant survivability & stand study (Chase, La, 2005)

Production – Producing quality plants

Response of sweetpotato to transplant treatments, Chase, La 2005.



Yield: 200 bu/ac ≈ 11,208 kg/ha

Production – Producing quality plants

Horizontal planting requires longer plants (Australia)

Three planting techniques were examined: vertical, flat and V-shaped (see Figure 2).

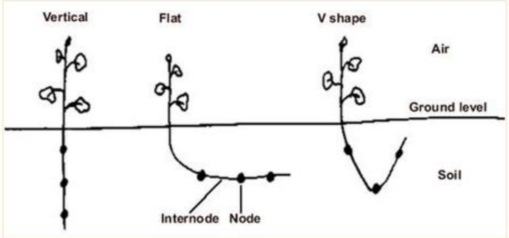


Figure 2. Sweetpotato planting techniques

The experiments showed that large improvements in sweetpotato root quality could be obtained with the flat planting technique (see Figure 3 and 4). This was thought to be due to the developing sweetpotatoes having more room to expand when planted flat, resulting in far less bending and twisting.

Figure 3. Flat planting

Figure 4. Vertical planting

The major concern with the flat planting technique is the impact of temperature in the hotter months and rapid loss of soil moisture when the cutting is planted flat on the top of the hill.

By comparing two flat planted configurations (25 mm and 50 mm deep) with vertical (seedling) and v-shaped planting. Figure 5 shows there is a reduction of potential marketable root numbers on the shallow flat planted cuttings. This reduction in potential marketable roots is thought to be due to high soil temperatures in the top 25 mm (see Figure 6).

Production – Producing quality plants

Length of cutting

小清水卓二，西　田　綠： 甘藷蔓苗の体内擴散型生長素の動靜と結藷との關係

Takuji KOSHIMIZU and Midori NISHIDA: On the relation between the distribution of free-auxin in the young sweet potato plant and its root-tuber formation.

緒　　言

甘藷蔓苗は，その榮養の大部分を直接その種藷から仰いでいたものを，採苗と共に急にその榮養關係をたち切られ，而も環境の著しく異つた圃場に挿植されるので，活着するまでの過程に於ける環境に對する苗の抵抗力や，發根とその生育に對する苗の体內生理的活動が結藷に大なる影響を及ぼす。

そのため甘藷栽培の技術者は，甘藷の結藷能力をあげるのに最も肝要なのは，良苗を得る事であるとしている[6, 8, 18, 19]。又蔓苗の中特に結藷の著しい節位は苗の中央部とされている[12, 17, 34]。

又蔓苗の親葉と側芽とが，結藷或は發根に對し極めて有効に作用するという者[5, 14, 19, 26]と，親葉よりも側芽が有効であるとする者[12]と，側芽は發根とその伸長とには有効であるが，塊根形成には却つて不利であるとする者[4]等がある。然しこれ等の理由を主として外的要因に結びつける者が多く，內的要因の方面からは單に蔓苗の全糖量や，灰分の動靜と發根關係を調べた[20]位に過ぎない。

茲に於て著者等は，甘藷蔓苗の內的要因として重要視すべき体內擴散型生長素の動靜が，發根，側芽發生，結藷等と如何なる關係を有するか，又側芽，親葉等が如何に結藷に影響するか等に就き，'43年から京大榎本教授の主催する學術振興會の甘藷班に屬して５カ年間研究を續行し，良甘藷苗の具備すべき必要な內的要因や，その結藷に及ぼす影響等の解決につとめた。

本研究は，學術振興會及び文部省科學研究費の援助によつてなされ，常に御支援を得た班長榎本京大教授，實驗材料を提供された大阪農專塚本教授，實驗の一部を分擔された藤田忠雄氏，藥師院美枝子氏，又種々御教示を賜はつた郡場先生を始め芦田，今村兩京大教授等に厚く感謝する。

實 驗 材 料

はじめ種々の品種を使用したが，四十日品種 *Ipomea Batatas Lam. f.* が早生で，結果が早いので主としてこれに就いて詳しく實驗した。又平均氣溫が 20°C 以下であると節部以外の節間に發根を起し，生長に支障が起り易いので，例年６～10月の間に實驗した。

實驗材料の節位の定め方は，甘藷班の申合せにより，開葉と閉葉との境から順次に，蔓の基方開葉の方向へ B_1，B_2，B_3…… とし，蔓の先方閉葉の方向へ A_1，A_2，A_3…… とした。又一節間は葉の附着部から先方の隣接葉の附着部までをそれぞれの節位の節間とした。その理由は，節の基方の隣接葉の附着部までの莖をその葉の同位節間とすると，一葉挿の場合に蔓の基部の切口からも發根して研究上思はしくないからである。

實 驗 方 法

各節位の節間及び葉身附葉柄から擴散型生長素を分離するのに，始はエーテル・アルコホル・水等で抽出する方法をとつたが，これ等の抽出法では複雜な他の生長素が同時に抽出されて思はしくないので，寒天

Fig. 1. Diagram of the distribution of free auxin (dotted) in the body of the young sweet potato plant. A_1, A_2.... orders of node bearing the close leaf; B_1, B_2.... orders of node bearing the open leaf.

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Table 2.
The length of root and lateral branch: The number of root and root-tuber.

Material \ Node	A_2	A_1	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9
Number of roots	10	12	15	18	15	12	11	15	16	11	8
Total length of roots in cm.		14	22	23	29	29	32	31	28		
Number of root-tubers		1	2	2	2	4	4	2	1		
Length of lateral branches			8	13	17.5	20	30	20	15	10	0

Production – Producing quality plants

Length of cutting

Adventitious root primordia formation and development in stem nodes of 'Georgia Jet' sweetpotato, *Ipomoea batatas*[1]

Jun Ma[2,3], Roni Aloni[4], Arthur Villordon[5], Don Labonte[6], Yanir Kfir[7], Hanita Zemach[2], Amnon Schwartz[8], Leviah Althan[2], and Nurit Firon[2,9]

develop from adventitious
ct of nodal position on AR
formed at different nodal
d they are well developed
r of AR primordia detected
the stem, determining the
ystems and develop better
can serve for studying the
eetpotato

nergy on marginal land
ithstand adverse abiotic
011).
logical process in sweet-
elopment. Storage roots
on of a vine (stem) cut-
white adventitious roots
these roots subsequently
attern and develop into
y lignified (Togari, 1950;
Firon et al., 2009). Wide
eetpotato cultivars, and
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al., 2014). The propaga-
imordia, which are pre-
er plant's developmental
potato ARs as well as the
further development are

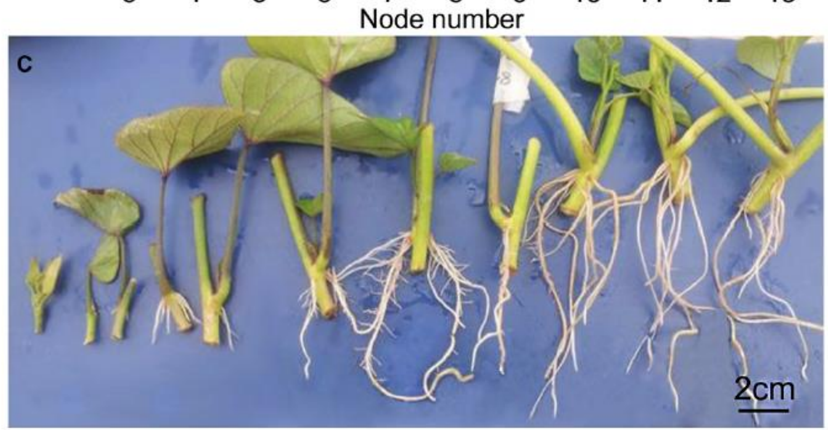


FIGURE 7 Representative nodes 3 to 13, in order, showing effect of nodal position on morphological characteristics of adventitious root (AR) 14 days after isolated nodes were planted in sand. Each nodal position analyzed consisted of eight replicates (each replicate included one stem node with one leaf and one axillary bud, planted in sand). Node positions could be divided into three groups according to the number and lengths of ARs formed at the node at day 14. (A) Mean number (± SE) of ARs per node, on both sides of the node. (Student's *t*-test: group 3 and group 2, $t = 4.07$, $df = 7$, $P < 0.01$; group 2 and group 1, $t = 9.44$, $df = 4$, $P < 0.01$). (B) Total length of the ARs per node for both sides of the node (means ± SE, group 3 and group 2, $t = 5.51$, $df = 7$, $P < 0.01$; group 2 to group 1, $t = 3.34$, $df = 4$, $P < 0.05$). (C) Scale bar = 2 cm (in C).

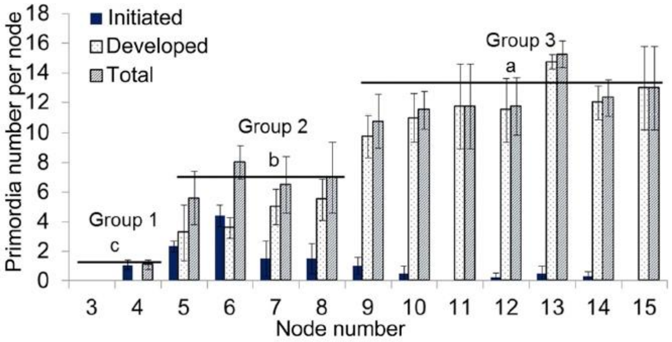


FIGURE 6 Sweetpotato adventitious root primordia number and developmental stage at different nodal positions. Each nodal position (3 to 15) consisted of six replicates, and the root primordia per node were counted. Node positions could be divided into three groups according to the root primordium number and developmental stage. Values are means ± SE; total root primordia number in the three groups were analyzed by Student's *t* test: group 3 and group 2, $t = 5.55$, $df = 9$, $P < 0.01$; group 2 and group 1, $t = 7.97$, $df = 4$, $P < 0.01$. Initiated: root primordia before formation of distinct vascular tissue, developed: root primordia with distinct vascular tissue, total: total number of root primordia (initiated + developed) per node.

Production – In-row spacing

Table 1. Storage root yields of 'Beauregard' sweetpotato grown under various in-row spacing regimes in Louisiana.

Dates[z]		In-row spacing (cm)[y]								
		20/22	30	38/40	20/22	30	38/40	20/22	30	38/40
		Yield grades (t·ha^{-1})								
Planted	Harvested	U.S. #1			Canner			Jumbo		
8 May 1990	27 Aug. 1990	21.5	19.4	20.8	11.1	10.1	8.2	6.0	7.6	7.7
29 May 1990	18 Sept. 1990	30.9	25.0	20.9	9.8	16.7	11.9	1.3	1.7	5.1
3 July 1990	29 Oct. 1990	13.4	12.7	14.4	10.2	10.4	8.1	0.1	0.5	1.3
4 June 1991	18 Sept. 1991	25.3	22.3	22.2	12.4	11.0	9.3	3.9	3.7	6.5
21 June 1991	8 Oct. 1991	30.2	29.2	28.3	15.2	11.6	9.1	3.4	7.9	6.4
10 July 1991	4 Nov. 1991	19.3	21.8	18.0	14.3	10.9	8.8	1.3	2.1	2.7
27 May 1992	10 Sept. 1992	34.3	38.0	36.9	17.9	14.7	14.2	2.3	5.2	6.8
16 June 1992	29 Sept. 1992	24.6	25.3	22.8	11.7	10.5	10.1	0.2	0.9	1.1
29 June 1992	20 Oct. 1992	26.1	25.4	23.8	12.1	14.7	15.2	2.2	1.2	0.9
6 June 2002	15 Oct. 2002	33.9	31.3	32.3	11.1	8.0	7.8	6.7	7.0	8.6
22 June 2007	5 Oct. 2007	14.6	16.5	13.3	14.8	10.0	10.0	7.0	3.0	5.0
20 May 2008	28 Aug. 2008	12.1	10.8	13.9	8.8	12.1	10.3	0.0	2.3	1.8
12 May 2010	3 Sept. 2010	41.1	32.1	24.0	19.5	14.1	10.0	0.0	0.0	7.3
20 May 2010	9 Sept. 2010	25.4	20.6	18.3	20.6	14.2	9.5	6.4	5.3	24.5
27 May 2010	15 Sept. 10	21.3	22.2	23.5	26.1	17.0	10.5	3.7	0.0	4.4
3 June 2010	4 Oct. 2010	27.4	13.7	14.4	22.2	17.0	13.9	8.7	22.7	6.1
9 June 2010	13 Oct. 2010	11.8	10.2	10.6	14.9	9.4	8.6	5.0	9.4	6.4

[z]Storage root yield data for planting dates in each of 1990 and 1991 were collected by Mulkey and McLemore (1992). Data for planting dates in 1992 were collected by Mulkey et al. (1994). All other data were collected by A. Villordon. In-row spacing for 1990 to 1992 = 22, 30, and 38 cm; in-row spacing for trials between 2002 and 2010: 20, 30, and 40 cm. Growing conditions are described in "Materials and Methods."

[y]U.S. #1 = 5.1 to 8.9 cm diameter and 7.6 to 22.9 cm in length; canner = 2.5 to 5.1 cm in diameter and 5.1 to 17.8 cm in length; and jumbo = larger than both groups (U.S. Department of Agriculture, 2005).

Production – Planting

Planting: May to June

Production – Land preparation

Considerations:

- Sufficient drainage
- No compaction in the root zone

Production – Planting

"For best stands…supply approximately 200 ml of water to each plant when planted…"

Root development at 10 days

Root development at 30 to 40 days

Root development starting at 90 days

Production

Production - Harvest

Harvest: August to October

Production - Harvest

Production - Harvest

Manual harvest is also being used

Production - Harvest

Sweetpotato (“Okinawa) harvester and packing, near Hilo, Hawaii

Production - Harvest

Postharvest - Curing

Curing:
- 29 C
- 85% RH
- 5 to 7 days

Postharvest – Long term storage

Long term storage:

- 15 C
- 85% RH

Postharvest – Packing

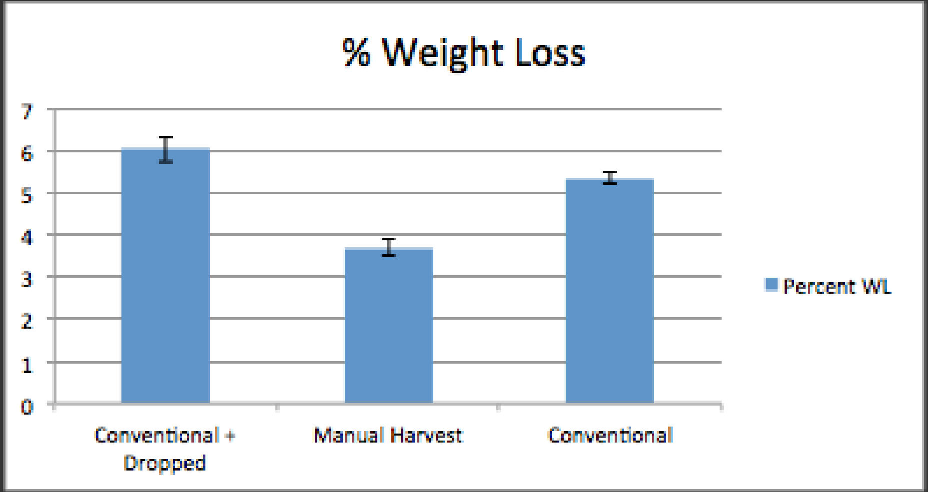
Postharvest – Transport

Postharvest - Quality

Optimal curing conditions do not substitute for observing
good harvesting and handling practices (Steinbauer and Kushman, 1971)

Postharvest - Quality

After curing: benchmarking weight loss due to mechanical handling



- Manual harvest – no skinning and bruising
- Conventional – mechanical harvest
- Conventional + drop – bruising and skinning

Postharvest - Quality

2011 storage studies:

- Storage roots were dug by hand and skinning and wounding were simulated

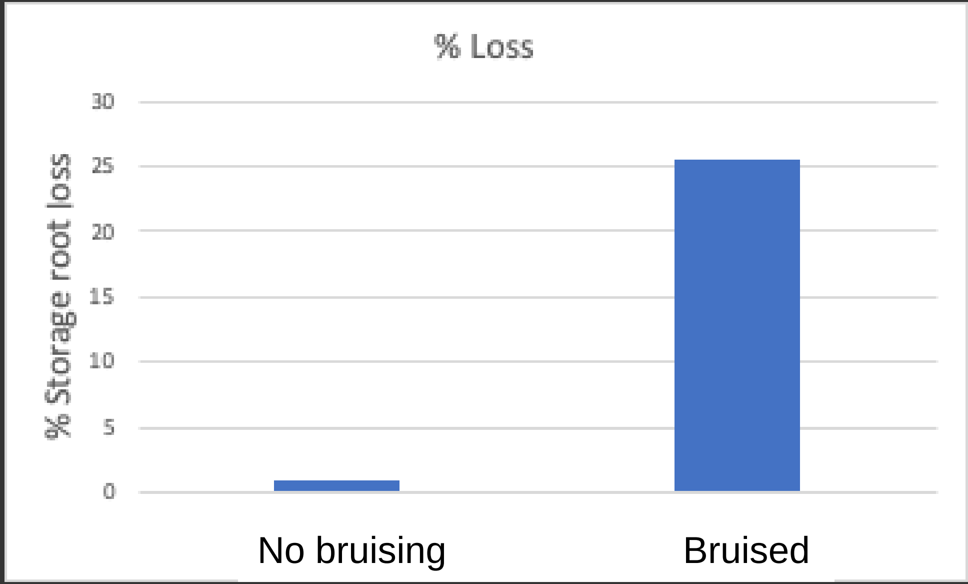
Postharvest - Quality

2011 storage studies:

- Storage roots were dug by hand and skinning and wounding were simulated

Postharvest - Quality

Storage root loss after three months in storage



Effect of Temperature

Question: Assuming optimum soil moisture and nutrients, what else can influence yield?

Effect of Temperature

Day	20	25	30	35	40	Celsius
Night	12	17	22	27	32	

Water Management

Principle of water management in sweetpotato

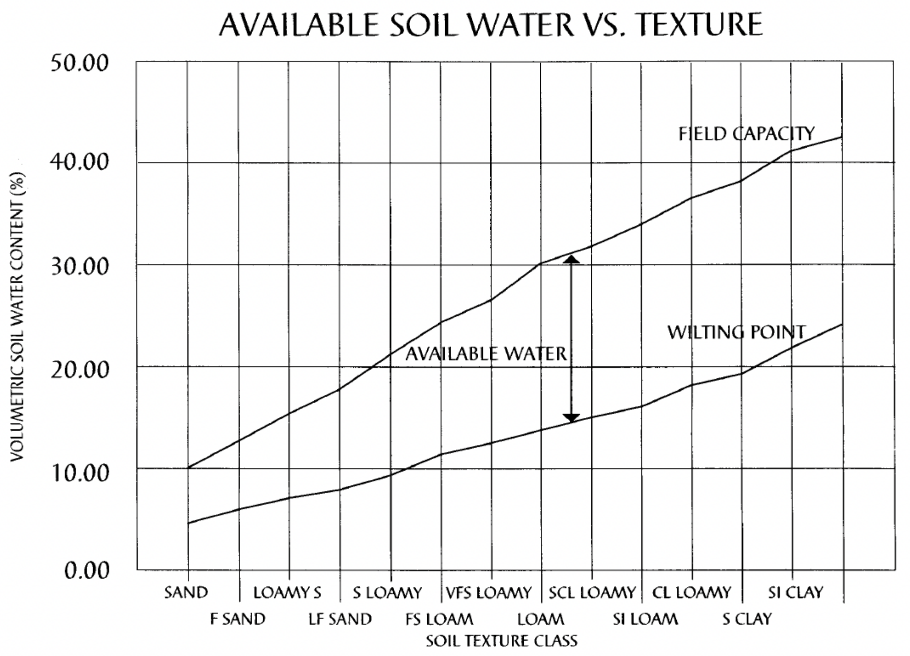
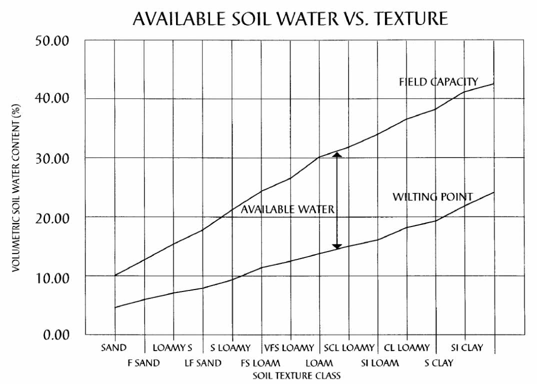


Figure 2. Available soil water vs. soil texture showing estimates of field capacity, permanent wilting point. S-SAND, SI-SILT, CL-CLAY, F-FINE, VF-VERY FINE, L-LOAMY

Ley, T.W., R.G. Stevens, R.R. Topielec, and W.H. Neibling. 1994. Soil monitoring and measurement. Published Dec. 1994 by Wash. State Univ. Pub. No. PNW0475.



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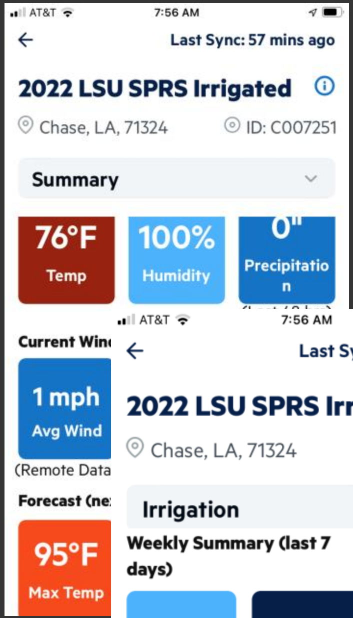
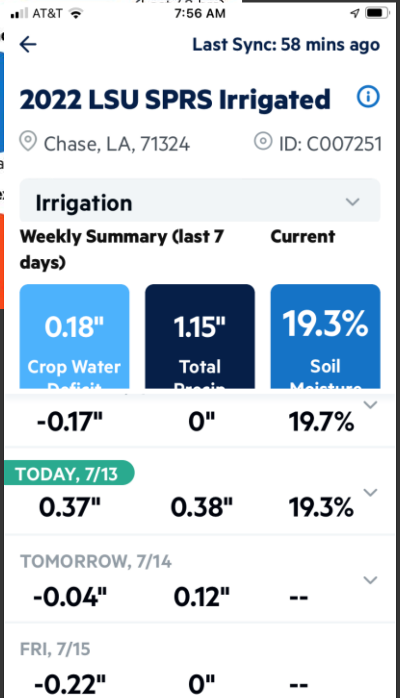
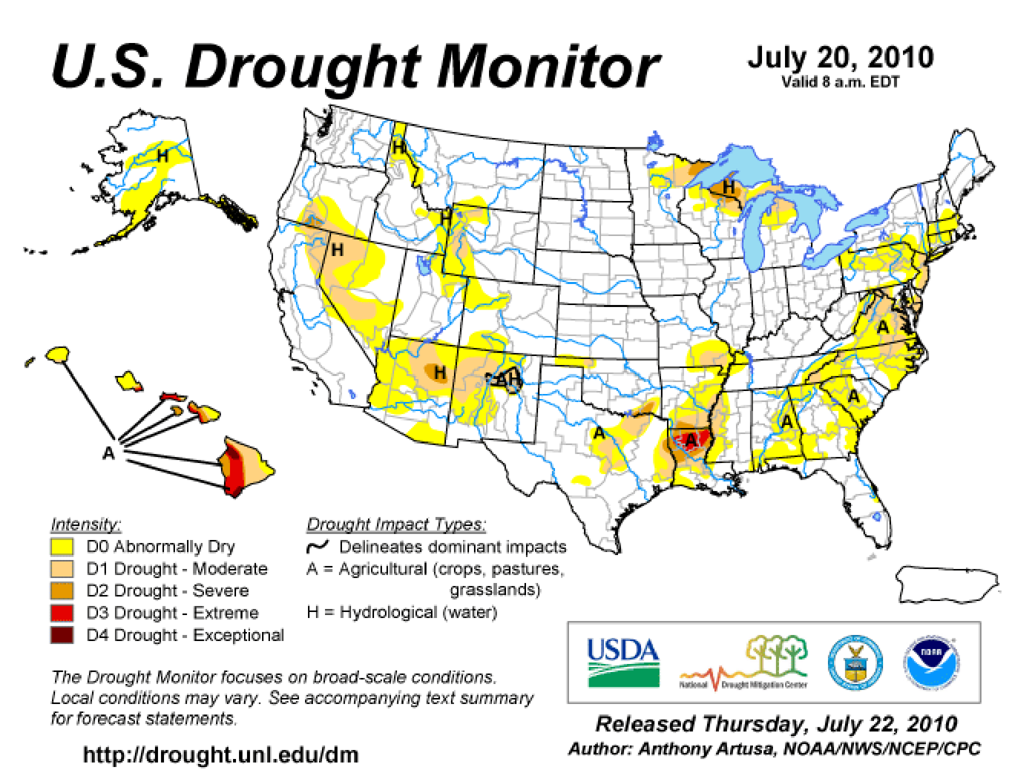




aluating remote weather sensors

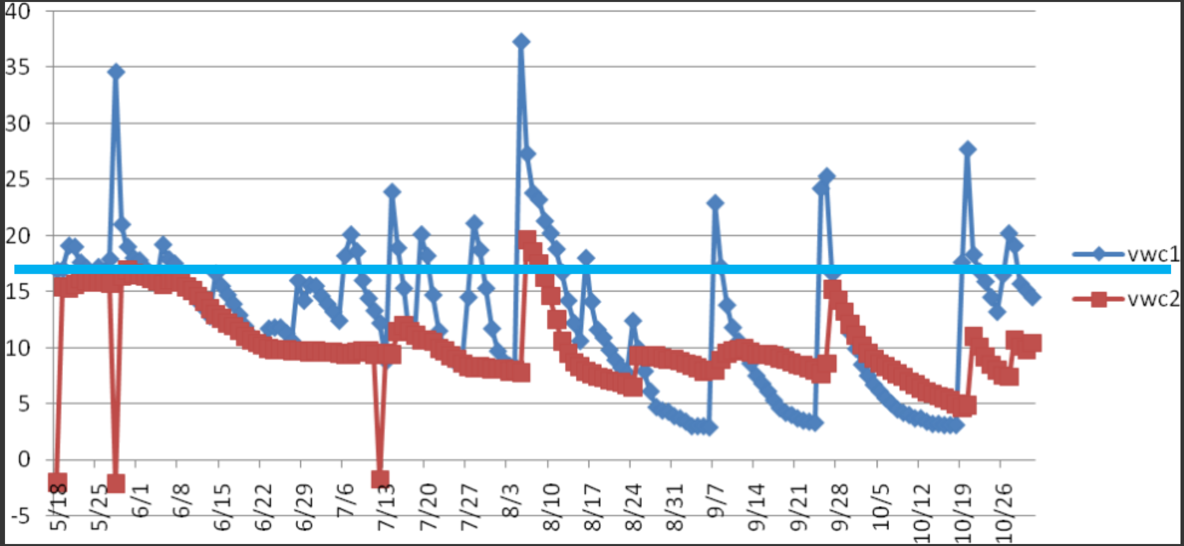
Water Management

Irrigation management under drought conditions: An example from 2010



Water Management

Irrigated vs non-irrigated plots (2010)



Water Management

60 days

With irrigation

w/o irrigation

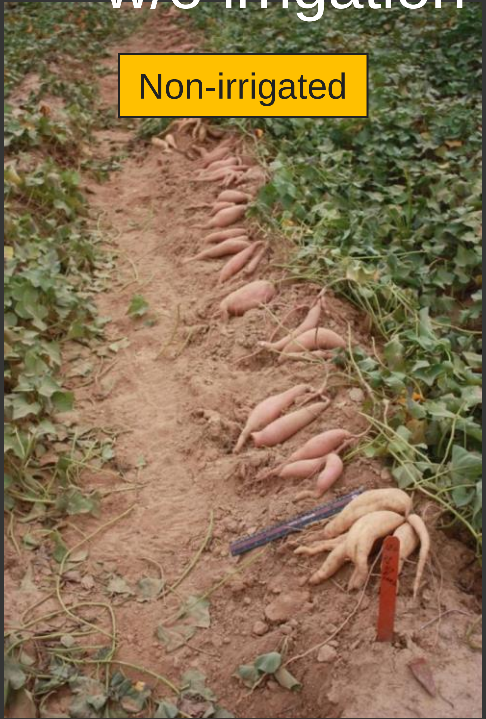
Water Management

120 days

With irrigation

Irrigated

w/o irrigation



Water Management

Soil moisture variability within a row

12.9% VWC

9.4% VWC

Water Management

At end of row:

69 roots

39 U.S.#1

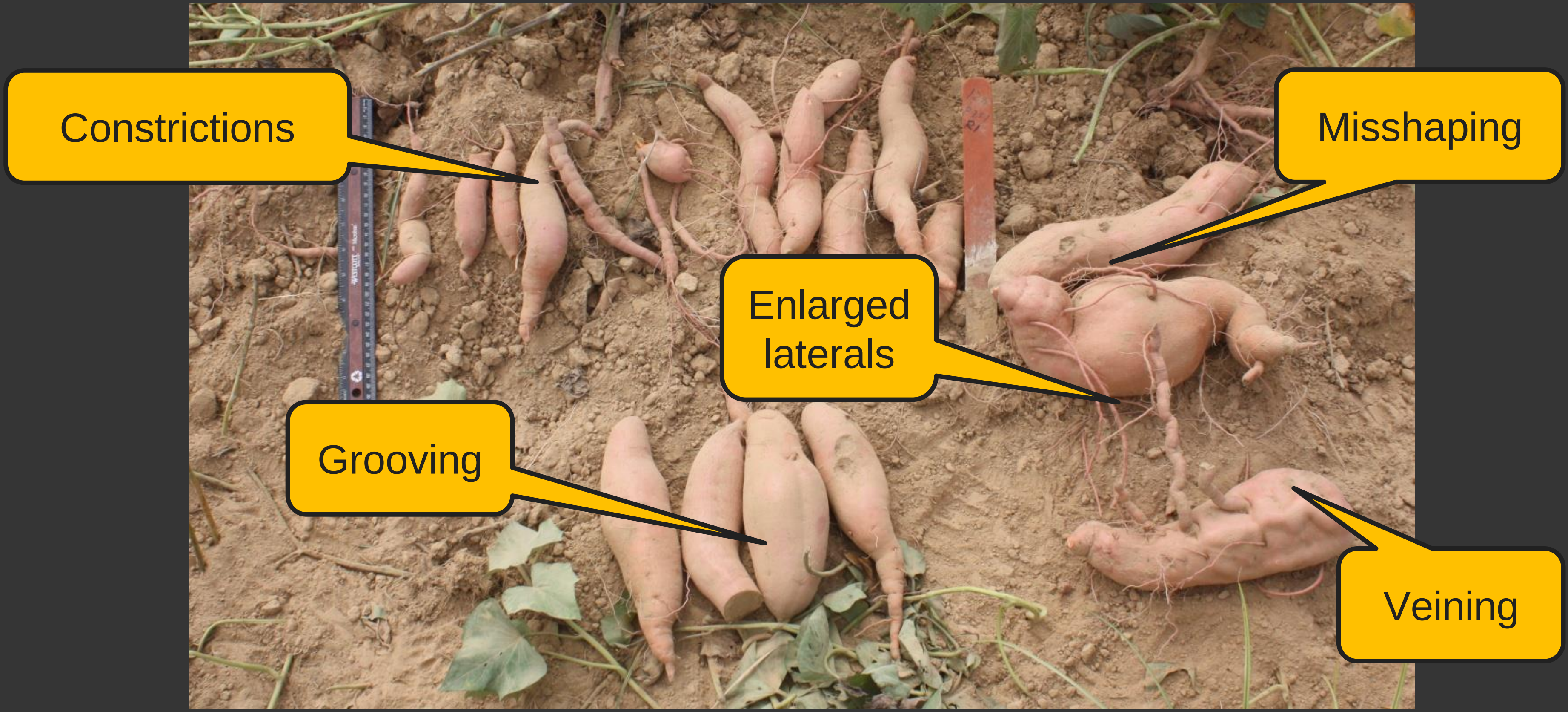
At middle of row

66 roots

12 U.S. #1

No irrigation

Planted 5/12; Harvested 9/7



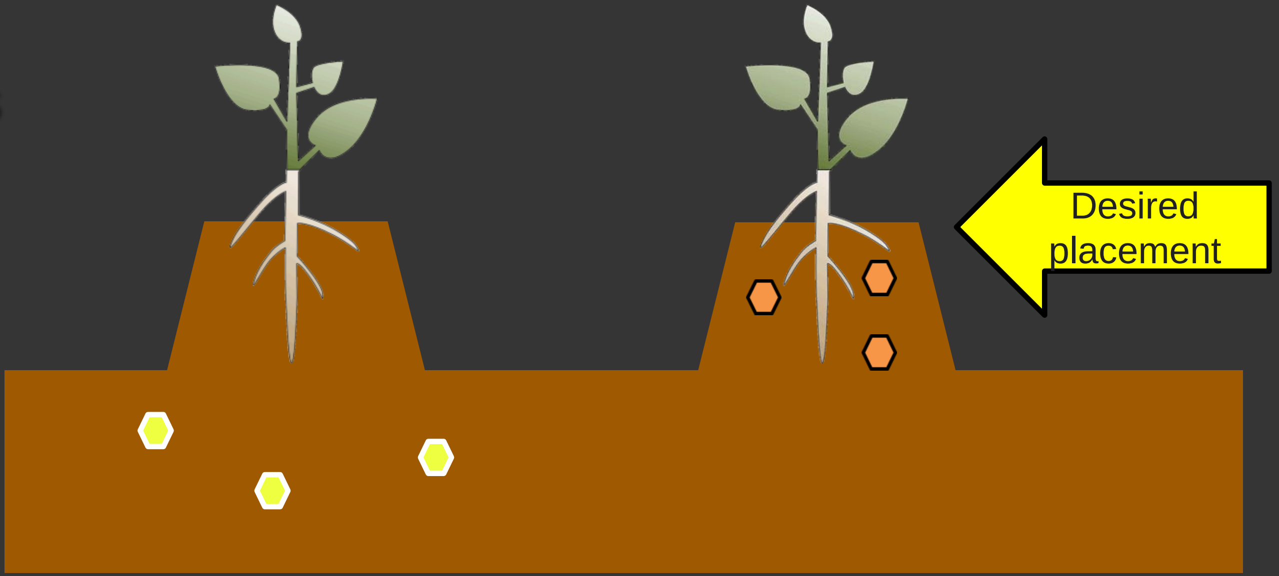
Salinity – Relative Tolerance

Crop	Tolerance based on	Threshold dS/m	Rating
Cotton	Seed cotton yield	7.7	T
Rice, paddy	Grain yield	3.0	S
Potato	Tuber yield	1.7	MS
Sweet potato	Fleshy root	1.5	MS

Source: https://www.fao.org/3/y4263e/y4263e0e.htm
Threshold = maximum soil salinity that does not decrease yield below non-saline conditons
T=tolerant; MS=moderately sensitive; S=sensitive

Nutrient Management

After determining rates, placement is critical



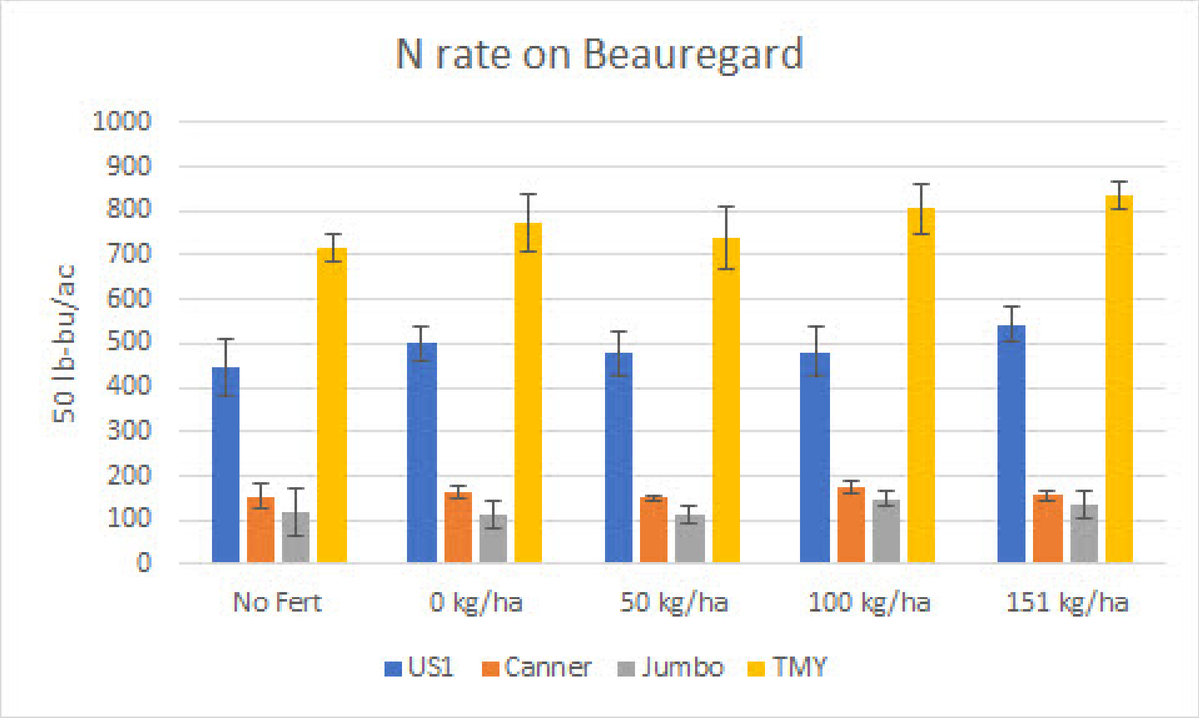
Nutrient Management

Managing phosphorus vs. nitrogen

Nitrogen	Phosphorus
Very mobile in the soil	Relatively immobile in the soil
Can be applied pre-plant or side-dressed	Best applied pre-plant, incorporated in the soil
Leaches easily with rain	Tied up in the soil

Nutrient Management

Nitrogen rate on Beauregard (Chase, La, 2003)



Yield: 200 bu/ac ≈ 11,208 kg/ha

Soil organic matter: 1.25%

Nutrient Management

Soil analysis data (Chase, La, 2016)

Every acre...Every year

SOIL ANALYSIS

Client :	Grower :		
Sweet Potato Research Station	Arthur Villordon	Report No:	16-083-1179
Arthur Villordon		Cust No:	11717
P.O. Box 120		Date Printed:	03/24/2016
Chase LA 71324		Date Received :	03/23/2016
		PO:	
		Page :	5 of 12

Lab Number : 21405 Field Id : Sample Id : F7

SOIL TEST RATINGS: Very Low, Low, Medium, Optimum, Very High

Test	Method	Results
Soil pH	1:1	5.2
Buffer pH	BPH	6.71
Phosphorus (P)	M3	34 ppm
Potassium (K)	M3	36 ppm
Calcium (Ca)	M3	593 ppm
Magnesium (Mg)	M3	117 ppm
Sulfur (S)	M3	10 ppm
Boron (B)	M3	0.1 ppm
Copper (Cu)	M3	0.6 ppm
Iron (Fe)	M3	221 ppm
Manganese (Mn)	M3	131 ppm
Zinc (Zn)	M3	1.0 ppm
Sodium (Na)	M3	55 ppm
Soluble Salts		
Organic Matter	LOI	1.4% ENR 72
Nitrate Nitrogen	NO3N	5 ppm
Ammonium Nitrogen	NH4N	3 ppm

Calculated Cation Exchange Capacity: 6.5 meq/100g

%Saturation

	%sat	meq
K	1.4	0.1
Ca	45.6	3.0
Mg	15.0	1.0
H	33.8	2.2
Na	3.7	0.2

K/Mg Ratio: 0.10

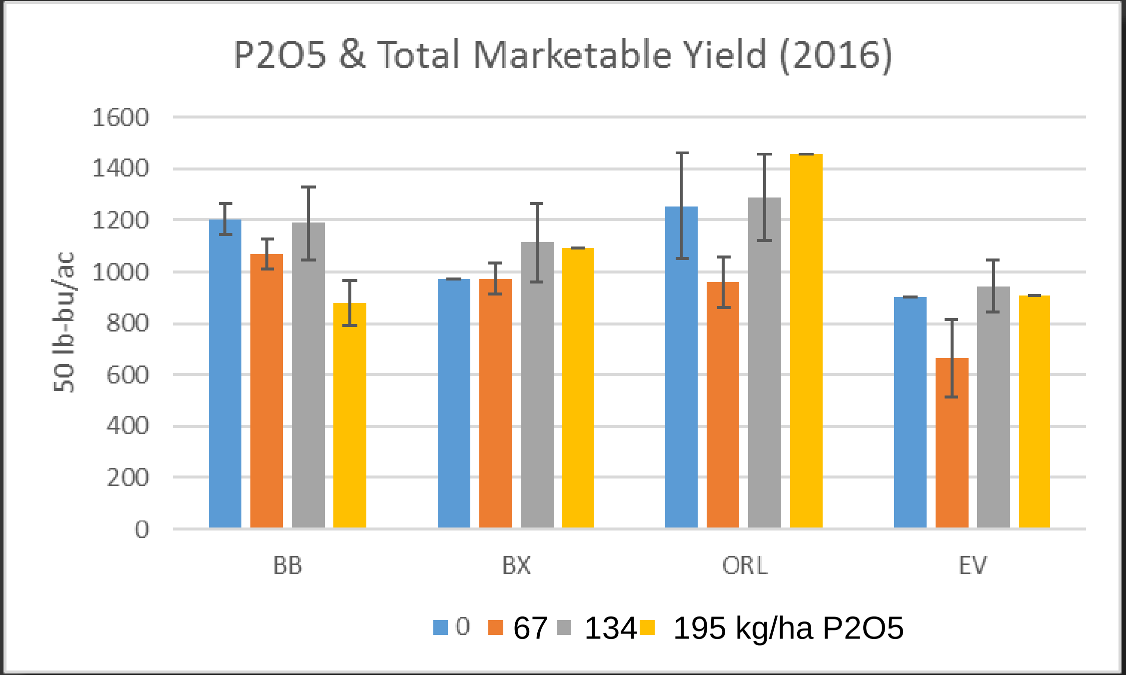
Ca/Mg Ratio: 3.04

Nutrient Management

Phosphorus test, Field 6
(Chase, La, 2016)

Nutrient Management

Response of four varieties to four P2O5 levels (Chase, La, 2016)

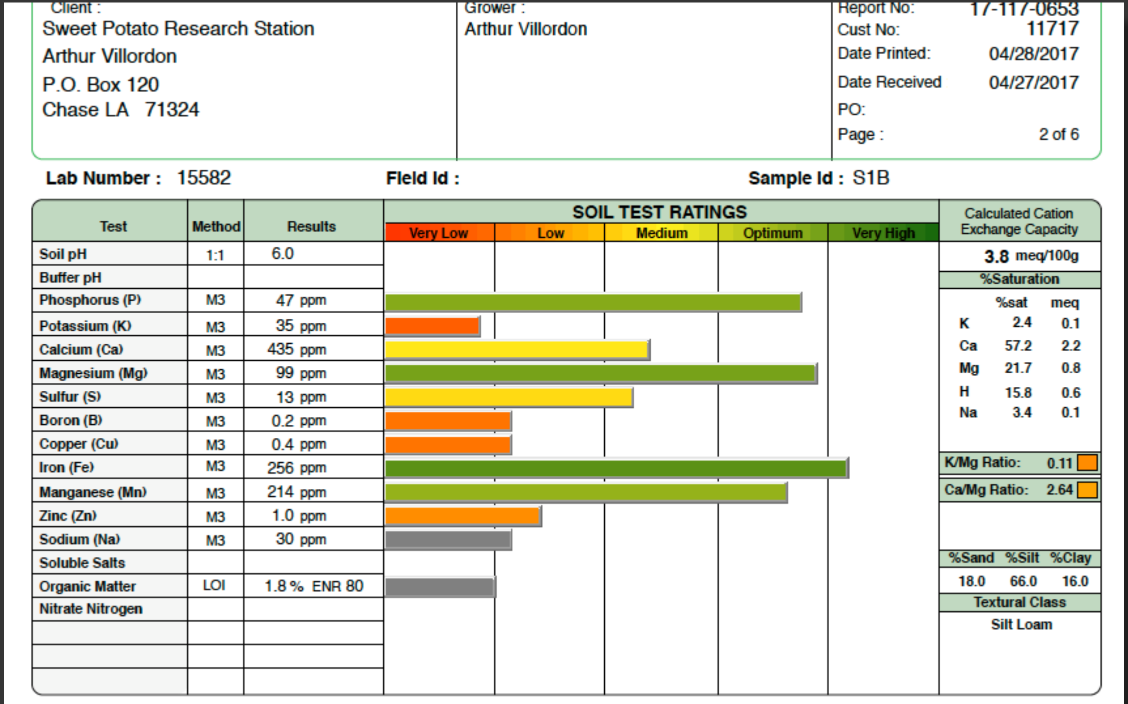


Yield: 200 bu/ac ≈ 11,208 kg/ha

Soil test: 34 ppm P

Nutrient Management

Soil analysis data (Chase, La, 2017)



Client :
Sweet Potato Research Station
Arthur Villordon
P.O. Box 120
Chase LA 71324

Grower :
Arthur Villordon

Report No:	17-117-0653
Cust No:	11717
Date Printed:	04/28/2017
Date Received	04/27/2017
PO:	
Page :	2 of 6

Lab Number : 15582 **Field Id :** **Sample Id :** S1B

Test	Method	Results	SOIL TEST RATINGS: Very Low / Low / Medium / Optimum / Very High
Soil pH	1:1	6.0	
Buffer pH			
Phosphorus (P)	M3	47 ppm	
Potassium (K)	M3	35 ppm	
Calcium (Ca)	M3	435 ppm	
Magnesium (Mg)	M3	99 ppm	
Sulfur (S)	M3	13 ppm	
Boron (B)	M3	0.2 ppm	
Copper (Cu)	M3	0.4 ppm	
Iron (Fe)	M3	256 ppm	
Manganese (Mn)	M3	214 ppm	
Zinc (Zn)	M3	1.0 ppm	
Sodium (Na)	M3	30 ppm	
Soluble Salts			
Organic Matter	LOI	1.8 % ENR 80	
Nitrate Nitrogen			

Calculated Cation Exchange Capacity
3.8 meq/100g

%Saturation

	%sat	meq
K	2.4	0.1
Ca	57.2	2.2
Mg	21.7	0.8
H	15.8	0.6
Na	3.4	0.1

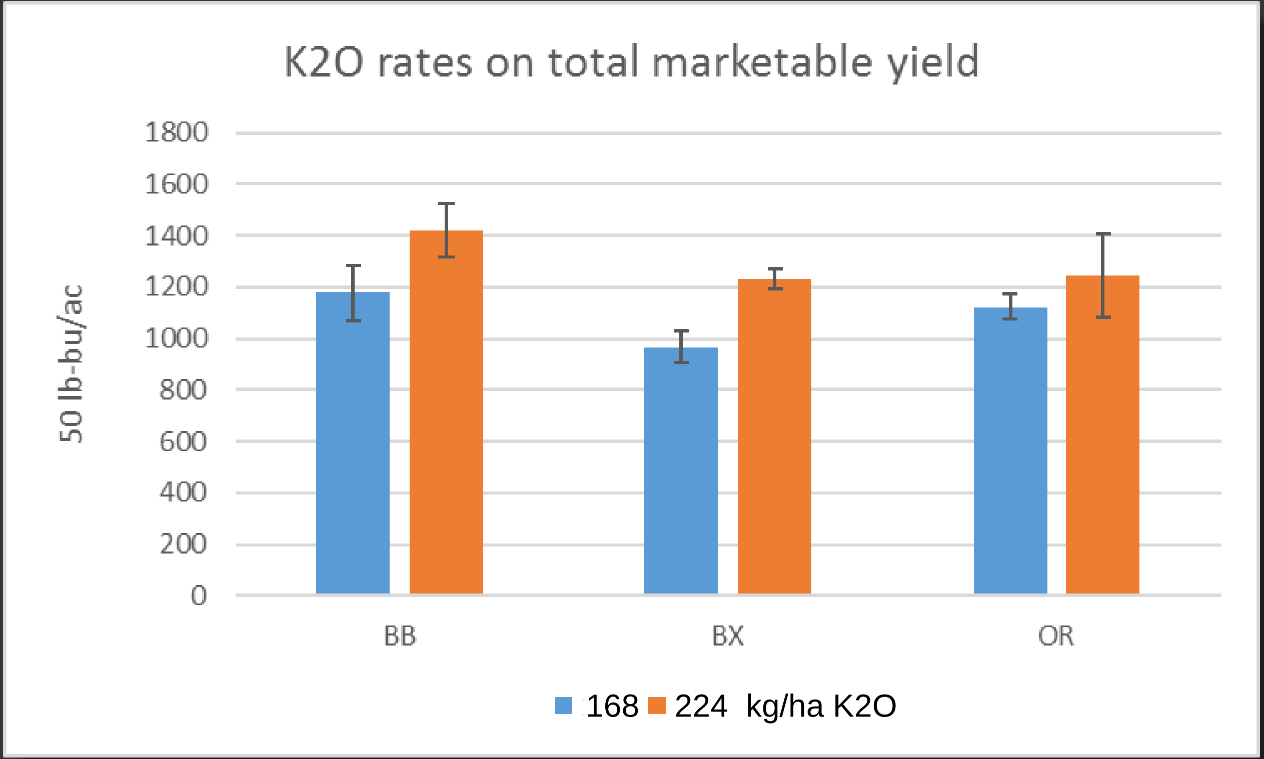
K/Mg Ratio: 0.11
Ca/Mg Ratio: 2.64

%Sand	%Silt	%Clay
18.0	66.0	16.0

Textural Class
Silt Loam

Nutrient Management

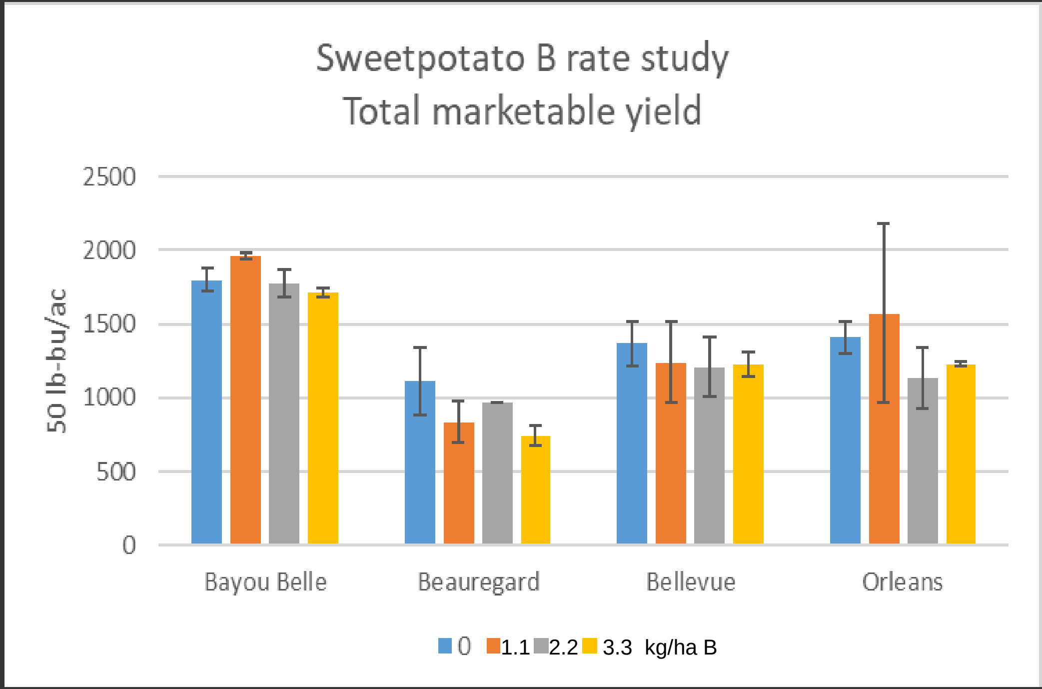
Potassium test, Field 6 (Chase, La 2016)



Yield: 200 bu/ac ≈ 11,208 kg/ha

Nutrient Management

Boron studies, Field 6
(Chase, La, 2020)

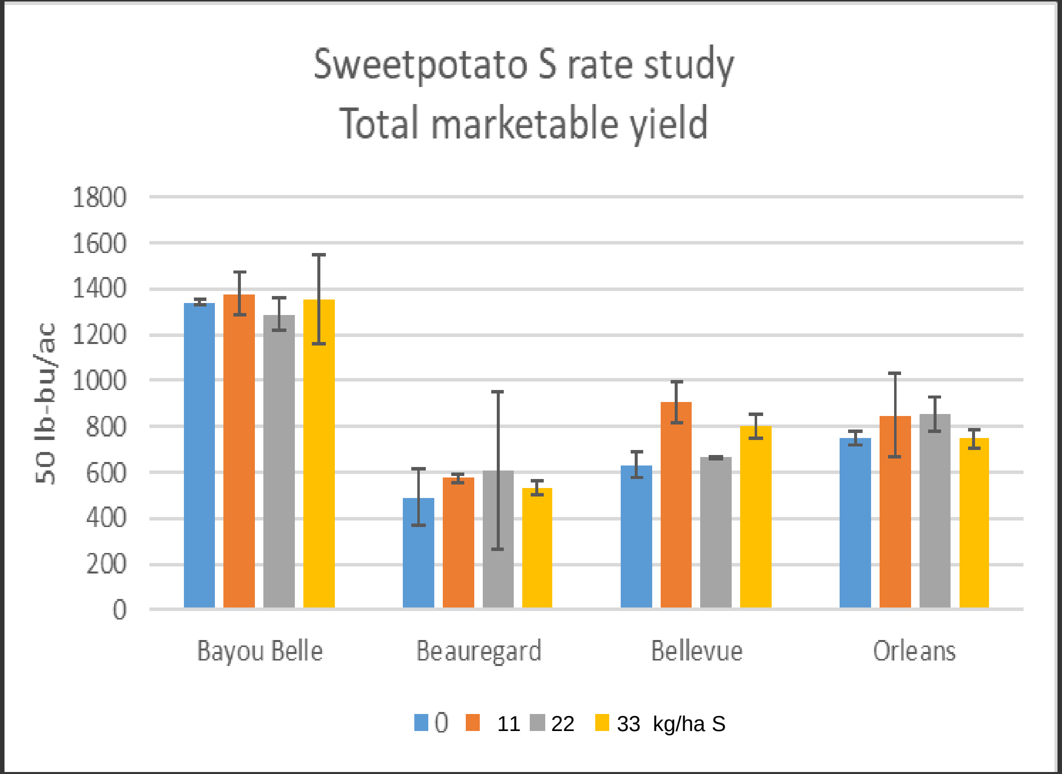


Yield: 200 bu/ac ≈ 11,208 kg/ha

Soil B test = 0.2 ppm

Nutrient Management

Sulfur studies, Field 6 (2019)



Yield: 200 bu/ac ≈ 11,208 kg/ha

Soil S test = 8 ppm

Thank you

Funding support from the Louisiana Sweet Potato Commission is gratefully acknowledged.

Additional Resources

Weed management

Weed Management in Sweet Potato

Effective weed management is a critical aspect to successful sweet potato production since weeds compete for nutrients, water and sunlight and impair crop yield and quality. Commercial producers largely rely on herbicides to combat troublesome weed species. Herbicide applications in conjunction with timely cultivation can effectively reduce weed competition, improve harvest efficiency and increase crop productivity.

Factors including proper weed identification, soil type, crop/weed vigor and environmental conditions can greatly affect herbicide performance. Herbicide labels should always be consulted for activity on weed spe-

and are stated on individual product labels. ***Read and consult all product labels prior to use.***

Research has indicated that addition of ammonium sulfate to herbicides such as glyphosate can be beneficial when "hard water" conditions exist. Proper nozzle selection and sprayer calibration are also important factors in maximizing herbicide activity and reducing injury. Consult the *Louisiana Suggested Chemical Weed Control Guide* at www.lsuagcenter.com or nozzle manufacturer for specific information.

Few effective herbicides are labeled for use in sweet potatoes. Effective weed management can be aided by

Insect management

Insect Pest Management in Louisiana Sweet Potatoes

Soil insects can pose serious problems in Louisiana sweet potato production.

The majority of insect damage in sweet potatoes occurs on the root surfaces and consists of unattractive scars and holes. The market tolerance for this cosmetic injury is very low, and even minimal insect damage can drastically affect the marketability of the crop.

Proper insect management requires the use of several management strategies aimed at protecting the crop and ultimately ensuring economic sustainability. An integrated pest management program includes cultural practices such as crop rotation, use of scouting and treatment thresholds and chemical control options. It is a challenge for a sweet potato producer to achieve the full potential of an insect management program, because many biological and environmental factors influence the sweet potato plants and the pests. Knowledge and identification of key insects is a critical first step in sweet potato pest management.