

MANAGEMENT OF COFFEE ROOT-KNOT NEMATODES



Hawaii
Coffee
Association
28th Annual
Conference



ROXANA MYERS

USDA ARS Daniel K. Inouye Pacific Basin Agricultural Research Center

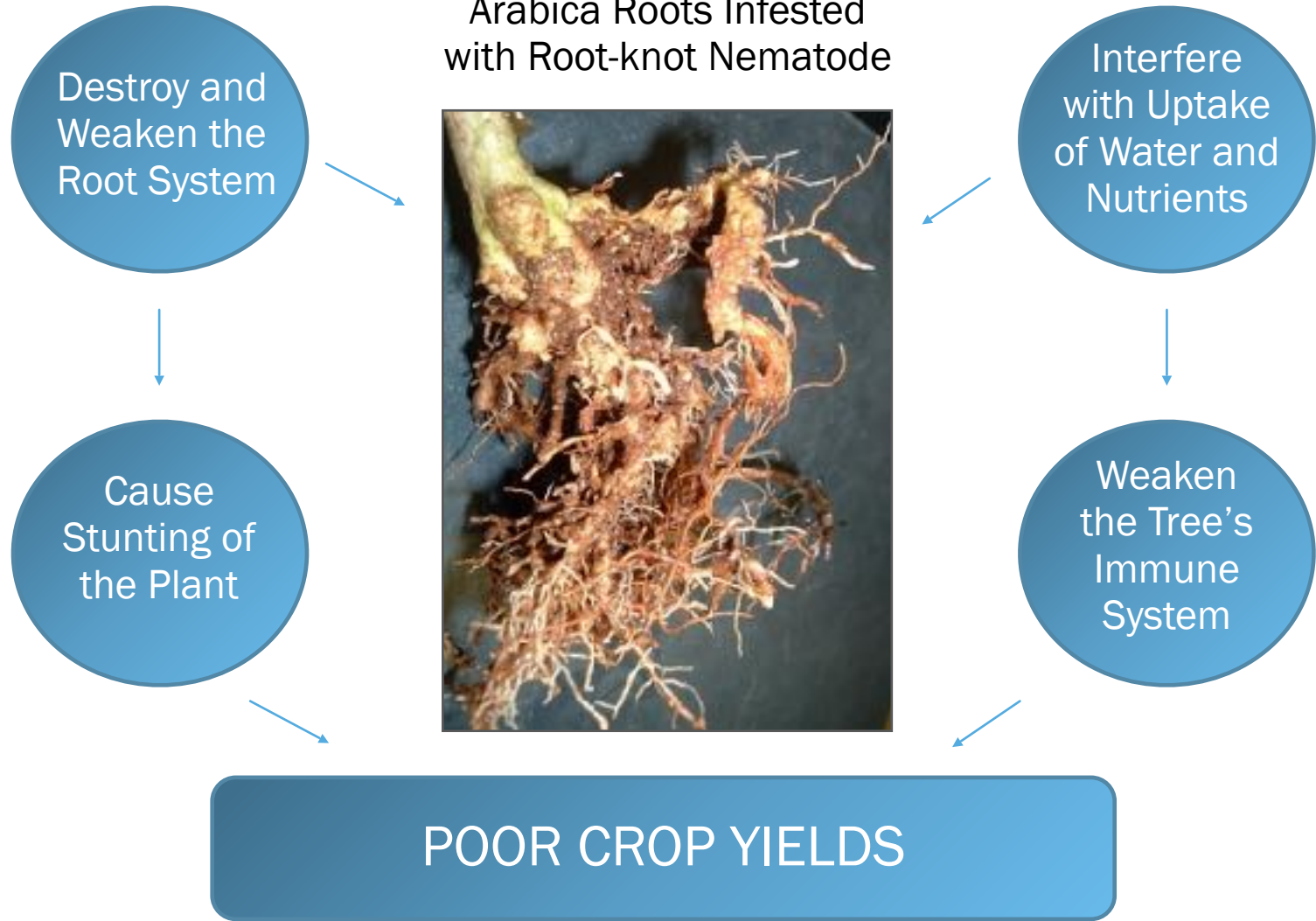
PLANT PARASITIC NEMATODES

- Microscopic Non-Segmented Worms
- Stylet Mouthpart for Piercing Plant Cells



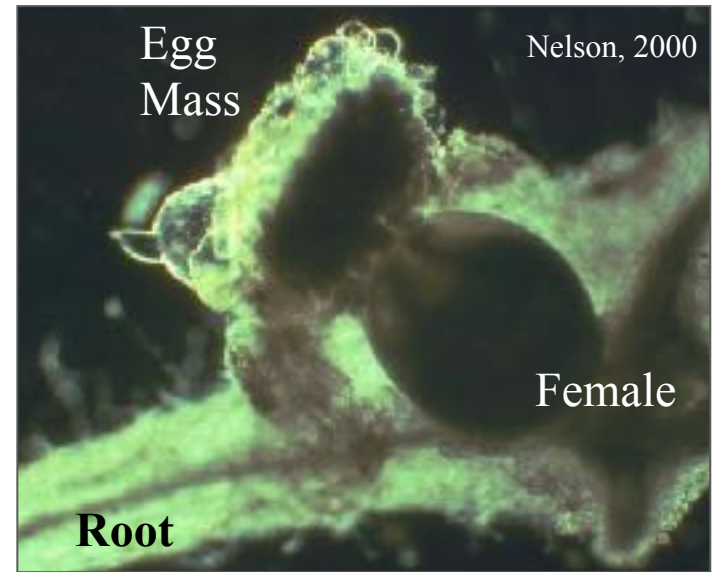
- Cause Billions of Dollars in Damage to Agricultural Crops Worldwide

HOW DO NEMATODES DAMAGE CROPS?



Kona Coffee Root-knot Nematode *Meloidogyne konaensis*

- Sedentary Endo-Parasite
- Highly Pathogenic on Coffee
- Destroys Feeder Roots, Causes Corky Tap Root & Stump Wobbliness
- Severe Tree Decline with Mortality in 10 Years



Management of Kona Coffee Root-knot Nematode

- Host Plant Resistance is the Most Effective Management Strategy
- Planting Cultivars with Nematode Resistance or Grafting on Nematode Tolerant Rootstocks



Non-grafted
Nematode
Susceptible Typica

Typica Grafted to
Nematode Tolerant
Rootstock

Tolerant Rootstocks Remain Vigorous Under Heavy Nematode Infestation

Coffea arabica cv. Typica

Nematode Susceptible

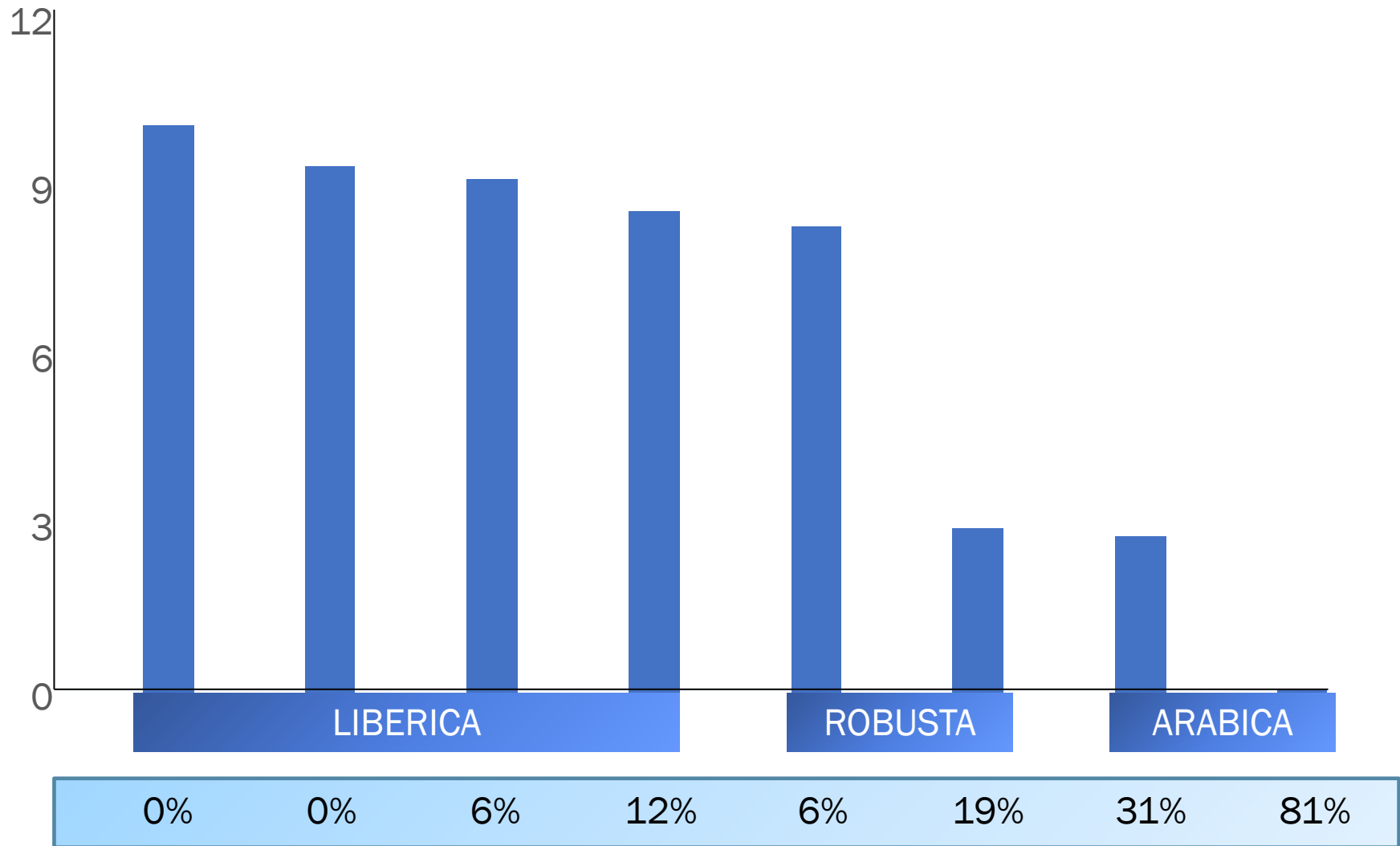


Coffea liberica var. dewevrei

Nematode Tolerant



Average Red Cherry Yield per Tree (kg)



Percent Mortality of Grafted Trees After 12 Years

SCREENING COFFEE LEAF RUST RESISTANT CULTIVARS FOR ROOT-KNOT NEMATODE RESISTANCE

Roxana Myers, Chifumi Nagai,
Brent Sipes, Cathy Mello, and
Tracie Matsumoto



Cultivars Tested
Obata, Tupi-HI,
Ethiopian Arabica,
Nemaya, Typica

Inoculation
2,500 Eggs
Meloidogyne
konaensis

Duration
1 Year
Greenhouse
Bioassay

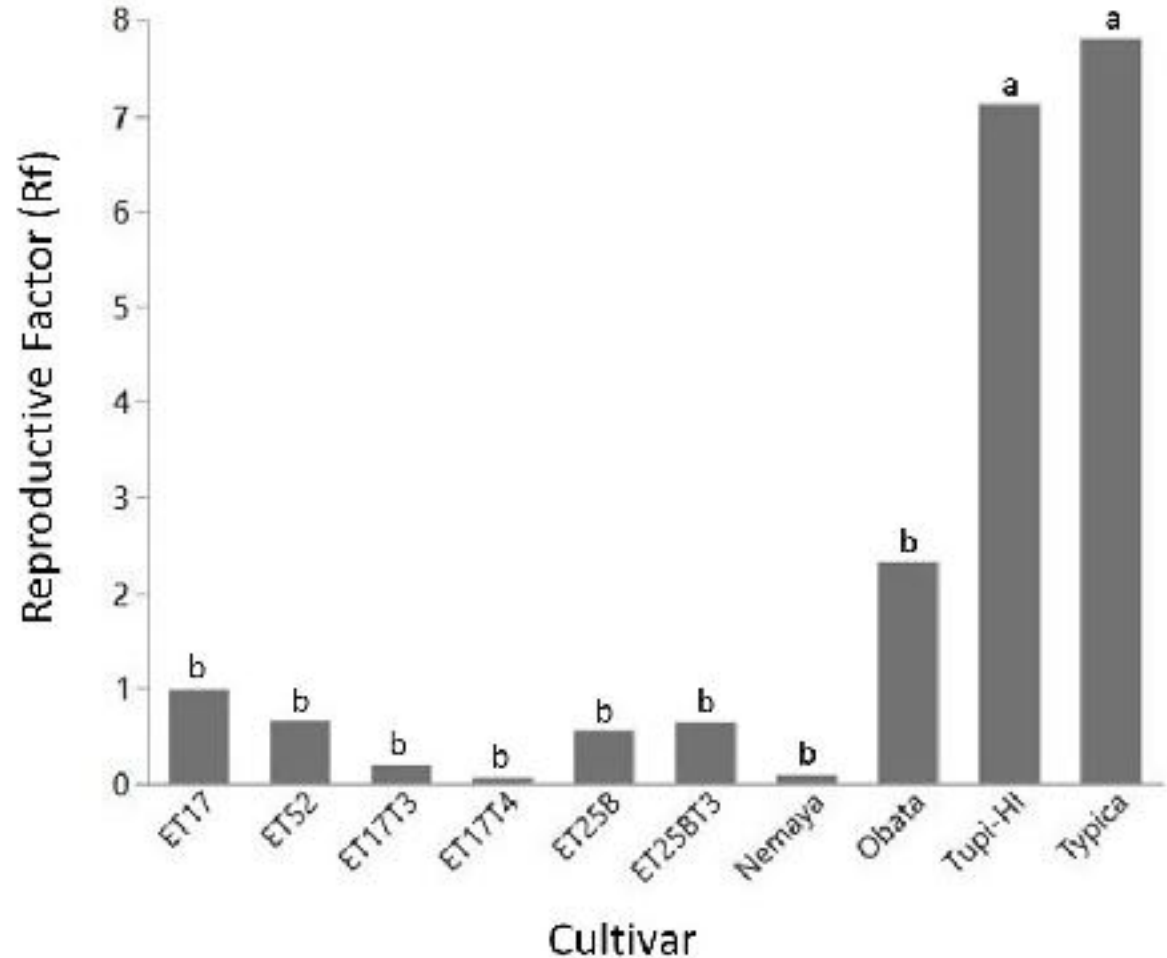
Evaluation
Plant Growth, Root Weight, Root Rot Rating, Root Health
Rating, Nematode Population, Reproductive Factor

MATERIALS AND METHODS



- I. Typica and Tupi had the highest nematode reproduction
- II. Nemaya and Ethiopian Arabica considered resistant ($RF < 1$)
- III. Obata had moderate nematode reproduction

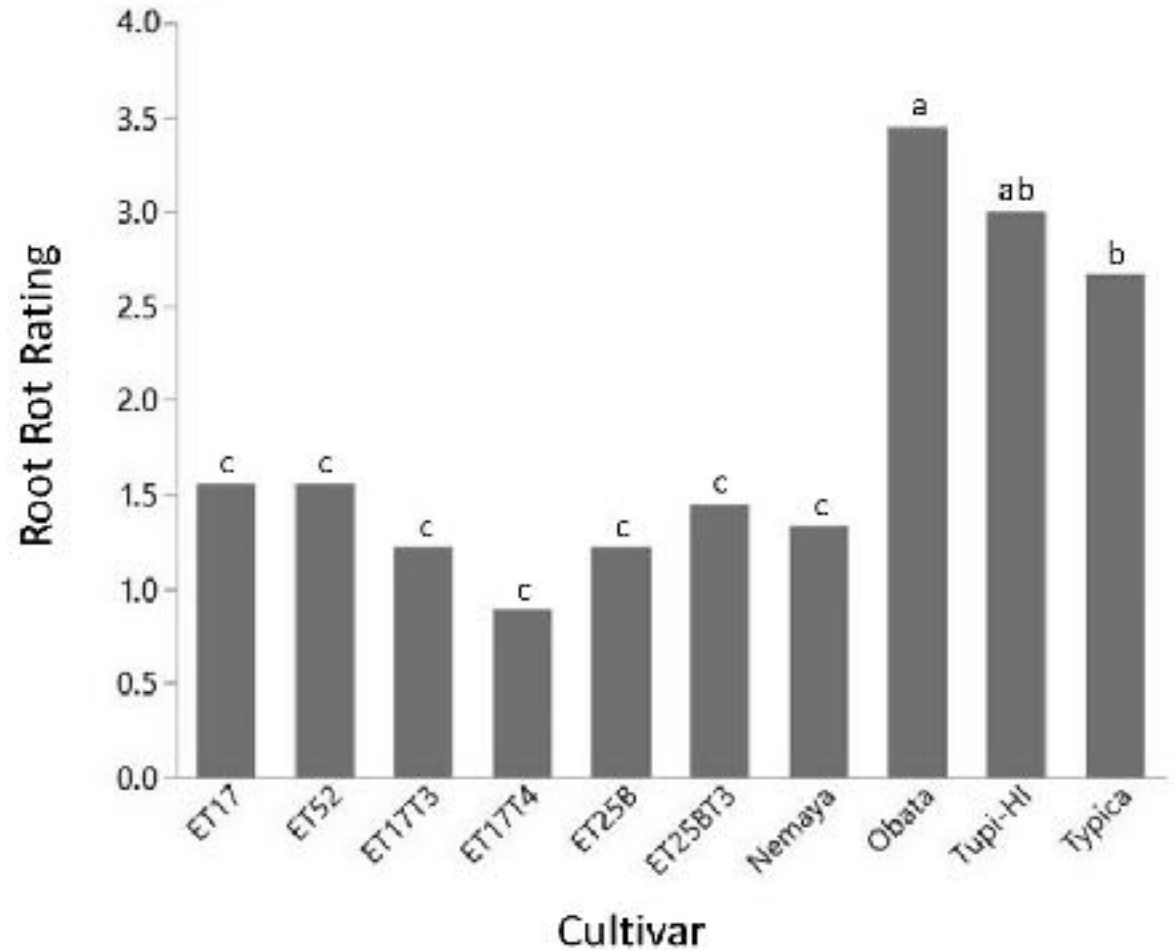
Root-knot Nematode Reproduction





- I. Obata had greatest amount of root rot indicating low nematode tolerance
- II. Statistically similar to Tupi and Typica
- III. Nemaya and Ethiopian Arabica had low root rot ratings

Root Rot of Nematode Infested Cultivars



CONCLUSIONS

- I. Tupi-HI and Obata (to a lesser degree) are Good Hosts for Kona Coffee Root-knot Nematode
- II. Tupi-HI and Obata are Highly Susceptible to Nematode Infestation
- III. Recommendation: When Replanting, Continue to Graft on Nematode Tolerant Rootstocks



Obata Roots



Future Research

- Greenhouse and Field Evaluation of CLR-Resistant Cultivars from World Coffee Research and Other Sources

ROOT-KNOT NEMATODE SURVEY ON COFFEE FARMS STATEWIDE

- Kona Coffee Root-knot Nematode is Widespread in Kona, Well Established in Ka'u
- Spread through Infested Seedlings/Pulapula and Using Infested Soil in the Nursery
- No Detections in Hilo and Hamakua
- Need to Sample Farms in Kauai, Oahu, Maui, and Molokai

Greenhouse Bioassay

- Inoculated Typica and Liberica coffee plants with *M. konaensis* (2500/plant)
- Terminated 14 months later
- Final whole plant assays to determine nematode populations
- % growth, stem diameter, root weights, root health and root rot ratings

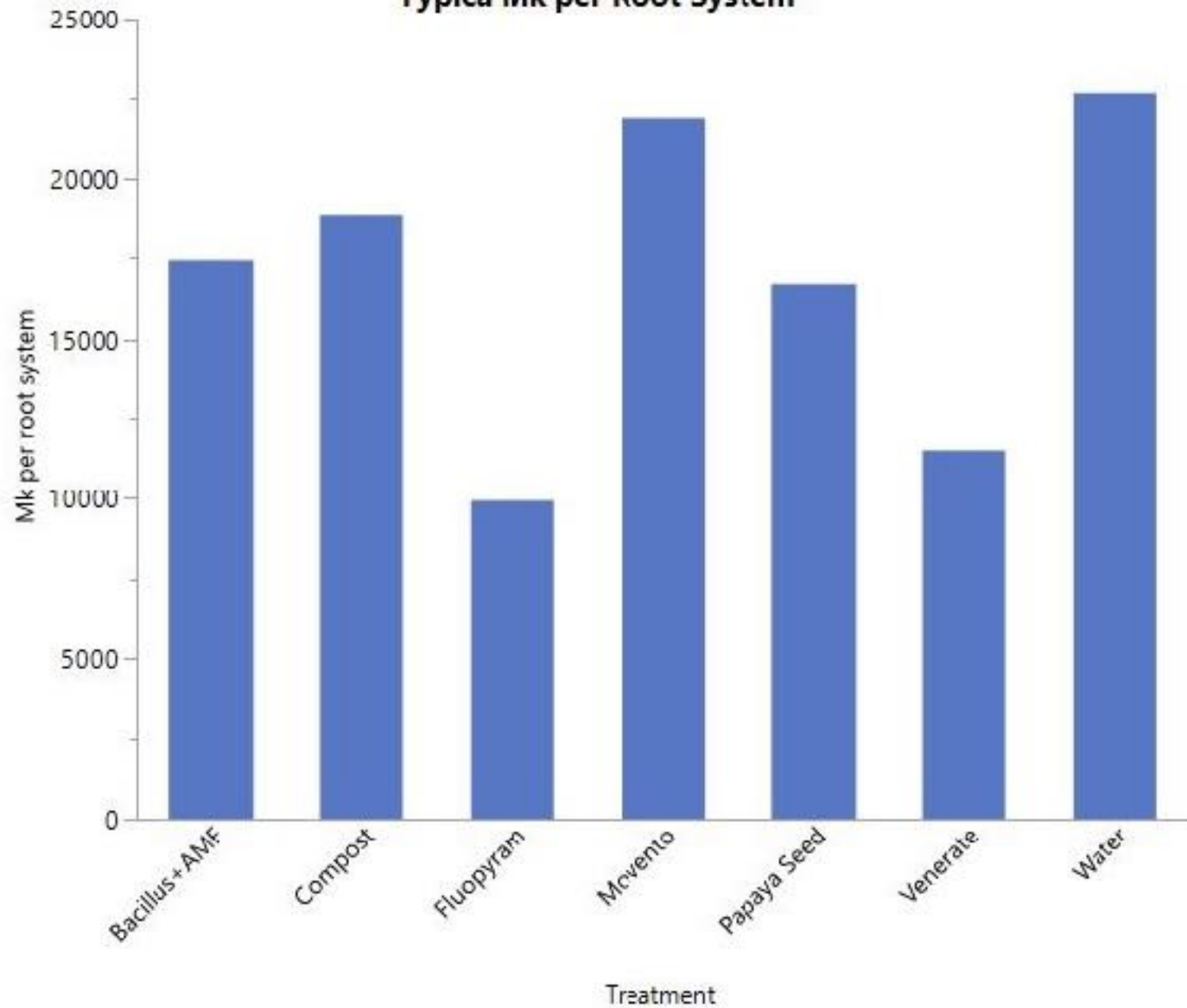


Nematicide Bioassay

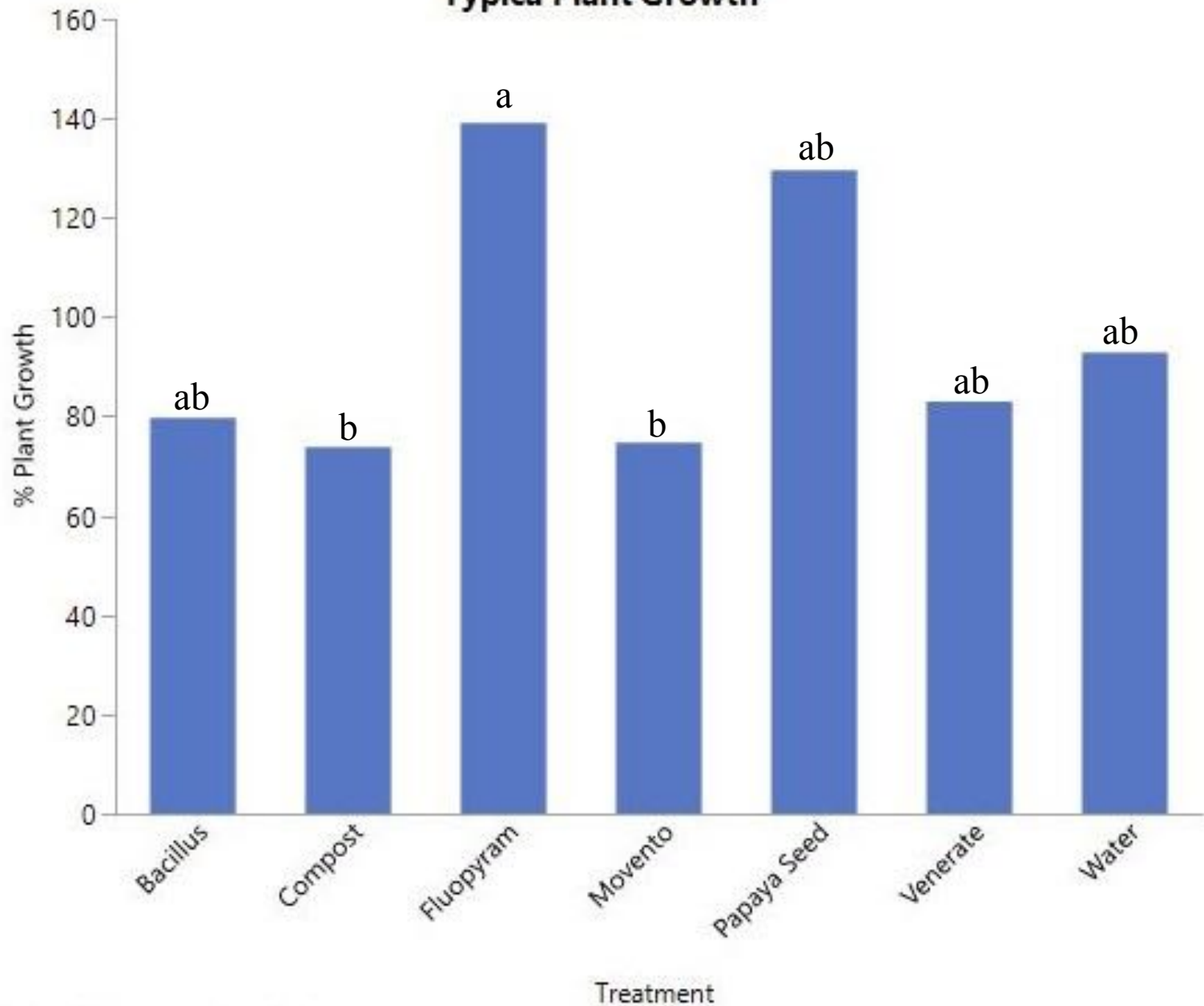
Applied
Every 3
Months at
Maximum
Label Rate

- Velum/Indemnify (fluopyram)
- Movento (spirotetramat)
- Venerate/Majestene (*Burkholderia* spp. Strain A396)
- *Bacillus subtilis* + AMF
- Papaya Seed (1% incorporated then drenched)
- Compost (1:1 incorporated then top dressed)

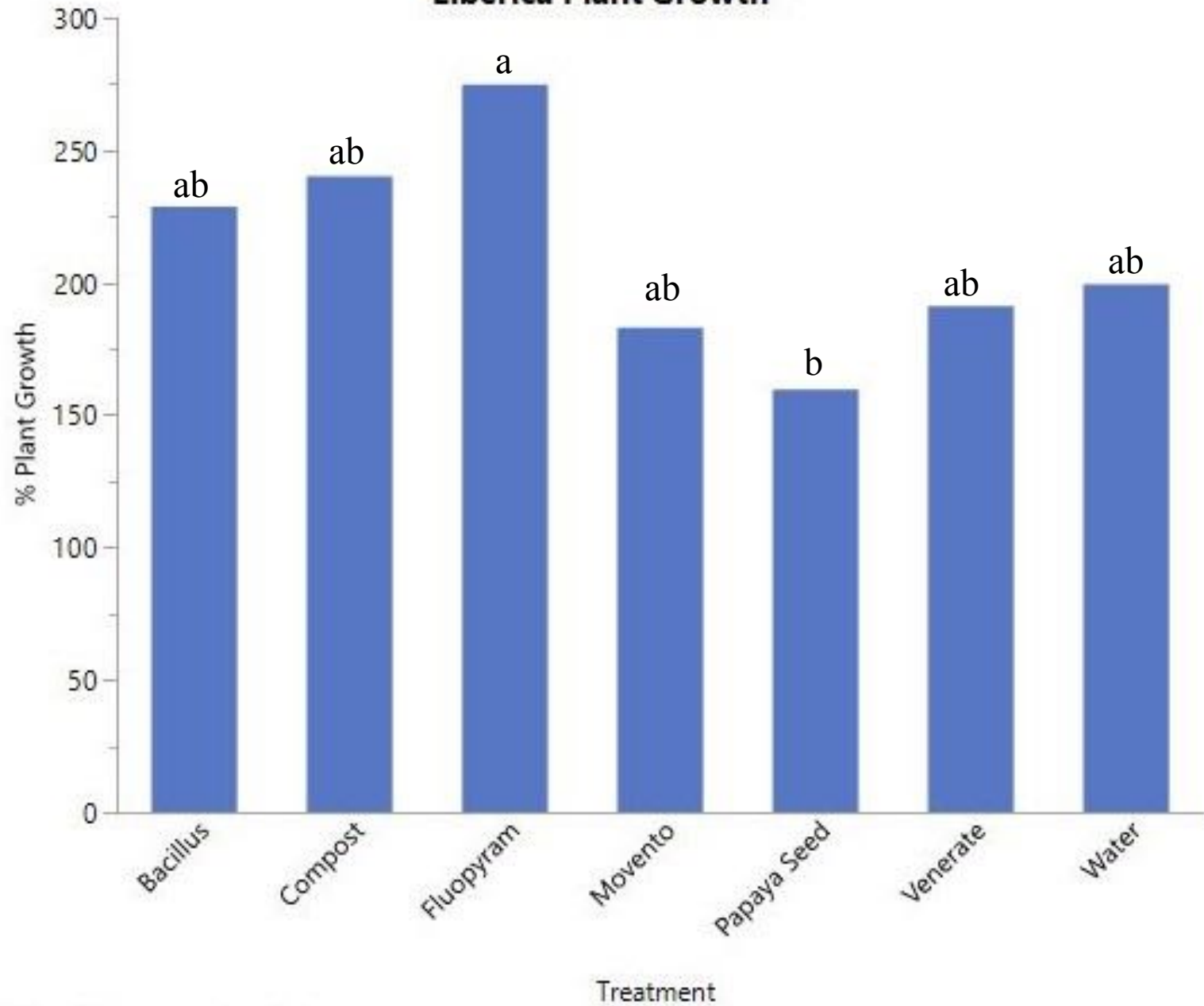
Typica Mk per Root System



Typica Plant Growth



Liberica Plant Growth

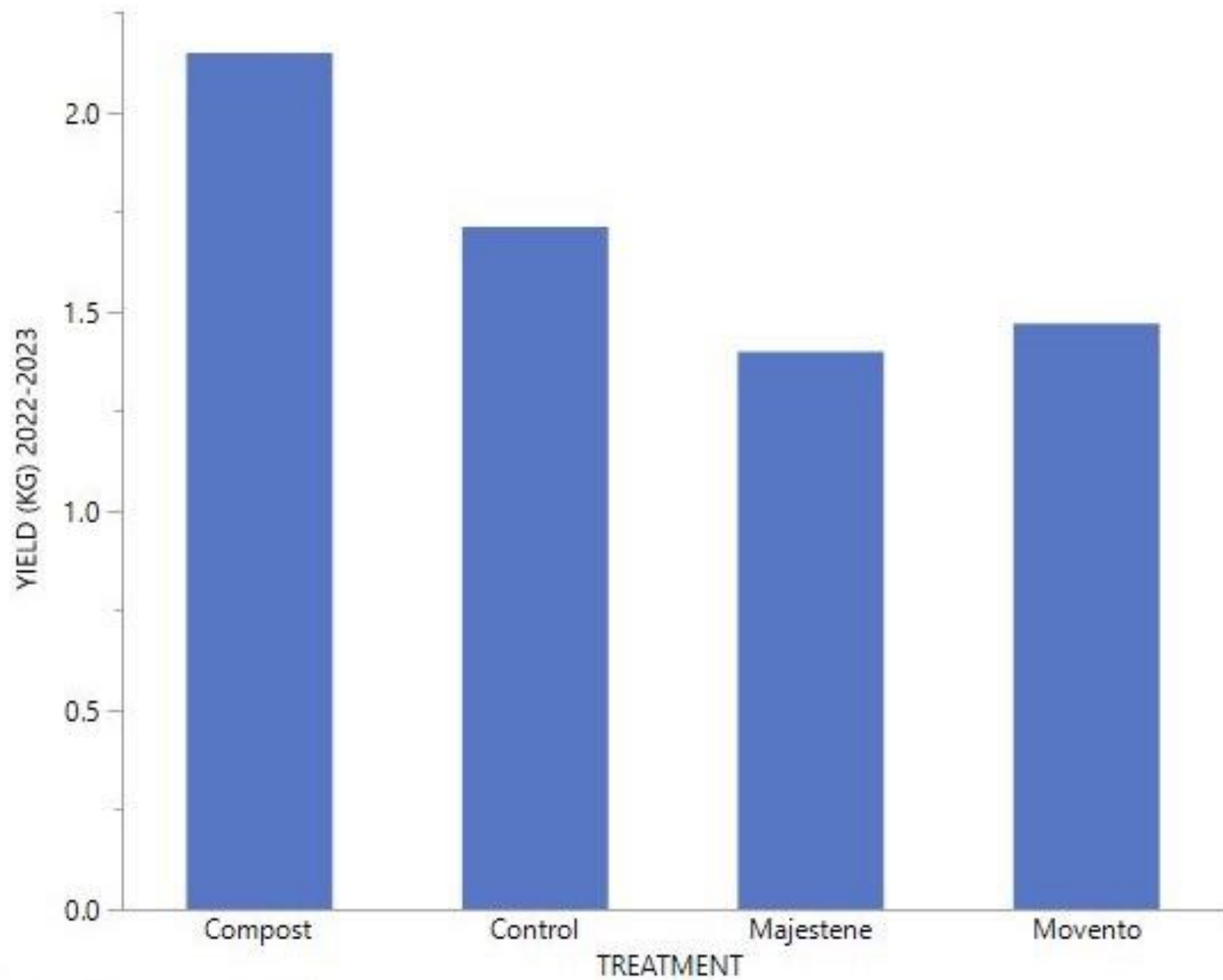




Field Trial

Typica Grafted
on Liberica
Rootstock and
Non-grafted
Typica

- Movento (spirotetramat)
- Venerate/Majestene
(*Burkholderia* spp. Strain
A396)
- Compost (1:1 incorporated
then top dressed)
- Untreated Control





A Pictorial Guide to Coffee Grafting

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Overview of coffee decline caused by the Kona coffee root-knot nematode

Since the early 1900s coffee growers in Kona, Hawaii, have been experiencing a decline of their crop. In 1907, Smith and Blagov noted plant-parasitic nematodes as pests capable of causing these losses (Schmitt et al. 2004). Then in 1935, Rypert et al. observed dieback of *Coffea typica* coffee, a coffee decline that was later found to be caused by *Meloidogyne freudensteini*, as described by Lawrence et al. in 1994. This serious disease of coffee was initially referred to by terms such as "transplanting decline," a "replant problem," "nutritional stress," and "Kona wilt."

A coffee survey conducted statewide in 2000–2001



Figure 1. Newly grafted coffee seedlings.

was 60%. Growers need to be vigilant in keeping CRKN out of uninfested areas and, if affected, to slow the spread of the pest. Kawabata et al. (2008) outline procedures for sampling a farm to diagnose a nematode infestation.

For additional and more detailed information about CRKN, cultural management of nematodes, replanting and more, see publications in the References and Literature Cited section of this publication.

Why it's important to graft coffee onto nematode-tolerant rootstock

In Hawaii, there currently are no chemicals that can legally be used to treat for CRKN. Nematode-resistant or resistant rootstocks are the only effective and practical



Kona Coffee Root-Knot Nematode Sampling Procedures

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Introduction

The Kona coffee root-knot nematode (*Meloidogyne freudensteini*) affects the health and productivity of coffee trees in Hawaii (Owen et al., 2002). This nematode causes lesions or galls on the roots of susceptible trees and causes dysfunction in the plant's ability to absorb water and nutrients in its branches, leaves, and leaves. Ultimately, *M. freudensteini* will reduce yield and cause tree death over time. The overall impact of the tree:

Typical tree symptoms during early infestation can be difficult to diagnose; however, trees with severe nematode infestation can exhibit symptoms of wilt, leaf yellowing and flagging, exuberant dieback, stomp rot/dieback, only upright, forward and/or backward, and overall decline (Serrano et al. 1999) (see Figures 1 and 2). Flower and fruit drop and premature ripening or maturation of the berries can also occur. Overall, *M. freudensteini* will result in significant yield losses over time if not managed.

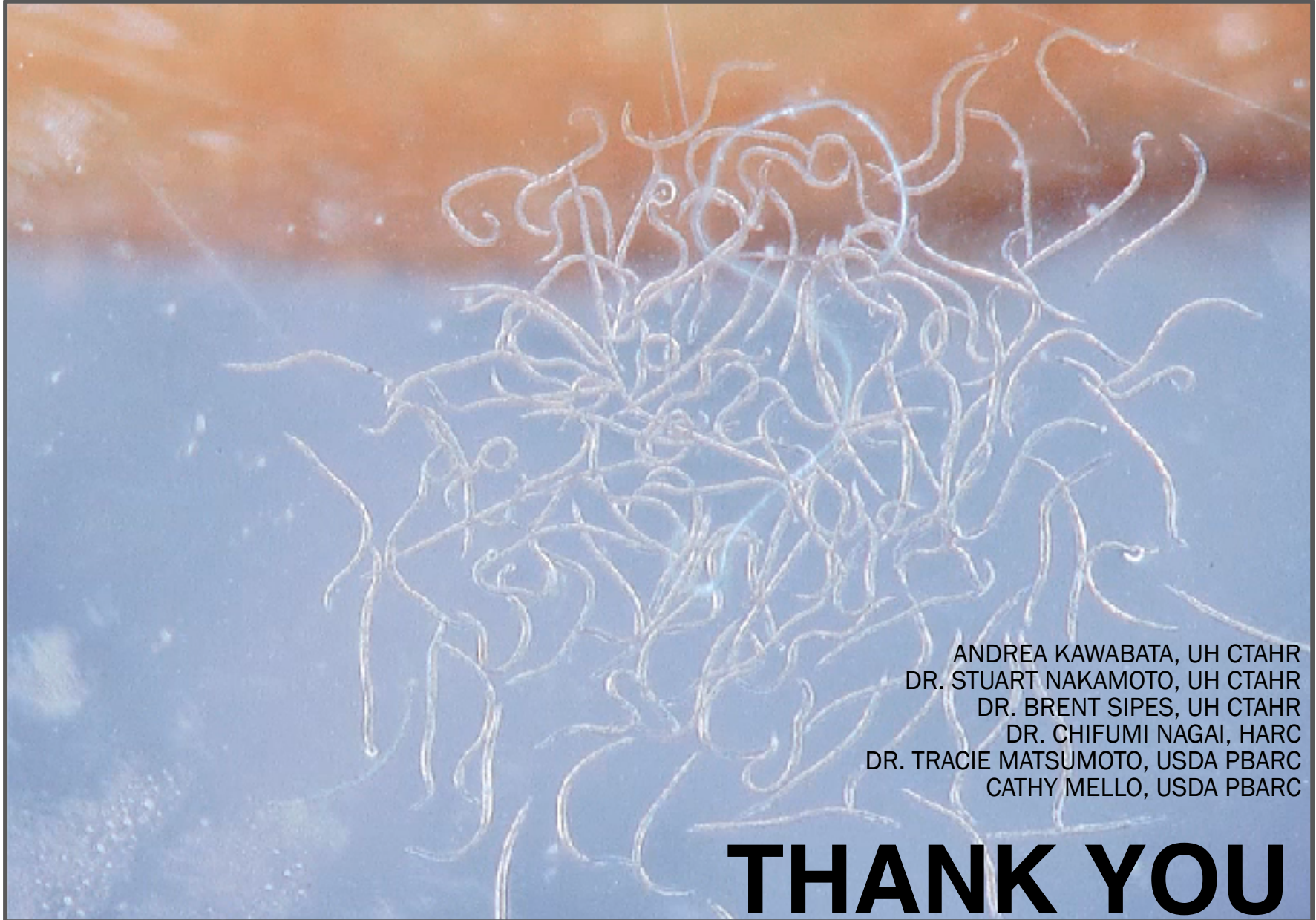
Determining the presence (or absence) of *M. freudensteini* on coffee farms can assist growers with



Figure 2. A visual comparison of 10-year-old Kona coffee trees grafted onto *M. freudensteini*-tolerant (left) or susceptible (right) rootstock. Trees grafted onto tolerant rootstock show no symptoms of decline.

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MORE INFORMATION



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THANK YOU