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
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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

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**Three Part Webinar Series**

**Webinar 1: Overview**

- Sowing/Transplanting
- Field Observations
- Harvest
- Compiled Data

Webinar 2  
**Thurs Sept 7**  
Specific examples of workflow and how we implement

Webinar 3  
**Thurs Sept 21**

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**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**

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Hello. How are you today? I am fine.
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Hello. How are you today? I am fine.
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

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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

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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

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*

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**Shopping List:**

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

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**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 ¼” 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

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