Anaerobic soil disinfestation as preplant soil treatment for perennial crop nurseries

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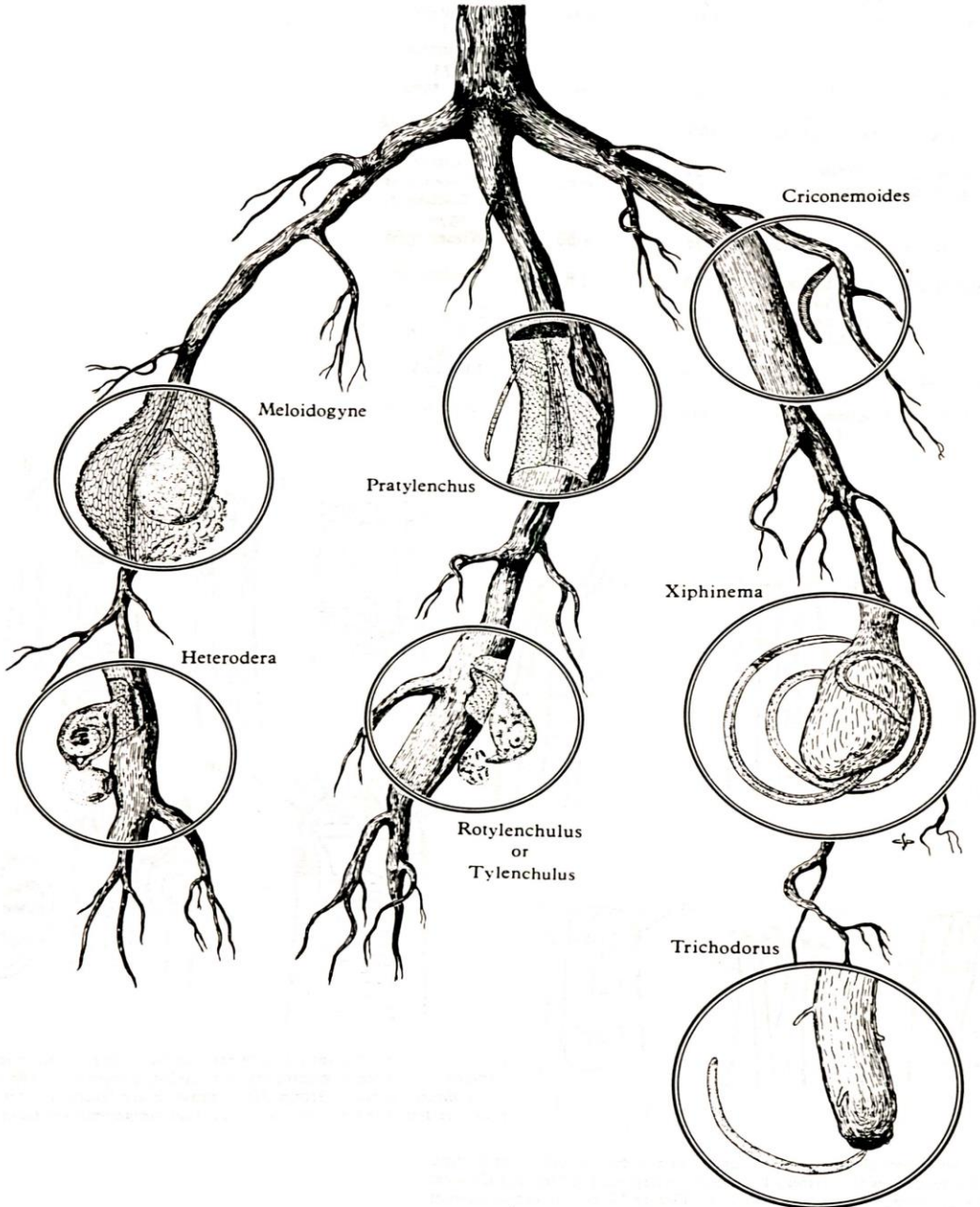
Producing nematode-free nursery stock

- Trees and vines are produced in open fields
  - almond, apple, cherry: 15 months;
  - grape: 12 months
  - walnut: 27 months
- Use of methyl bromide under special regulation
- 1,3-D as replacement in question

Outline

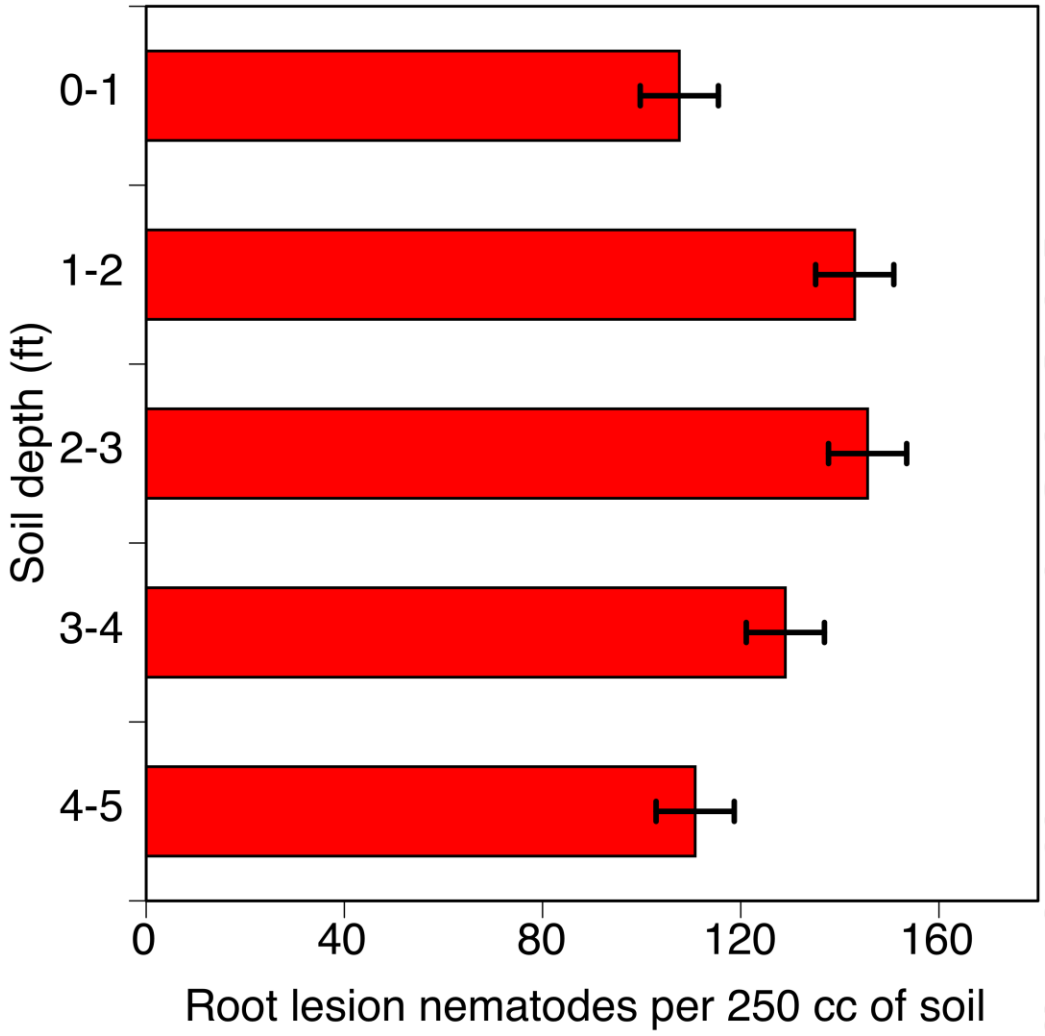
- What is anaerobic soil disinfestation (ASD)?
- What substrates can be used?
- How to suppress plant-parasitic nematodes?
- How does it fit into nursery systems?

Feeding habits of plant-parasitic nematodes



(Papp)

Root lesion nematode population density distribution



Anaerobic soil disinfestation (ASD)

- Apply carbon-rich substrate
- Incorporate with a rototiller
- Install irrigation lines, cover soil with TIF add water (6 inch; 150 L/m^2)
- Keep moist for one month (1 inch, 25 L/m^2 every other day)
- Remove TIF film, allow for aeration, and plant crop

Anaerobic soil disinfestation

Anaerobic soil disinfestation

Soil drenches with treatment suspensions

Cover the soil service with totally impermeable film

Substrates for (ASD)

(typical application rates: 9 ton/acre; 20.2 ton/ha)

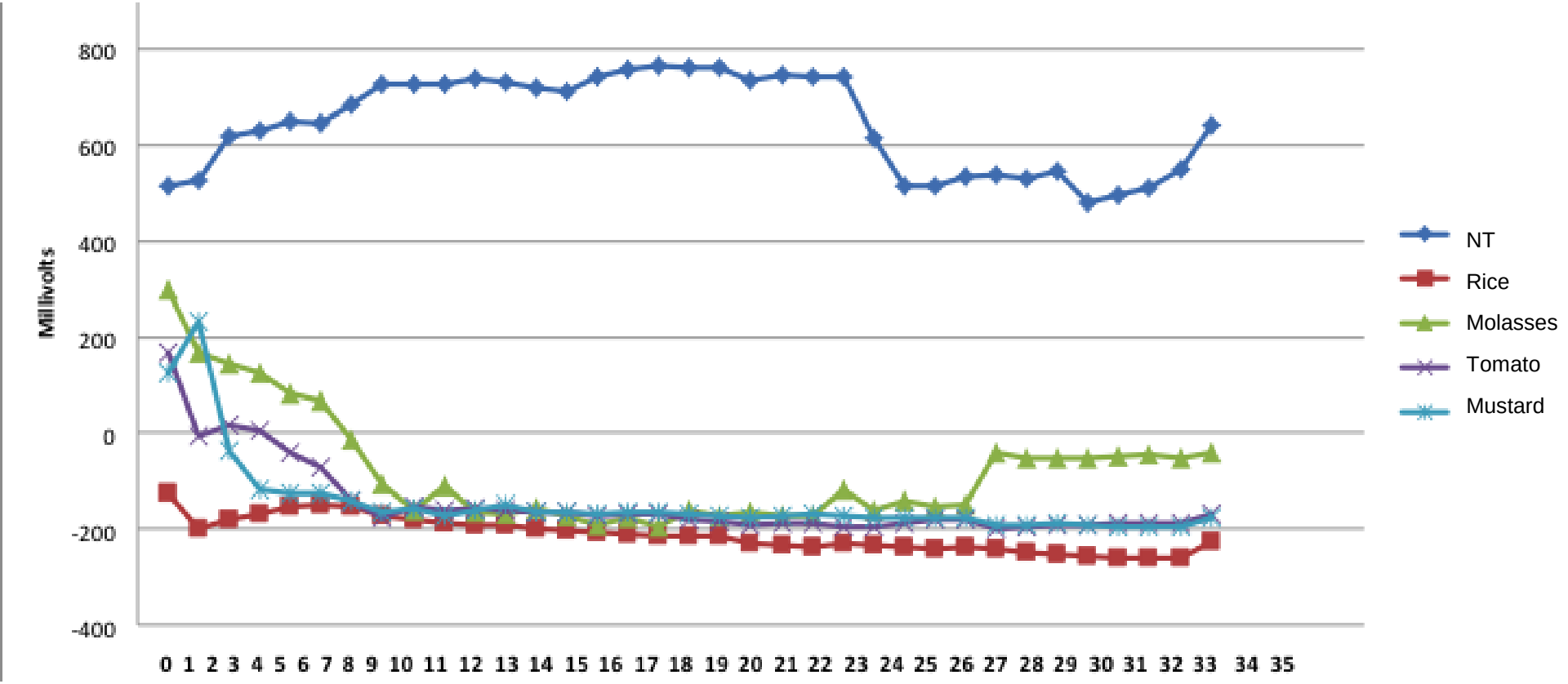
- Rice bran
- Molasses
- Tomato pomace
- Mustard seed meal

Anaerobic soil disinfestation

- Naturally infested field after prunus
- Determined nematode population densities
  - At treatment (August 15, 2016)
  - At plant (November 9, 2016)
- Planted pre-stratified ‘Nemaguard’ seeds
- Monitored emergence and plant growth
- Determined nematode root penetration
- Continue monitoring plants and determine nematode numbers

Soil anaerobic conditions during ASD incubation

(18-inch deep)

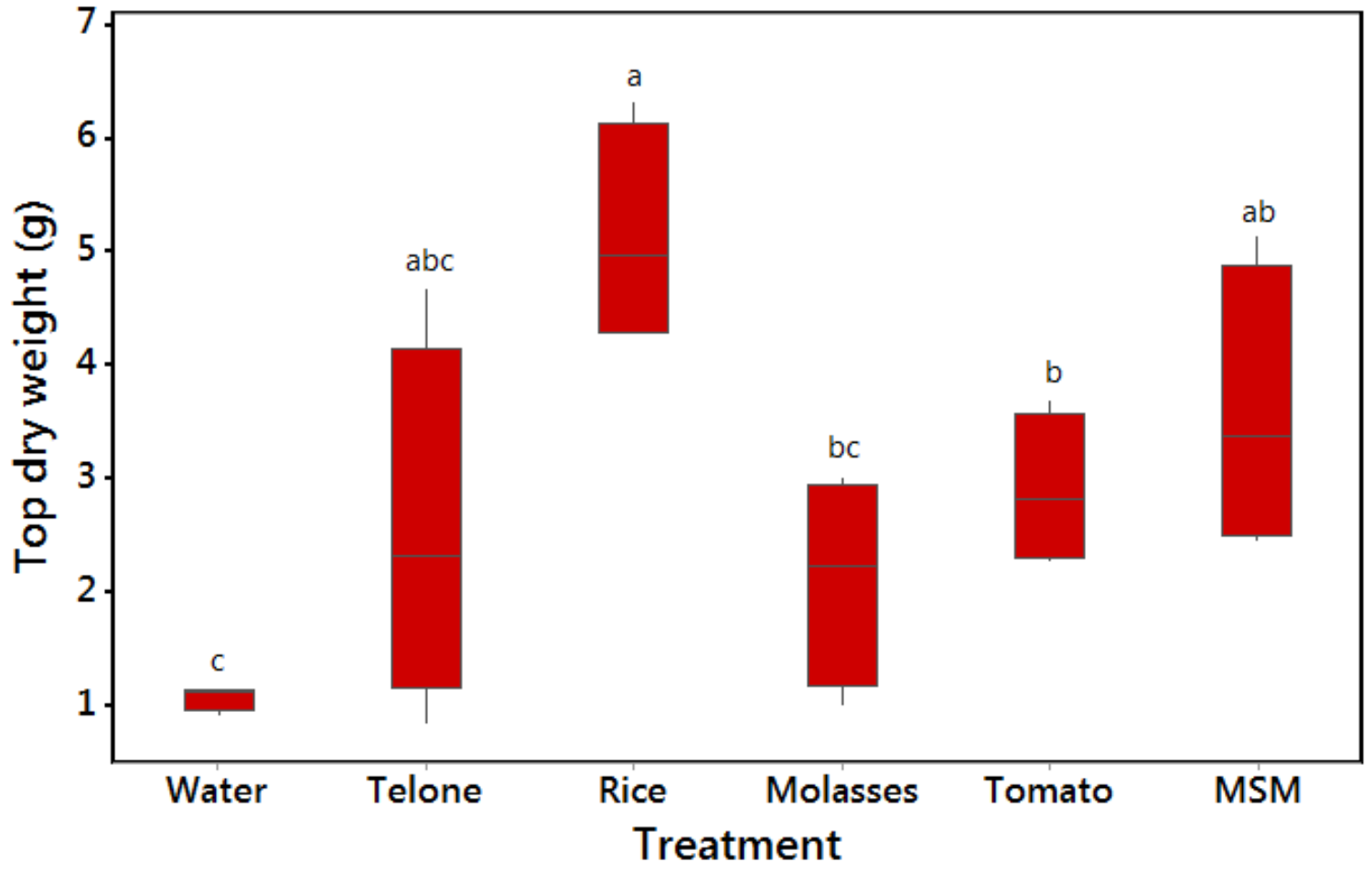


Incubation time under plastic (days)

Soil populations at planting of ‘Nemaguard’ seeds post treatment by ASD (Nov. 2016)

All ASD treatments reduced the population densities of *Pratylenchus vulnus* to a similar level as soil fumigation.

Top dry weight of peach rootstock ‘Nemaguard’ in *Pratylenchus vulnus*-infested soil May 2017



Root infection of 'Nemaguard' rootstock in *Pratylenchus vulnus*-infested soil

After 15 months Root extractions of *P. vulnus* were close to the detection level in all ASD treatments similar as after Telone fumigation. Populations were detected in plants that had grown in non-treated soil.

After 27 months Some *P. vulnus* were extracted from roots form most treatments, non-significant ranges were similar for plants in fumigated and ASD-rice bran soils, numbers were more variable for other ASD treatments.

Field experiments for scaled-up applications (summer 2018)

#			METHOD
1	Water	Water	Surface continuous
2	Telone II	N/A	shank
3	Methyl bromide	N/A	shank
4	ASD	Water	Surface continuous

Plant seeds of peach rootstock ‘Nemaguard’ (one year) and ‘Paradox” walnut rootstocks (two years)

Soil population densities of *Pratylenchus vulnus* after soil treatments

Soil population densities at 0-5 ft depth were lower after fumigation with Telone II, Methyl bromide, and ASD treatment than in the non-treated control.

Ground cover of weeds was reduced after fumigation with Telone II, Methyl bromide, and ASD treatment compared to the non-treated control.

Pratylenchus vulnus in walnut roots after soil preplant treatments (2nd year)

When postplant Reklemel was applied after one year, fewer *P. vulnus* were extracted from roots from plots after preplant fumigations and the ASD treatment than from roots grown in the control.

A similar trend was observed when no Reklemel was applied.

Hypothesis:

Need tarp – exclusion of atmospheric oxygen

Application procedure:

Amount of substrate?

Amount of water?

Root-knot nematodes in nursery stock after preplant soil treatments after ONE year

Experiments were conducted with:

3, 5, 7, 9t/A of rice bran at 1-inch post treatment water

9t per acre of rice bran at 1/2, 1/4, 1/8 – inch of water as post treatment water

Most consistent nematode reduction was observed after 9t/A and 1” of water.

Application procedure:

Time of year?

Vigor and nematode infections of nursery stock Prunus after preplant soil treatments varying application timing

Vigorous growth of Prunus nursery stock was observed after ASD conducted in July, August, September and October.

Weed suppression was less under ASD than under covered fumigation treatment, especially at the October treatment timing.

After the second year of growth, root galling was low after ASD treatment in plants from plots at every treatment timing.

Limitations

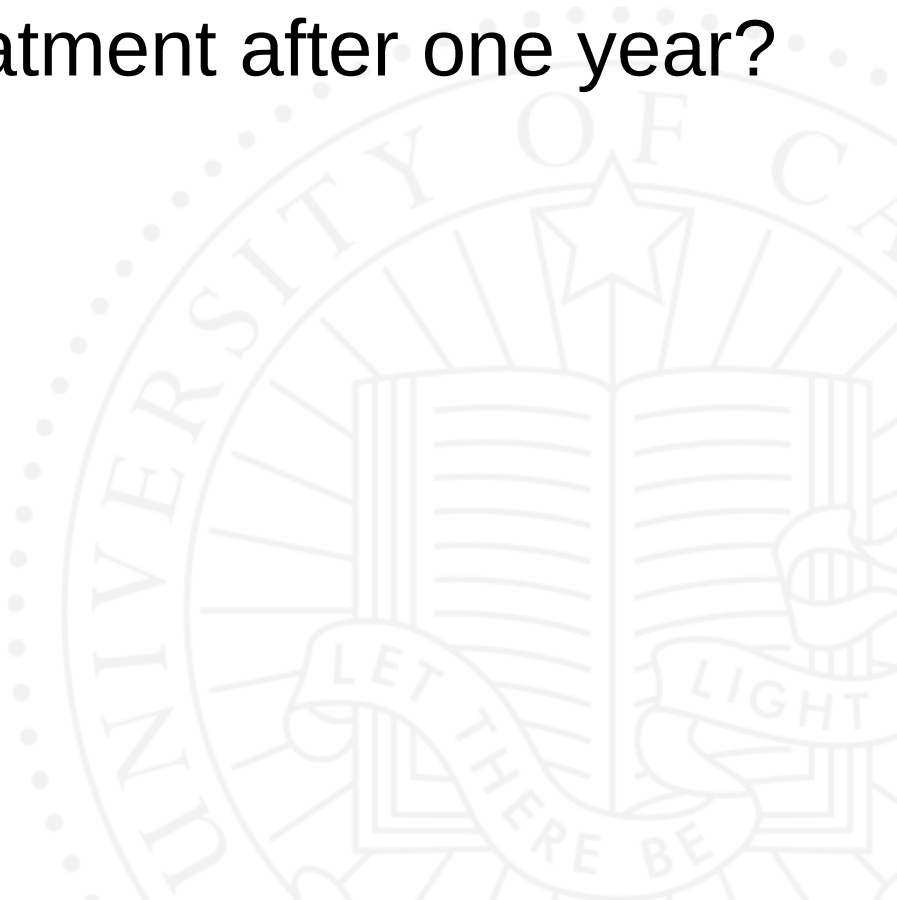
Efficacy of ASD in soil with different sources of nematode infestation

Remnant grape roots can be a source of RKN inoculum difficult to reduce with ASD.

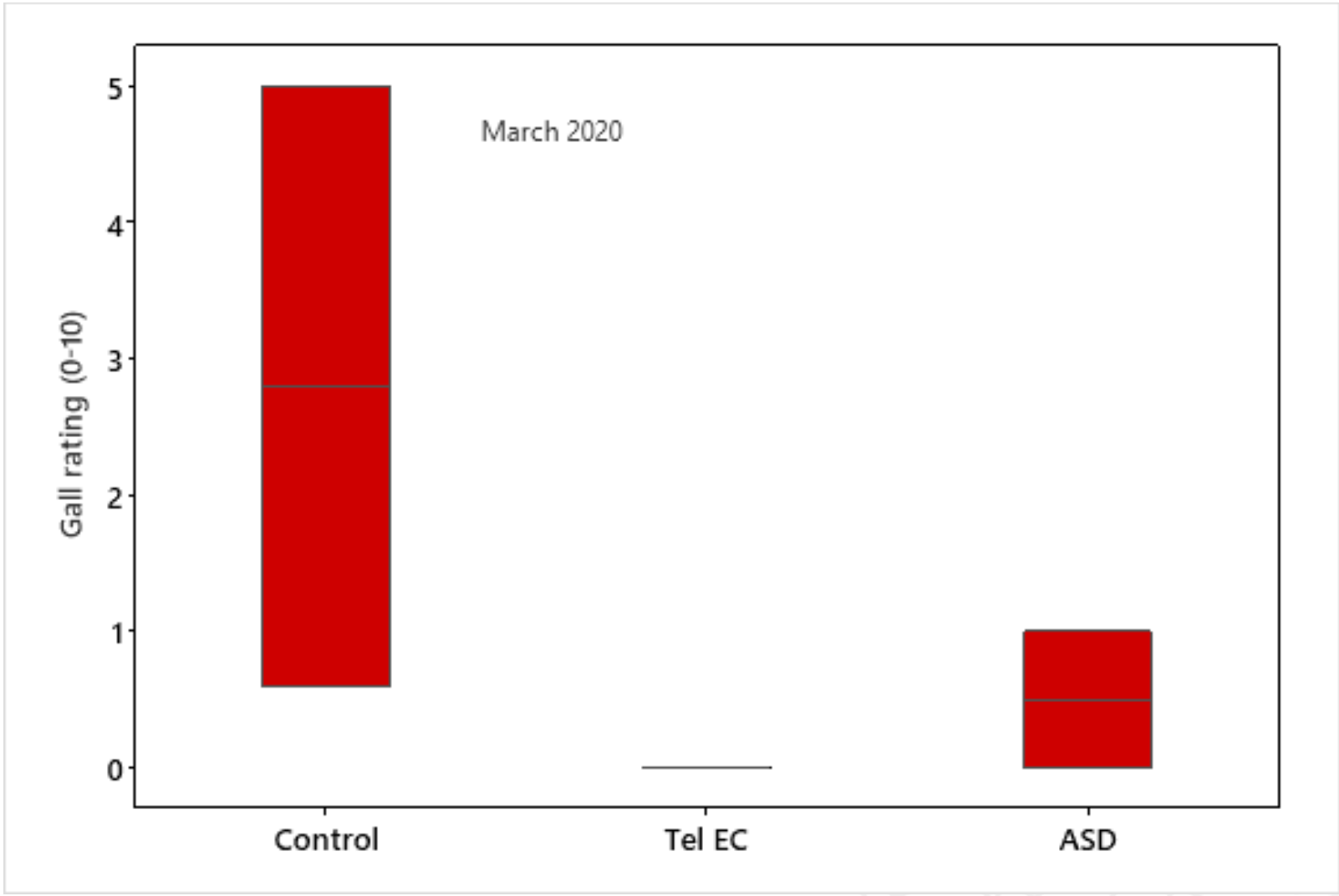
RLN population densities after treatments in pure sand, Rio Oso, CA

Sandy soils are more challenging to treat with ASD.

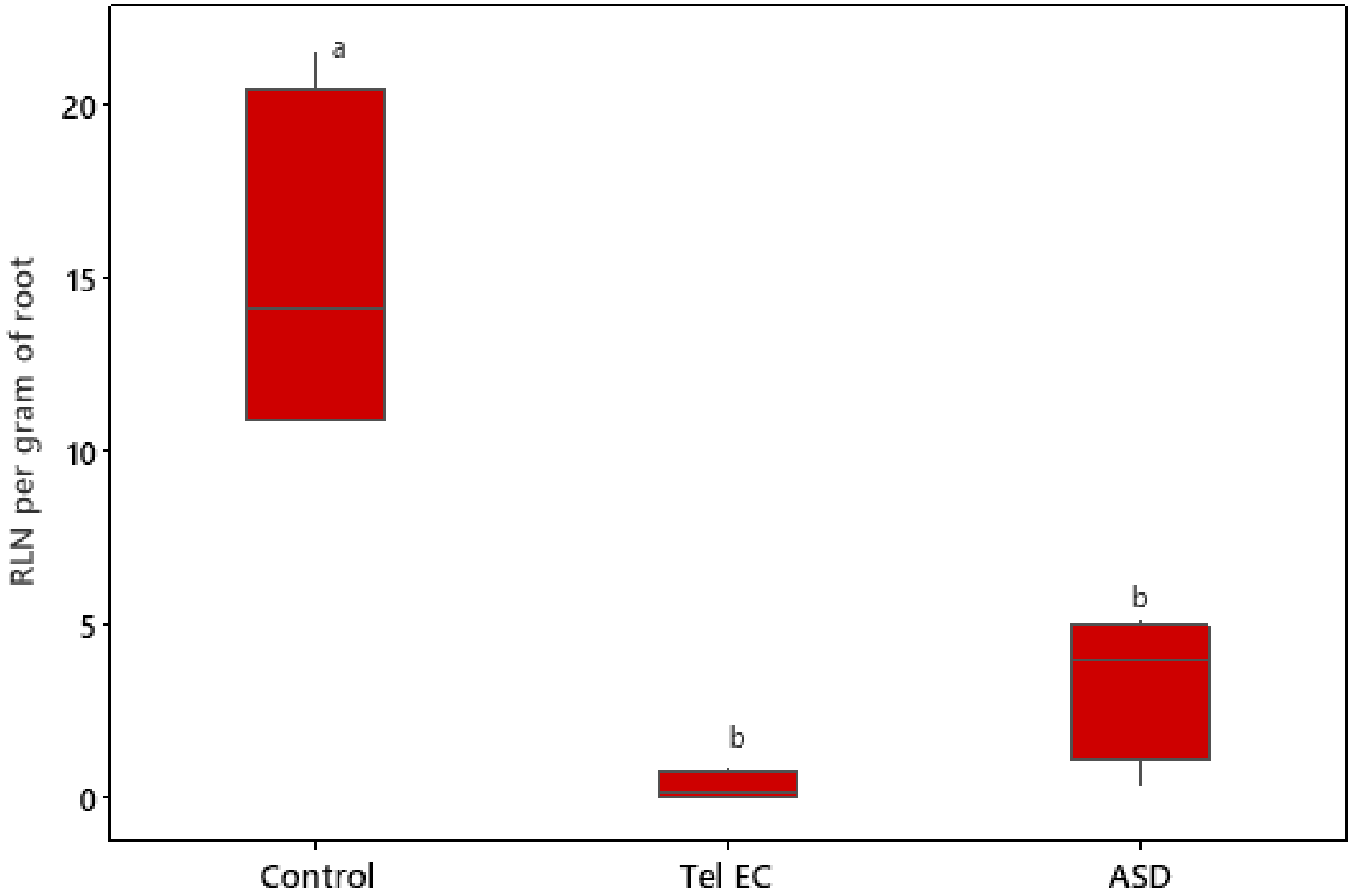
Why Salibro postplant treatment after one year?



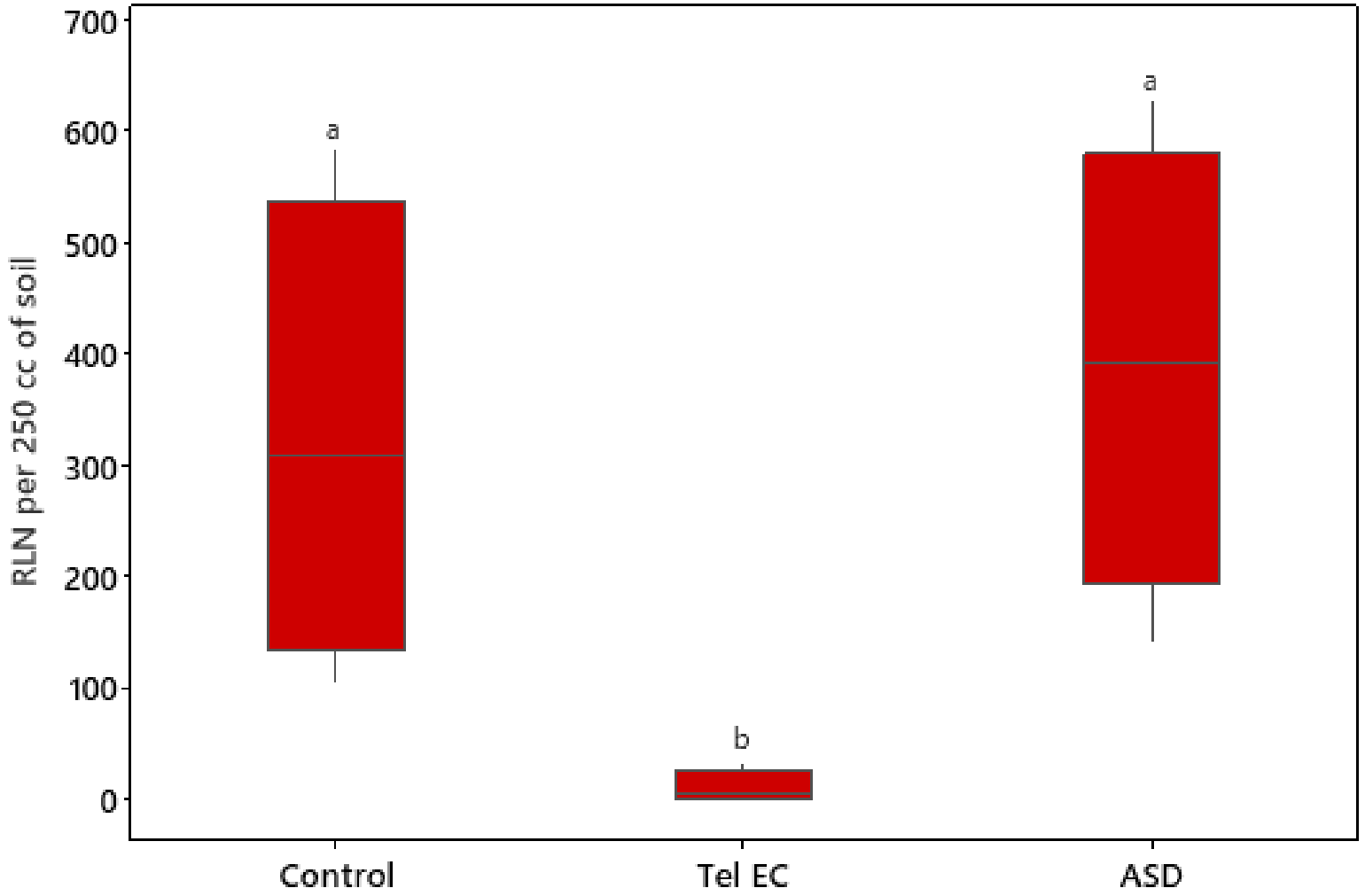
RKN-induced root galling of Prunus after preplant soil treatments



RLN in roots of Prunus after preplant soil treatments



RLN in soil in the root zone of Prunus after preplant soil treatments



Results and Conclusions

- Anaerobic soil disinfestation is as effective as soil fumigation in RLN-infested ground.
- For nursery applications, anaerobic soil disinfestation needs post-plant remedies, at least for stock being propagated two seasons.
- Numbers of RLN in walnut roots (2 years) were similar after ASD as after fumigation.
- Grape roots may allow survival of RKN.
- ASD is a candidate for nursery applications for nematode suppression.

The Team - Acknowledgements

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Thank you!!

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