How Sampling and Statistics Can Save Time and Improve Success

Observations and Advice from the Field

Eric Flora, Pacific Ag Research, 20 January 2017 NAICC Annual Meeting

Plot environment affects variability of sample data

- Biological influence of adjacent area & buffers
- Site, it's preparation and management
- Size of trial & plot, & No. of plants in plot

Pest distributions are influenced by

how pest moves

how pest reproduces

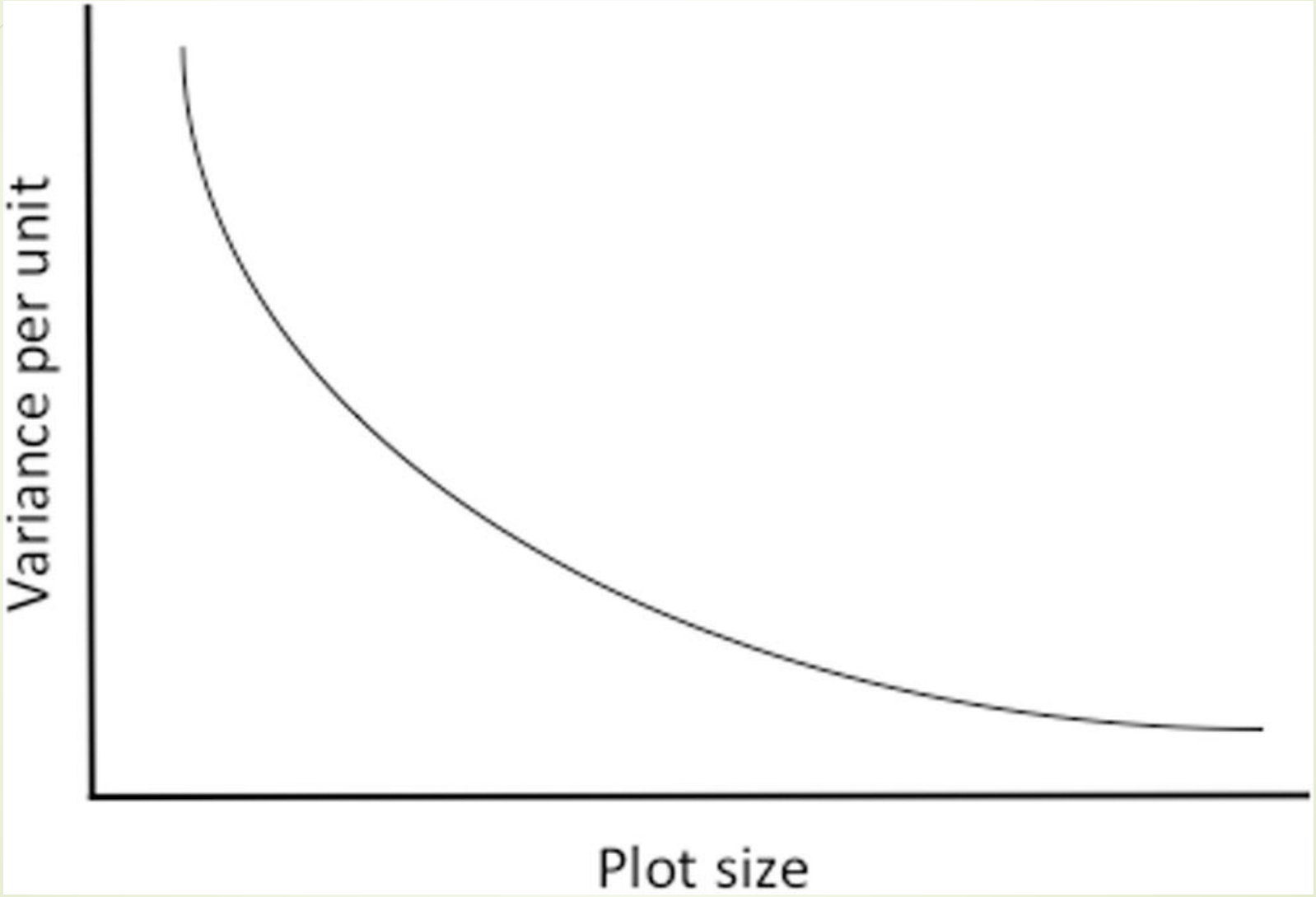
density of pest

crop species & canopy size

&

Pest distributions influence sampling options

Relationship between variability and plot size or sample unit



Basic premise of sampling

- Estimate a population by sampling a proportion
- What proportion of the Sampling Universe or Plot are you examining for an assessment – 10, 25, 50%?
- If you measure an entire population in a plot, precision increases only by increasing plot size
- Impractical to sample all soil in plot – so sampling to estimate is only means to measure

Larger sample units may be necessary to address

low pest pressure;

variable plant development and stands;

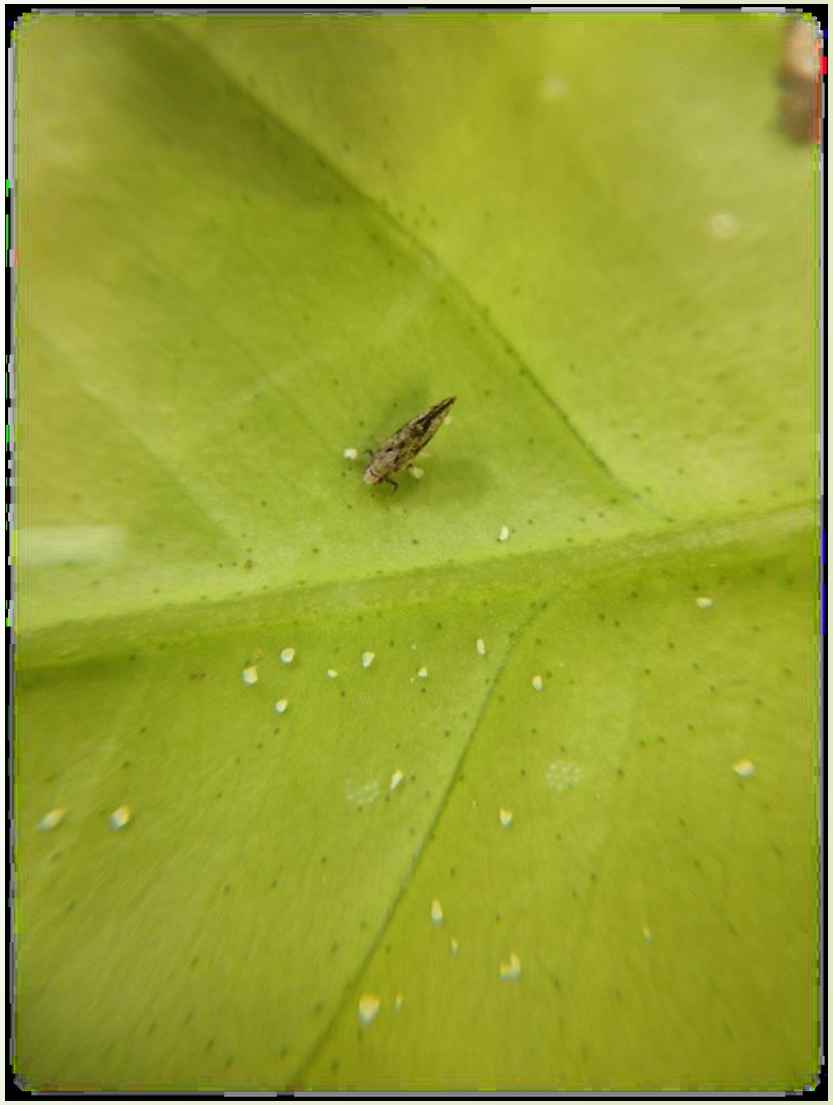
poor placement and distribution uneven;

if expected product efficacy is inconsistent.

Sampling using damage scales tied to EILs

e.g., Greene's 1-6 damage scale on cabbage

Indirect efficacy assessment – measure psyllid sugar



Use rating time effectively

- Estimating man-hours in advance for assessments
- How to divide up sampling work by rep and data type
- Assessment frequency can influence sample unit
- Remote sensing can deliver objective data quickly

Divide assessment/sampling labor by rep and task

Photos & Assess 2.0 to quickly measure objectively

+ Crop Circle & other NDVI readers for biomass

Good crop vigor throughout each plot and uniform plant development

Sometimes you just need to start over, be attentive early in crop establishment

Nutrition plots necessitate precise apps

Chemigated areas need to extend beyond sampling area

Define a treated area that ensures sample unit coverage

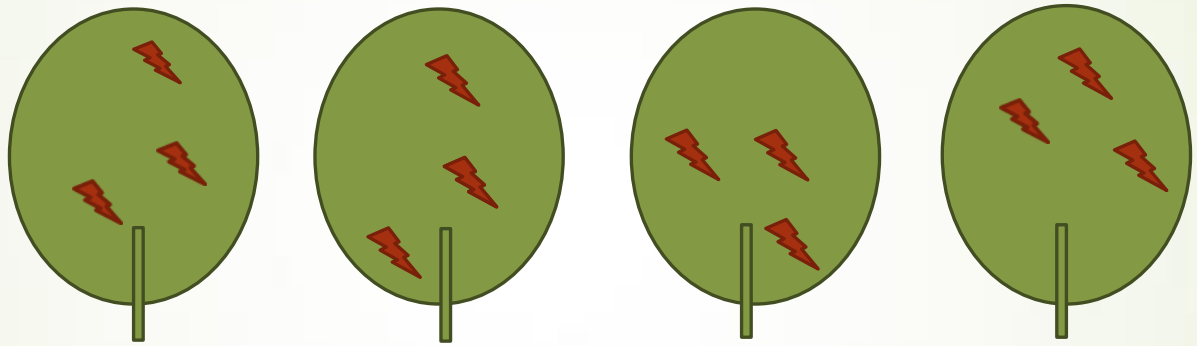
Treat 4 trees to sample center 2 trees

Small plots with uniform pest pressure can work

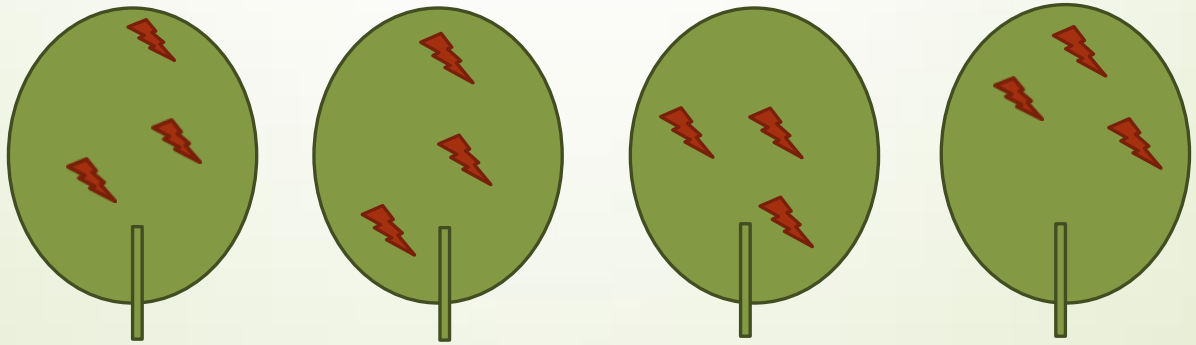
To reduce plot size and sampling, artificially infest & inoculate

How to use treated buffers

Center 2 rows sprayed



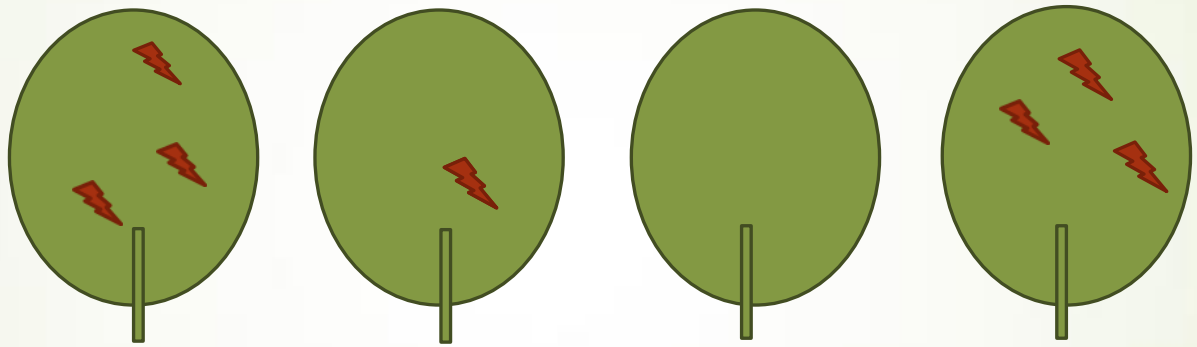
All 4 rows sprayed



Pre Application

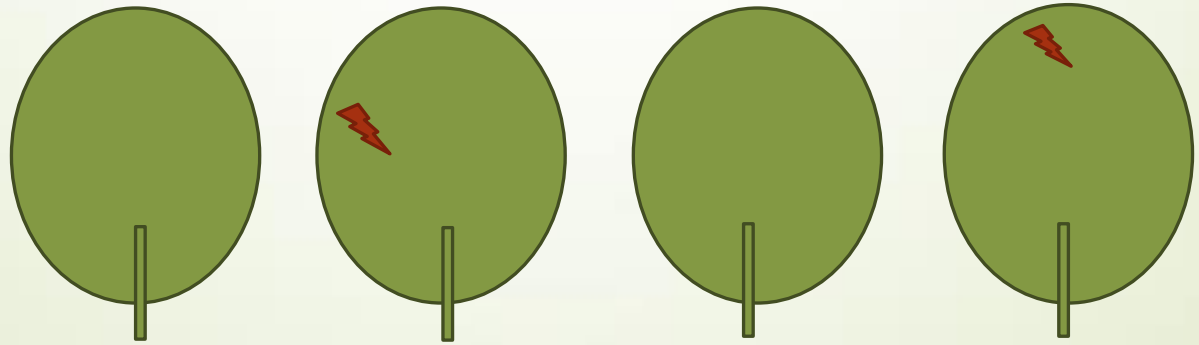
How to use treated buffers

Center 2 rows sprayed



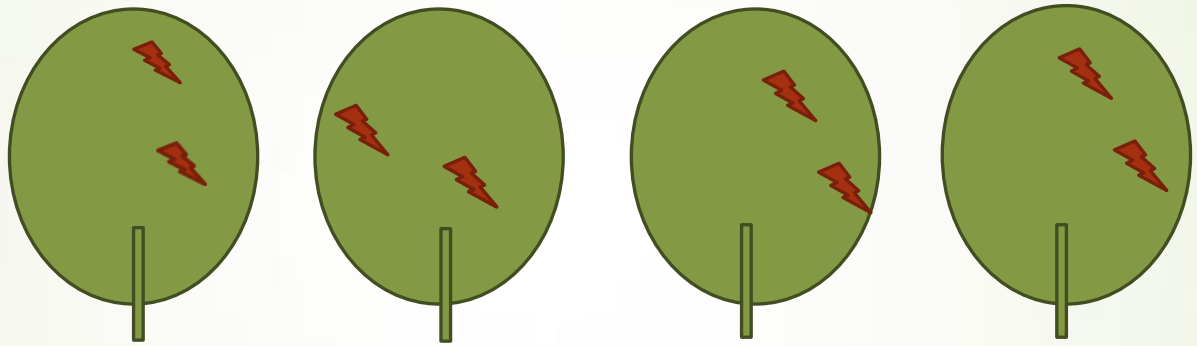
1-DAA

All 4 rows sprayed



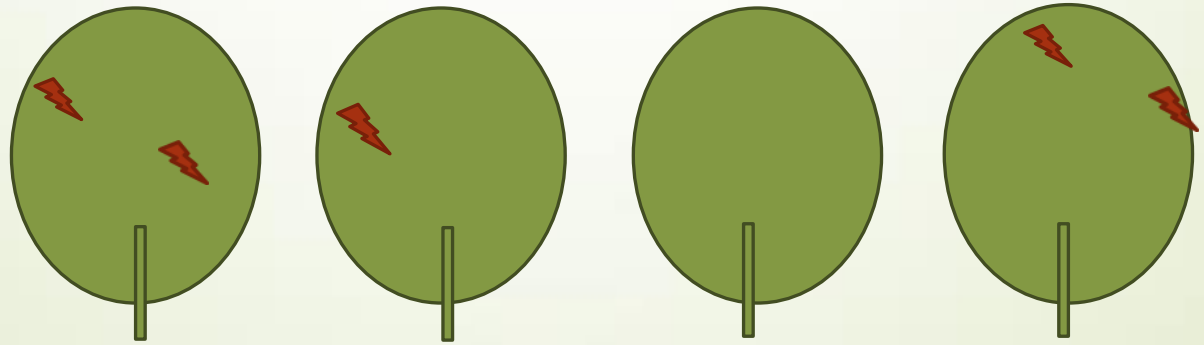
How to use treated buffers

Center 2 rows sprayed



14DAA popn

All 4 rows sprayed



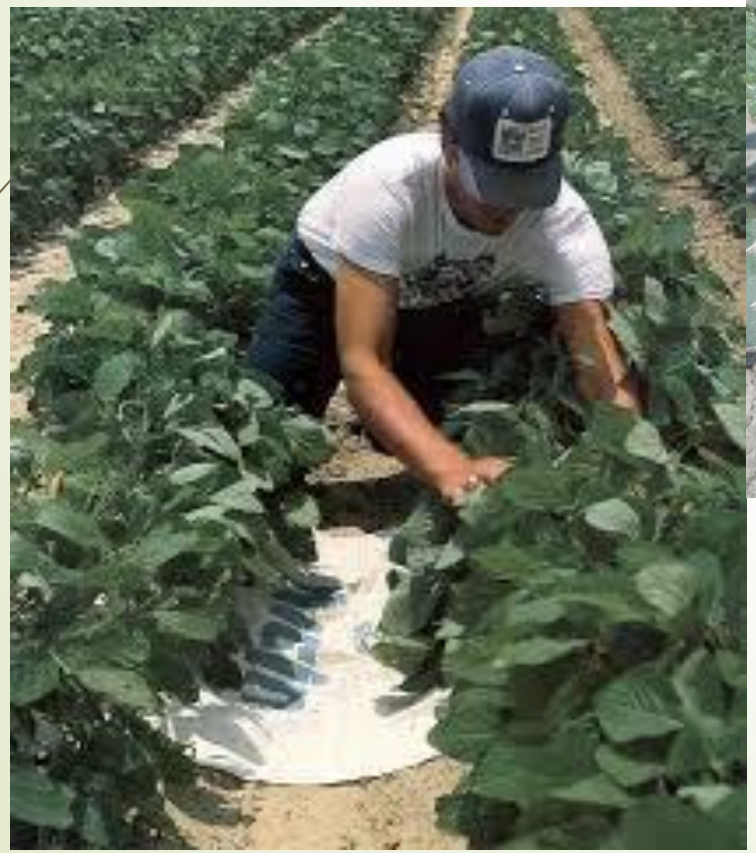
Waiting to apply too late can make plot data variable

Weeds and crop adjacent to different plots can influence pests & growth of test crop within individual plots

Do Sampling Plan Homework

- Read accepted sampling references before start
- Review with senior researchers and area experts
- Preview pest pressure in UTC plots first
- Determine most / least pest pressure in canopy

Estimate time needed to complete sampling of plot



Basic approaches to sampling

- Completely Random sampling
- Stratified sampling
- Systematic sampling

Error of Random Sampling

Systematic Sampling can reduce uncontrolled variability

Pre-selecting plants based on uniformity - avoid variability

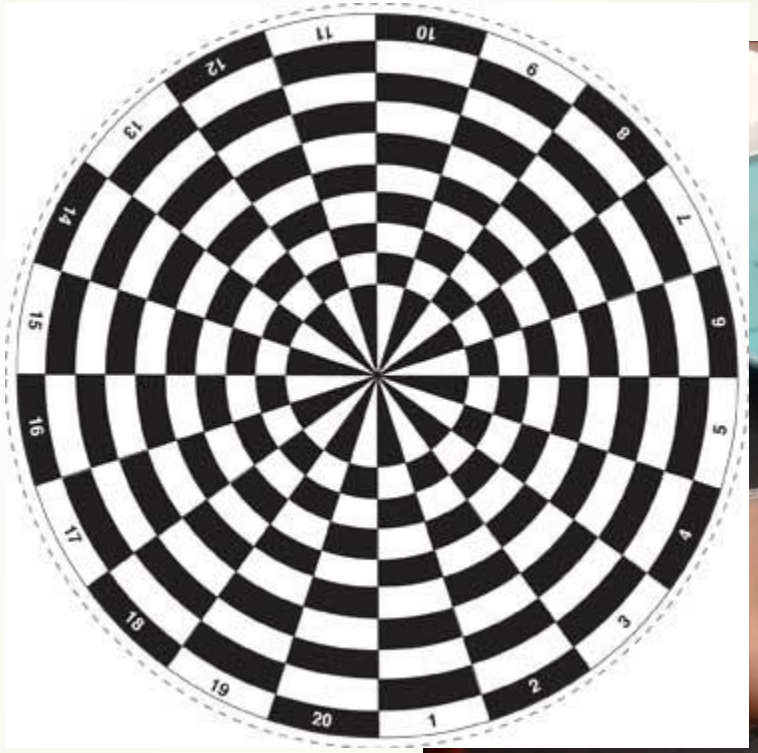
Repeating counts from same plants as means of monitoring

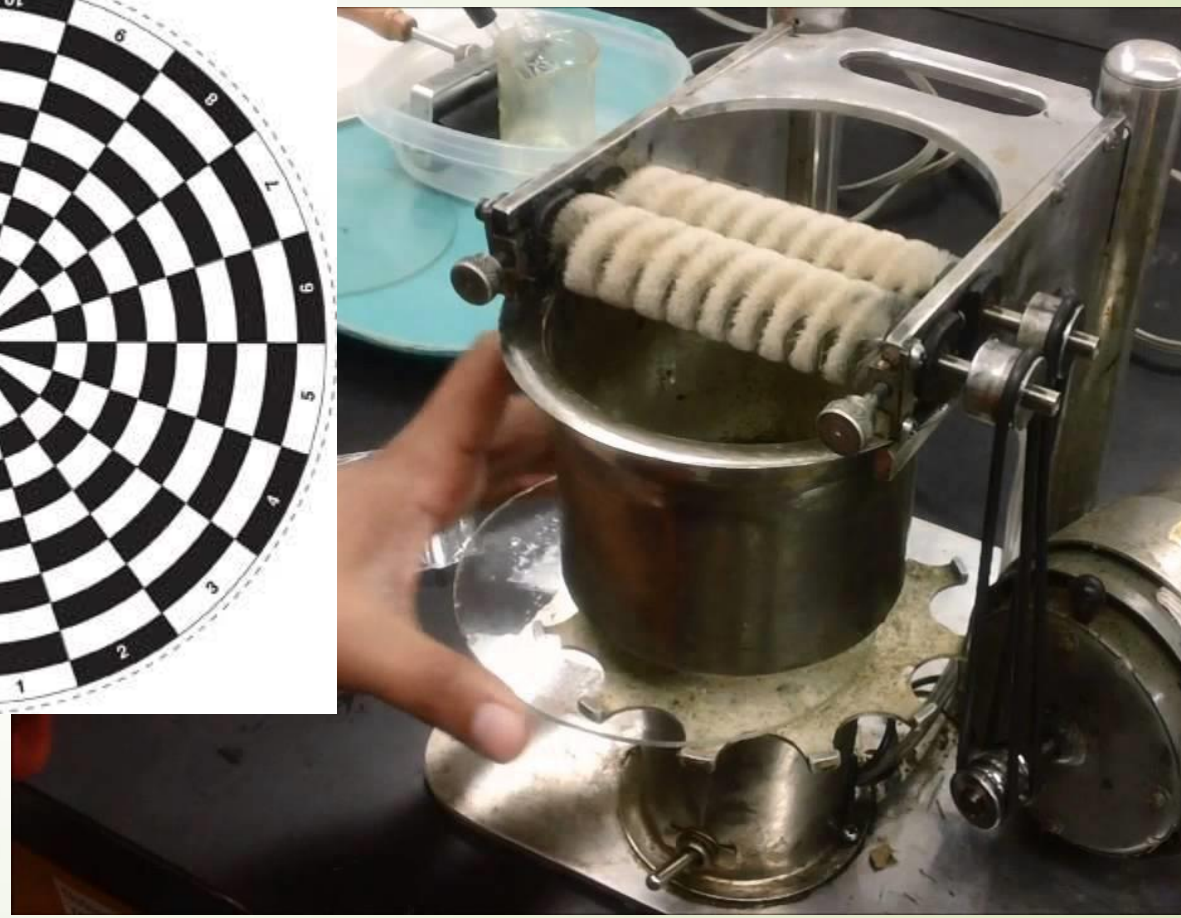
Sampling complex plant architecture

Sample region majority fruit produced

Sample from same location over time

Vary subsample or sample unit by mite density



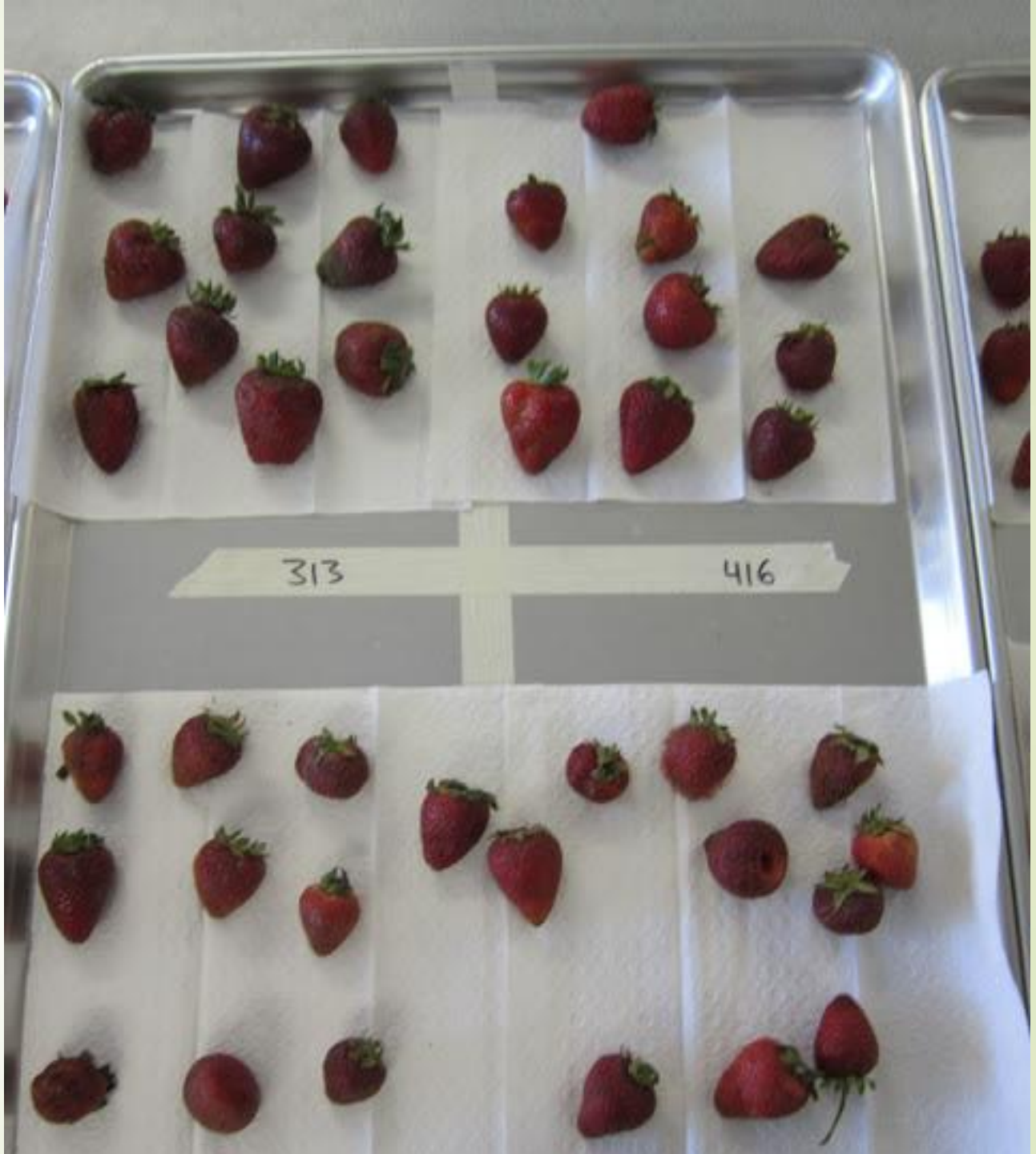


Reduce the amount of plant to rate

Learn behavior of species on crop

Field Collect then Assess in Lab

Can allow for larger sample units with fewer resources

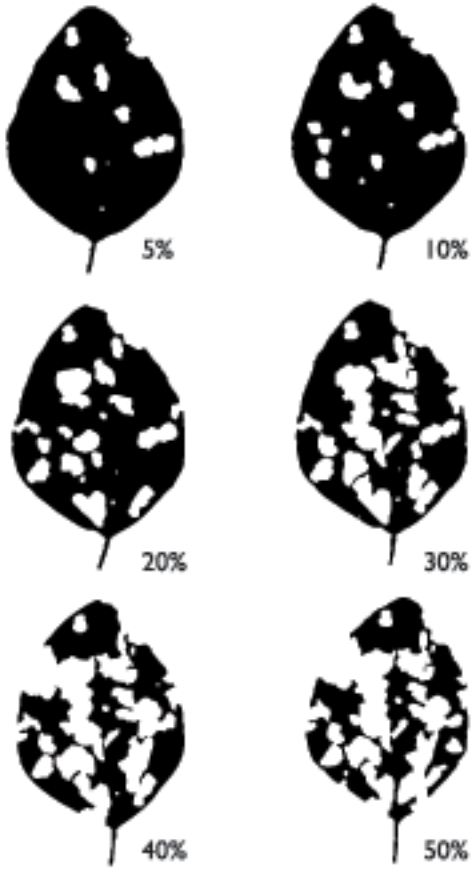


Bait and count sample estimates

Relative estimate of symphylans

RATING SCALES

A good scale key can improve repeat-ability, precision, & variability

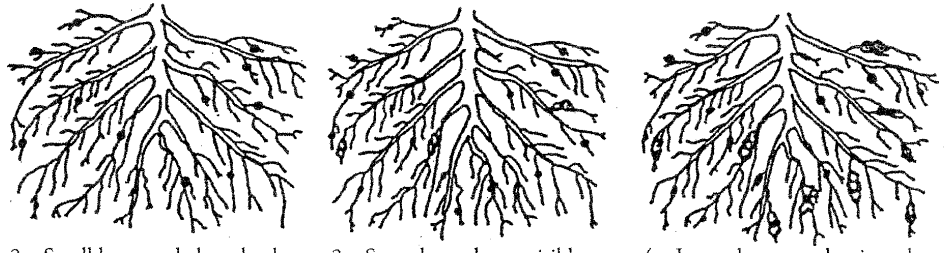


Diagrammatic root-knot scoring chart

Courtesy of John Bridge and Sam Page (1980).

0 – No knots on roots.

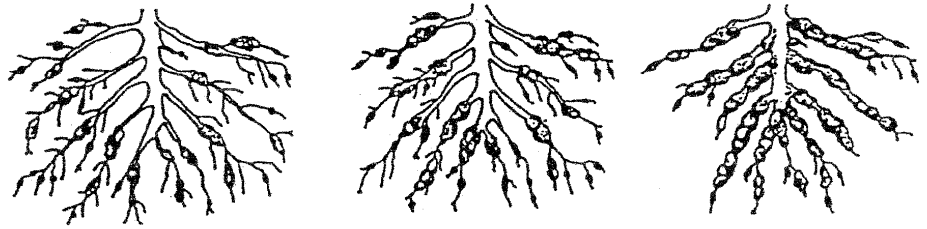
1 – Few small knots, difficult to find.



2 – Small knots only but clearly visible. Main roots clean.

3 – Some larger knots visible. Main roots clean.

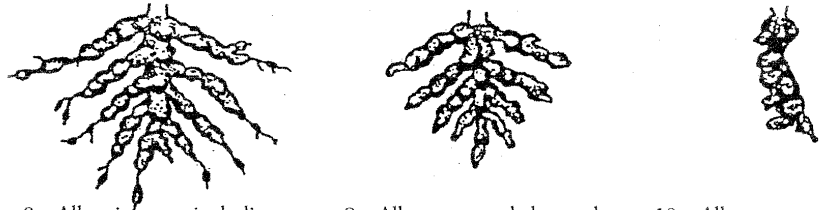
4 – Larger knots predominate but main roots clean.



5 – 50% of roots affected. Knotting on some main roots. Reduced root system.

6 – Knotting on main roots.

7 – Majority of main roots knotted.

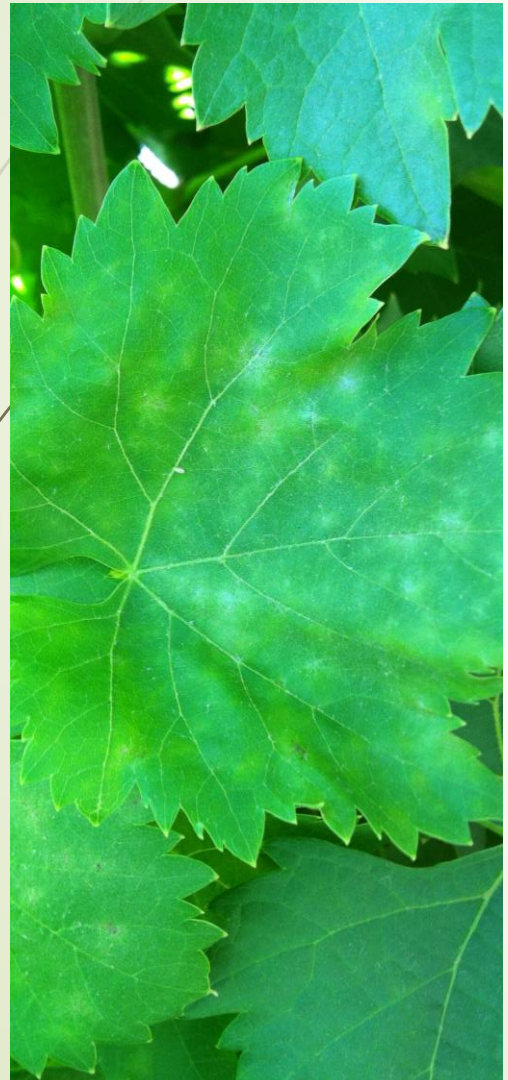


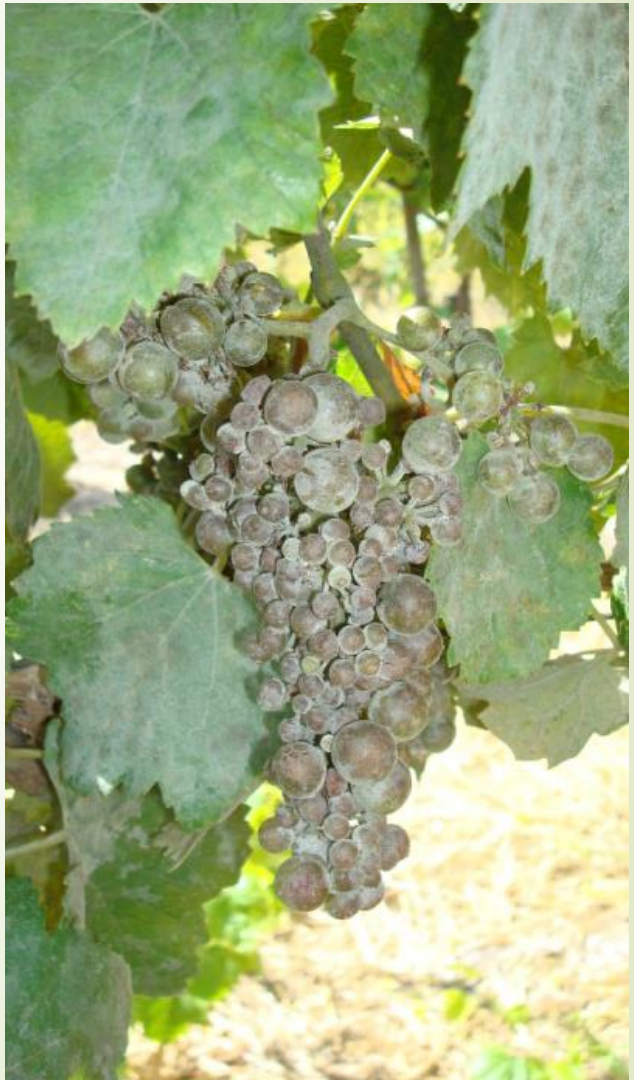
8 – All main roots, including tap root, knotted. Few clean roots visible.

9 – All roots severely knotted. Plant usually dying.

10 – All roots severely knotted. No root system. Plant usually dead.

Increase Assessment Precision where its needed
Combine Counts and Subjective Rating





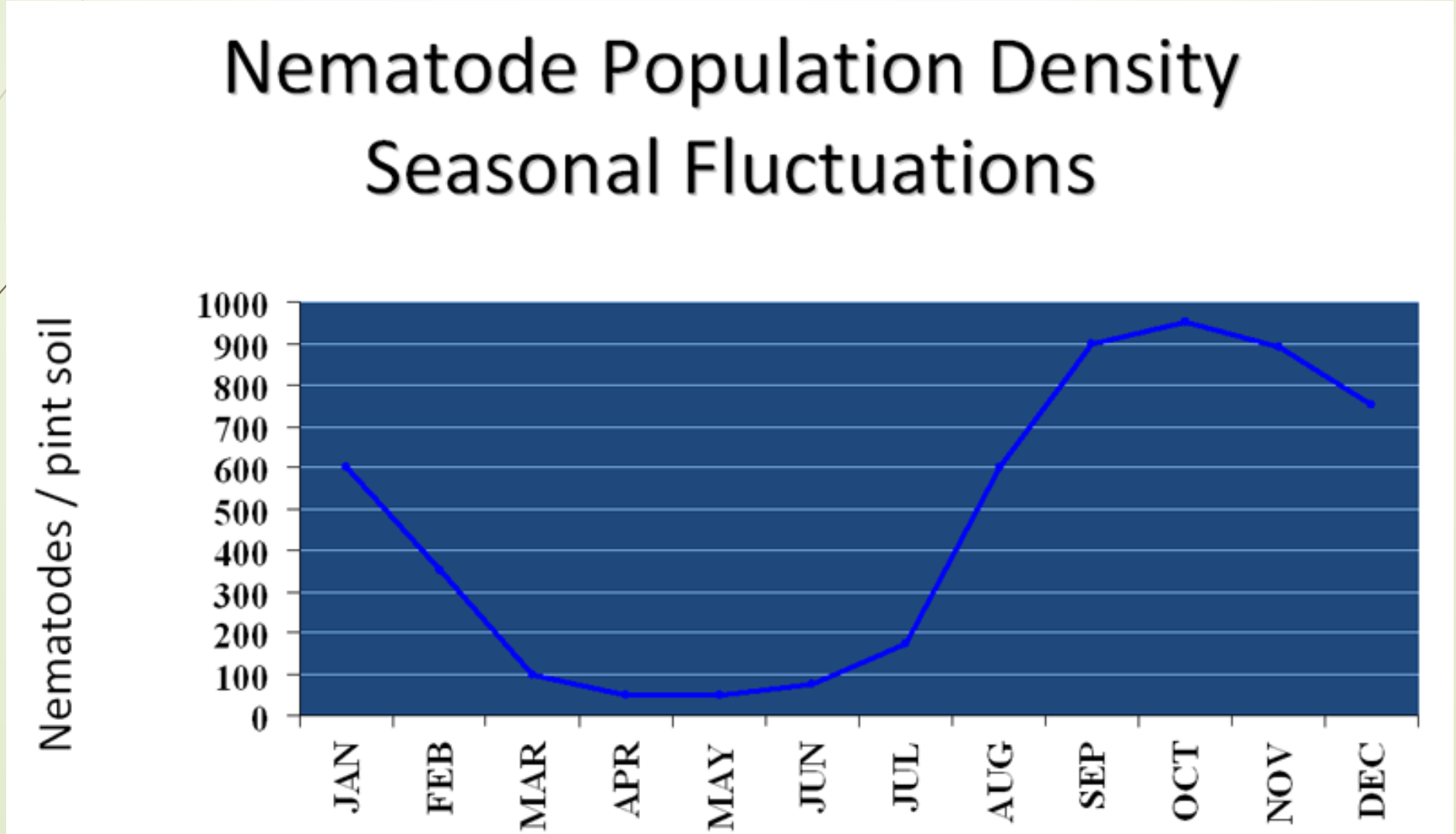
Use of plot-specific data versus composite samples

Composite Sample Mean values don't differ from Rep Samples

Compositing saves lab costs

Valuable for soil disease, nematode, and fertility research

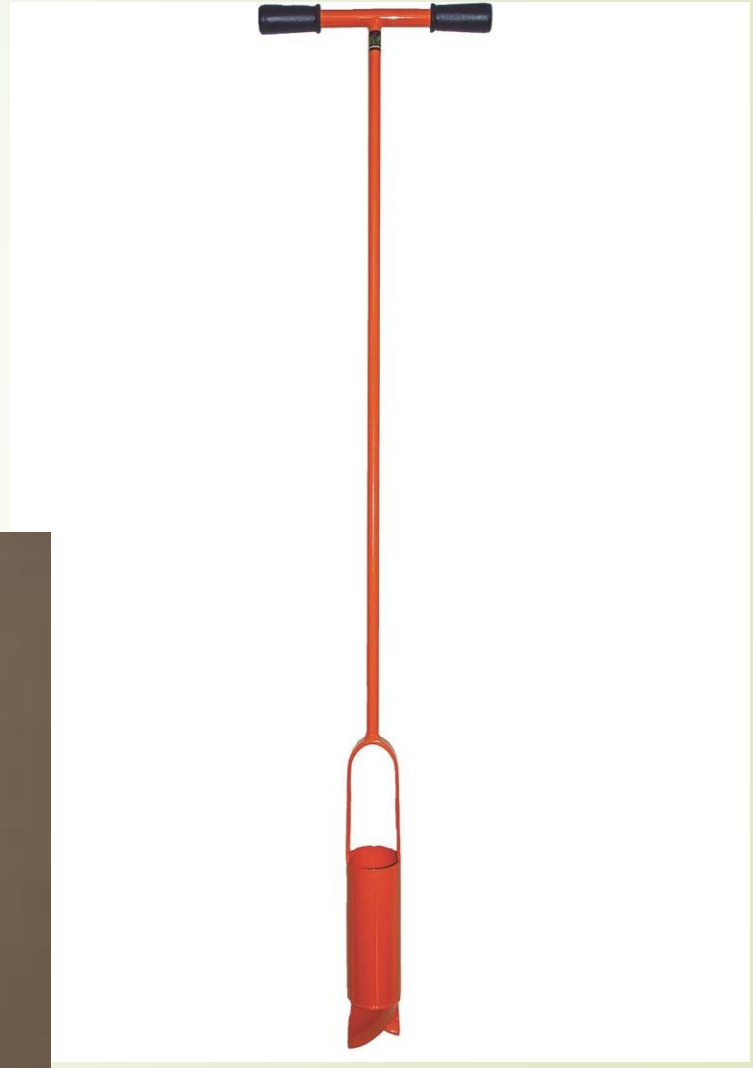
Plan nematode sample timing



Better nematode samples

Sample soil systematically - same position, same side & depth

Soil sampling equipment choices



Better nematode samples

Collect fine roots and soil in direct contact with roots

Improve data quality - handle samples carefully

Marginal spray coverage influences sampling

Poor herbicide coverage is easy to see

It adds variability to assessment data

Emitter spacing & flow rate, and tape placement affect variability in the plot

One Drip Tape

Two Drip Tapes

Sample Data Recordkeeping

- Clearly note sampling units on data sheets
- Describe subjective assessment scales in detail
- Use calculated data - Insect-Day Avg & SAUDPC

Data collection and PI Accountability

- Are sample units hardwired into the protocol?
- Do you understand the assessments requested, and sample units requested?
- Are they appropriate? If not or uncertain - discuss

Summary

- Study your protocol and sampling plan
- Obtain assessment/sampling input as needed
- Assess and guide trial setup to improve uniformity and adequate size plots
- Estimate time needed to complete sampling event early to plan for adequate manpower
- Refine your sampling plans using previous data collection and sampling records

You are in luck no equations or math today

Fundamentals of Experimental Design
Agron. J. 107:692–705 (2015)

Extensive on-line stats training course
http://stattrek.com/license/register.aspx

Calculator for Sample size
http://sampsize.sourceforge.net/iface/