Evaluation of Pre-plant & Post-plant Treatments for Replanted Peach Orchards

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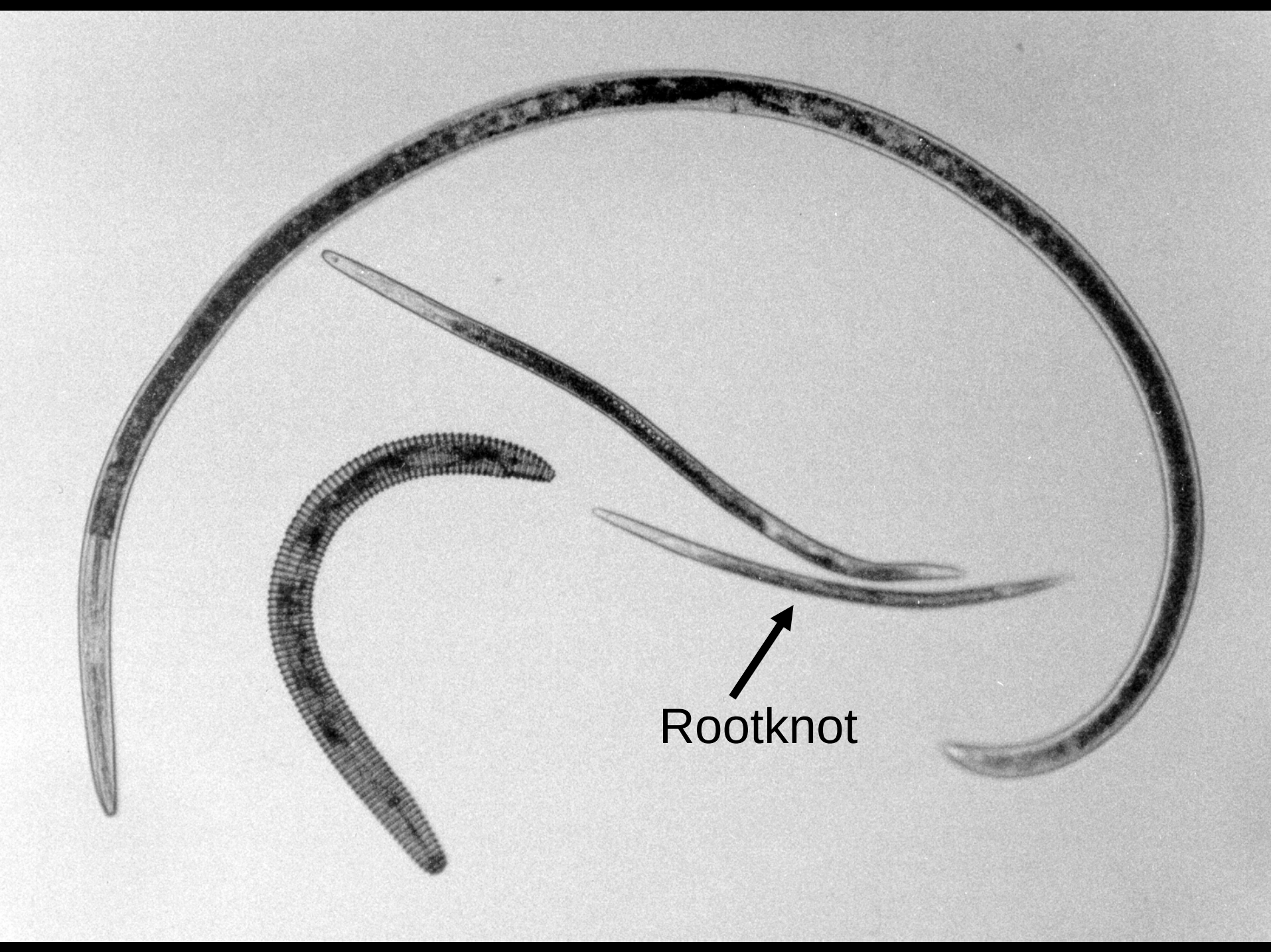
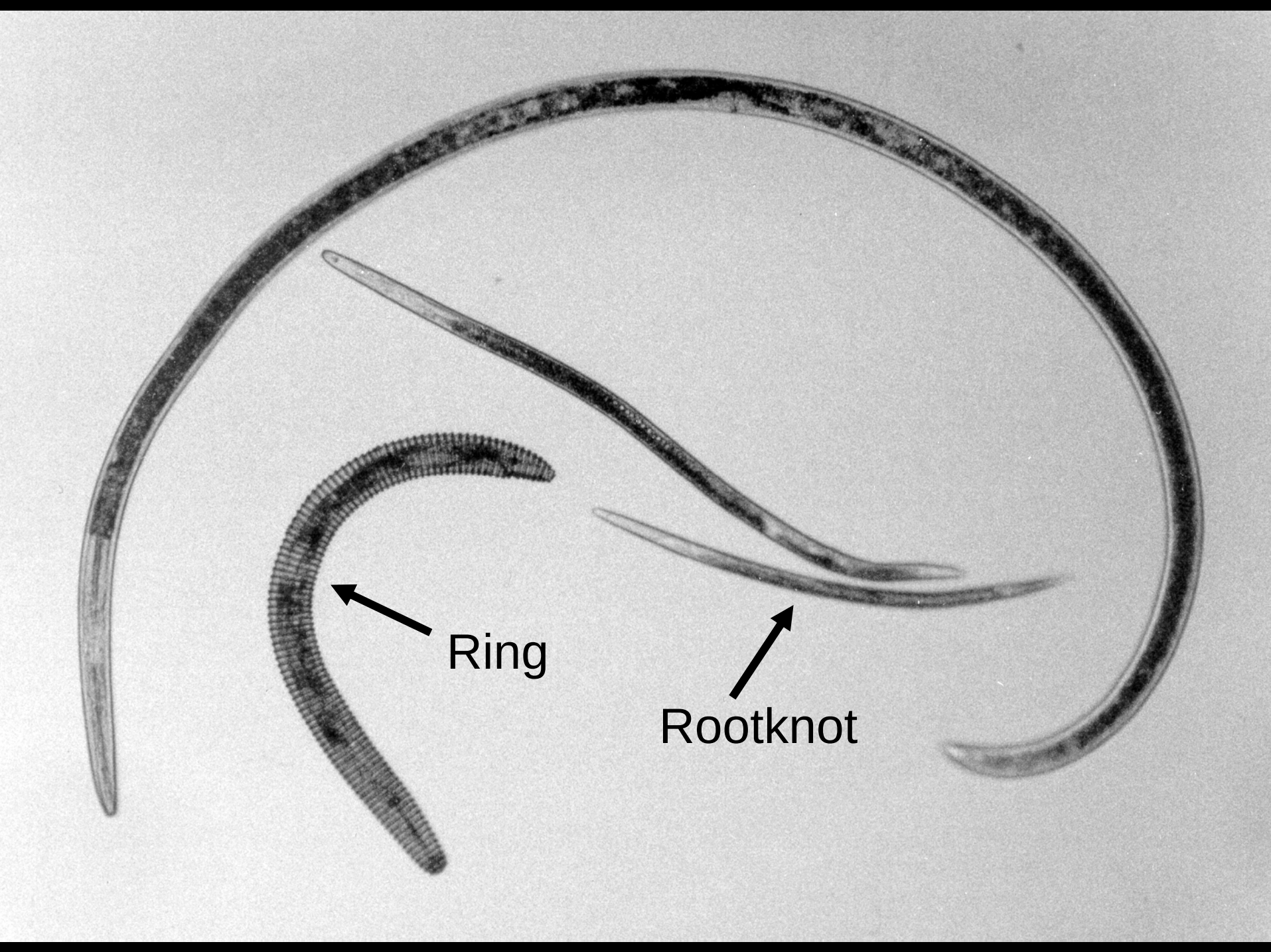
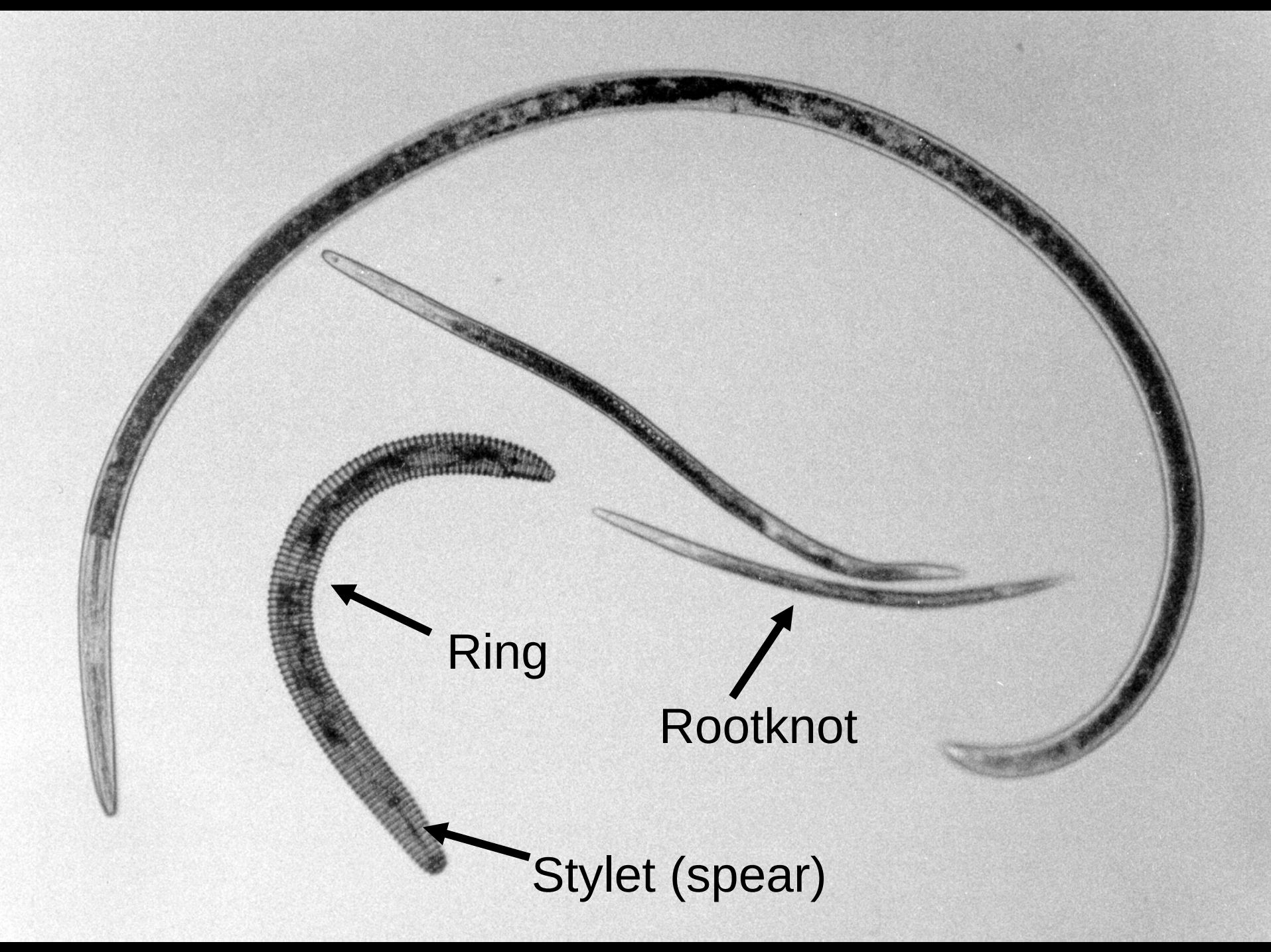
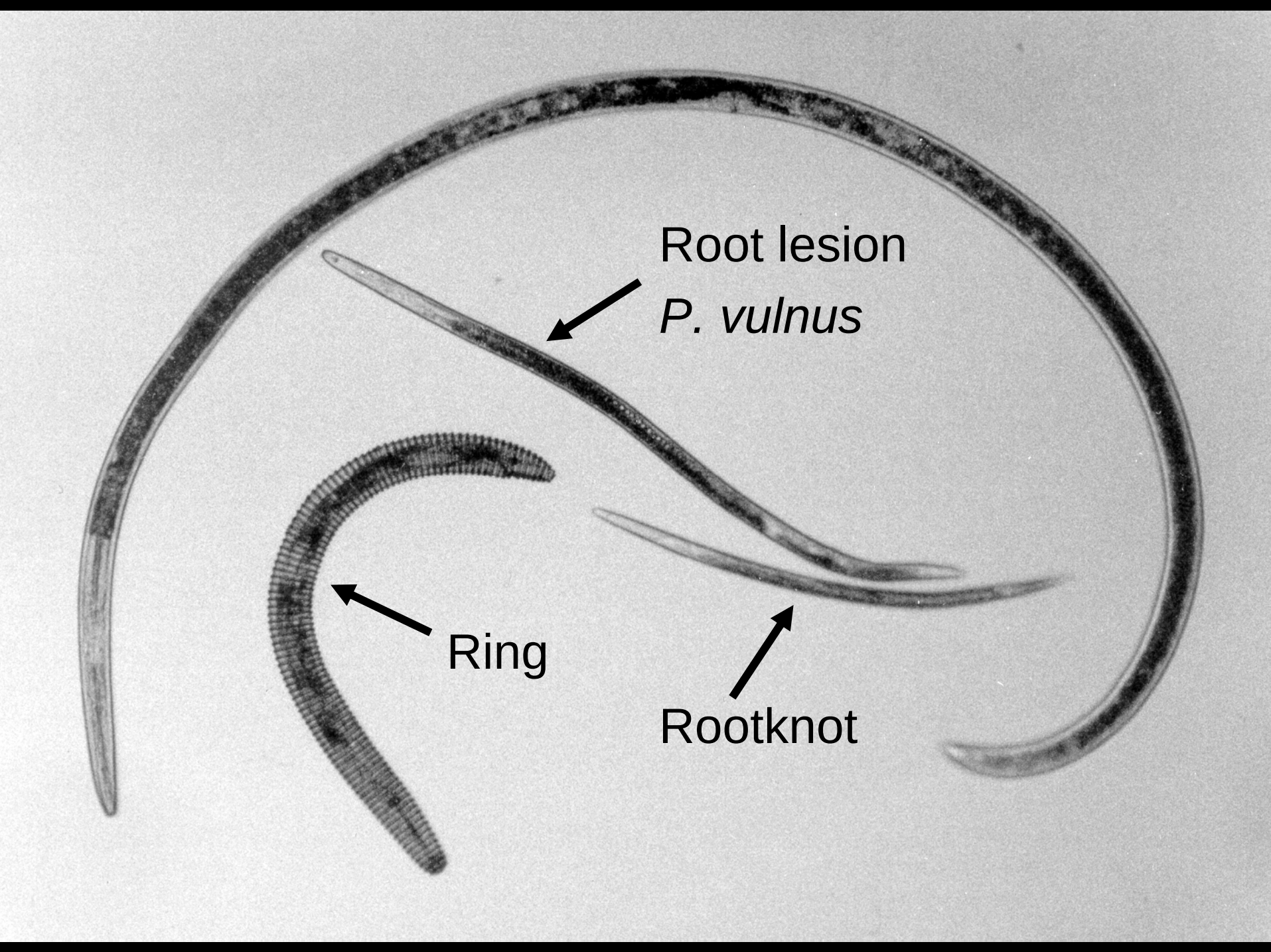
Second generation orchards do not grow as well because of...

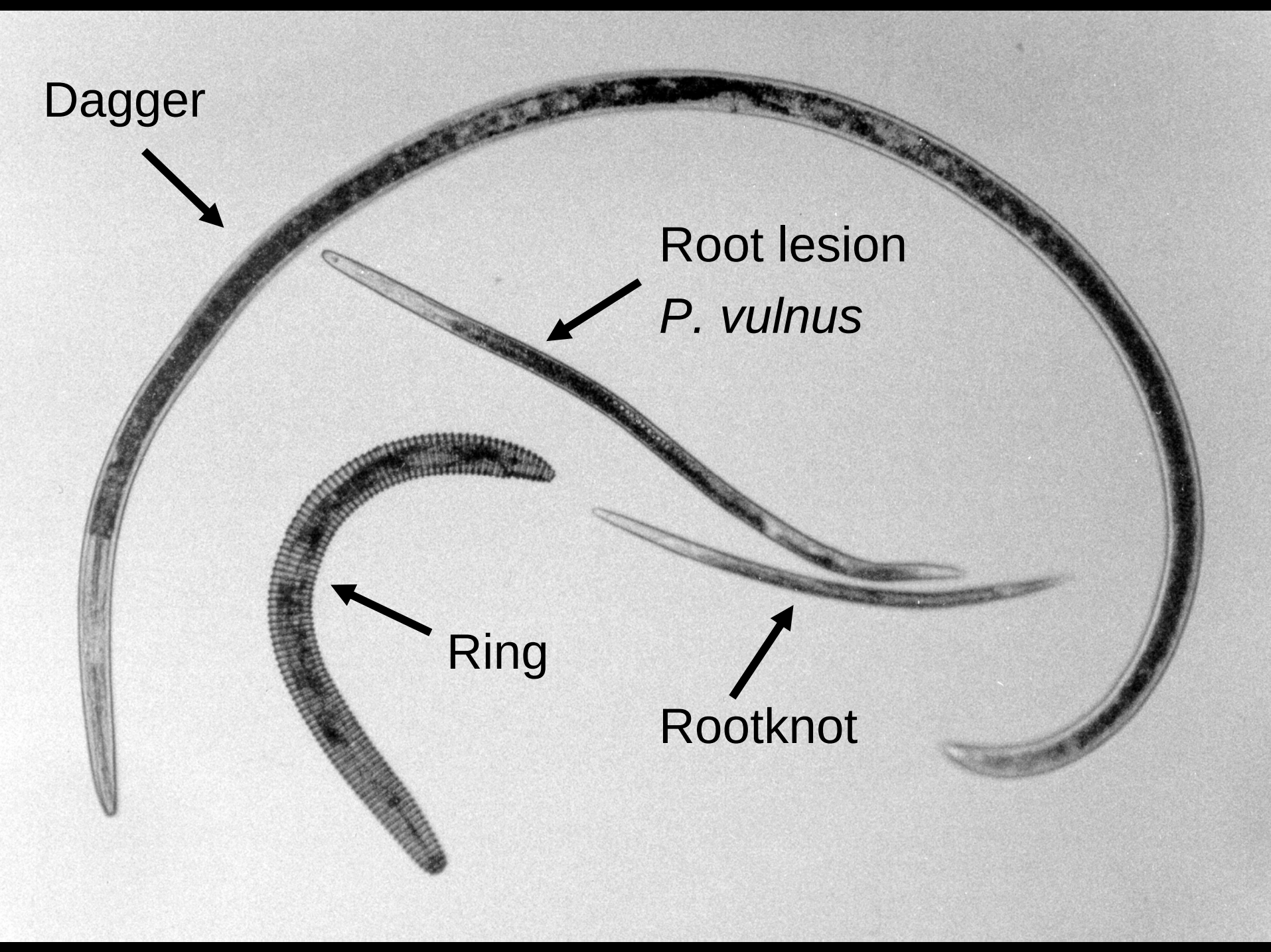
- Nematodes
  - ring, root lesion (*P. vulnus*), root knot
- Poorly defined fungal / pathogenic microorganism complex
- Nutrient depletion


Rootknot


Ring
Rootknot


Ring
Rootknot
Stylet (spear)


Root lesion
P. vulnus
Ring
Rootknot


Dagger
Root lesion
P. vulnus
Ring
Rootknot

How do we fix this?

- Fumigation
  - methyl bromide excellent fumigant
  - addresses all three components of replant problem
  - phased out??
  - very expensive
  - new regulations are very limiting

Questions:

- Can we use a combination of pre-plant and post-plant treatments to obtain results equal to, or better than, methyl bromide fumigation?

- What about microbiological soil amendments?

Cling Peach Replant Trial

Field location:

- Third generation peach orchard.
- Land fallow for two years prior to planting.
- Soil = loamy sand.
- History of bacterial canker.
- Moderate / high populations of ring and root lesion nematodes. One rep also has rootknot.

Cling Peach Replant Trial

- **Pre-plant treatments; October 2000**
  - Nonfumigated
  - Methyl bromide tarped @ 400 lb per acre
  - Vapam HL at 250 ppm (75 gpa) drenched
  - *Telone II strip shanked @ 32 gpa. Telone applied to ~ 2 acres as observation only.

Applied East - West across rows

Solid, tarped fumigation with methyl bromide @ 400 lb per acre. Other strips treated with Vapam or left untreated. October, 2000

Cling Peach Replant Trial

Pre-plant treatments applied across rows (East - West).

Post-plant treatments applied down rows (North-South).

Allows for combination of pre-plant and post-plant treatments in a checkerboard design.

Cling Peach Replant Trial

Post-plant treatments

- Enzone @ 1000 ppm twice annually
- Nemacur 3 @ 1 gpa twice annually
- DiTera DF @ 10 lb per acre twice annually

Applied April & Oct. 2001, 2002, 2003

- Additional N (~50 lb fertigation, fall foliar with 100 lb urea)
- Composted green waste & manure + oyster shell flour at planting, Ca-12 injected 3X, foliar CaCl 3X
- Compost & oyster shell + Tilth ® & Iota ® microbial amendments; 3 apps Apr, June, Sept.
- Compost & shell + humic acid, Shurcrop Supra ® kelp product, Spectrum® microbial amendment; 3 apps Apr, June, Sept.
- Black polyethylene soil covering
- Four annual sprays with foliar micronutrients

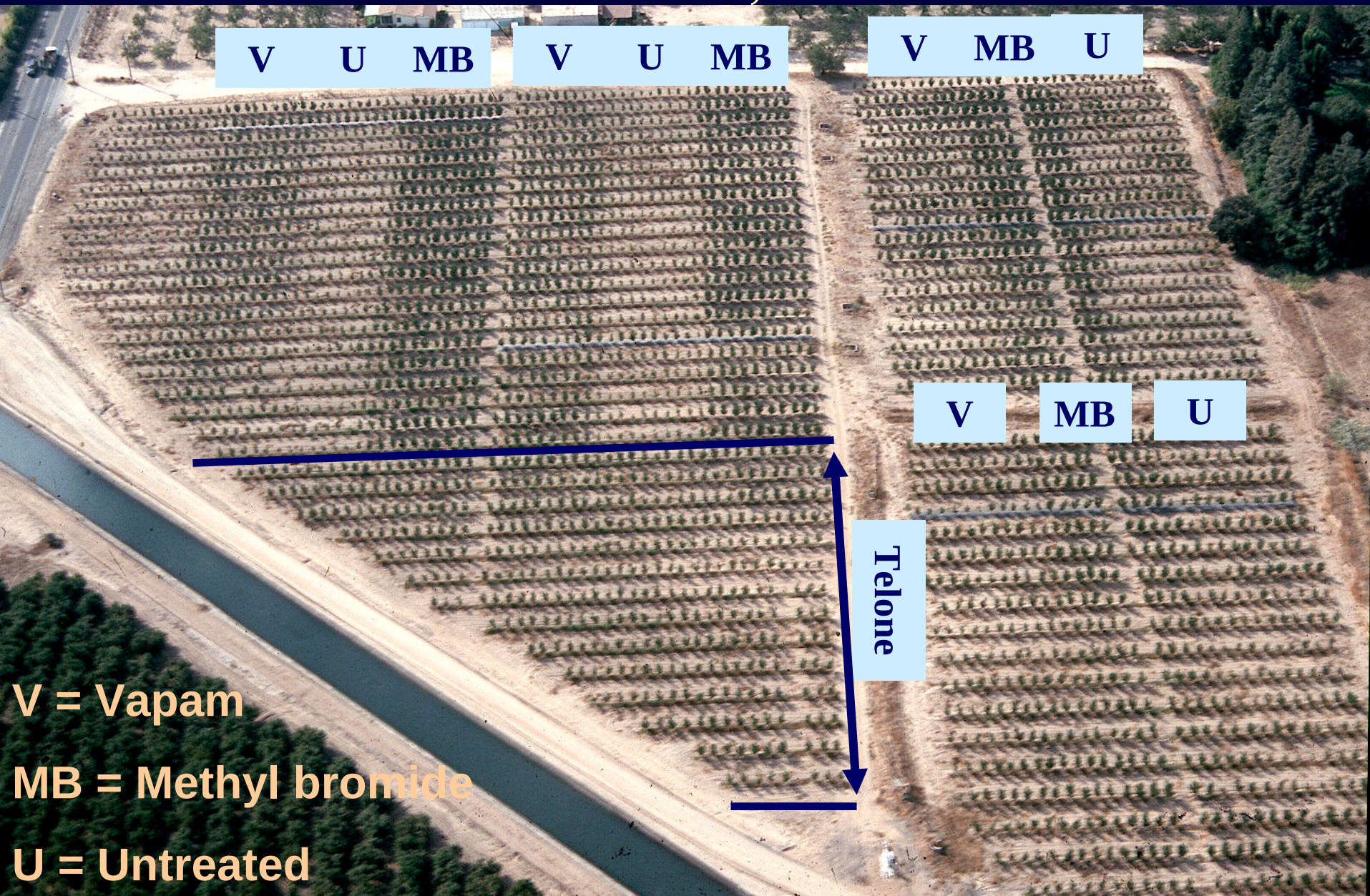
Application of compost to berms prior to planting. January 2001

Some trees were dipped in kelp extract and / or microbiological “cocktails”

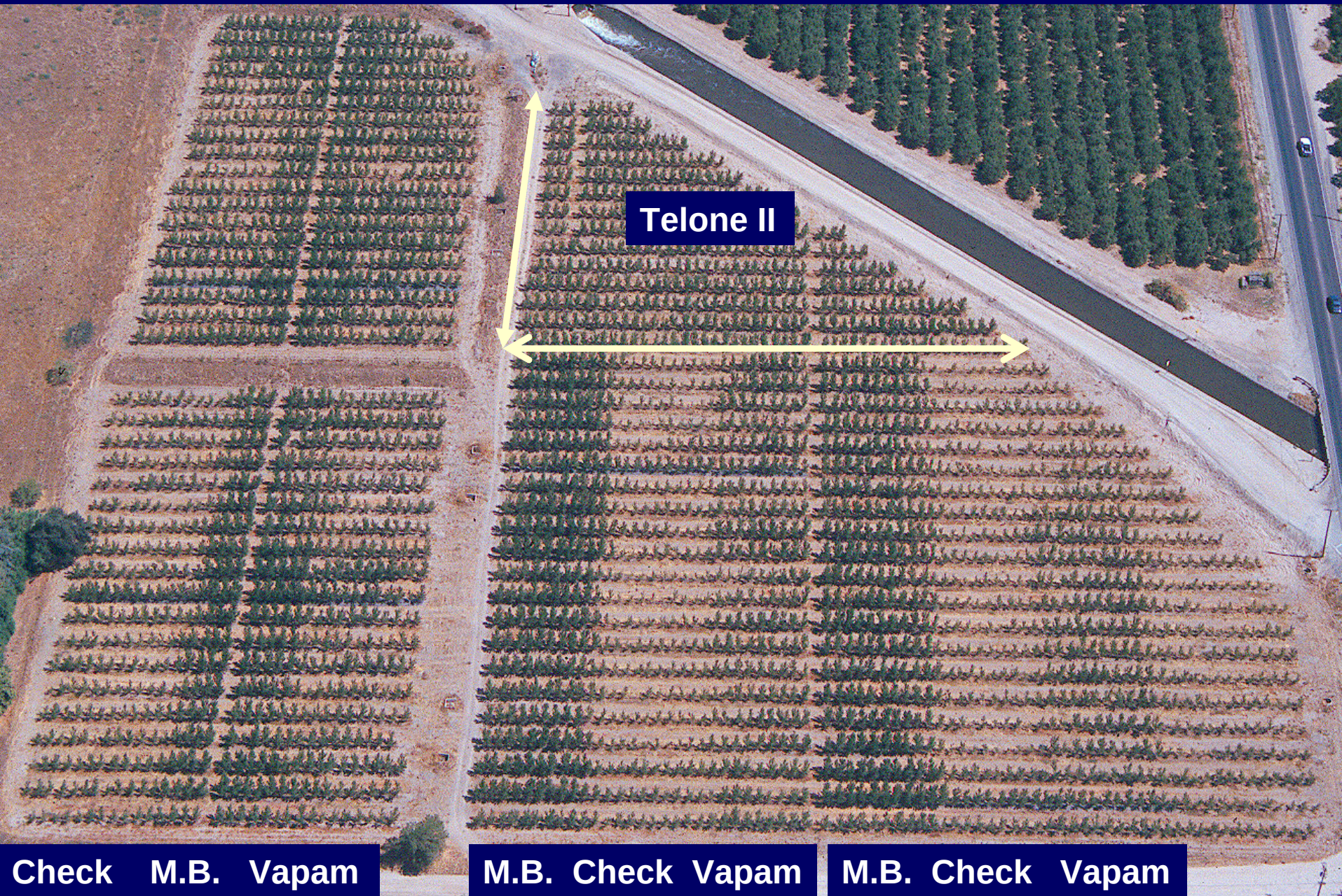
Compost and oyster shell flour backfilled into planting hole. February 2001.

First-leaf trees in treatment with black polyethylene mulch applied down tree row at planting.

Kline Peach Replant Trial - First-leaf trees
October 15, 2001



Peach Replant Trial, Stanislaus County. Sept. 20, 2002
Second leaf 'Loadel' on Lovell Rootstock



Patterson Road Replant Trial. October 1, 2003. Third Leaf

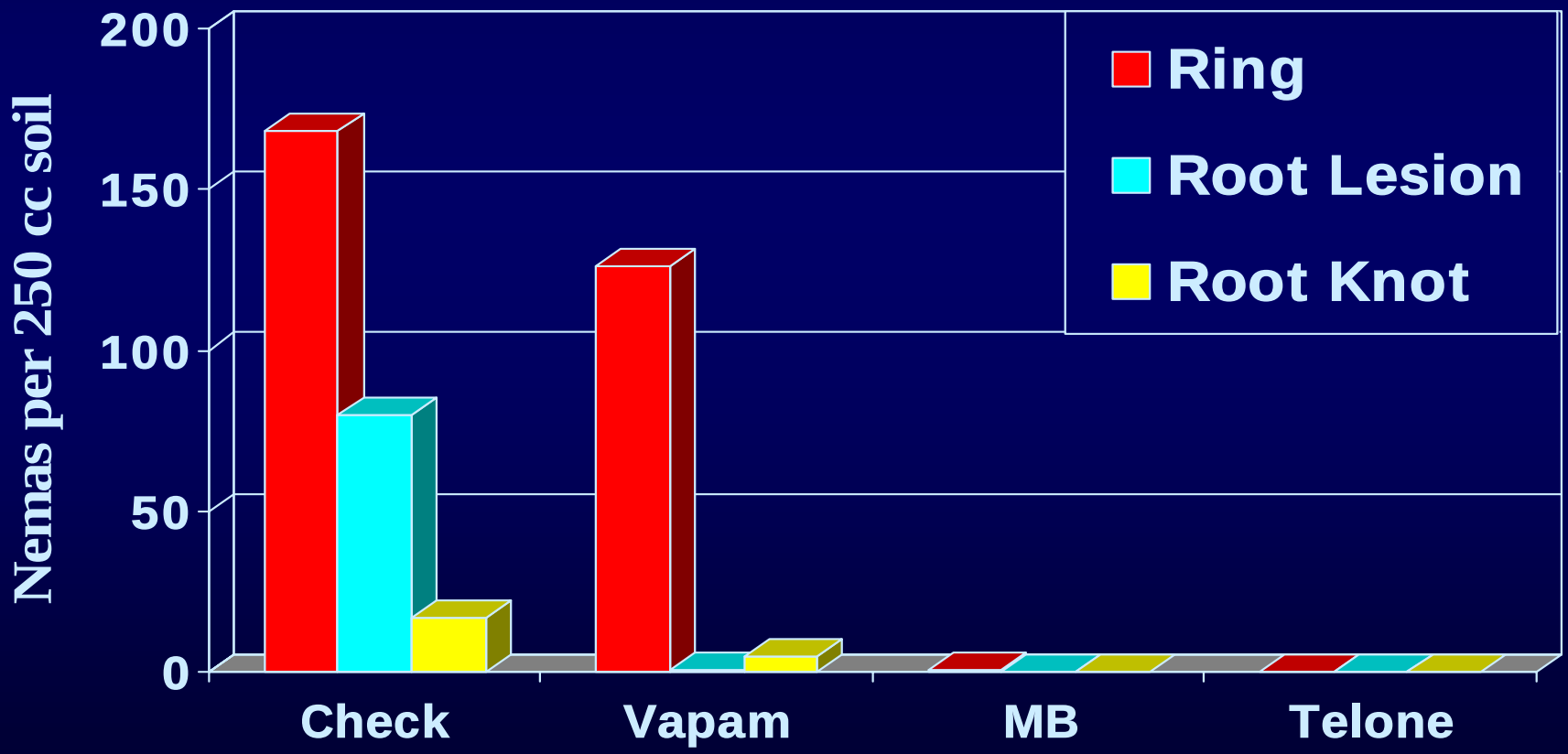
Patterson Road Replant Trial. October 1, 2003. Third Leaf

Preplant Fumigant Effects on Native, Pathogenic Nematodes

	Nematodes per Liter of Soil at Time of Planting					
	Unfumed		MB		Vapam	
Soil Depth	Ring	Root Lesion	Ring	Root Lesion	Ring	Root Lesion
1’	13	62	15	0	3	0
2’	165	384	0	0	87	35
3’	698	596	1	0	79	27
4’	913	1041	1	0	11	11
5’	828	588	4	0	0	0
Mean	523 a	534 a	4 b	0 b	36 b	15 b

Pathogenic Nematodes in the Rootzone <u>One Year</u> After Soil Fumigation

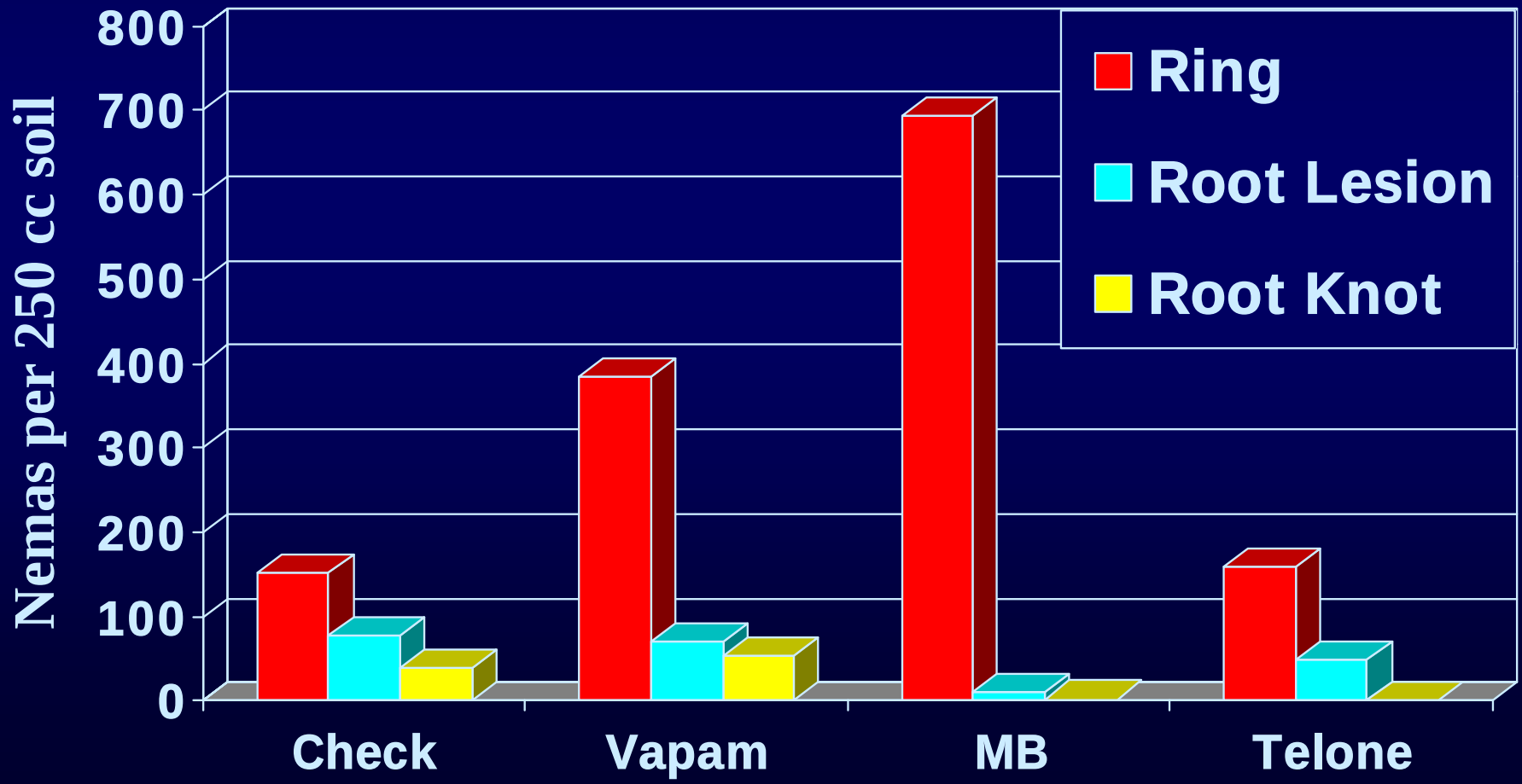
Samples taken October, 2001 at 0-18”



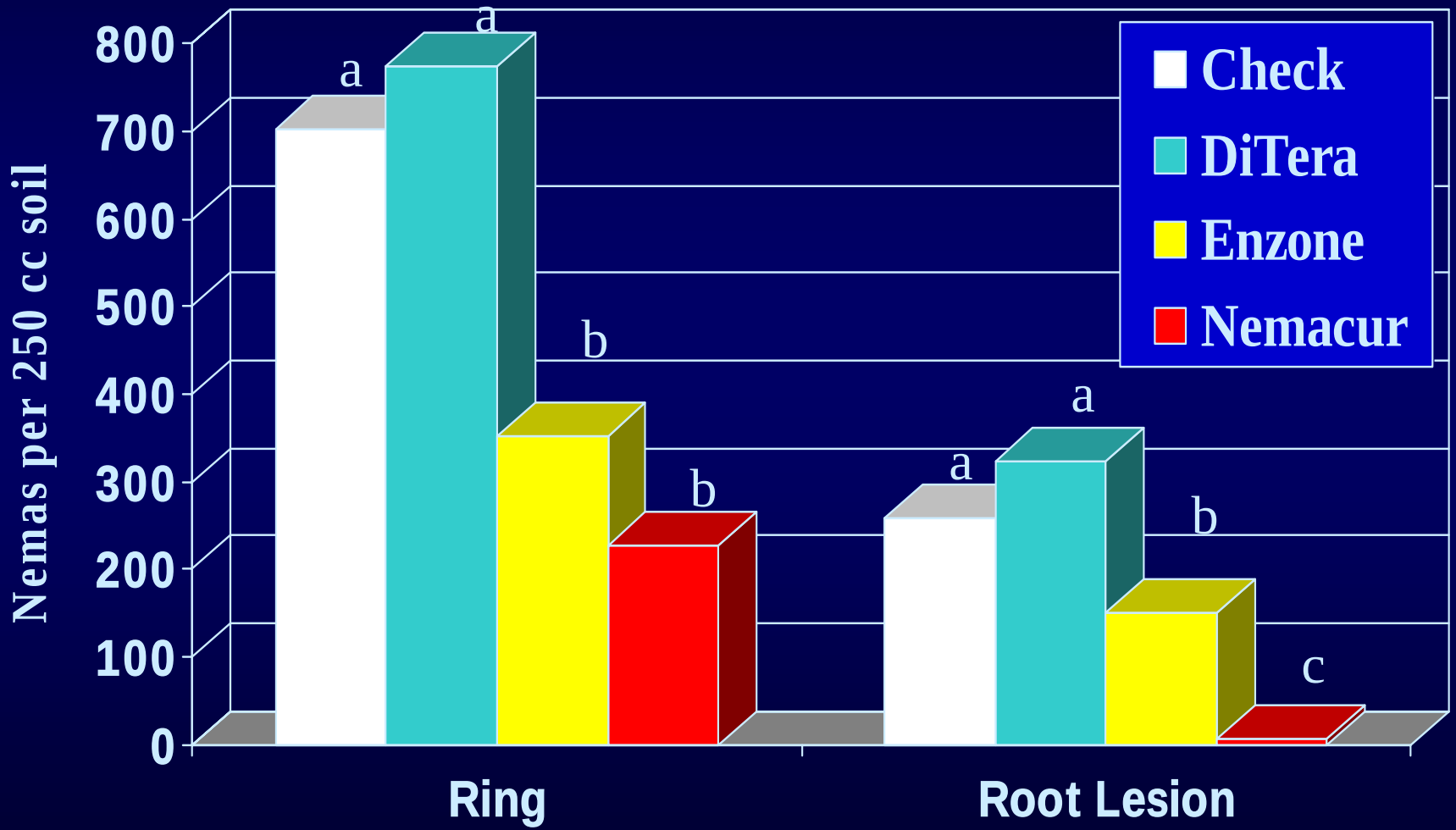
***All nematodes in Vapam treatment found in Rep 3 only.**

Pathogenic Nematodes in the Rootzone Three Years After Soil Fumigation

Samples taken October, 2003 at 0-18”



Pathogenic Nematode Numbers on Nonfumigated Peach Trees as Influenced by Post-plant Nematicide Treatments - Second Leaf



•Soil sampled February, 2002.

Summer Pruning M.B. Fumigated Trees
Second-leaf. June 19, 2002

Summer Pruning Nonfumigated Trees
June 19, 2002

“Dormant” Pruning

Brush weights

Unfumigated

"Dormant" Pruning

Brush weights

Unfumigated

"Dormant" Pruning

Brush weights

MB Fumigated

Pruning Weights. April 15, 2003

Brush Weight (lb. per tree)

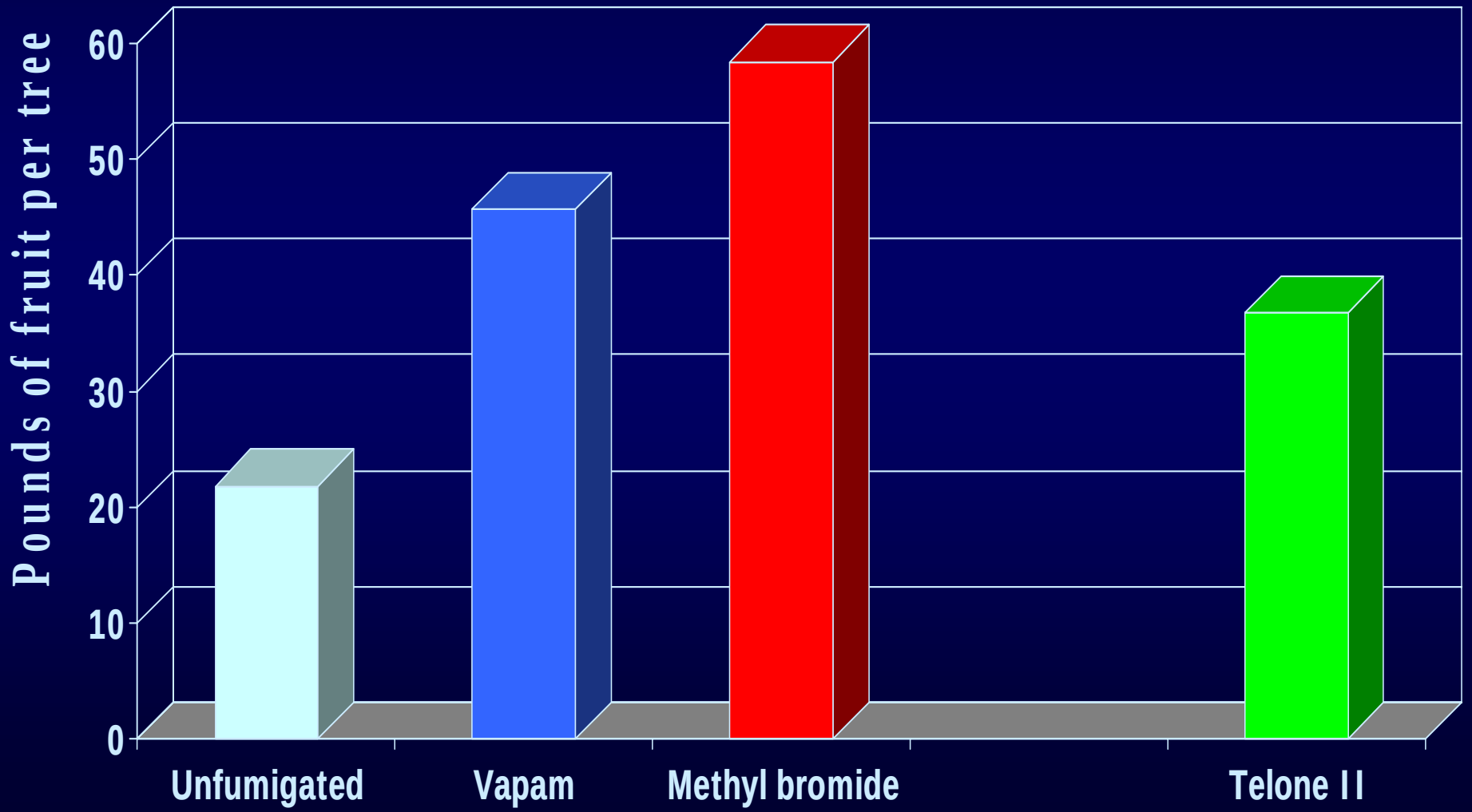
	Unfumed	M. B.	Vapam	Average	Telone
Untreated	2.7 b	13.5 a	7.2 a	7.8 a	7.1
Enzone	2.2 b	11.7 a	5.7 a	6.5 a	
Nemacur	3.2 b	11.5 a	4.6 a	6.4 a	
DiTera	2.4 b	13.7 a	6.0 a	7.4 a	
Nitrogen	2.4 b	12.5 a	6.9 a	7.3 a	
Calcium	1.4 b	11.4 a	4.9 a	5.9 a	
Microbes	2.6 b	12.5 a	5.2 a	6.7 a	
Kelp & Humic A.	2.1 b	10.0 a	4.5 a	5.5 a	
Black Plastic	6.1 a	13.5 a	7.2 a	8.9 a	
Foliar Micros	4.0 ab	13.1 a	8.2 a	8.4 a	
Average	2.9 c	12.3 a	6.0 b		

Yield (Kg) of Fruit per Tree July, 2003

	Unfumed		M. B.		Vapam		Average		Telone
H. acid + kelp	9.0	c	24.4	ab	14.6	b	16.0	b	
Calcium	9.3	c	21.0	b	14.3	b	14.9	b	
Untreated	9.9	c	26.7	ab	20.8	ab	19.1	ab	16.7
Microbes	10.2	c	22.5	b	16.1	b	16.3	ab	
Enzone	10.5	bc	23.0	ab	19.8	ab	17.8	ab	
DiTera	11.1	bc	24.5	ab	18.4	ab	18.0	ab	
Nemacur	11.5	bc	29.4	ab	17.2	ab	19.3	ab	
Nitrogen	12.3	b	30.8	a	22.8	a	22.0	a	
Foliar micros	13.5	ab	28.3	ab	21.2	ab	21.0	a	
Poly mulch	15.3	a	24.6	ab	20.1	ab	20.0	ab	
Average	11.3	c	25.5	a	18.5	b			

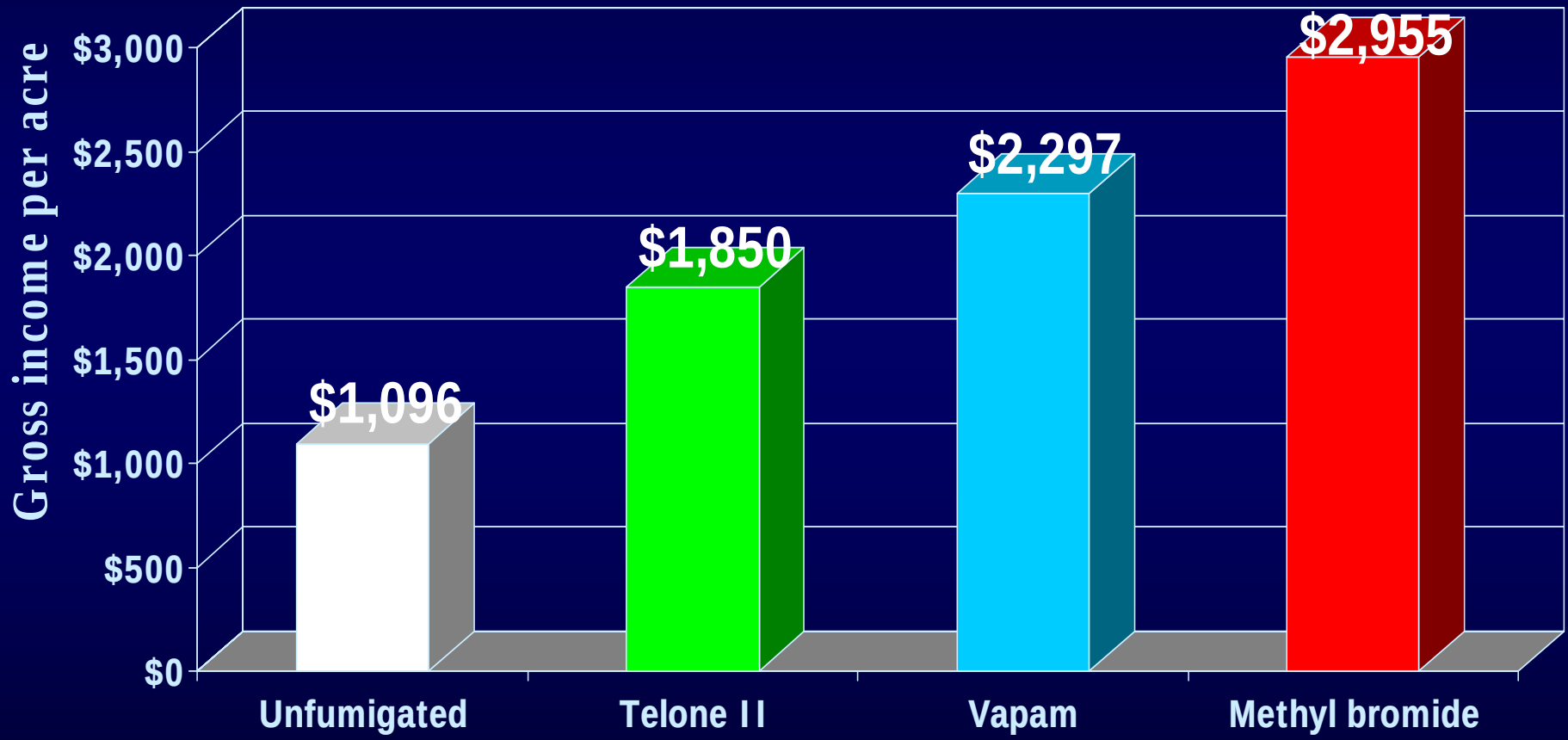
Effect of Pre-plant Fumigation on Yield of 3rd-leaf Loadel Peach Trees. July 2003

Peach replant trial - Patterson Rd.



Effect of Pre-plant Fumigation on Gross Income of 3rd-leaf Loadel Peach Trees. July 2003

Peach replant trial - Patterson Rd.



Gross revenues based on 372.3 trees per acre and a price of $270 per ton

Fumigation Effects on Yield and Gross Income of 4th-Leaf Loadel Cling Peach Trees. July, 2004

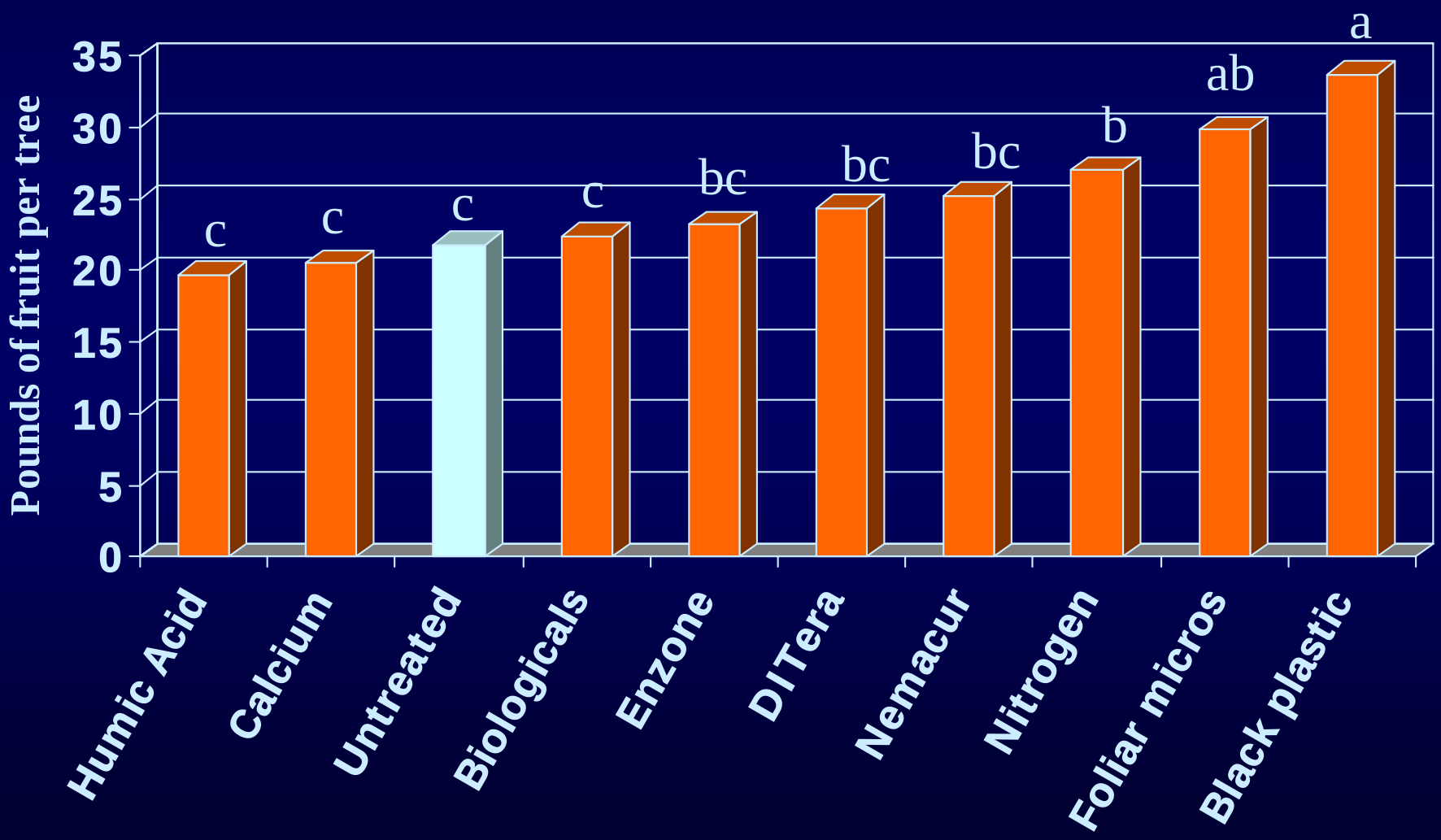
Fumigation Treatment	Avg. Fruit Diameter (mm)	Pounds of Fruit per Tree	Calculated Tons per Acre*	Gross Income per Acre**	Increase in Income Over Unfumigated
Unfumigated	64.2 b	39.2 c	7.3	$2044	–
Vapam	65.4 ab	56.5 b	10.5	$2945	$901
Telone II	66.5 a	59.4 b	11.1	$3096	$1052
Methyl bromide	67.2 a	82.9 a	15.4	$4312	$2268

* Per acre yield calculated by multiplying pounds of fruit per tree times 372 trees per acre.
**Gross income per acre calculated by multiplying tons per acre times $280 per ton for the Loadel variety under 4% offgrade.

Cumulative Fumigation Effects on Yield and Gross Income Over Two Years (third and fourth-leaf).					
Fumigation Treatment	**2003 Tons per Acre**	**2004 Tons per Acre**	**Cumulative Yield**	**Cumulative Gross Income**	**Increase in Income Over Unfumigated**
Unfumigated	4.1	7.3	11.4	$3140	--
Vapam	8.5	10.5	19.0	$5242	$2102
Telone II	6.9	11.1	18.0	$4946	$1806
Methyl bromide	11.0	15.4	26.4	$7267	$4127

Effect of Post-plant Treatments on Yield of Unfumigated, 3rd-leaf Peach Trees.

Peach replant trial - Patterson Rd. July 2003



Influence of Black Plastic or Micronutrient Sprays on Unfumigated Tree Yield and Gross Income

Third-leaf harvest. July, 2003

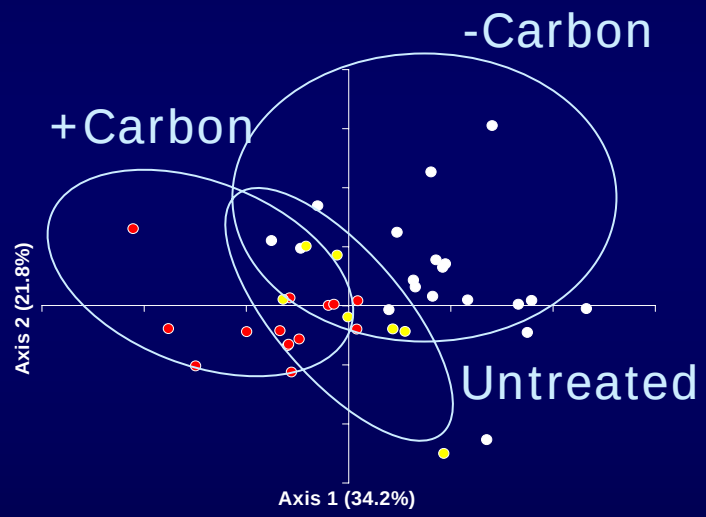
	Pounds / tree	Tons / acre	$ per acre	Income increase
Black Plastic	33.7	6.3	$1694	$598
Foliar Micros	29.8	5.5	$1498	$402
Control	21.8	4.1	$1096	--

Gross revenues based on 372.3 trees per acre and a price of $270 per ton

Peach soil microbial community

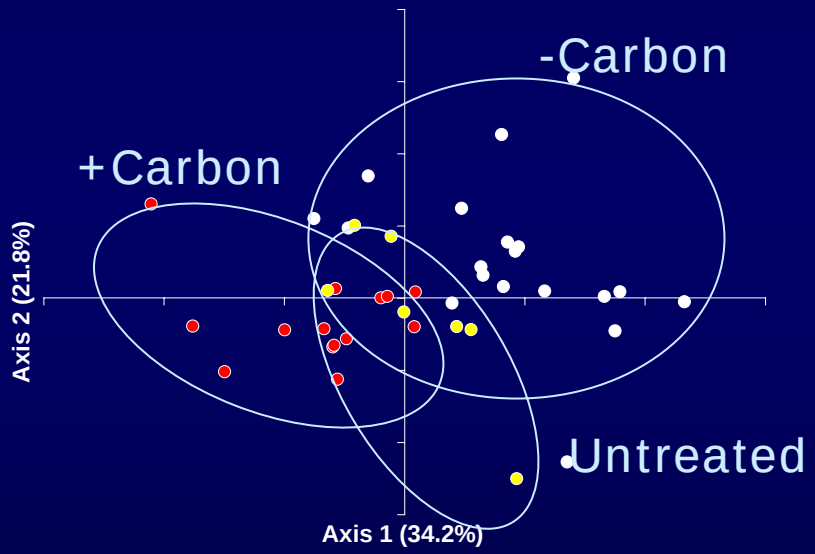
- How do alternative fumigants and soil amendments alter soil microbial communities?
- How do soil microbial communities relate to plant performance?

Peach soil microbial community



- Carbon (compost) addition most important in shaping microbial community
- Microbial biomass higher in +C treatments, lowest in MB fumigated and mulched plots
- Microbial inoculants had no overall effect on community composition

Peach soil microbial community



- MB decreased biomass and certain functional groups
- Tree growth best in fumigated treatments
- Long term benefits of larger microbial community?

Lab and Field Test for Tissue Susceptibility to *Pseudomonas syringae*

Bacterial canker lesion developed after inoculation

Effect of Foliar Urea and CaCl Sprays on *P. syringae* Lesion Size

Fertilizer Treatment	MB Fumigation?	Lesion length (mm)
Standard	No	301 a

Effect of Foliar Urea and CaCl Sprays on *P. syringae* Lesion Size

Fertilizer Treatment	MB Fumigation?	Lesion length (mm)
Standard	No	301 a
CaCl	No	78 b

Effect of Foliar Urea and CaCl Sprays on *P. syringae* Lesion Size

Fertilizer Treatment	MB Fumigation?	Lesion length (mm)
Standard	No	301 a
CaCl	No	78 b
Urea	No	27 c

Effect of Foliar Urea and CaCl Sprays on *P. syringae* Lesion Size

Fertilizer Treatment	MB Fumigation?	Lesion length (mm)
Standard	No	301 a
CaCl	No	78 b
Urea	No	27 c
Standard	Yes	26 c
CaCl	Yes	23 c
Urea	Yes	20 c

Conclusions

- Preplant fumigation eliminated more than 99% of the parasitic nematodes to a depth of at least 5 feet at planting time.
- After three seasons, there were significantly more ring nematodes in fumigated areas compared to nonfumigated.
- Nematicides applied annually knock nematodes down 50-75% but they quickly build back to pre-treatment levels in less than one year.

Conclusions

- Preplant fumigation has significantly increased plant growth and yield.
- MB increased gross revenue by $4100 per acre in the first two harvests compared to nonfumigated.
- Vapam and Telone II increased gross revenue by about $2100 and $1800, respectively.

Conclusions

- Plastic mulch, foliar micronutrients and foliar nitrogen were the only post-plant treatments that increased yields in unfumigated areas.
- No post-plant treatment has increased yields in fumigated areas.
- We have seen no effects at all from microbiological amendments, kelp-based materials or humic acid treatments.

Conclusions

- Nitrogen fertilization significantly increased bark N%.
- Supplemental nitrogen fertilization significantly decreased peach susceptibility to BC in the presence of ring nematodes.
- Ca fertilization also reduced BC susceptibility, but not as much as N.

Conclusions

- Why haven't nematicides (applied annually for 3 years) resulted in increased yields??

Something other than nematodes is affecting tree performance.

Thank you for your attention.

Questions??