NEMATODE SUSCEPTIBILITY RANKINGS FROM SOFT-TISSUE X-RAY IMAGING

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Phenotype Screening CORPORATION *enabling discovery*

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A New Method for Nematode Studies is Being Developed

- The method is based upon soft-tissue X-ray imaging.

- The entire root system of the cotton plant under study is captured in an X-ray image.

- The resolution of the X-ray imaging system allows for reniform nematode egg mass site identification and counting.

- Egg mass location can be tied to specific attributes of the plant's root system architecture.

Six Cotton Lines from the Auburn Breeding Program, and Two USDA Germplasm Lines Were Evaluated

- Resistant lines: A107, B103, and LONREN-2, BARBREN-713.

- Susceptible lines: A118, A209, B124, B227

- Infection density:1500 nematodes per 100 cc of soil.

- Plants were grown for six weeks in conetainers at the UT greenhouse.
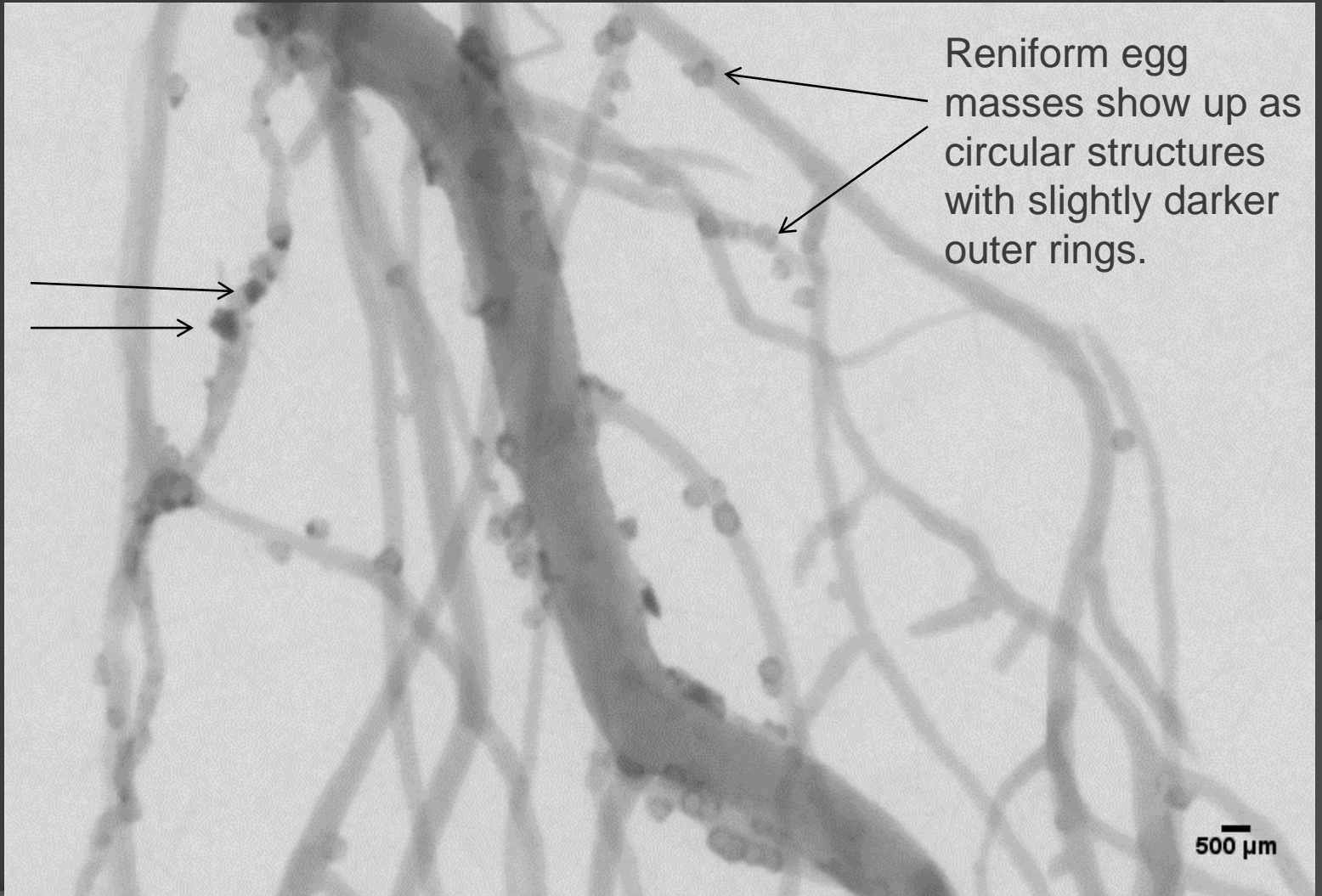
Root Systems Were Carefully Washed and Prepared for X-ray Imaging

Soft-tissue X-ray Image of B227 Cotton Root System With Reniform Egg Masses

Reniform egg masses show up as circular structures with slightly darker outer rings.

Soil particles are uniformly dark.

500 µm

An Analyst Clicks on the Egg Mass Locations Which are Then Logged

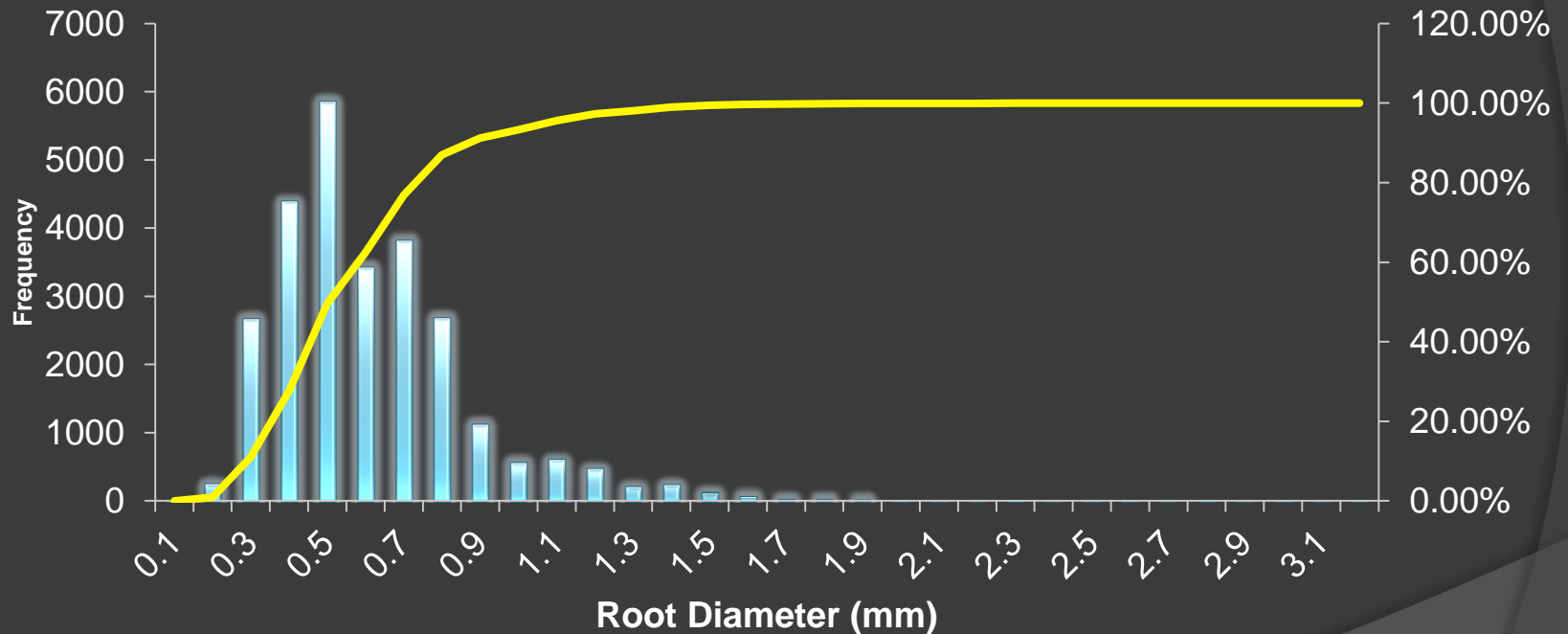# Egg Mass Count by Line

At Six Weeks the Cotton Plants Tended Towards Smaller Root Diameters

Root Diameter and Cumulative % Distribution of all Plants

The Root System Is Analyzed by Root Diameter Ranges (Size Classes)

Original X-ray of root system
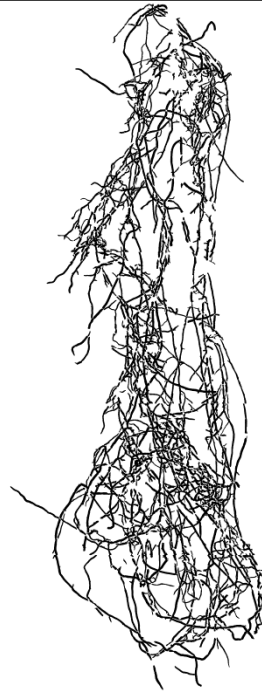
1,392u – 2,900u diameter roots

Size Class 3

696u – 1,450u diameter roots

Size Class 4

348u – 725u diameter roots

Size Class Five

Susceptible Line A209

Egg mass count ➝ 172, 38, 381, 97, 113, 165, 71
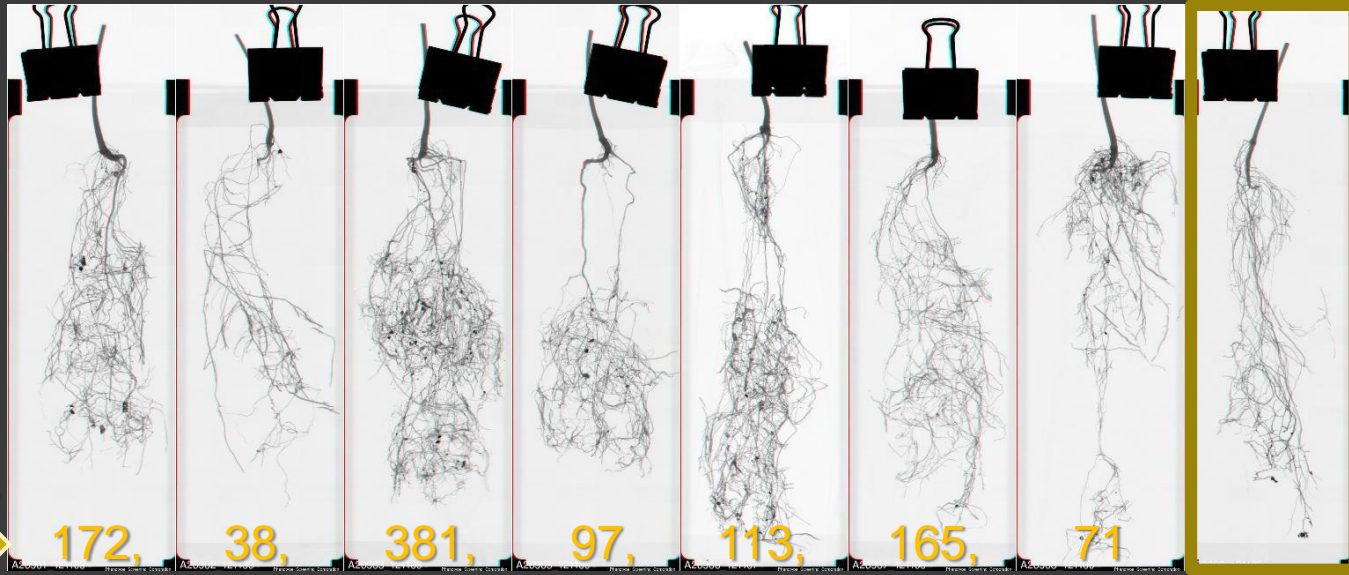
Total Root Length (m) of A209 Line by Root Size Class

Legend: SizeClass3, SizeClass4, SizeClass5

Categories: A20901, A20902, A20903, A20905, A20906, A20907, A20908, A20909
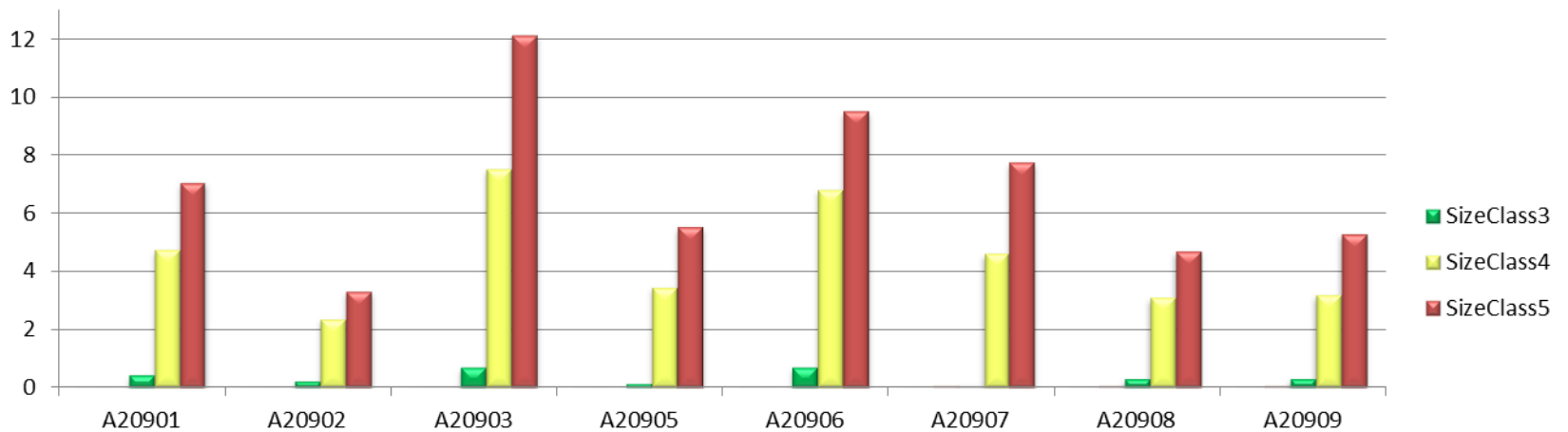
Total Root Length Line Signatures

Mean Total Root Length (m) of Cotton Lines by Root Size Classes (all infected plants) w/Standard Error bars

Legend: SizeClass3, SizeClass4, SizeClass5

X-axis labels: A107, A118, A209, B124, B103, B227, BARBREN-713, LONREN-2
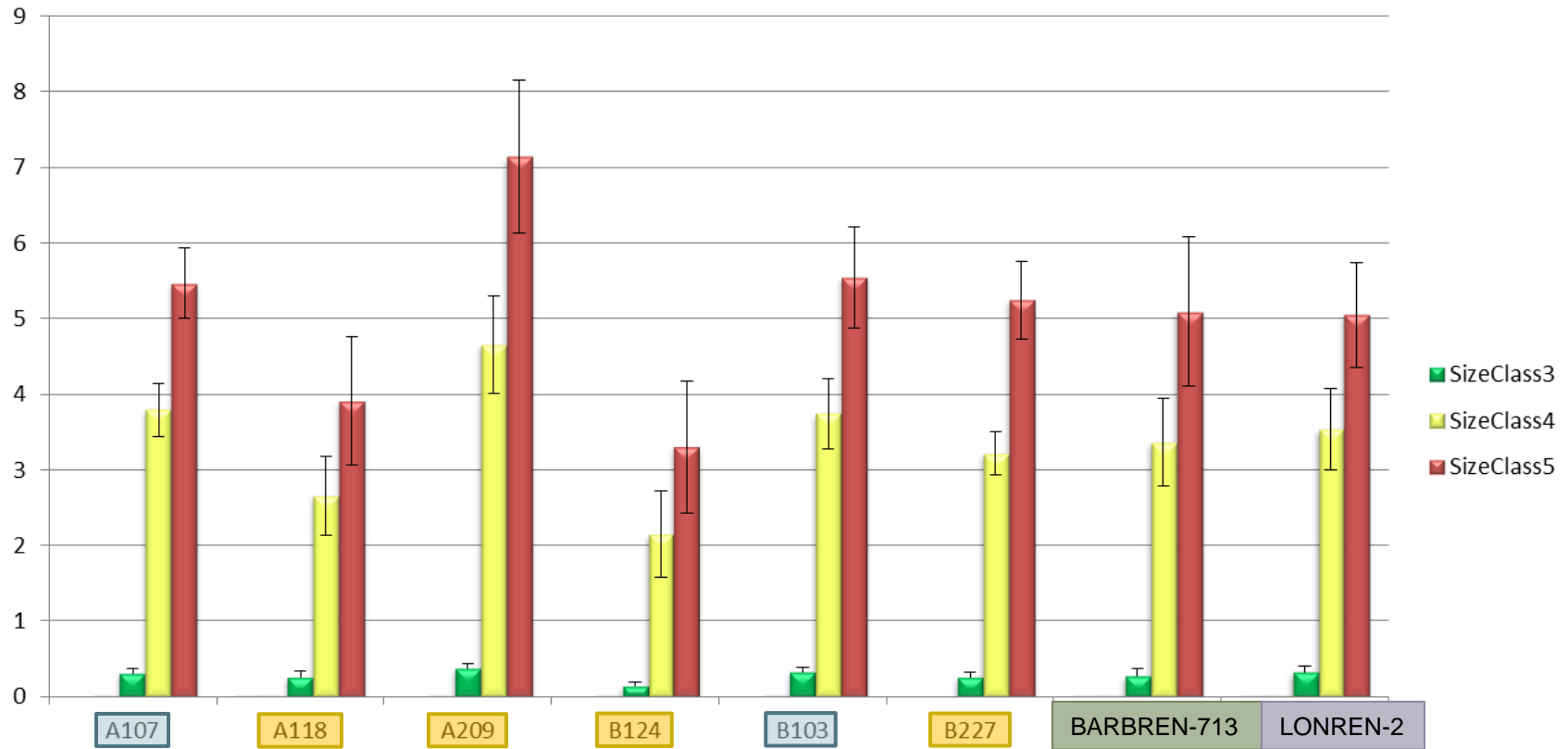
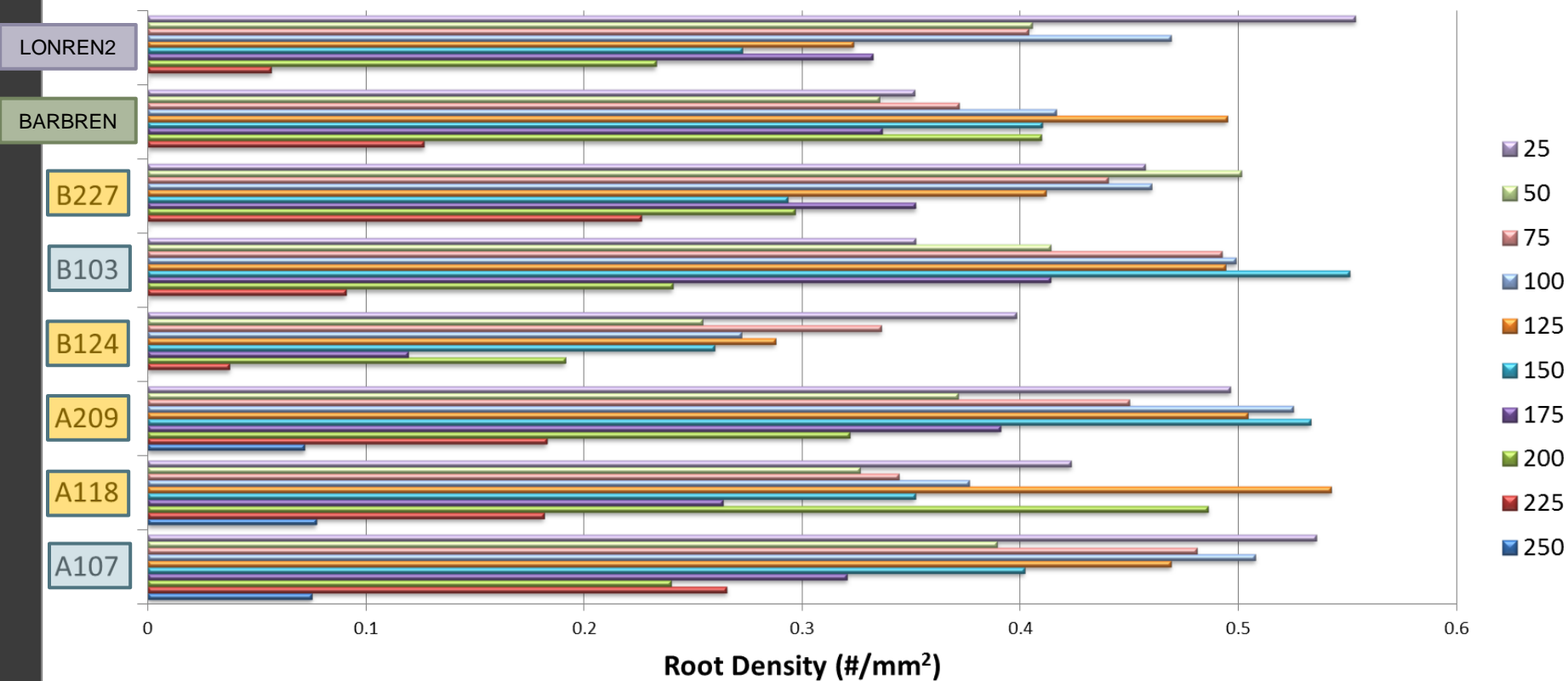Shown with standard error bars

Resistant Line | Susceptible Line | Resistant Line | Resistant Line

Size Class 5 (348u – 725u) Root System Distribution by Depth

Mean Root Density (#/mm²) of Size Class 5 Roots for Each Line by Root Depth (mm) (infected plants only)
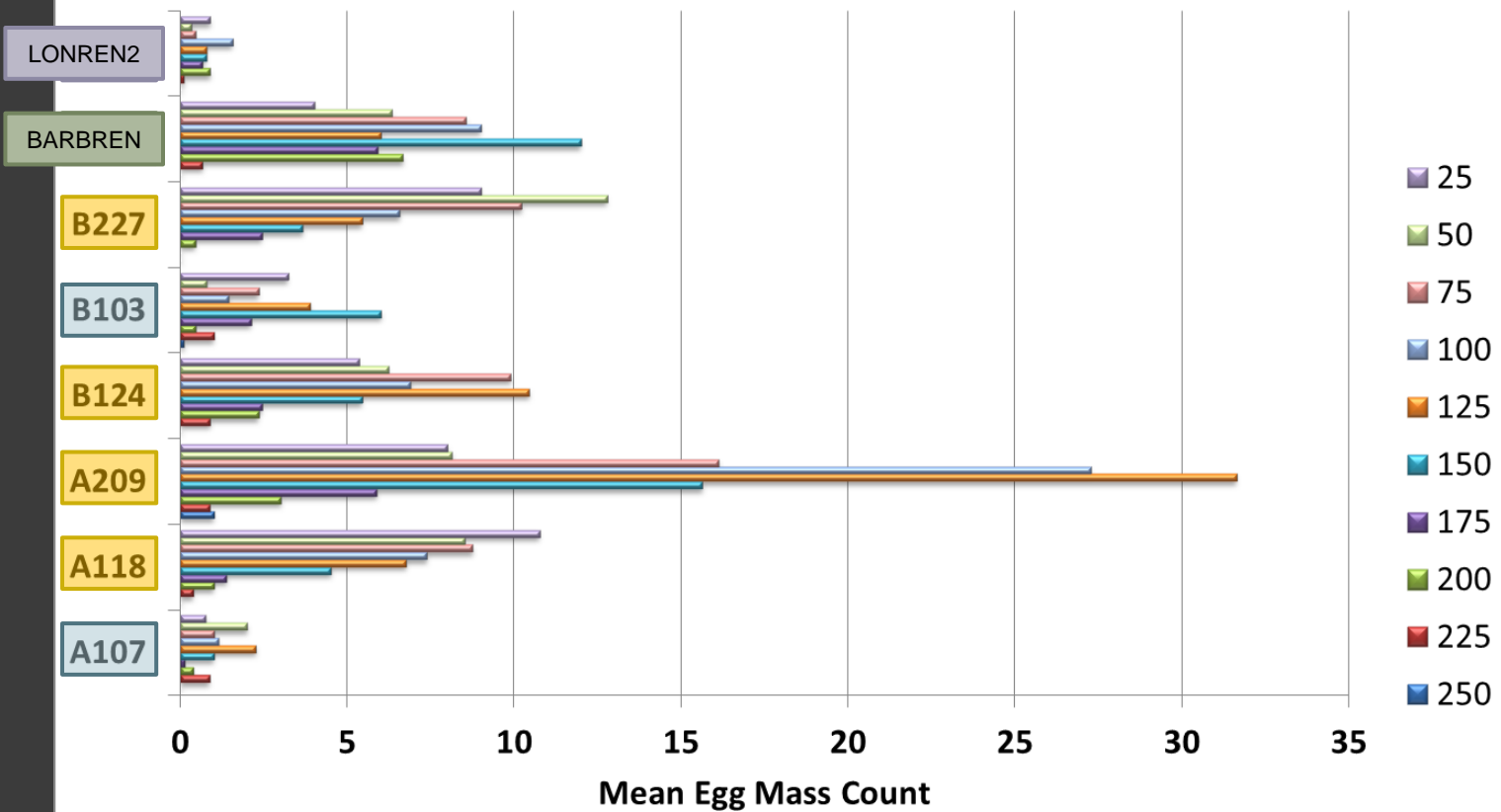
Resistant Line   Resistant Line   Resistant Line   Susceptible Line

Mean Egg Mass Count of Each Line by Root Depth

Mean Egg Mass Count of Each Line by Root Depth (mm)
(infected plants only)

Legend (Root Depth mm): 25, 50, 75, 100, 125, 150, 175, 200, 225, 250

Lines: LONREN2, BARBREN, B227, B103, B124, A209, A118, A107

X-axis: Mean Egg Mass Count (0, 5, 10, 15, 20, 25, 30, 35)

Resistant Line   Resistant Line   Resistant Line   Susceptible Line
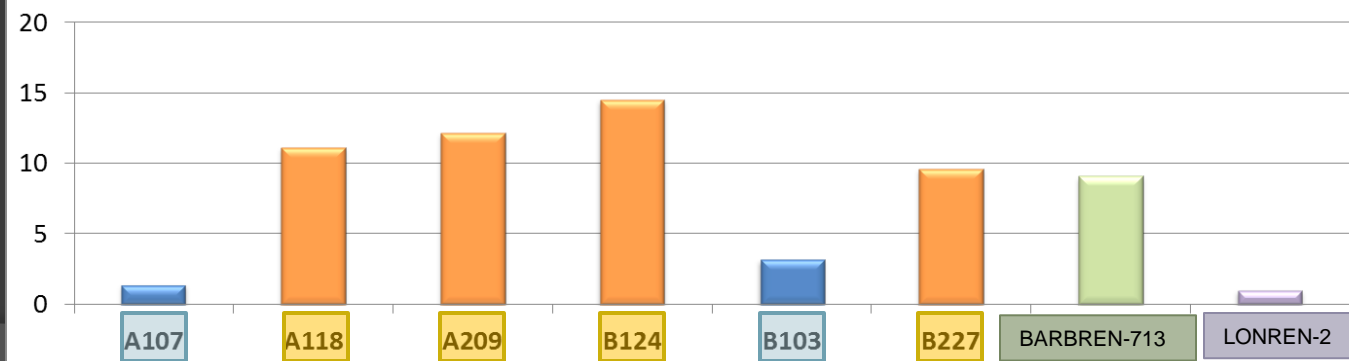
Normalizing Counts to Root Length

Mean Total Root Length (m) of Cotton Lines by Root Size Classes (all infected plants)
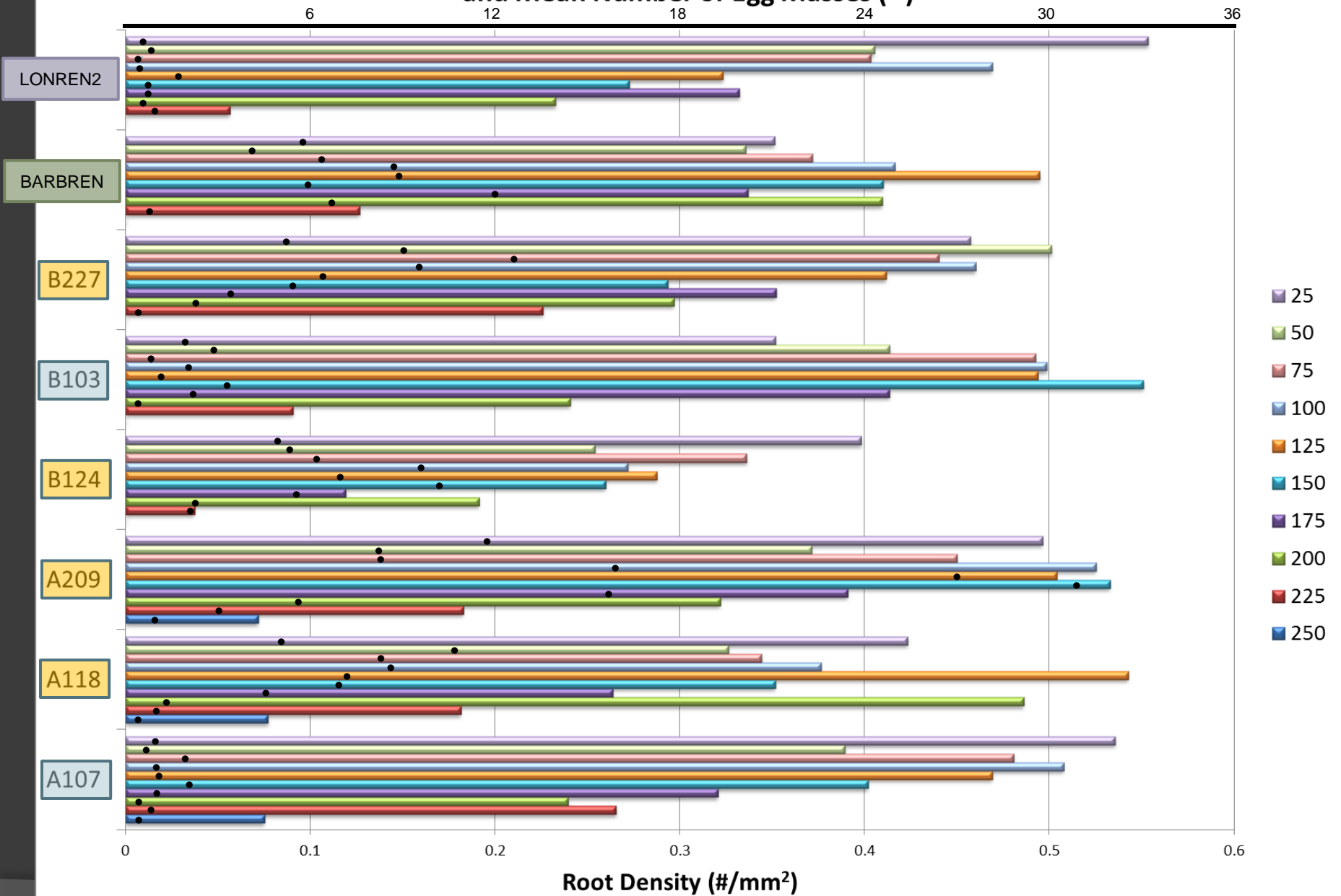
Mean egg mass count ➡ 13.6, 76, 148.1, 81.2, 30.9, 83.7, 79.6, 8.9

Egg Mass Count per Unit Root Length

Mean Root Density (#/mm²) of Size Class 5 Roots for Each Line by Root Depth (mm) and Mean Number of Egg Masses (●)

Study Conclusions

⦿ The resistant lines A107 and B103 supported low nematode reproduction.

⦿ The resistant germplasm line BARBREN-713 supported higher nematode reproduction.

⦿ All lines had unique root system architecture signatures, supported varying degrees of nematode reproduction and had unique nematode feeding site distributions.

⦿ When normalized for total root length, of the susceptible varieties B124 ranked the most susceptible and B227 the least.

Method Summary

- X-ray based method captures root architecture and reniform nematode egg mass distribution in a single image.

- Screening costs are reduced due to elimination of egg extraction step and to automated root architecture analysis. (Egg mass counting can be automated, further reducing costs.)

- Root development and nematode distributions can be studied in an integrated manner.