

## Getting Started with Barcode-based Digital Data Collection for Vegetable Breeding Programs

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Genomic And Phenomic Tools To Support  
 Vegetable Cultivar Development:  
 Winter Squash As An Initial Target  
 USDA-AFRI 2013-67013-21232



United States  
 Department of  
 Agriculture

National Institute  
 of Food and  
 Agriculture

## Digital Season of Squash



## **Our Goals**

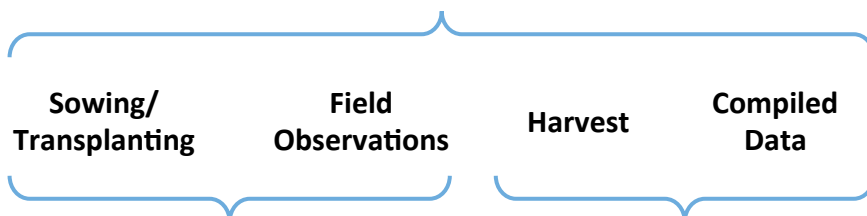
- 1. Efficiency and accuracy**
  - No transcription or transcription errors
  - No funded downtime in the winter to “type it up”
- 2. Security and availability**
  - No risk of losing only copy or pages
  - Viewable by whole team anywhere, anytime
- 3. Understand progress during the season**
  - Plot your data as it comes in

## **Our System**

- **Fits fresh market harvest crops**
  - Multiple harvests, trace individual fruit
- **Field appropriate**
  - Sun, rain, dexterity
- **Quickly learned by seasonal assistants**
  - Simple spreadsheets, point and click, etc
- **Off-the-shelf components**
  - Grateful for tech support
- **Digital input**
  - Barcodes ID samples, measurements by barcode, USB, Bluetooth

## Three Part Webinar Series

### Webinar 1: Overview



**Webinar 2**  
*Thurs Sept 7*

**Webinar 3**  
*Thurs Sept 28*

Specific examples of workflow and how we implement

## What is a Barcode?

Translation of text into machine readable code

### 1. One Dimensional (1D)

Common, robust in field,  
character limited, substitute for ruler  
compatible with all scanners



### 2. Two dimensional (2D)

Ex QR code, less robust in field,  
more characters, need 2D reader



### 3. RFID in future

Hello. How are you today? I am fine.

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## What are Barcodes Good For?

### 1. Sample ID

Harvest crates, etc scanned in just like at store, package  
delivery, etc  
Faithfully reproduced, Unique Identifiers

### 2. Input routine responses

Anything you might write out frequently  
Scanned barcode replaces pencil and keyboard

### 3. Measure

Stacked barcodes substitute for rulers

## Unique Identifiers

- Format for naming genotypes etc in planting plans
- Unique, consistent identifiers essential for compiling data
- Keep it brief to have simple barcode fit on label
- Unique characters that delimit levels:  
hyphen, underscore, decimal, *never asterisk*

Breeding:

**Year-Plot\_Plant.Fruit**

Trials:

**Year-Plot" T" \_Rep.Fruit**

## Unique Identifiers

Breeding:

**Year-Plot\_Plant.Fruit**

Ex of F2 population

**17-812\_43.4**

**2017**, plot 812, plant 43, fruit 4



## Unique Identifiers

Breeding:

**Year-Plot\_Plant.Fruit**

Ex of F2 population

**17-812\_43.4**

2017, **plot 812**, plant 43, fruit 4

Field stake: 17-812

## Unique Identifiers

Breeding:

**Year-Plot\_Plant.Fruit**

Ex of F2 population

**17-812\_43.4**

2017, plot 812, **plant 43**, fruit 4

## Unique Identifiers

Breeding:

**Year-Plot\_Plant.Fruit**

Ex of F2 population

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2017, plot 812, plant 43, fruit 4

## Unique Identifiers

Trials:

**Year-Plot\_Rep.Fruit**

Ex of replicated trial

**17-643T\_C.4**

2017, Trial plot 643, rep C, fruit 4

## Unique Identifiers

Trials:

**Year-Plot\_Rep.Fruit**

Ex of replicated trial

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2017, Trial plot 643, rep C, fruit 4

## Unique Identifiers

Trials:

**Year-Plot\_Rep.Fruit**

Ex of replicated trial

**17-643T\_C.4**

2017, Trial plot 643, rep C, fruit 4

Field stake: 17-643T\_C

## Unique Identifiers

Trials:

**Year-Plot\_Rep.Fruit**

Ex of replicated trial

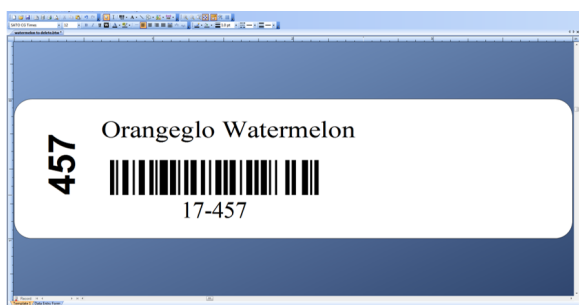
**17-643T\_C.4**

2017, Trial plot 643, rep C, **fruit 4**



## Shopping List:

- Barcode printing software: \$500
  - Translates your spreadsheets in to barcodes
  - Designs printouts on stakes or labels
  - Free online generators, fonts, but lack layout



## Shopping List:

- **Printers:** labels \$600, stakes \$3,300
  - Thermal transfer required (no direct thermal)
  - Horticultural printers for pot stakes
  - Can purchase sheets of water resistant sticker labels for existing laser printer, but not as efficient
  - Supplies: stakes and ribbon 1-3 cents each



## Shopping List:

### Scanners

\$150-\$1,500

- **Connectivity**
  - Bluetooth or USB
- **Scan type**
  - 1D laser – use with 1D barcodes as ruler
  - 2D imager – faster, read off screens
- **Format**
  - All in one PDA
  - Connect to tablet



## Cost for Digital Field Observations

- Barebones with laser labels, code 39 font and scanner connected to existing tablet
  - \$200 plus consumables
- Our setup with barcode label software, stake printer, step in post label printer, imager PDAs
  - \$4,500 + \$1,500 per user in field for PDA (\$500 used)

## Shopping List:

### Scales

**\$600**

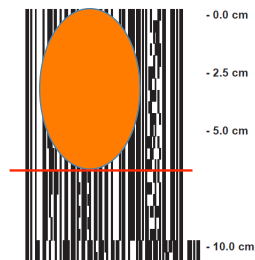
- Many older scales have RS232 output
- Many newer scales have USB adapter option
- Bluetooth adapter now available for either
- Keyboard wedge software ?





## Other Measurement Input

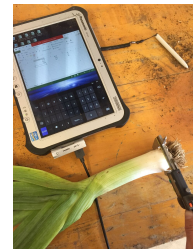
**Barcode Ruler**



**Brix Refractometer with Bluetooth**



**USB Calipers**



## Integrating Digital Images




















See webinar 2&3

Quick fixes for exposure and color balance issues for veggies

Wifi enabled camera's can often substitute for drones for aerial images in field



Mount a camera to a window washer pole with 1/4" x 20 bolt \$35

				
<u>09-201</u> Diva	<u>09-202</u> Greenfinger	<u>09-203</u> Poinsett 93	<u>09-204</u> Poinsett 97	<u>09-205</u> Marketmore 97
				
<u>09-206</u> Marketmore 420	<u>09-207</u> Marketmore 2000	<u>09-208A</u> Salt and Pepper	<u>09-208B</u> Boothby's Blonde	<u>09-210</u> Platinum
				
<u>09-211</u> Silver Slicer	<u>09-213</u> A&C Pickling	<u>09-214</u> Early Fortune	<u>09-215</u> Snow's Fancy	<u>09-216</u> Poona Kheera
				
<u>09-217</u> County Fair	<u>09-218</u> Cross Country	<u>09-219</u> Clinton	<u>09-220</u> Ivory Queen	<u>09-221</u> Regal
				
<u>09-222</u> Sassy	<u>09-223</u> Eureka	<u>09-225</u> PMR551Bw	<u>09-227</u> Gy57	<u>09-228</u> Gy14xPMR551Bw

## Challenges

- Startup costs
- Planning ahead
- Seeing red targeting
- Shift in how you interact with data
  - Collecting columns instead of filling in "datasheet"
  - Need to support staff who are upset by loss of clipboards

## **Webinar Part 2 and 3 in September**

- September 7 - Part 2
  - Labels for propagation house and field
  - Collecting observations into spreadsheets
  - Overhead plot photos without a drone
- September 28 – Part 3
  - Labels for harvest
  - Morphometric and quality measurements
  - Harvest photos
  - Data compilation

## **Acknowledgements**

- |                  |  |
|------------------|--|
| • Lindsay Wyatt  | <b>Genomic And Phenomic Tools To<br/>Support Vegetable Cultivar<br/>Development:<br/>Winter Squash As An Initial Target<br/>USDA-AFRI 2013-67013-21232</b> |
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| • Emily Rodekohr |  |
| • Buckler group  |  |
| • Alice Formiga  |  |

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.



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