

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

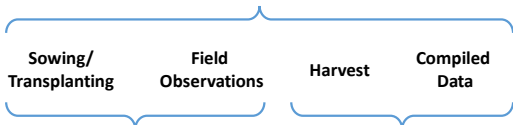
1. **Efficiency and accuracy**
 - No transcription or transcription errors
 - No funded downtime in the winter to “type it up”
2. **Security and availability**
 - No risk of losing only copy or pages
 - Viewable by whole team anywhere, anytime
3. **Understand progress during the season**
 - Plot your 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 21

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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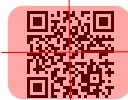
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What are Barcodes Good For?

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 our 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:

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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

17-643T_C.4

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

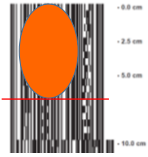
\$600

- 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

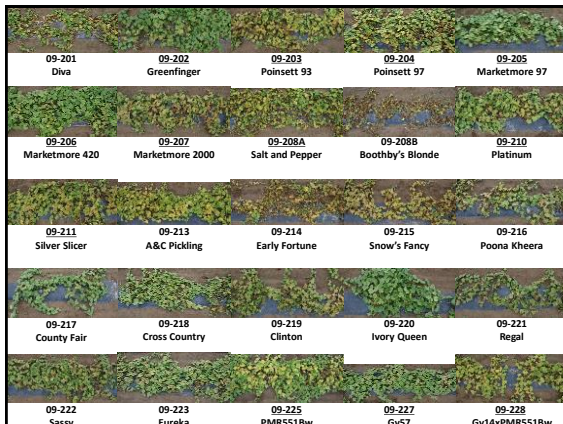
See webinar 2&3

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



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 21 – Part 3
 - Labels for harvest
 - Morphometric and quality measurements
 - Harvest photos
 - Data compilation

Acknowledgements

- Lindsay Wyatt
 - Sara Shapleigh
 - Emily Rodekohr
 - Buckler group
 - Alice Formiga
- Genomic And Phenomic Tools To Support Vegetable Cultivar Development:
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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.