Nematicides delivered:
1/via resistant rootstocks
2/foliar-applied systemics

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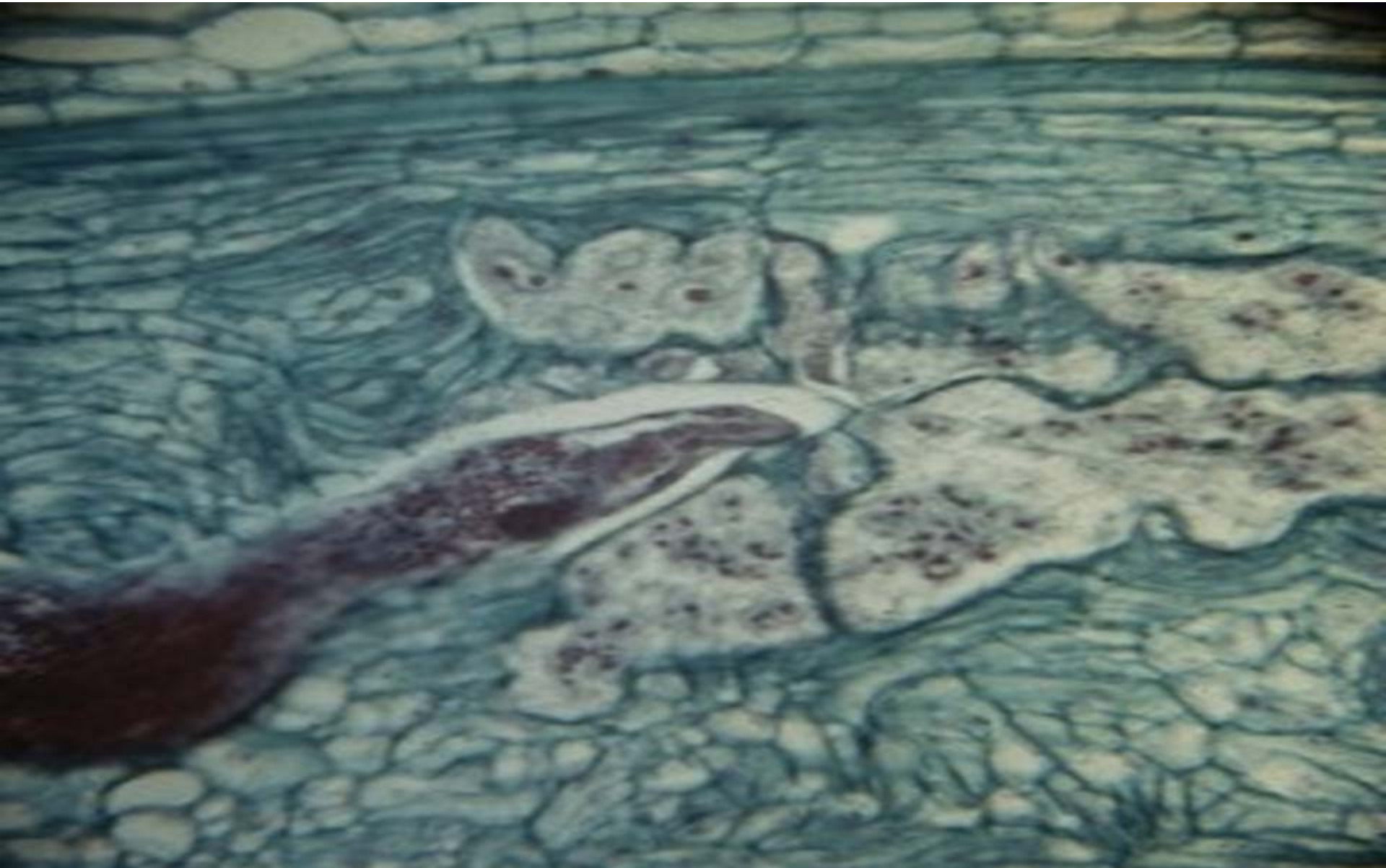
Nematicides must travel through 5,000 lbs of soil / vine to reach the 14 lb / vine of grape roots.

It is time to deliver nematicides via the 14 lb of vine roots!

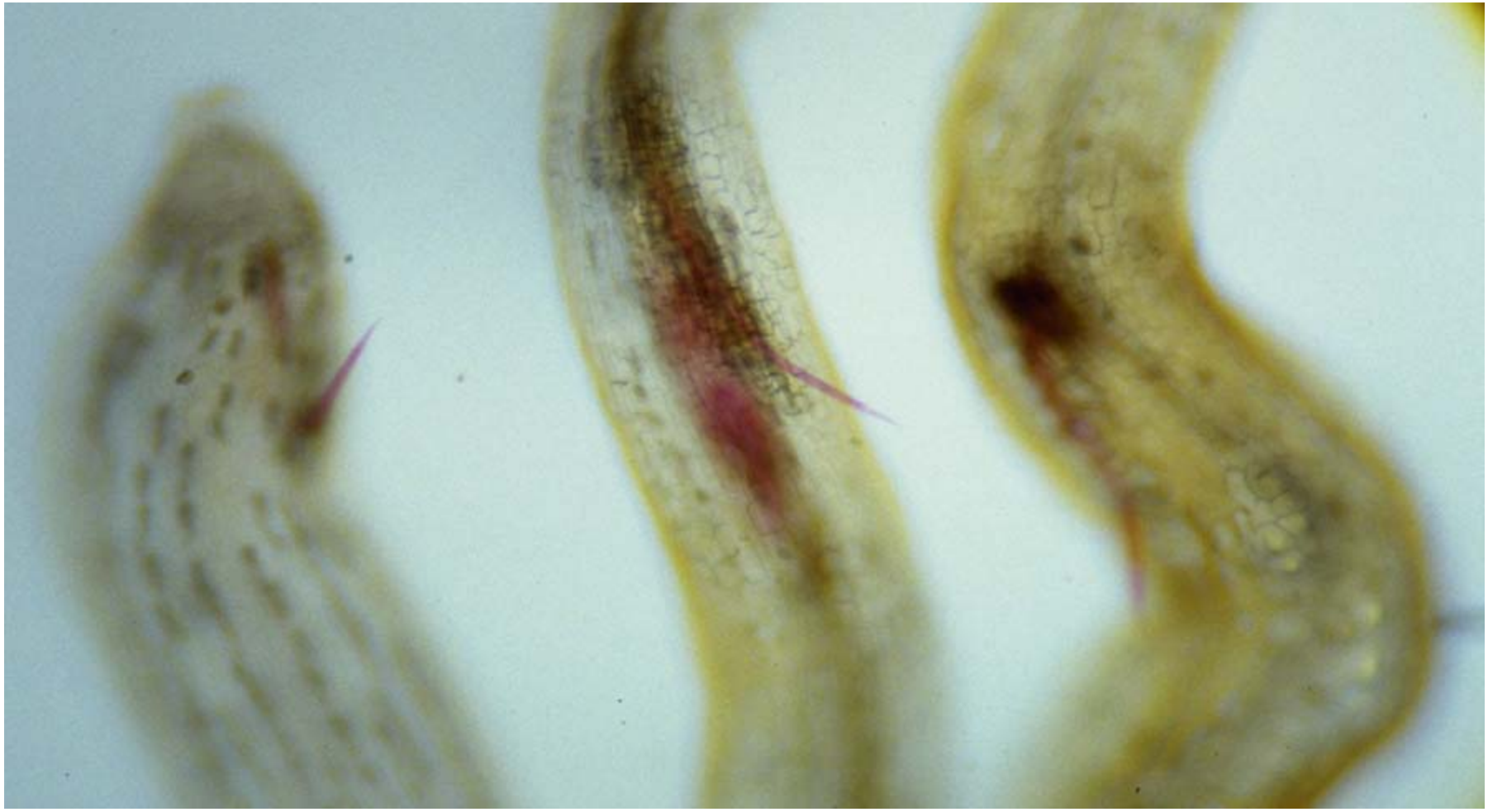
A successful adult female in her gall at ~ 20 days

The adult female of root-knot nematode changes plant cells into feeding cells, photo ~30 days after entry.



Root-knot nematodes that enter roots at the wrong location are commonly greeted by a Hypersensitive Response (HR).

Freedom and Harmony were the only sources of root-knot resistance. HR occurs as they enter root tips



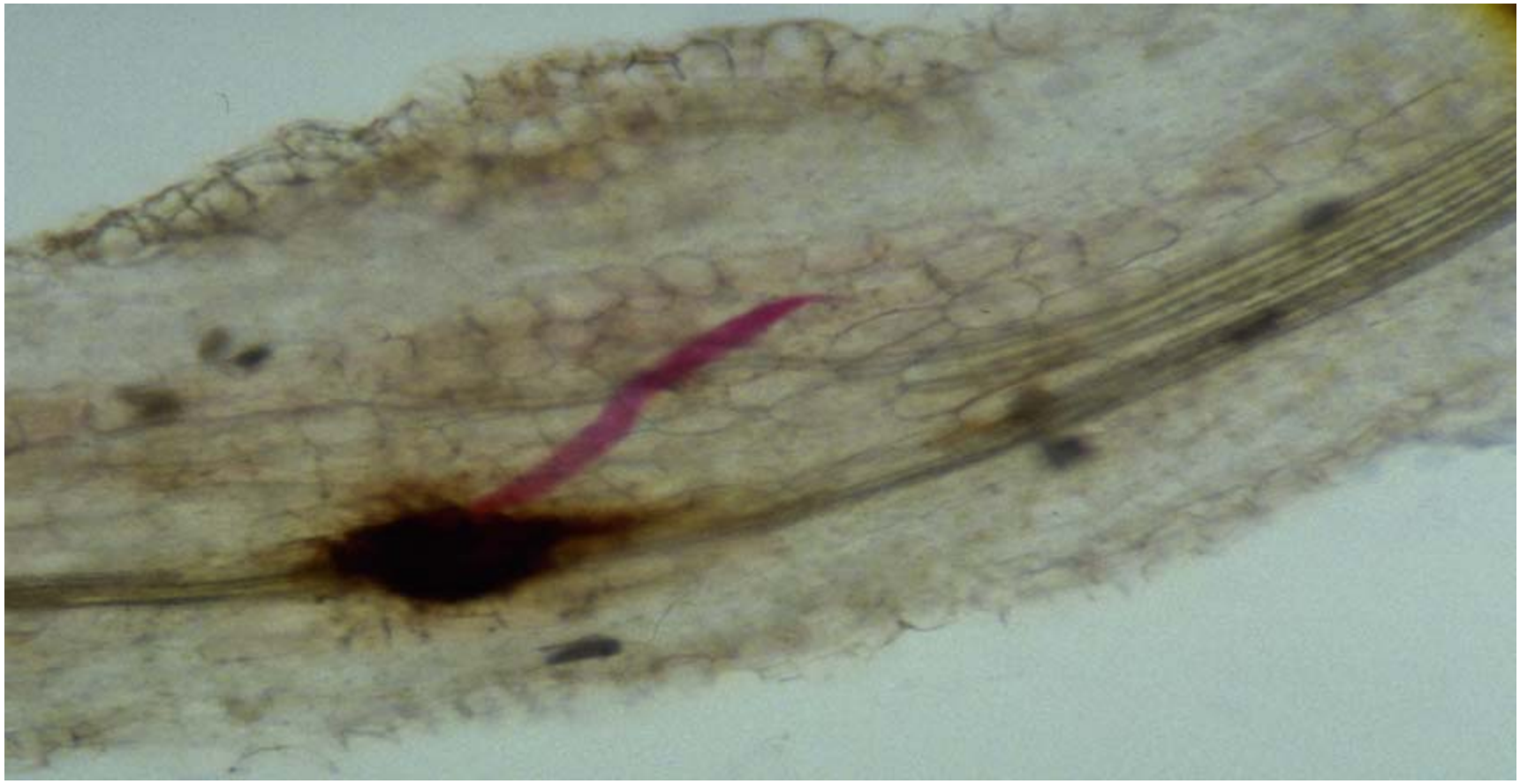
But, ---root knot populations began to develop that could slip by detection and HR

By the early 1990s we had identified 5 rootstocks that were not so easily tricked.

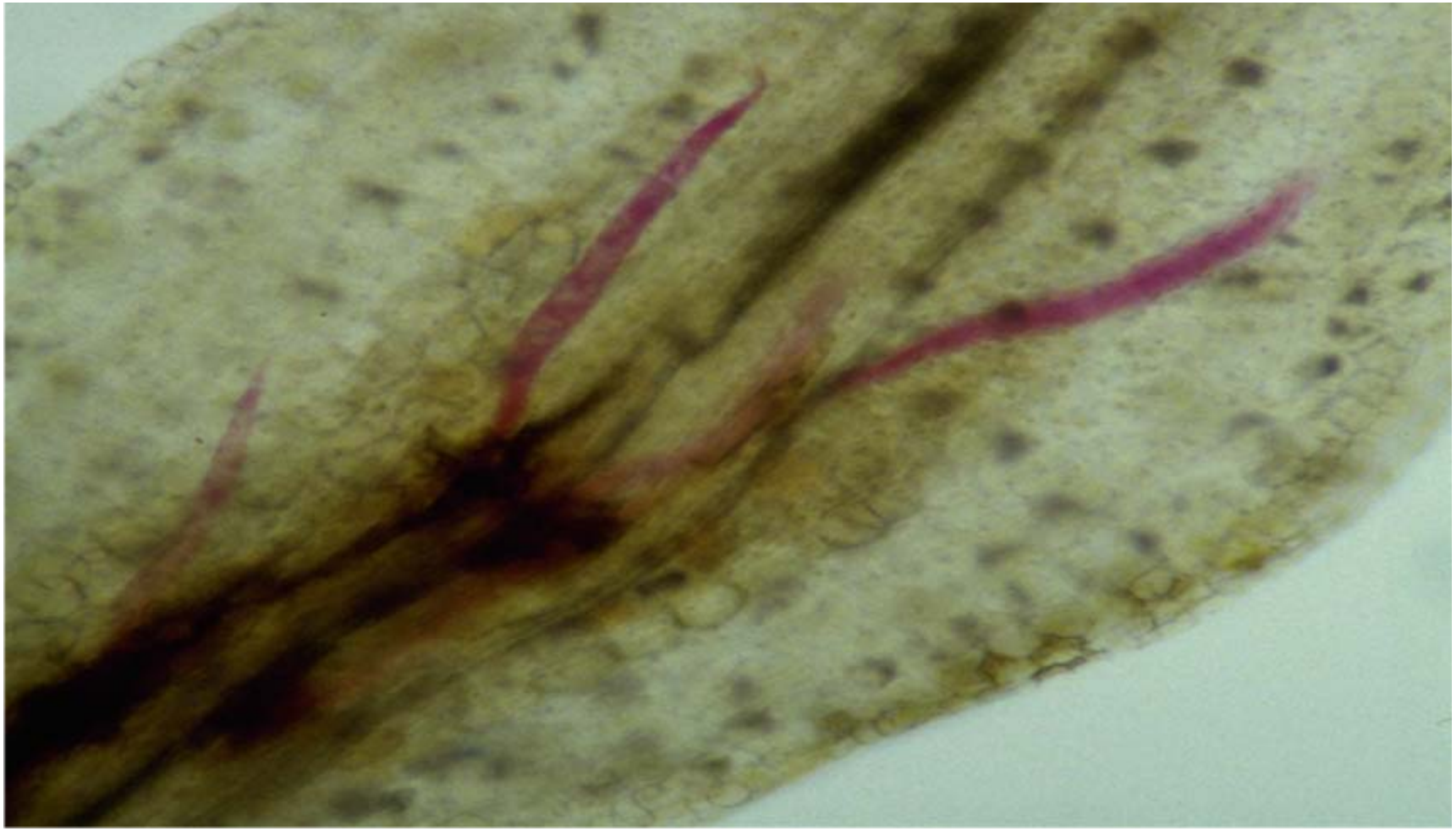
Rootstocks with broad and durable nematode resistance from my lab include:

- RS-3, medium vigor, available at nurseries
- RS-9, low vigor, available at nurseries
- 10-17A, medium-high vigor, some availability
- 10-23B, medium vigor, propagation problems--avoid
- 6-19B, too low of vigor, some control lost--avoid

New resistant rootstocks have the ability to detect and provide larger HR as the juveniles enter.



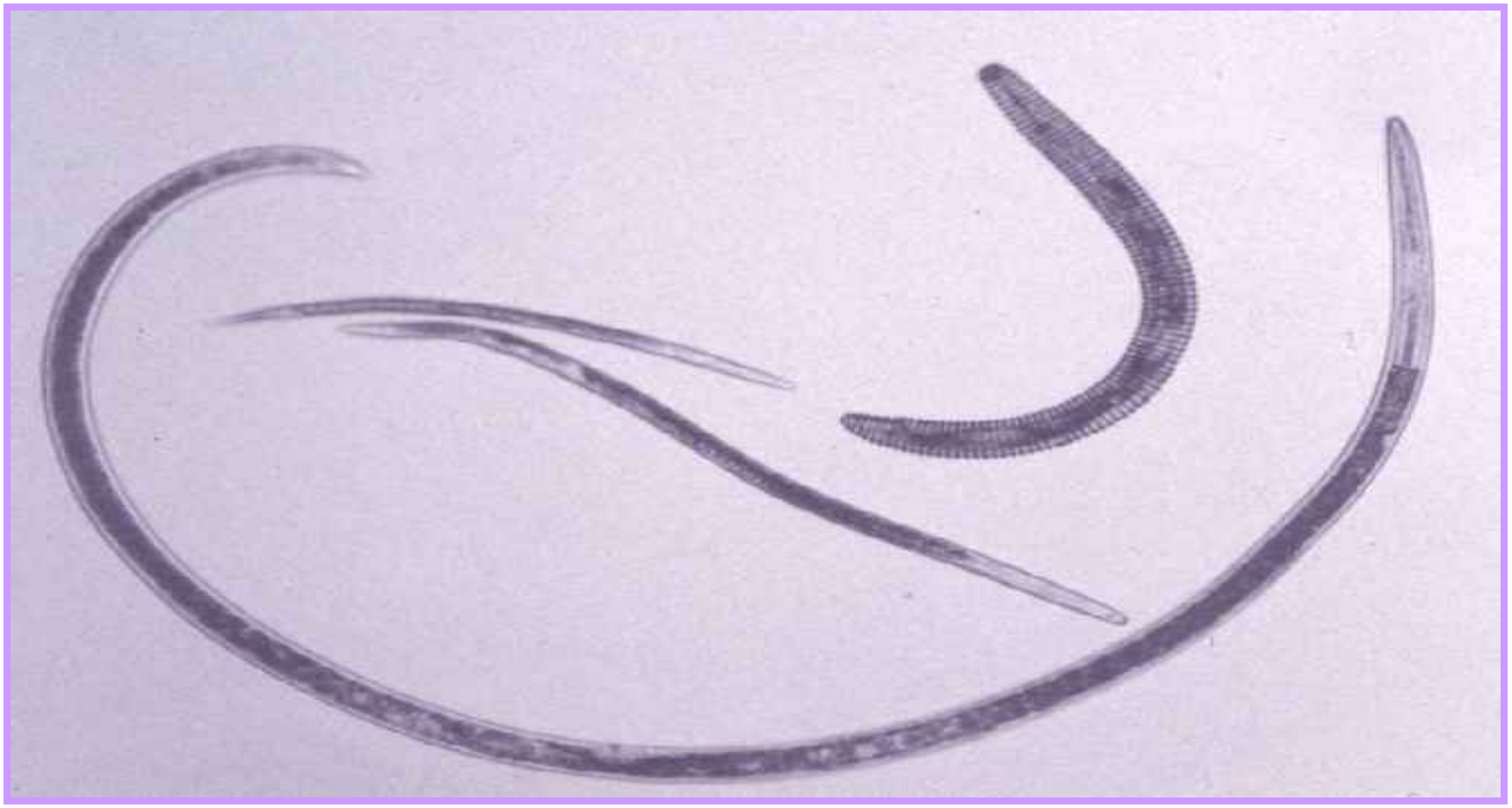
These rootstocks detect and defend as nematodes enter, line up along vascular bundles, or as they attempt to enlarge.



The new rootstocks not only cause HR but possess several other resistance mechanisms after nematode entry.

There are even mechanisms of defense that dissolve adult females ~20 days after entry.

But for grape growers there are a dozen nematode types



Grape growers need rootstocks with broad and durable resistance.

This is accomplished with activation of nematicides wherever the nematode may feed.

Table 1. Rootstock responses to selected soil-borne problems

Pest-Disease Problem	**Harmony**	**Freedom**	**O39-16**	**RS-3**	**RS-9**	**10-17A**
Meloidogyne spp	R	R	S	R	R	R
aggressive *Meloidogyne* spp	HS	HS	S	R	R	R
Pratylenchus vulnus	S	MR	S	R	R	R
Tylenchulus semipenetrans	S	S	S	ss	ss	ss
Xiphinema americanum	S	S	S	S	S	S
Xiphinema index	R	R	R	MR	R	R
Mesocriconema xenoplax	S	S	S	MR	S	S
Paratylenchus hamatus	S	S	S	R	R	S
Rejection component, RP	S	S	T?	S	S	T?
Grapevine Fan Leaf Virus	IT	IT	T	T	?	IT

The take home message is: broad and durable nematode resistance mechanisms in rootstocks are the result of nematodes being detected and chemicals delivered precisely where needed.

Nematicides delivered:
1/via resistant rootstocks

2/foliar-applied systemics

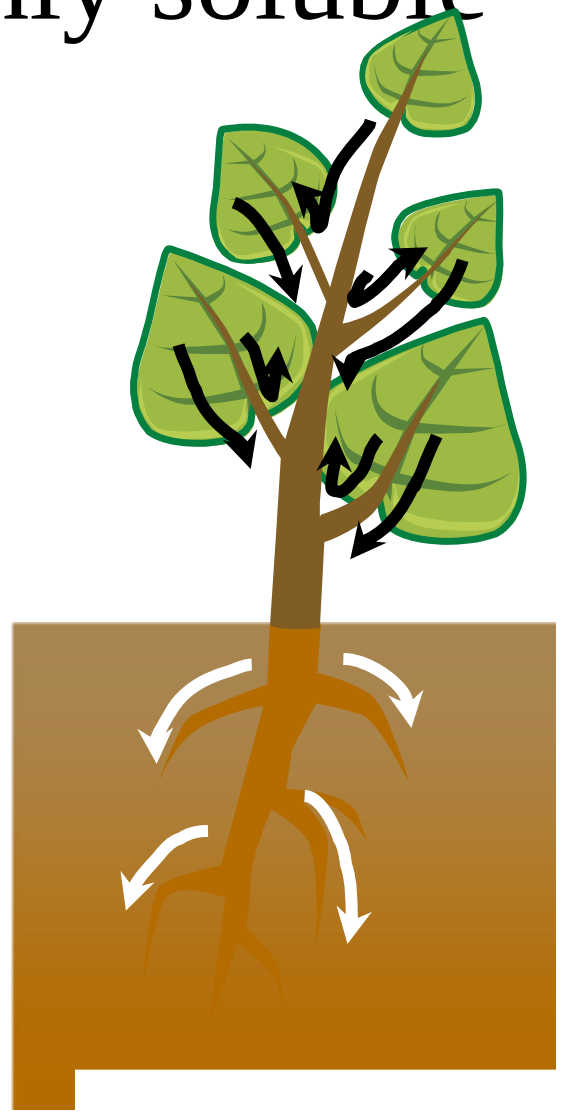
2/ Where are we with nematicides delivered systemically?

Two years ago we didn't think a foliar-applied nematicide was possible?

MOVENTO

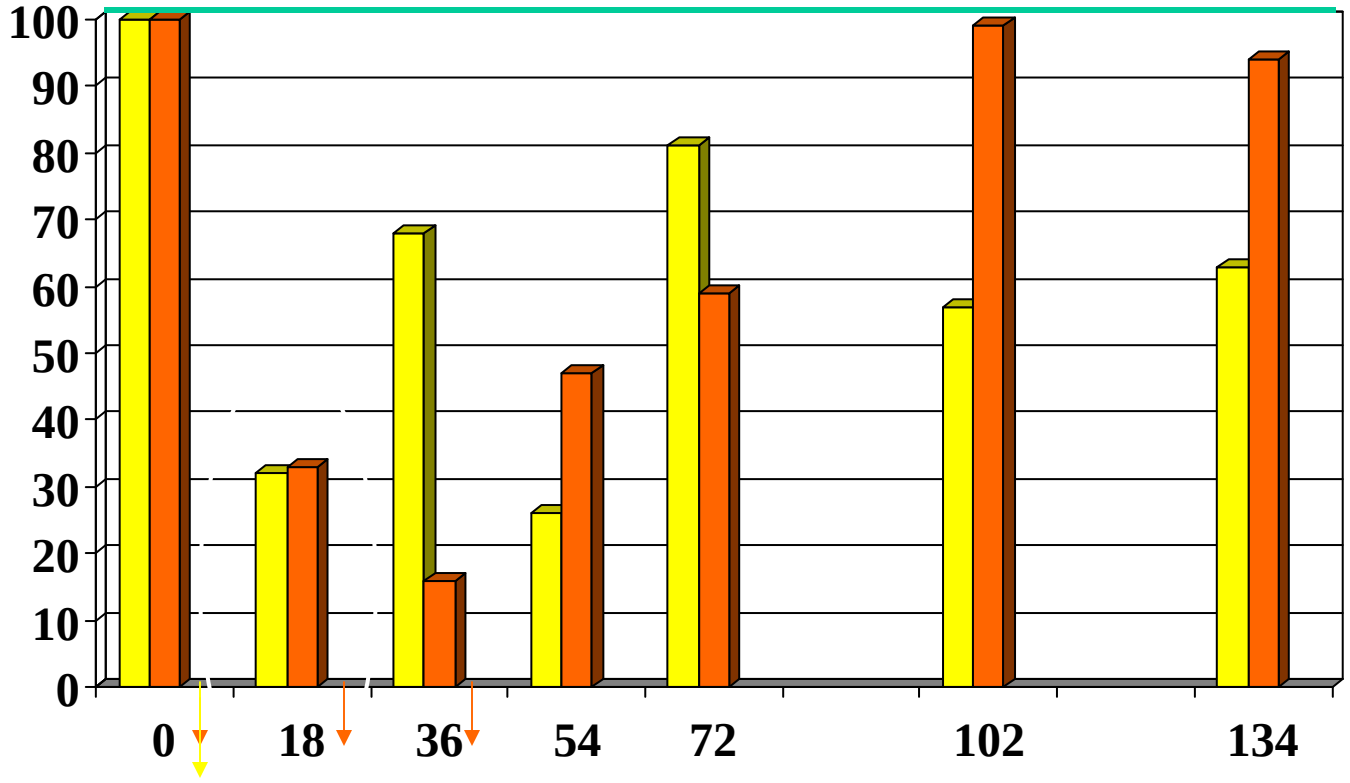
Foliar-applied and highly soluble in plants

- Hinders lipid biosynthesis
- Nematodes utilize stored lipids during egg-laying, molting, etc.
- The ai and/or its metabolites move quickly through plants, think days not weeks



P. vulnus in water suspension

X. americanum/250 cc soil as compared to untreated at Orosi-East

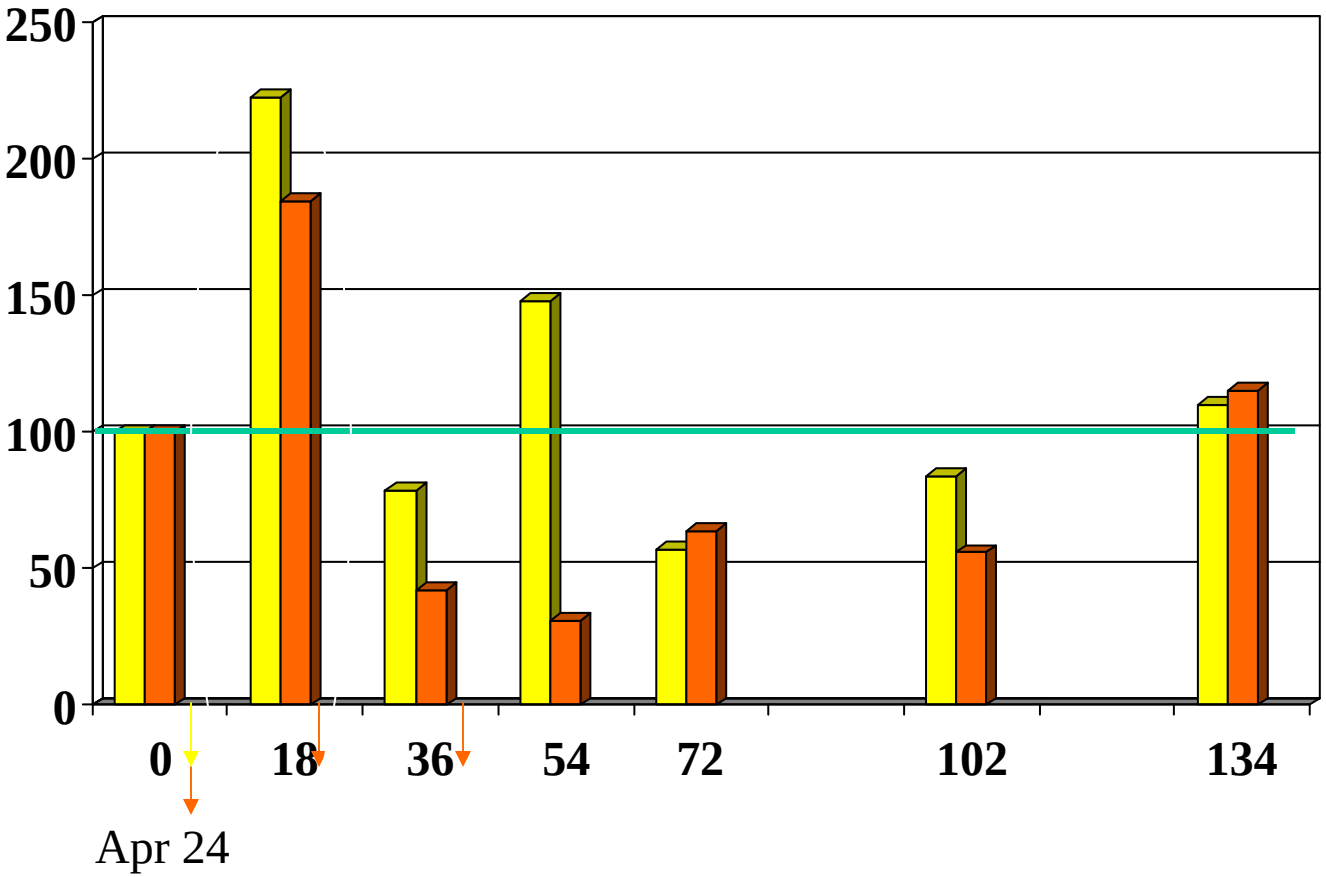


ns

Apr 24

Nematodes extracted using sieve/mist

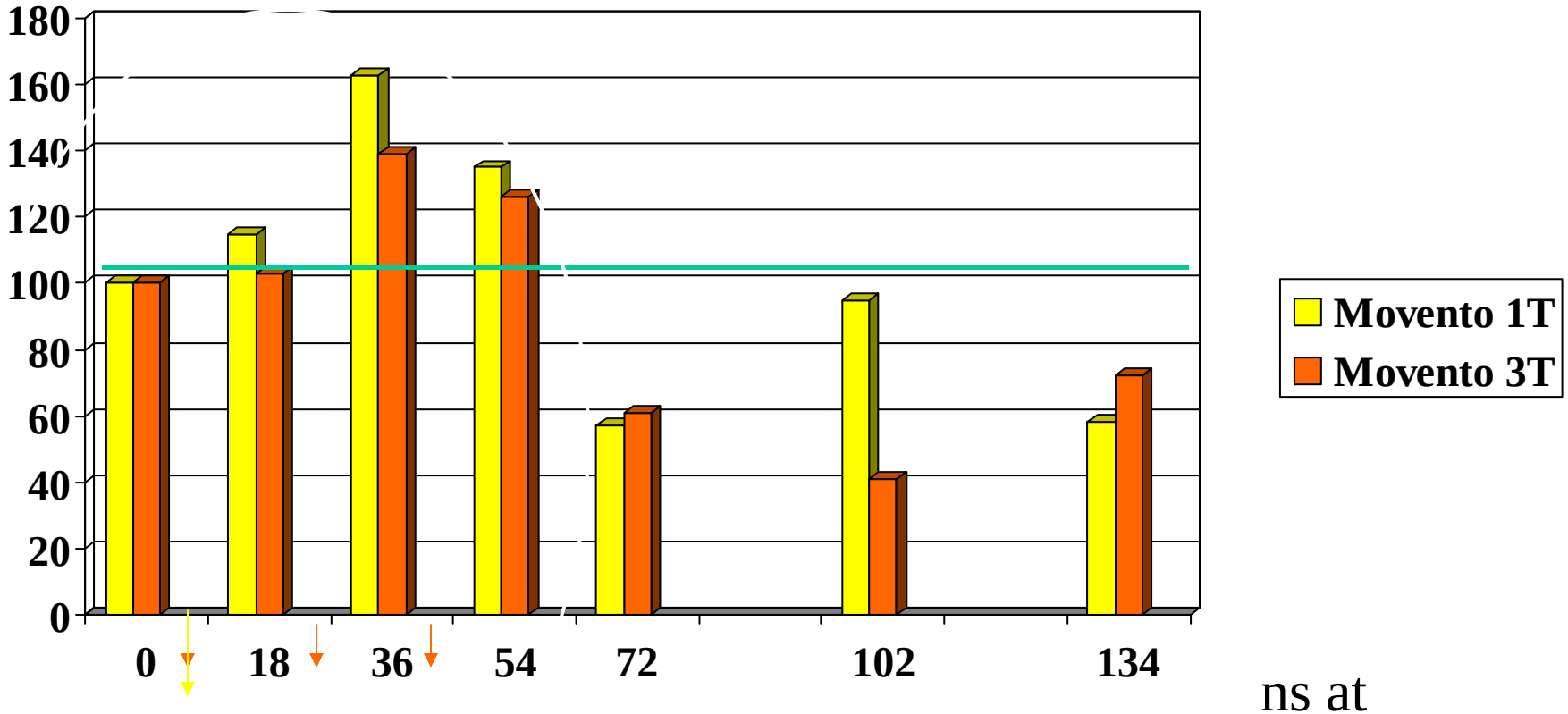
X. index/250 cc soil at Orosi-West expressed as % of untreated



ns at
P=0.05

Nematodes extracted on cheese cloth

Control of ring nematode, as compared to untreated at Orosi-West



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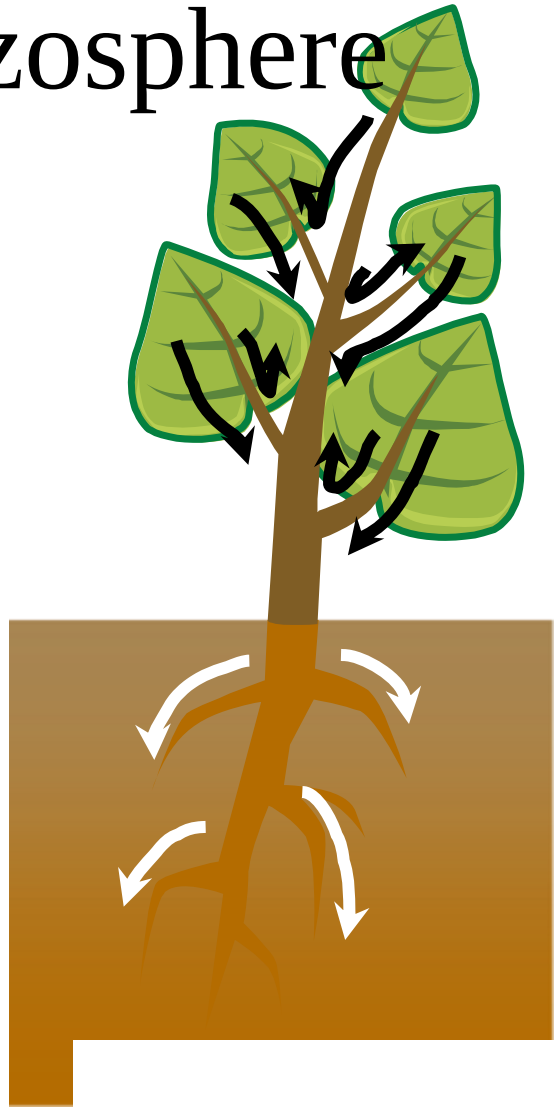
ns at
P=0.05

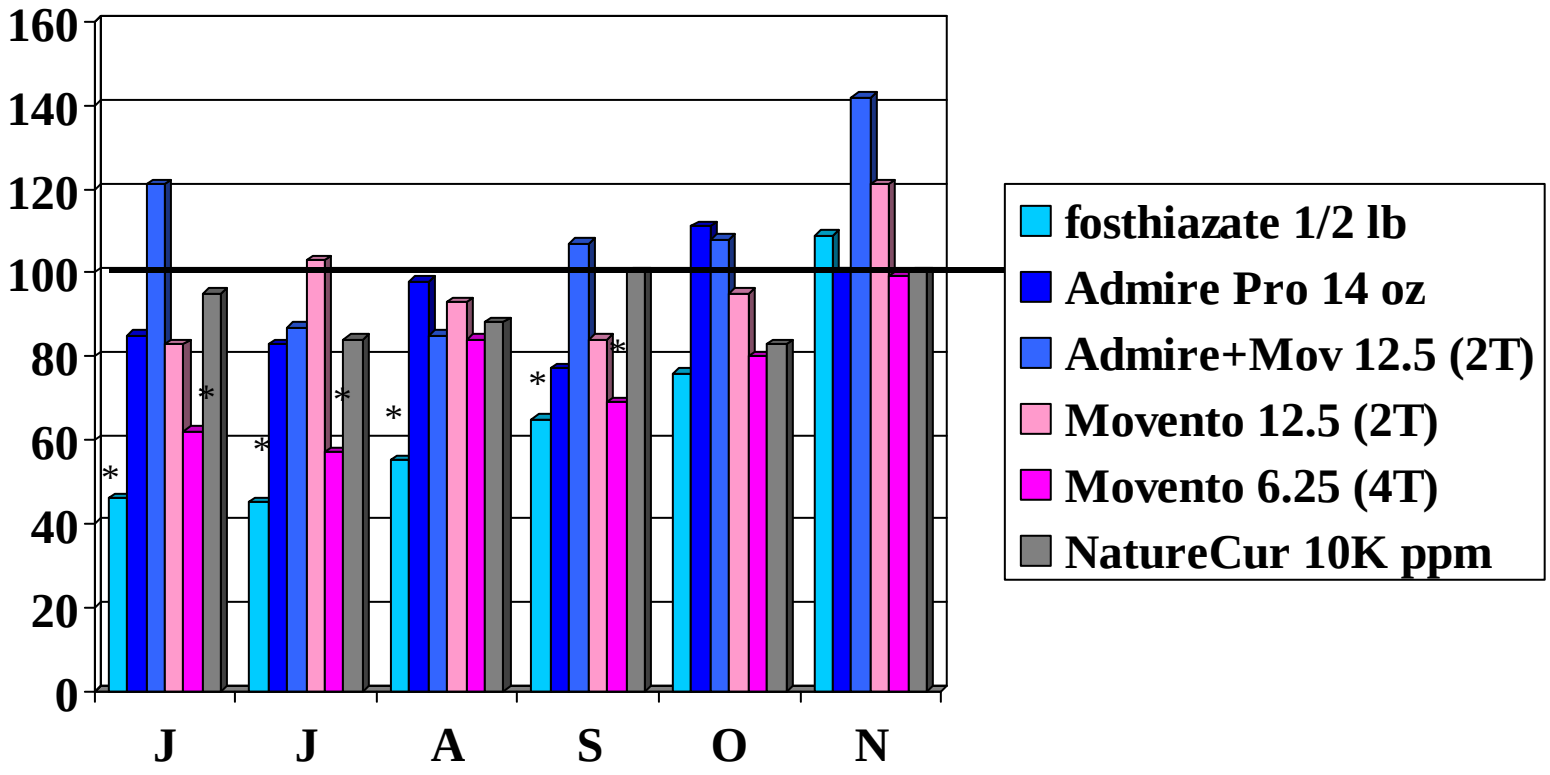
Nematodes extracted using sieve/centrifugation

Activity appears to pass quickly from the roots into the rhizosphere

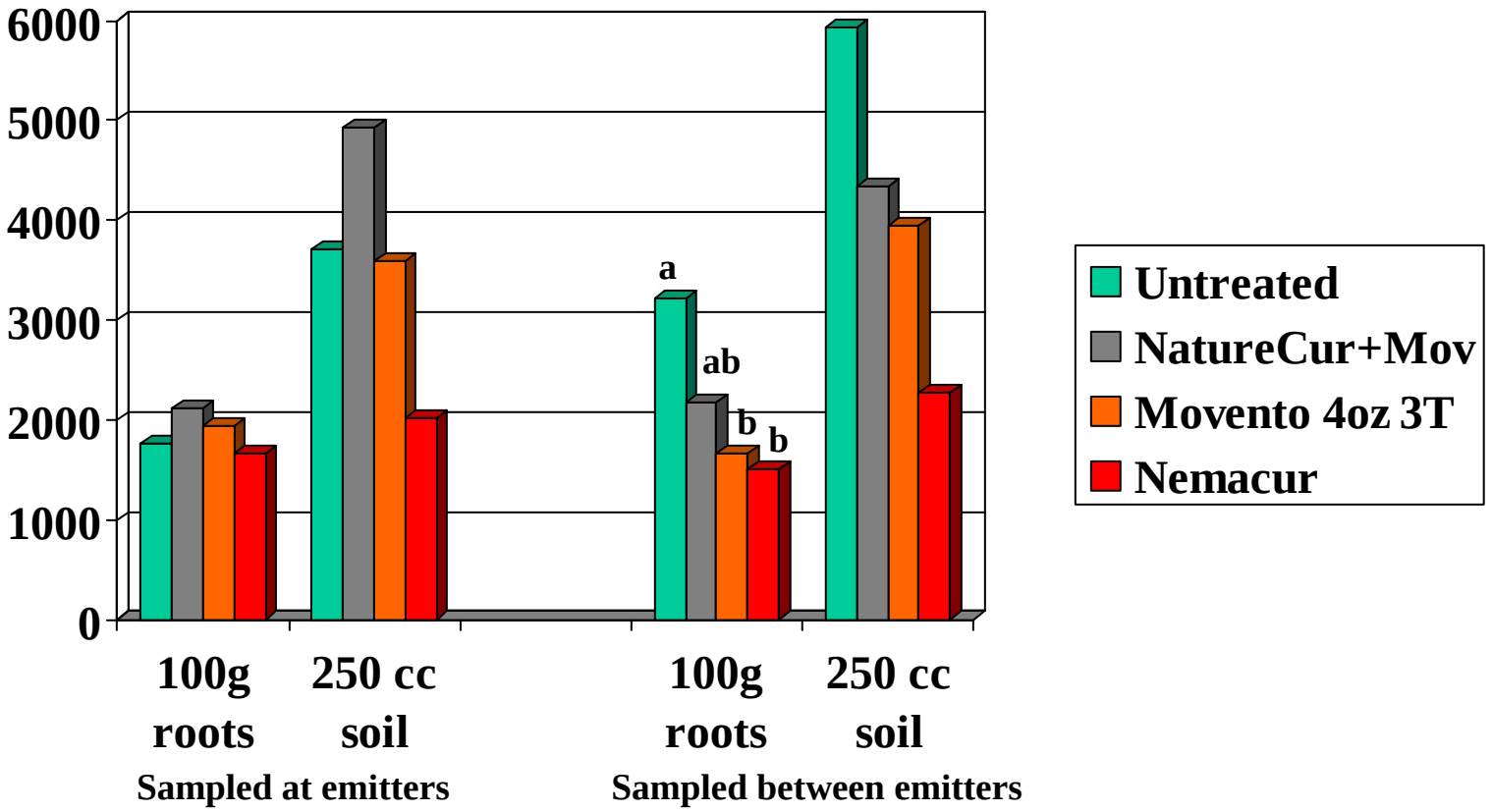
- Impact on dagger nematode appears faster than impact on ring nematode. This is likely just an artifact attributable to our techniques.
- Impacts fungal and bacterial feeding nematodes



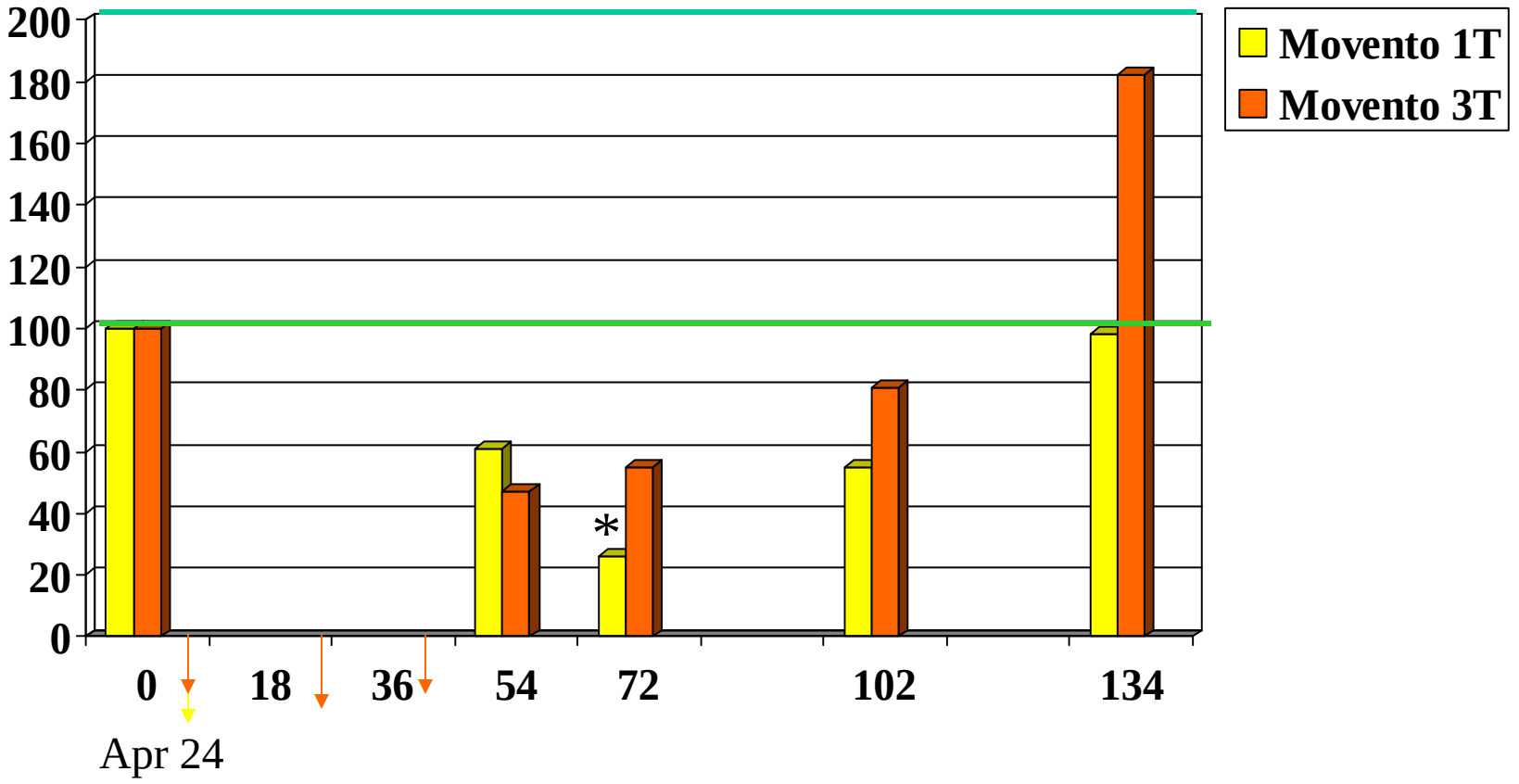
Control of **saprophytic** nematodes while rejuvenating Ruby Seedless vines, expressed as a % of untreated



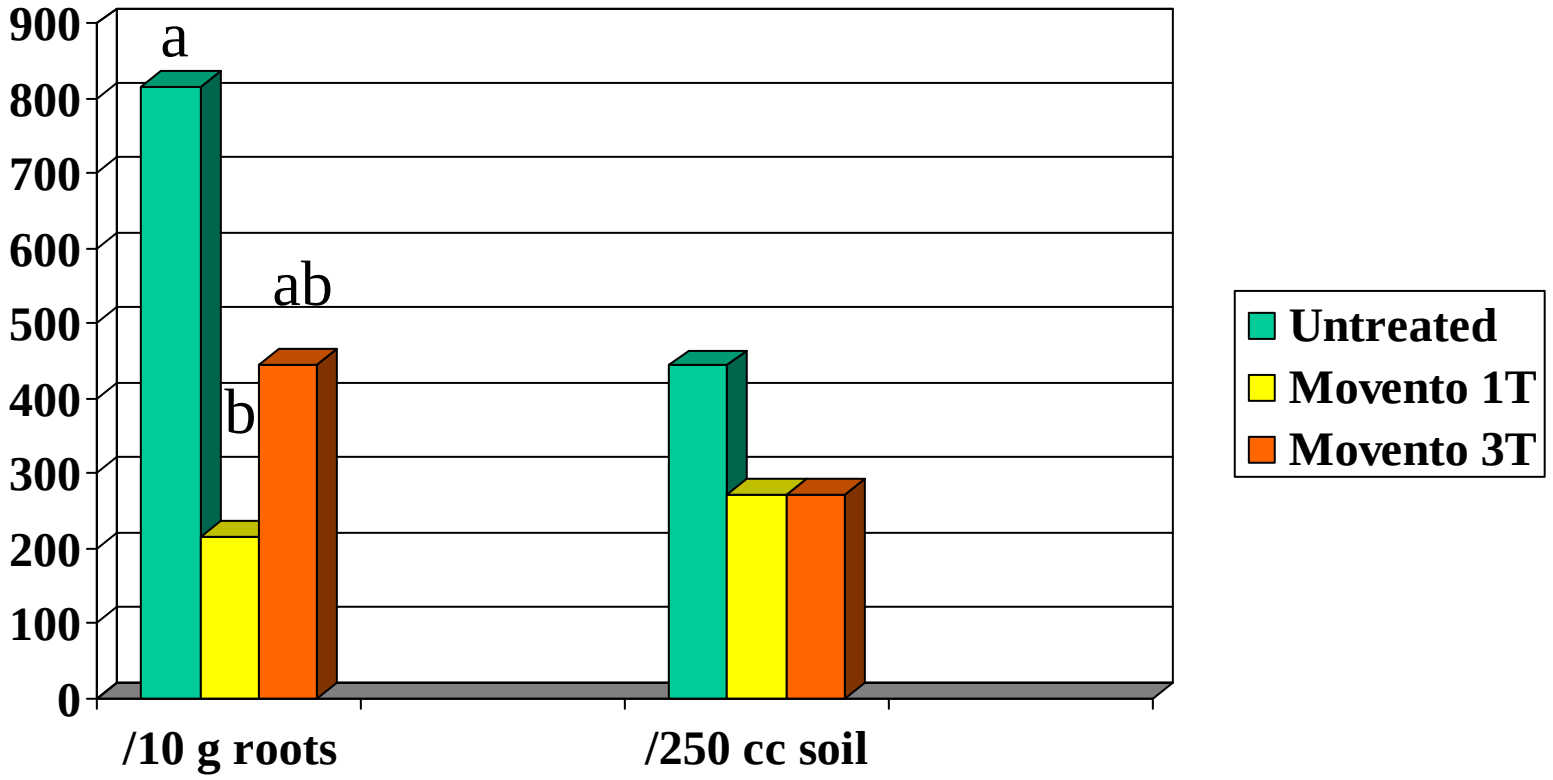
Control of citrus nematode at or between drip emitters, July 31, 2008 (63 DAFMT)



root-knot/g root as compared to untreated at Orosi-East



Control of root-knot nematodes in brownish young roots July 7, 2008 at Orosi-East



Our studies with Movento as a possible systemic nematicide were begun two years ago. We know that some % of the ai can be delivered via roots and beyond. Our effort is now focused on timing and improved strategies.

Nematicides delivered via the root system can provide post-plant nematode control!

But, the grower needs an established vine!

They are not a useful replacement for pre-plant soil fumigation!

Grapes after grapes vs grapes after almond (B. Peacock)

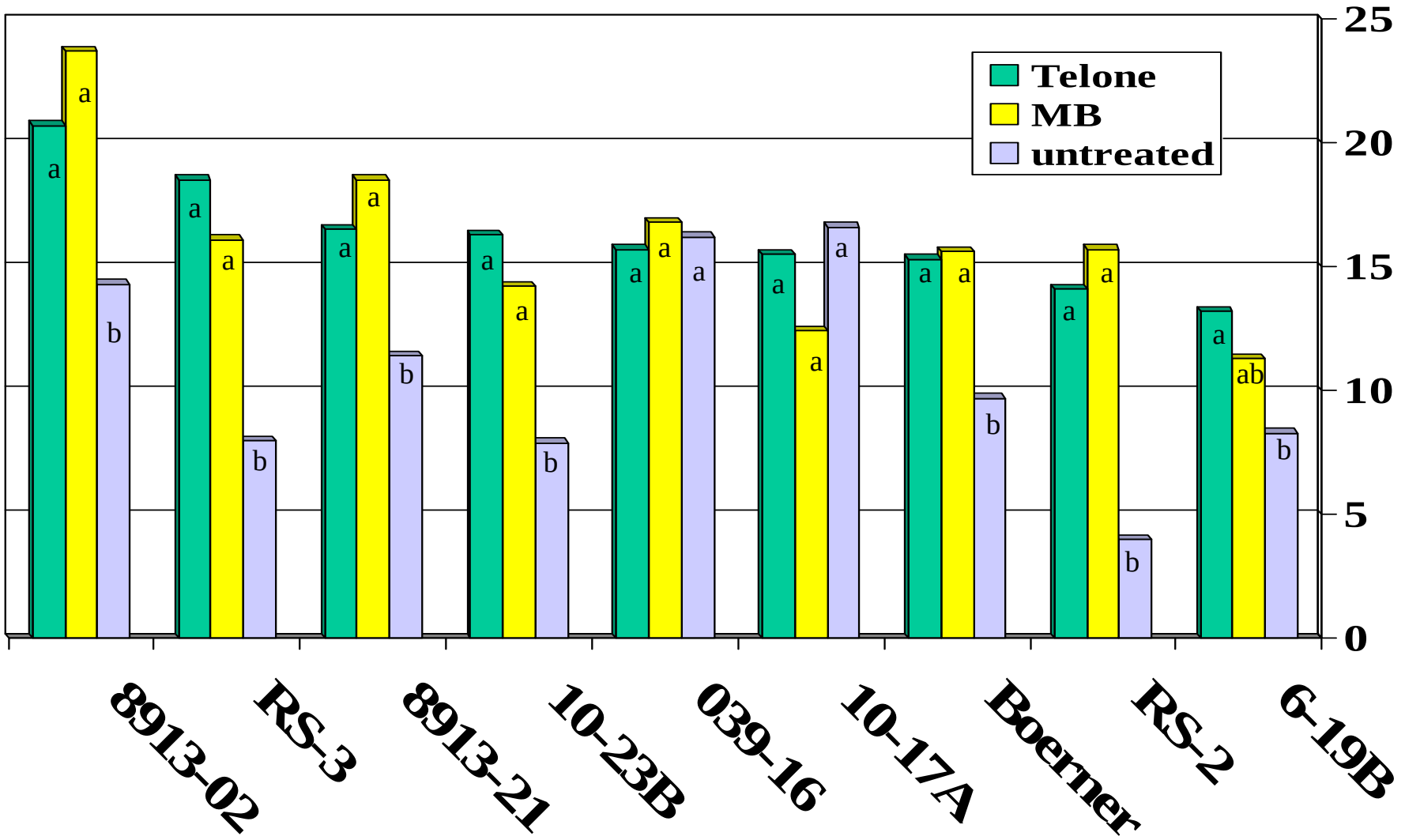
And…old grape roots remain alive 8 year after vine removal, nematodes and viruses too.

In an attempt to conserve the resistance mechanisms in your rootstock:

- Try not to unleash 8 years of huge nematode pressure on the new rootstock
- Consider “starve and switch” as an alternative to soil fumigation

So, lets compare some new rootstocks and collect yield data

Chardonnay yield (kg/vine) of nine rootstocks in 2001 + 2002



Thus, it is possible to find rootstocks having tolerance to the rejection component of the replant problem.

Researchers will find this tolerance among pest resistant rootstocks having very different *Vitis* parentage

“Starve and Switch”

Starve: kill old grape roots using February, March applications of Roundup applied to cut trunks and wait one full year.

Switch: Choose a rootstock with tolerance to the rejection component of the replant problem

Conclusions:

1/ Rootstocks can detect nematode entry and deliver a biocide to kill root cells to avoid pest build-up

2/ Foliar-applied nematicides are a possibility. We don't yet know how to use them correctly.

Conclusions:

3) But for Lodi and south, there is more to the replant problem than nematodes. Does your rootstock have tolerance to the rejection component?

4) Don’t count on foliar systemics to solve the rejection component.

Our studies to find an alternative to Nemacur have been underway 8 years with funding from the CA Table Grape Commission

…it is now time to expand these studies to raisin and wine grapes