

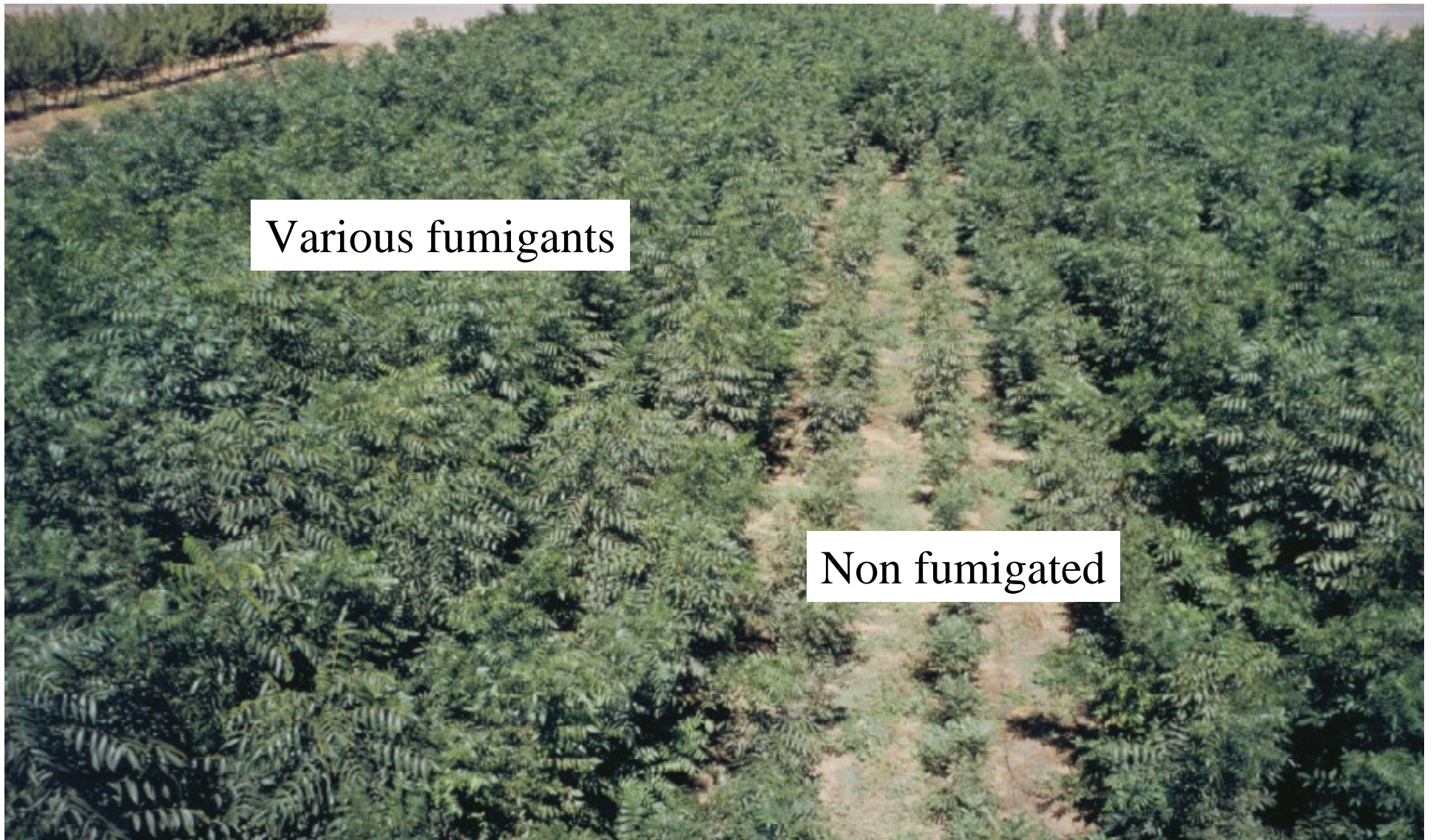
# Items to Consider When Replanting Walnuts

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UC Riverside/Kearney Ag Center

Feb 7, 2008

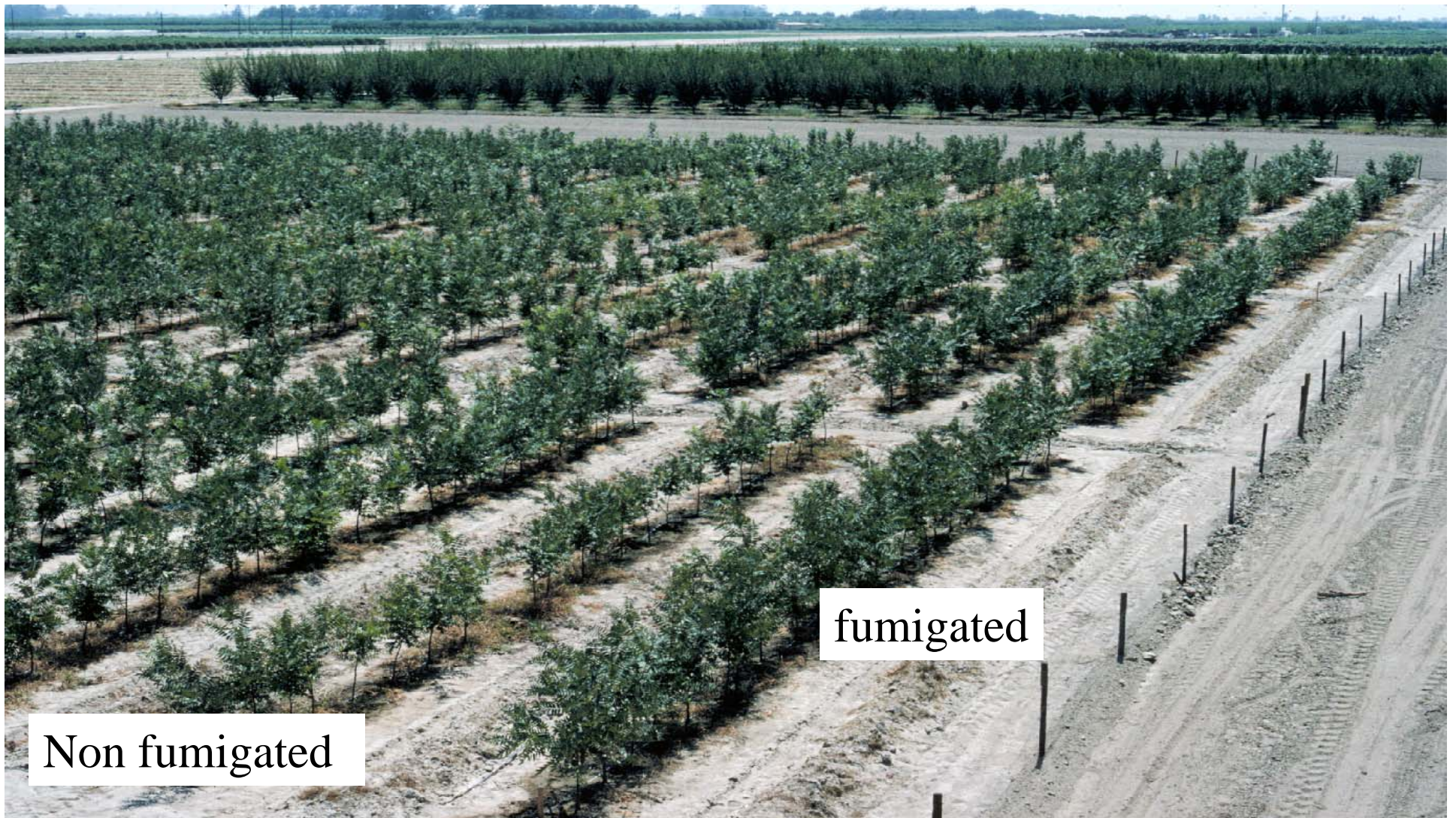
Wait 2 years, rip to five feet, walnuts after  
walnuts in clay loam soil, replant with seeds



Various fumigants

Non fumigated

Wait 2 years, rip four feet deep, walnuts to walnuts in sandy loam soil, replant 1 yr olds



Non fumigated

fumigated

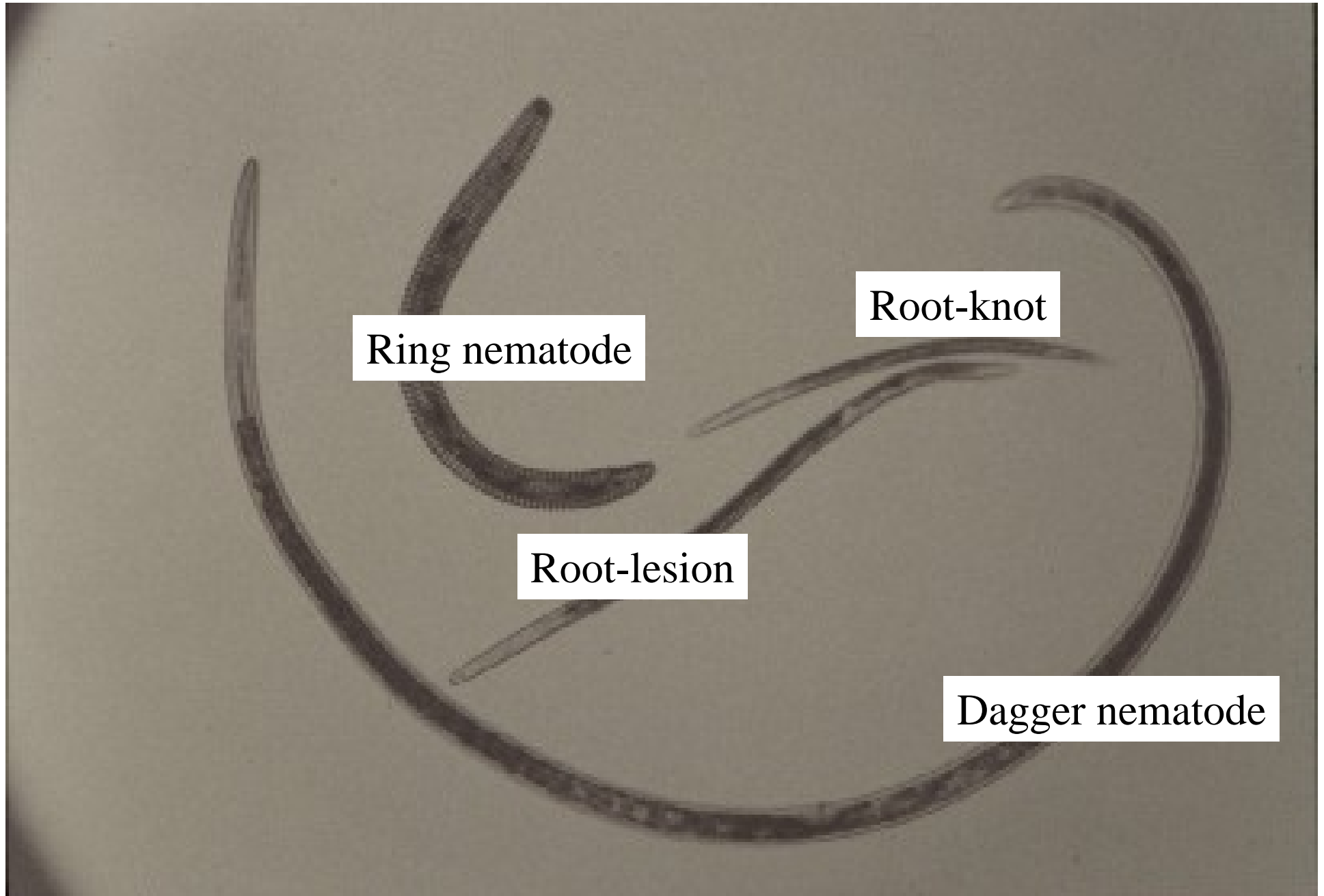
# Both sites were impacted by one or more components of the walnut replant problem

- 1/ The rejection component (old soil ecosystem)
- 2/ Soil pest and disease component (commonly root lesion nematode)
- 3/ Soil physical and chemical factors (plow pans & chemical residues usually resolved with ripping)
- 4/ Small amounts of macro and micro nutrients at the time of planting.

The rejection component appears as poor growth, unevenly distributed across the field but only for the first 1 to 1 ½ yrs after replanting.

But, if root lesion nematode is also present, the new trees may never grow well.

# Nematodes are a major soil pest of walnuts





# First-year root structure of Serr vs. NCB



NCB fleshy roots range from 3cm to 15cm in length



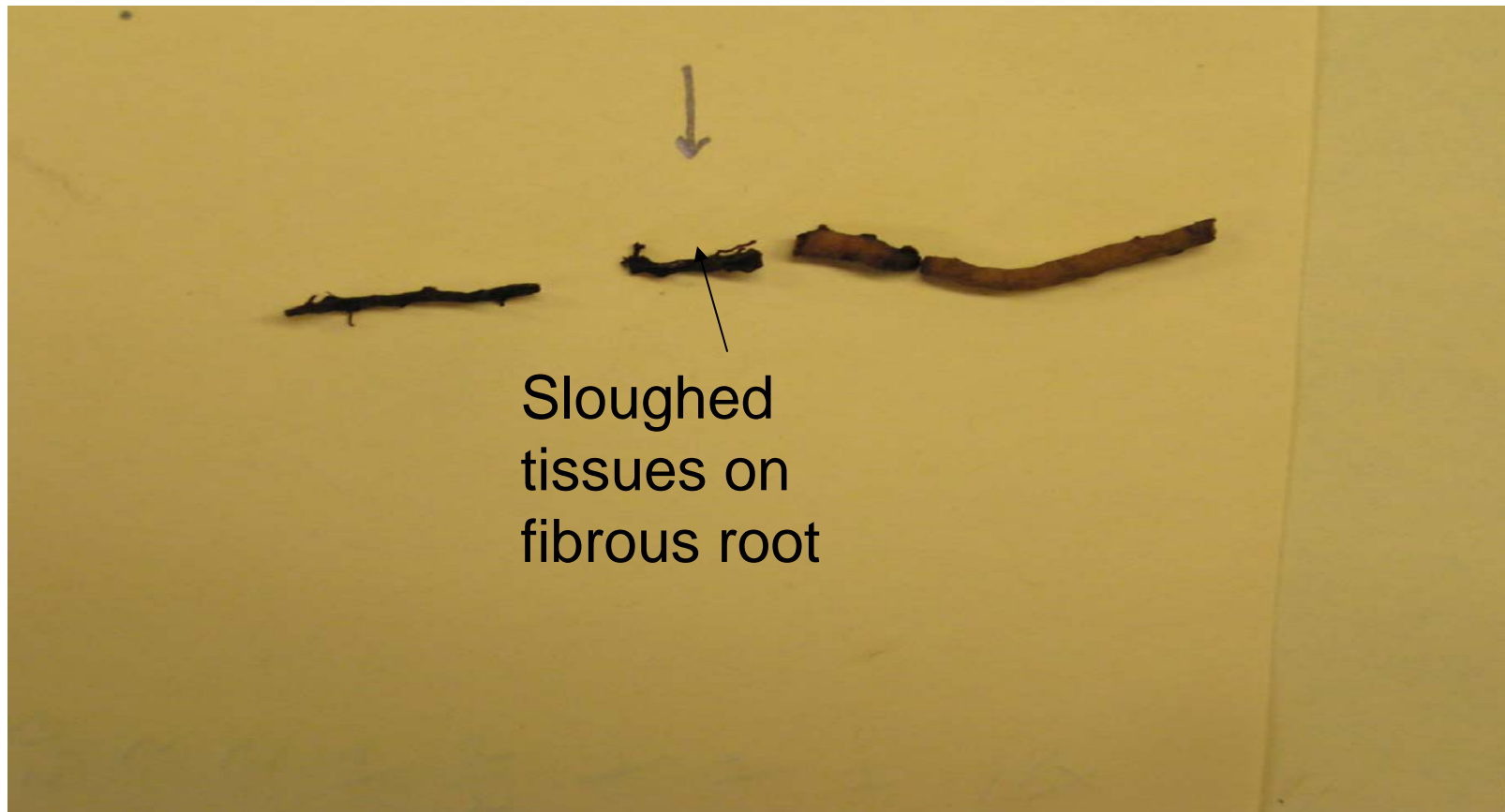
Serr root tips range from 1cm to 5cm



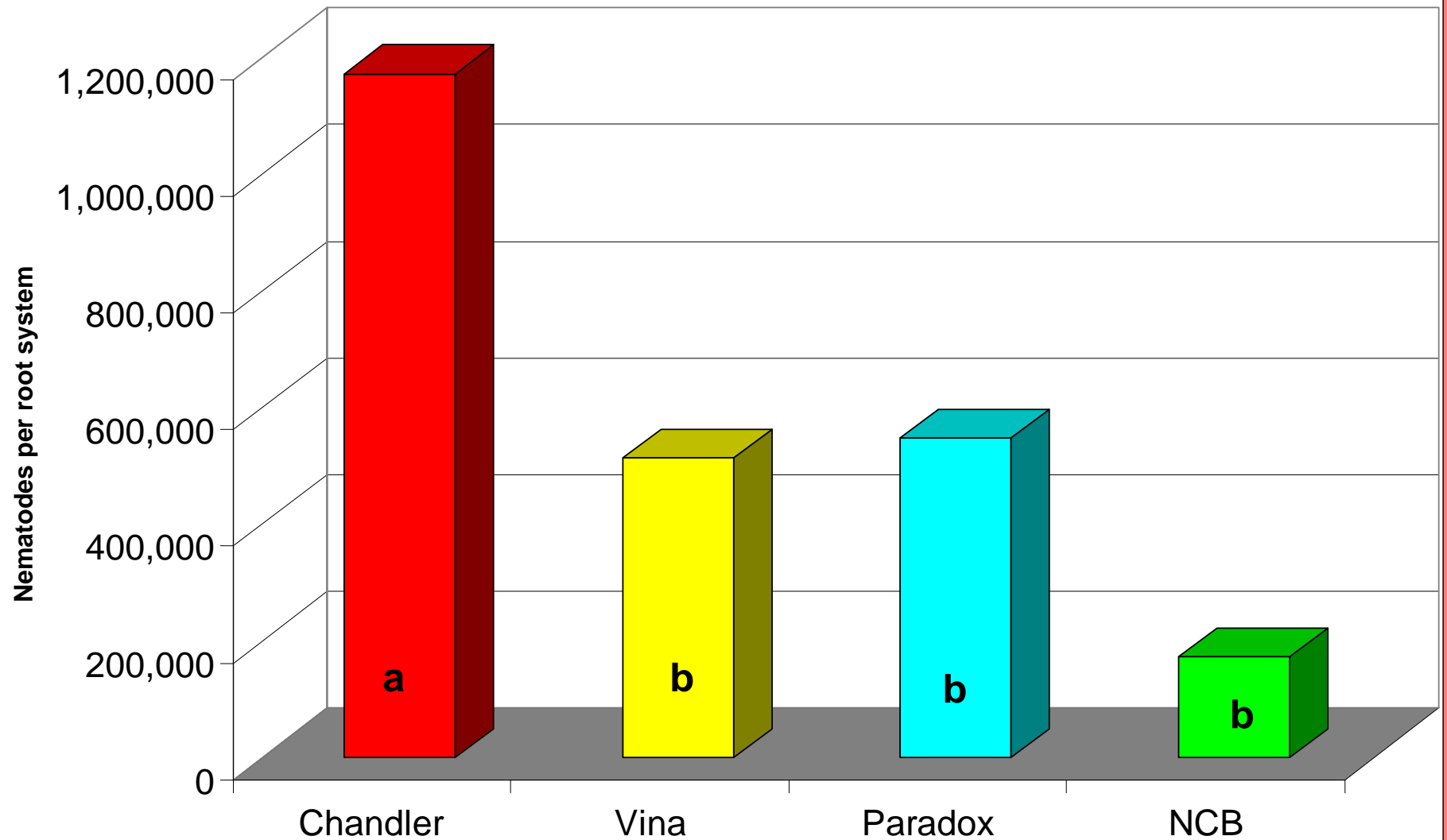
English stocks have multiple tips more often  
than NCB



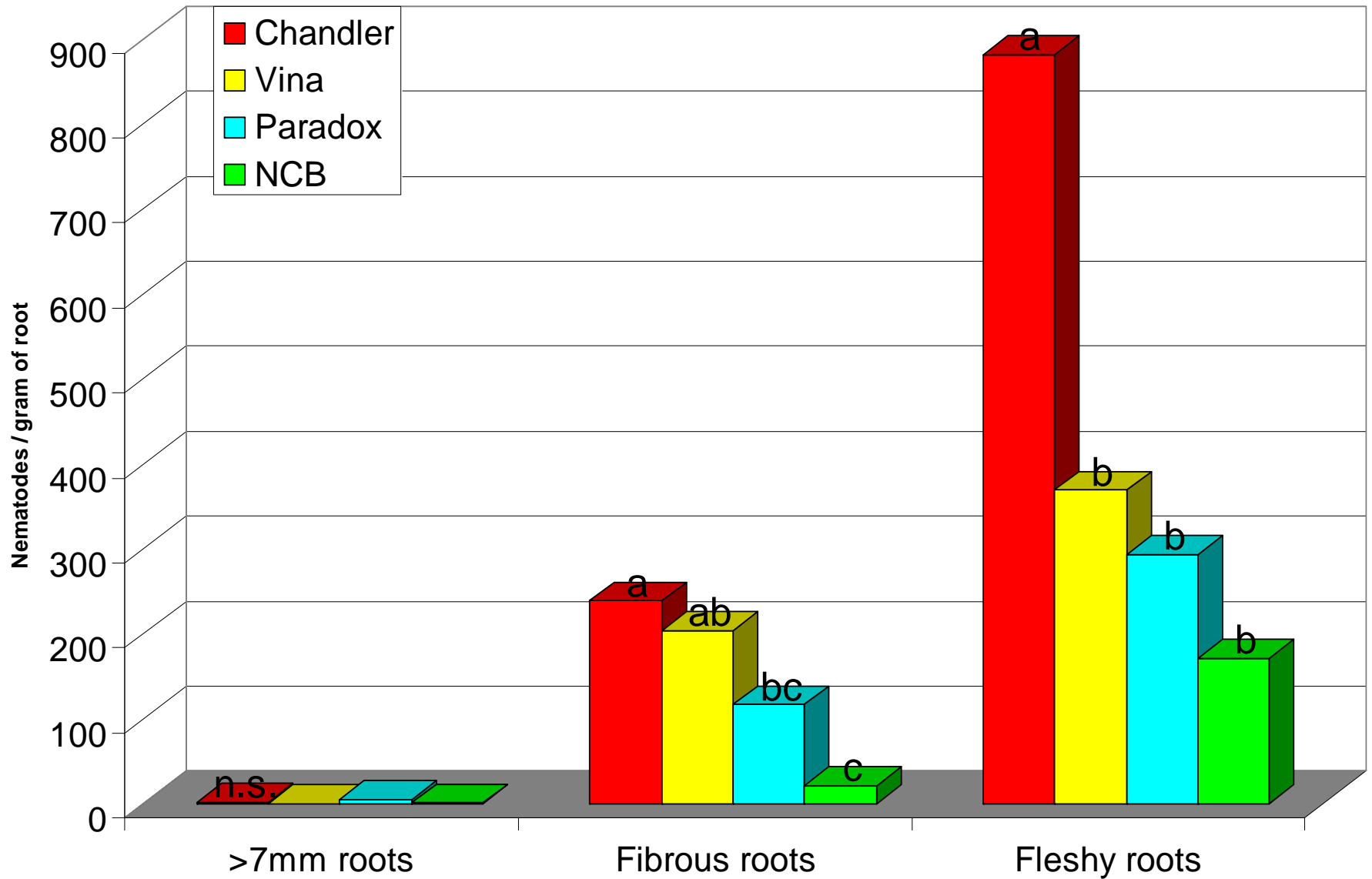
Fleshy root tip, fibrous root covered with sloughed tissues and further back the fibrous portion of the root



Relative host status of four walnut rootstocks 220 days after exposure to 22,400 *P. vulnus* and 110 *M. incognita* race 3 + eggs



Preferred feeding sites for root knot and root lesion nematode in the first 220 days after inoculation



# Lets re-think old notions about how nematodes damage walnut

- Root-lesion and root-knot damage is to roots that are 50 days old or less.
- 99% of an established walnut root system is relatively resistant to nematode feeding
- Start the tree out nematode-free because 5% of nematode off-spring can live five years without food as they await the next new root tip to emerge in their vicinity.

Before I address resistance..what is pre-plant fumigation accomplishing?

A grower near Rio Oso, CA by the name of Donald Norene has helped us answer this question!

# Relative tree sizes in 2005, four years after various fumigations

Broadcast



Strip



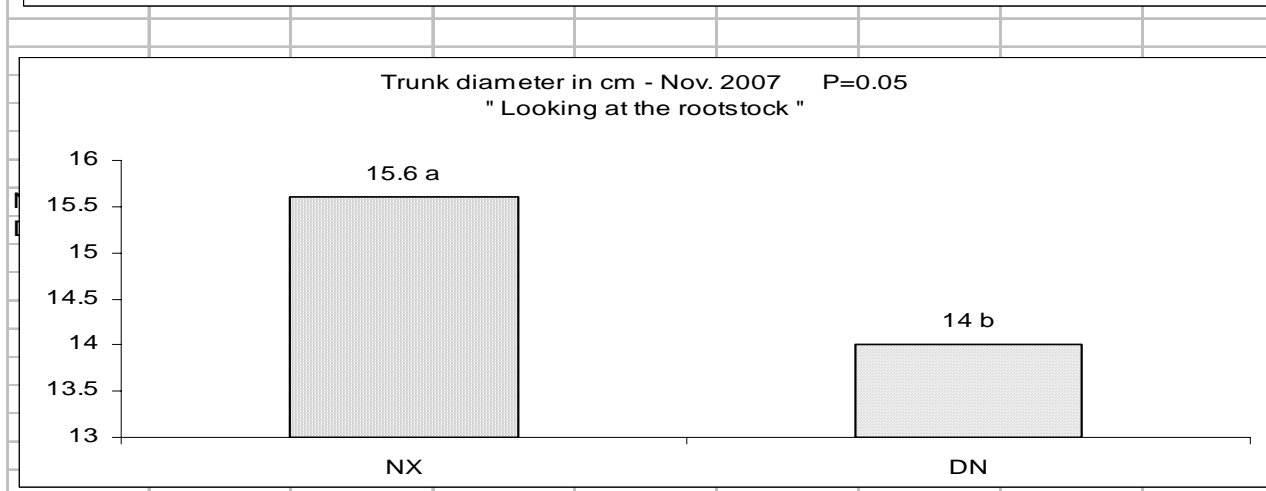
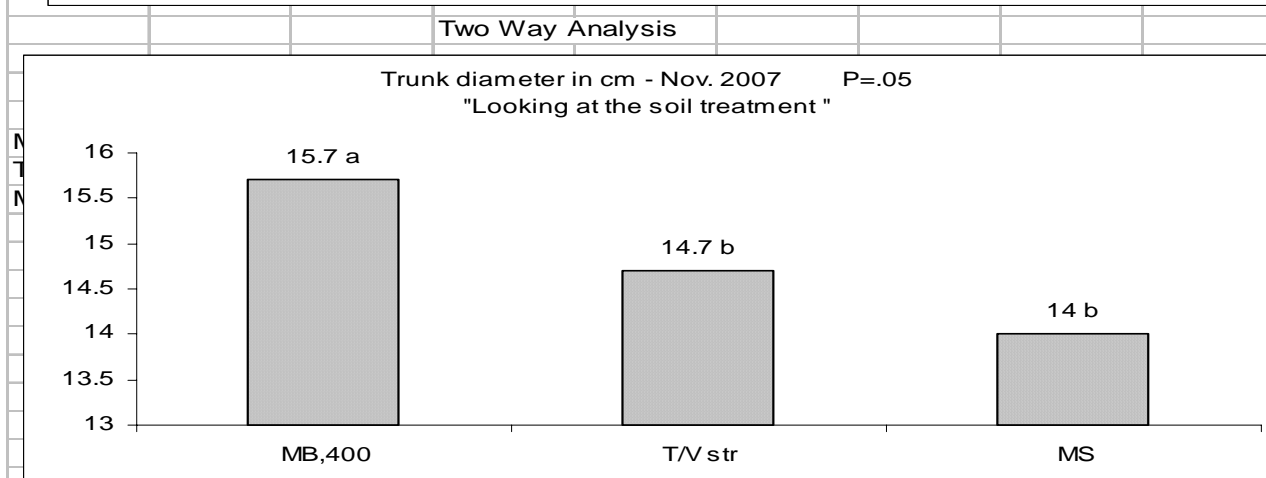
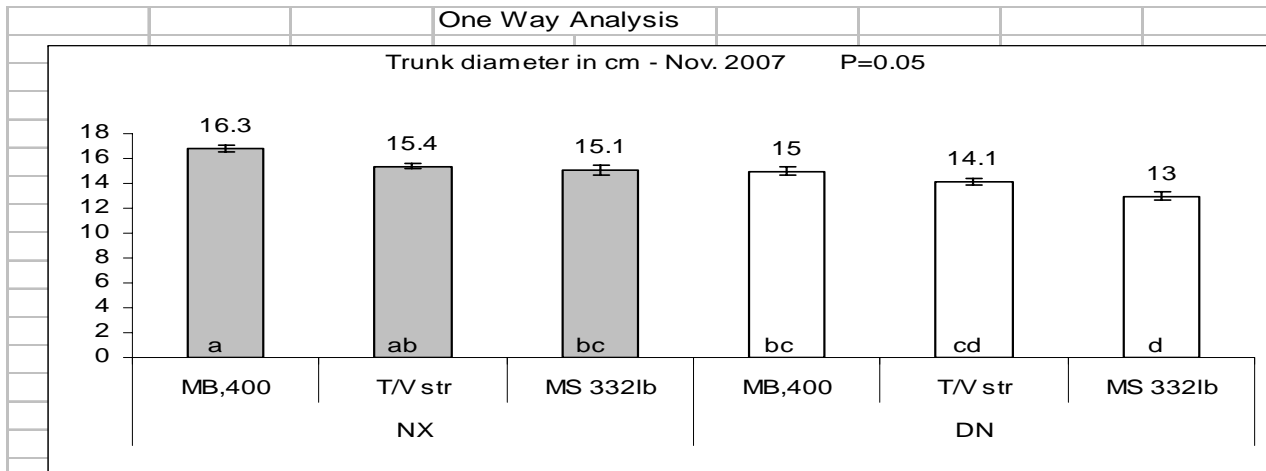
# NX vs DN Paradox seedlings in fall 2006



NX

DN

Sixth-leaf differences, 2007



## Incidence of *P. vulnus* 6 years after various soil treatments at Rio Oso

Soil Treatment	Volume of soil fumigated/ac	Mean counts/250cc soil when replanted to NX Paradox	Mean counts/250 cc soil when replanted to DN Paradox
400lb/ac MB (tarp) broadcast	99.99% control in 24M lbs soil	2 a	123 ab
500lb/ac rate Telone stripped + 110lb MS	99.99% control in 9M lbs soil	301 bc	145 abc
325 lb/ac MS broadcast in 6" water	99.90% control in 16 M lbs soil	432 c	332 c

**Sample each foot to 5 feet deep**

**Samples from top 2 feet at canopy edge**

*Pratylenchus vulnus* / 250 cc from each foot to 13 ft depth at  
2.5 yr after Garlon

Depth [ft]	Garlon + MB	No Garlon + metam sodium
1	0	0
2	0	0
3	0	0
4	0	9
5	0	43
6	0	1
7	2	14
8	3	2
9	5	1
10	0	3
11	3	7
12	0	1
13	5	0
Mean	1.4	6.7
DMRT (.05)	n.s.	

Collect soil from each foot to 5 foot depth

If soil moisture exceeds 12%, Telone and Pic do not move beyond

At 12 to 15% use Buessing shanks and 50% more fumigant



For walnuts there is no  
resistance, no post plant  
treatments and soon no methyl  
bromide

3500 plants screened

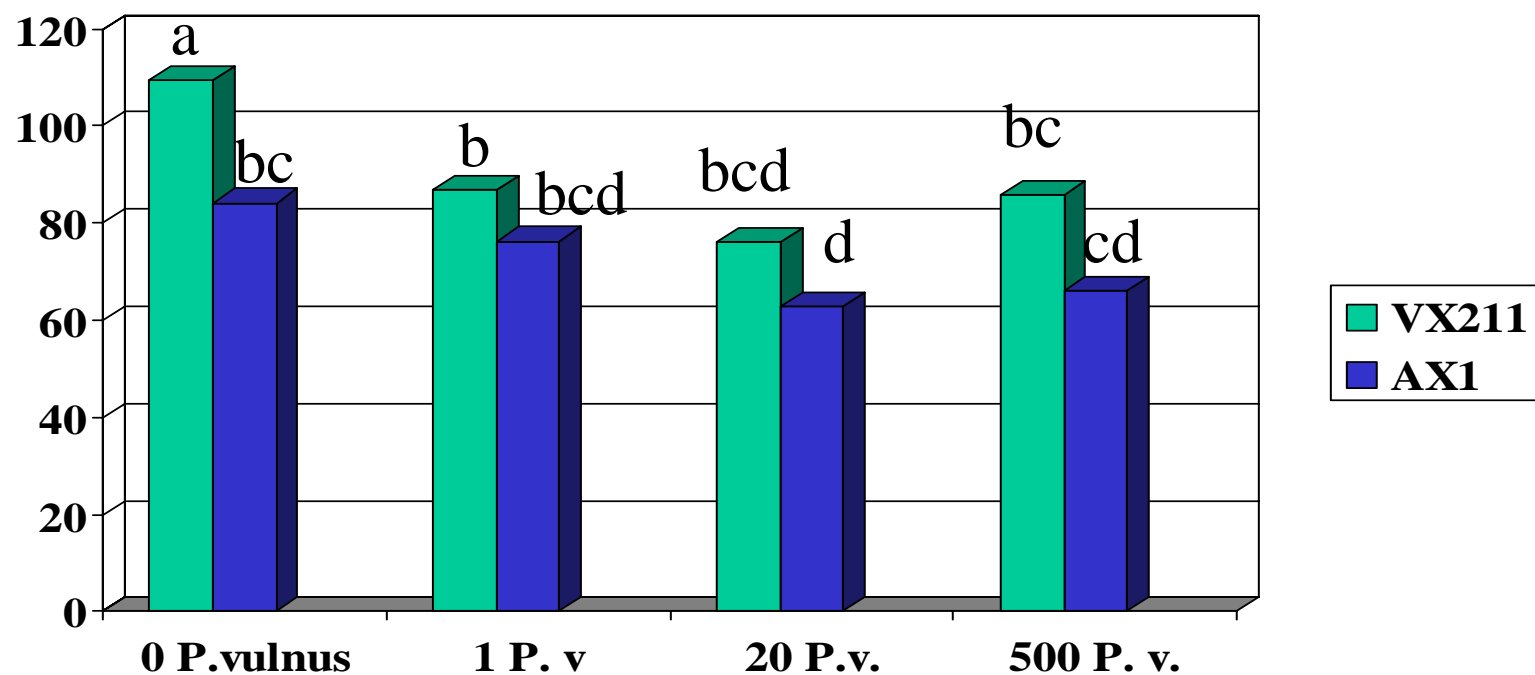


# Clones of VX211 compared to AX1 Paradox in first-leaf

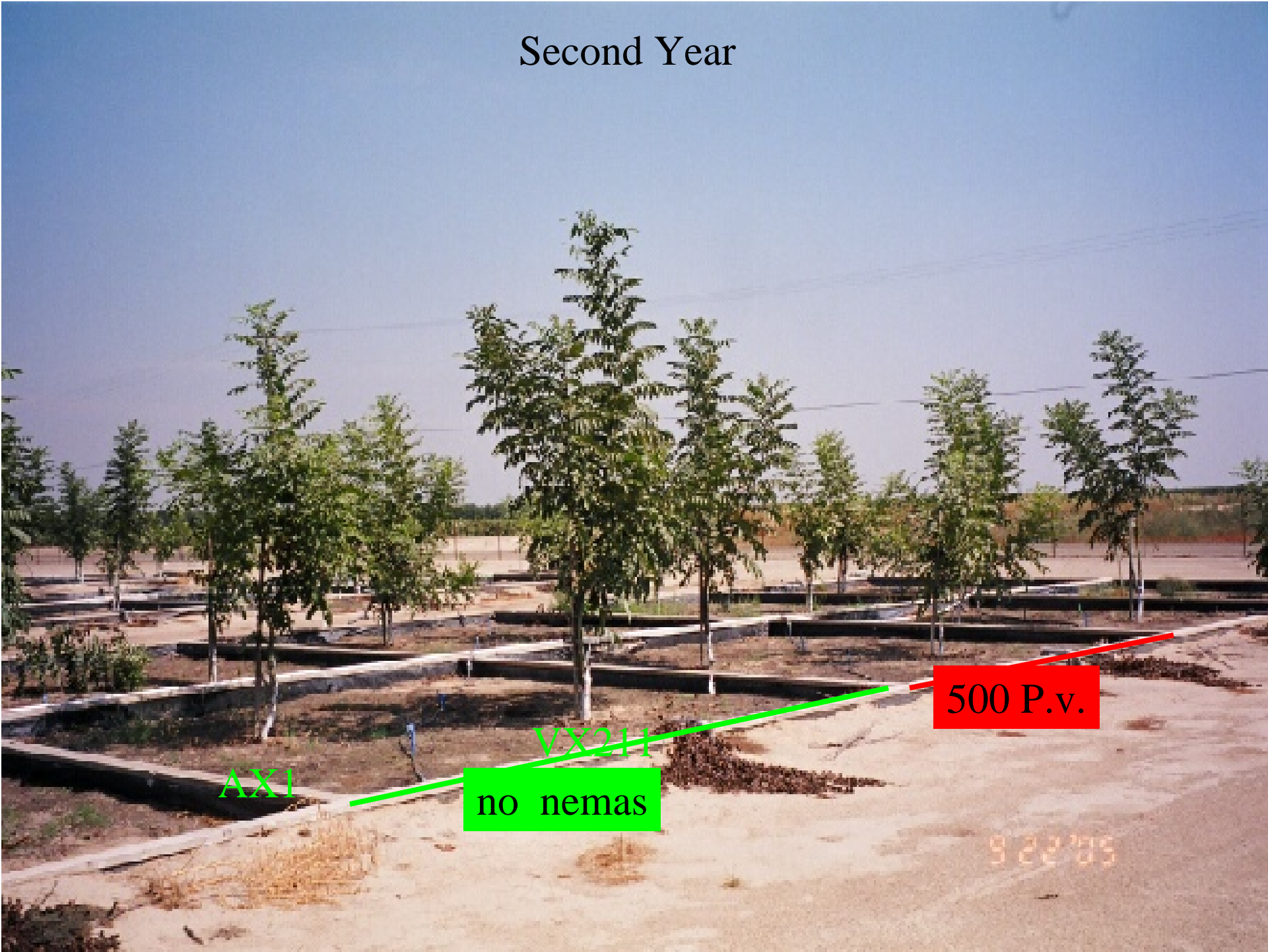
1. Each plot is 1/100<sup>th</sup> acre
2. Plots contain either 0, 1, 20, or 500 *P. vulnus*/250 cc soil



# First-year heights of VX211 and AX1 planted to various *P. vulnus* population levels/250cc soil



Second Year



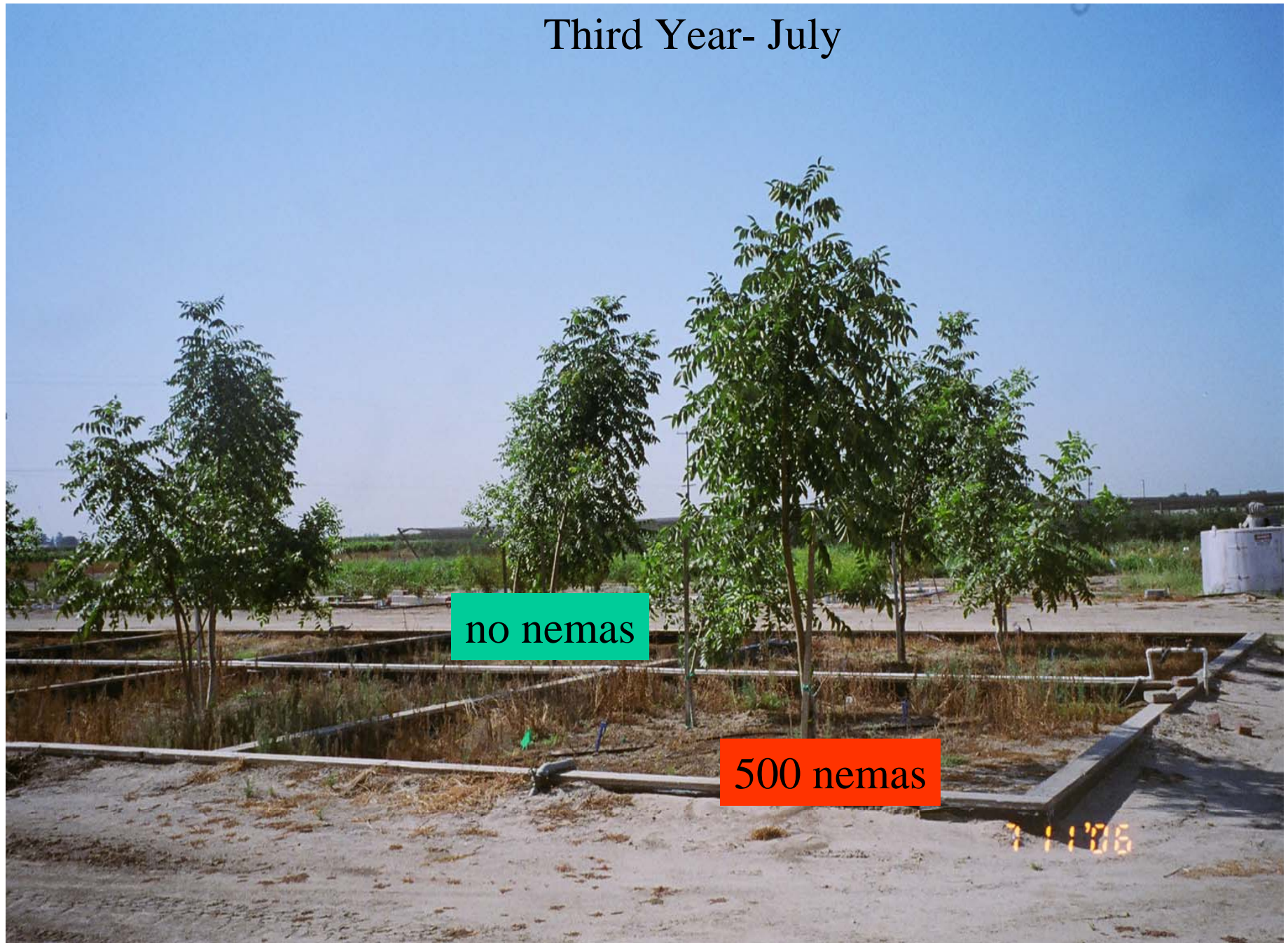
AX1

VX211  
no nemas

500 P.v.

9 22 '05

Third Year- July



no nemas

500 nemas

7/1/06

## Third-year (October) growth of VX211 vs AX1



## Root system of VX211 in the non-inoculated check



## Roots of third-leaf VX211 without nematodes



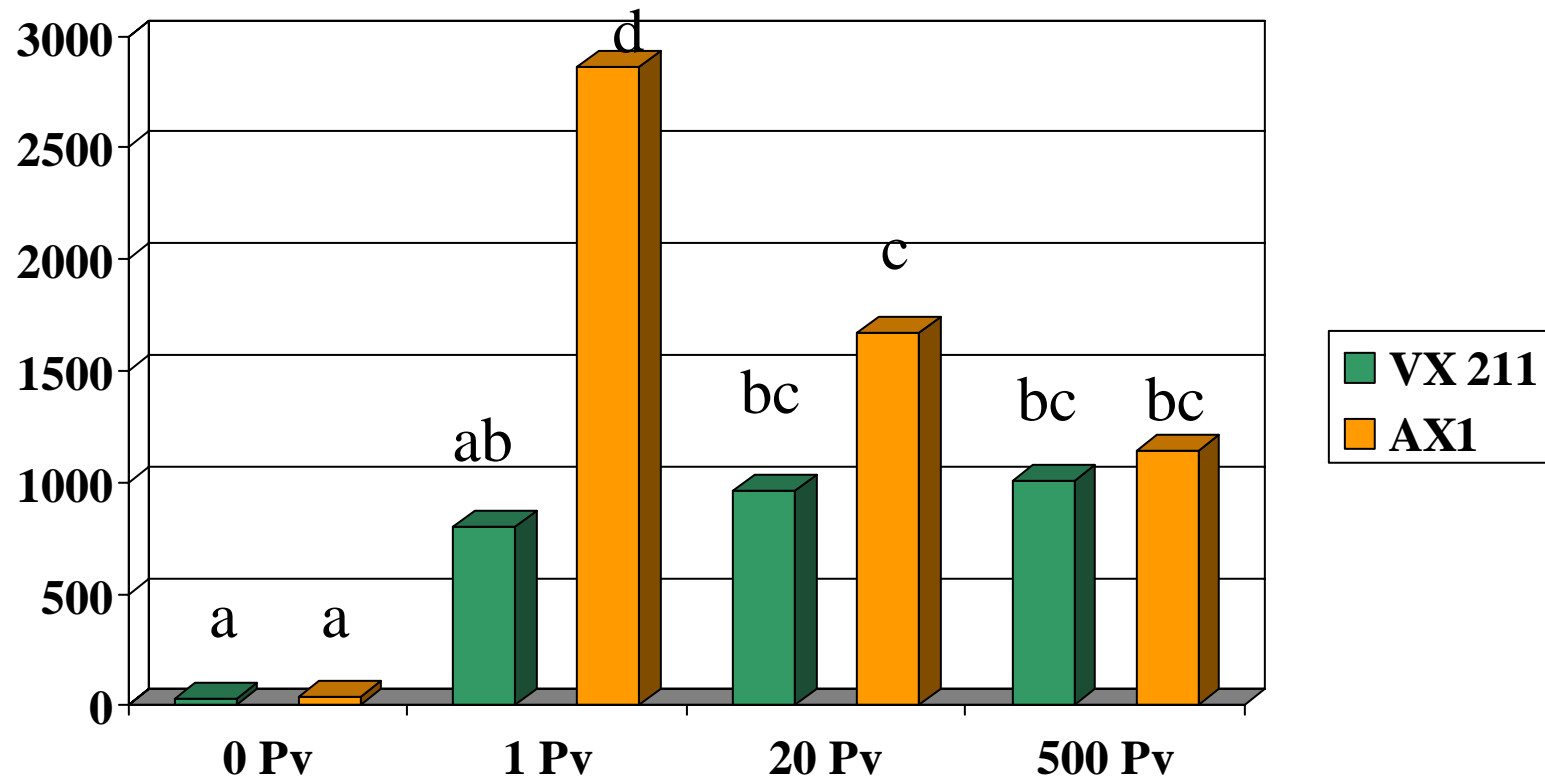
Roots of third-leaf VX211 inoculated with 500 *P. vulnus*/250 cc soil



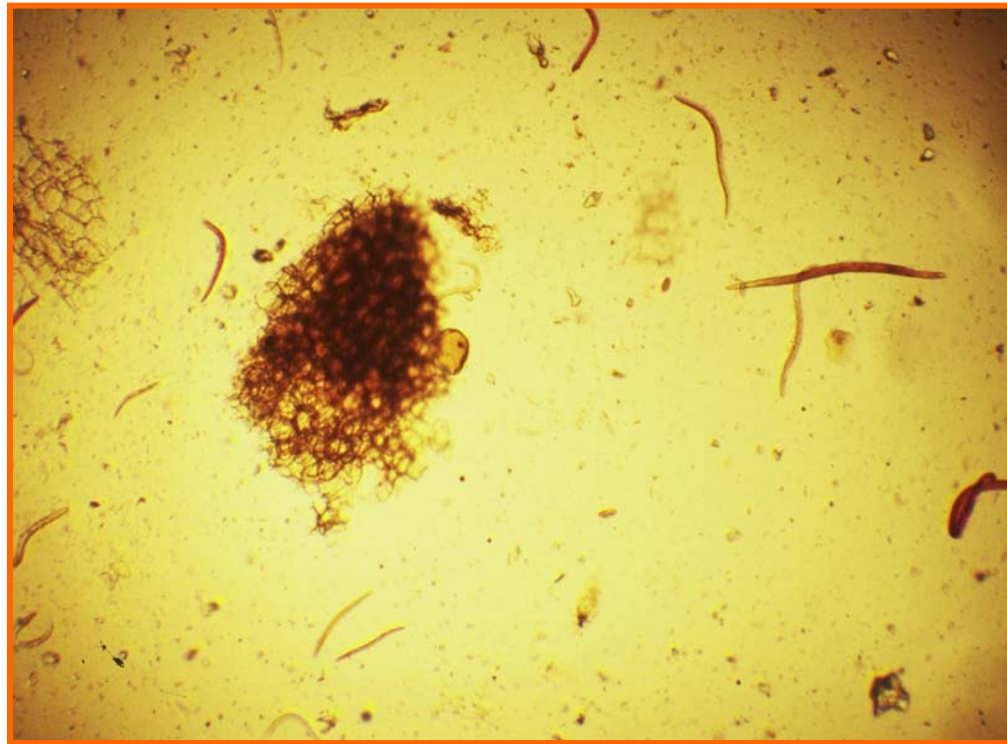
Root systems of VX211 and AX1, in 500 *P. vulnus*/250 cc soil



# *P. vulnus* / 250 cc soil in third-leaf



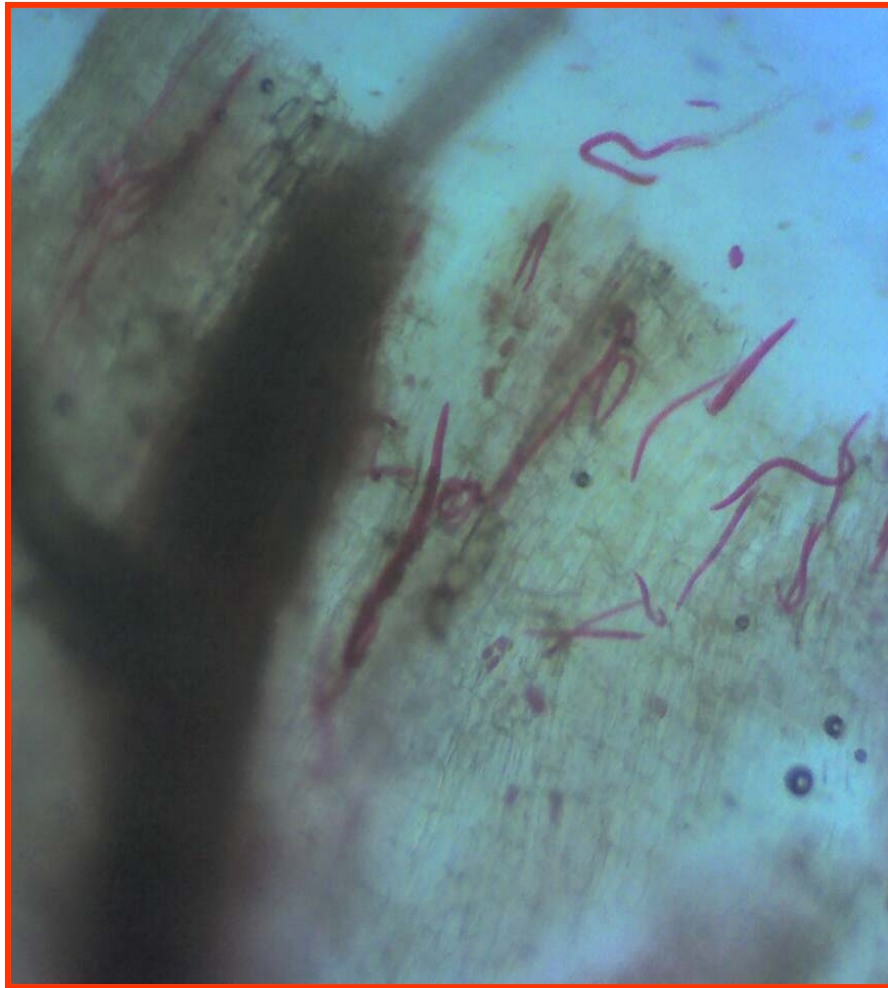
# Root-lesion in AX1 Paradox, within the first inch of root tip



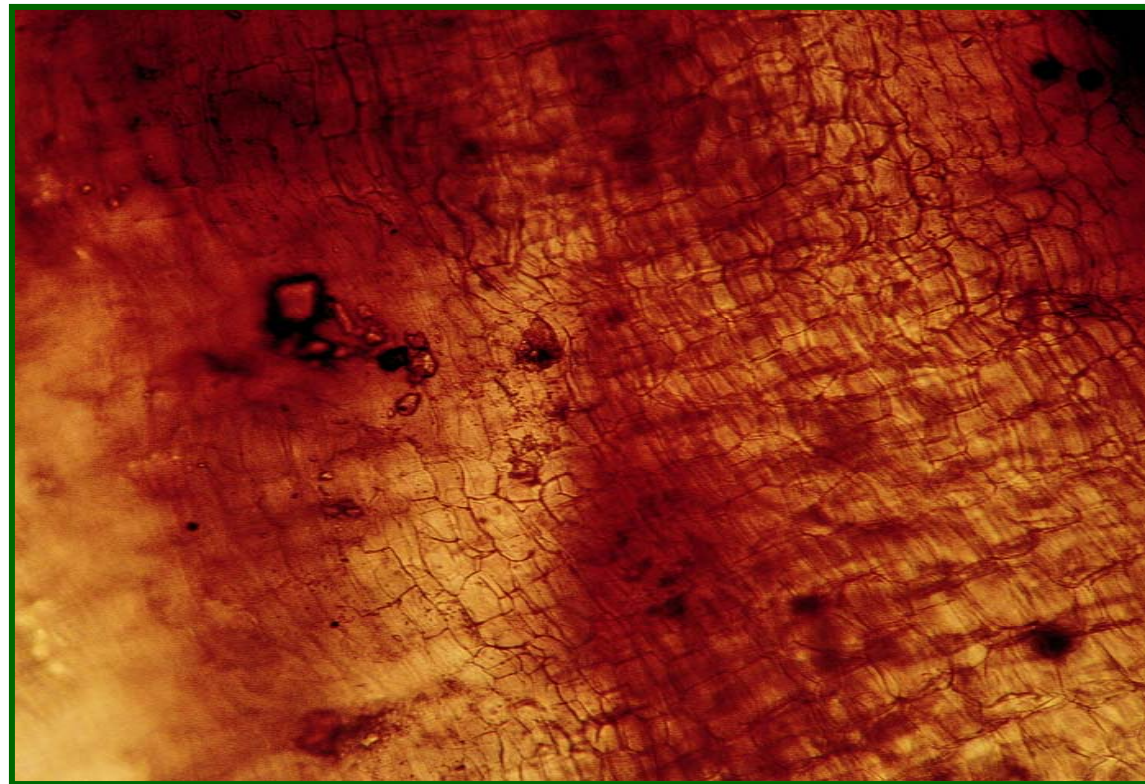
Root-lesion in AX1 Paradox at 1 to 4 inches  
back from the root tip.



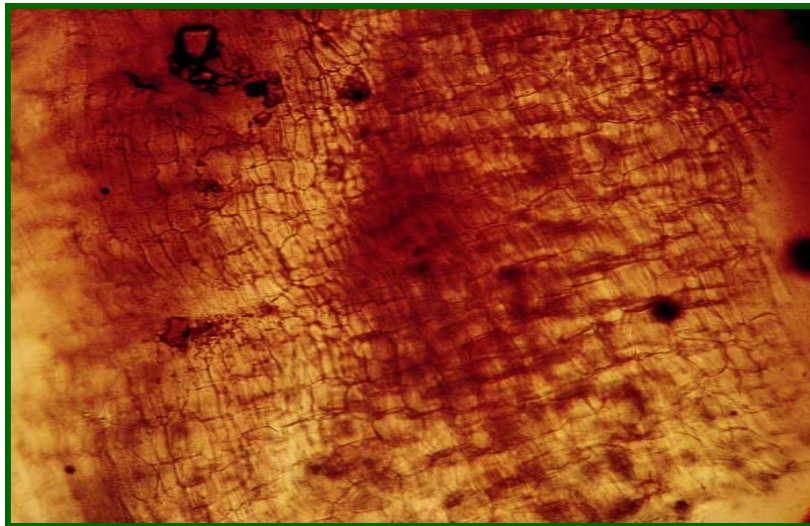
Root-lesion in AX1 Paradox at 4 to 12 inches back from the root tip.



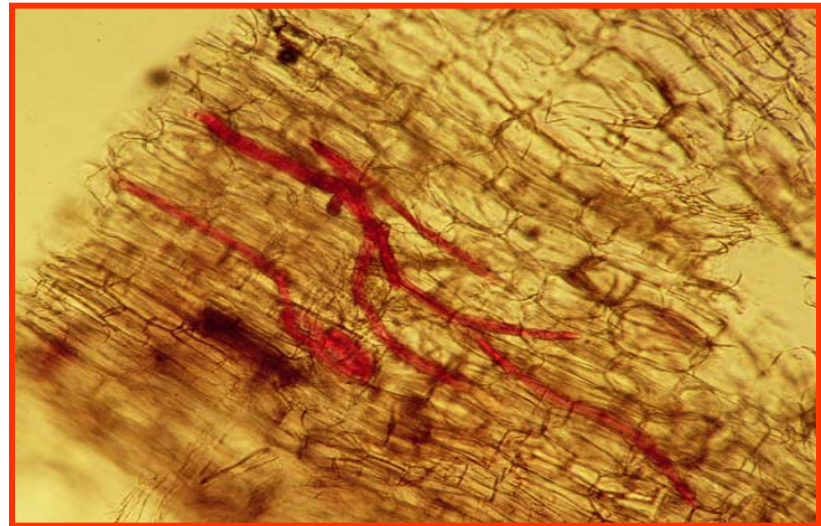
Very few root-lesion found in VX211 root cortex. This photo is at 3 to 9 cm back from the root tip



# Root-lesion Nematode in roots of two Paradox walnut clones



VX211-Few nematodes in cortex at 0 to >9 cm from root tip



AX1-nematode in cortex throughout new roots including samples >9 cm back from the root tip

Table 1. *P. vulnus* in three sections of stained, washed roots counted directly beneath the scope

	0 to 3 cm	3 to 9 cm	> 9 cm
VX211	+	-	-
AX1	+++++++	++++	++

# Actual nematodes extracted from within root sections and from soil

Rootstock	0 to 3cm	3.1 to 9 cm	>9cm	per 250 cm <sup>3</sup> soil
VX211	5.9 a	7.9 a	4.0 a	881.
AX1	272. b	345. b	104. b	541.
			<i>P</i> =0.05	ns.

# VX211

- Offers high vigor compared to other Paradox selections.
- Offers a resistance mechanism within root tips but root-lesion can still feed outside the roots.
- Offers a degree of tolerance to nematode feeding, probably because root feeding is limited.
- Will always perform best where the soil has received a broadcast fumigation.

## Paradox Selections Compared:

- 1) in a lath house
- 2) in a field experiment

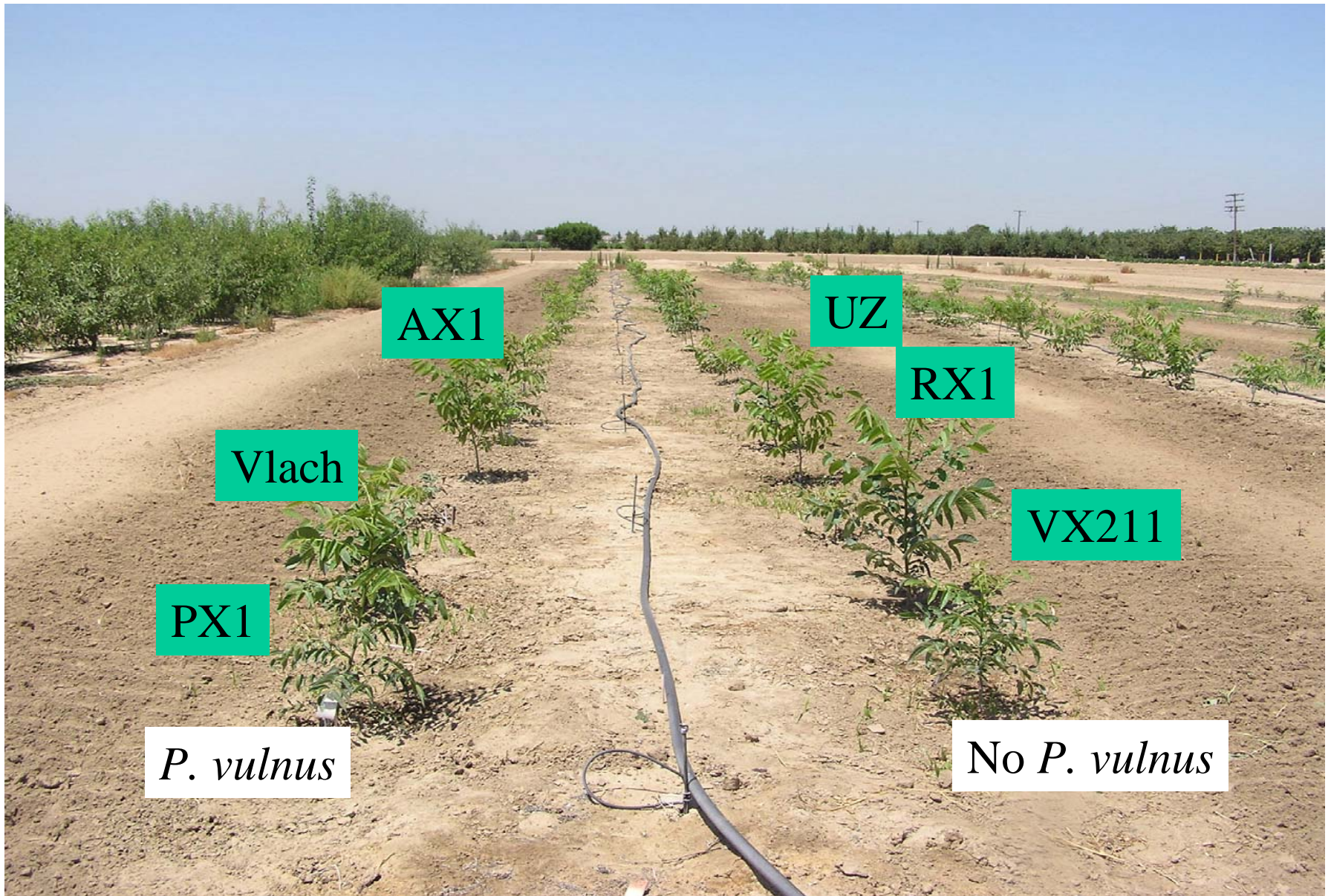
Remember: resistance =  $<0.2$  nematodes/gram of root

One-year lath house evaluation of *P. vulnus* host status /gram of root tips on several Paradox clones

clones	R1	R2	R3	R4	mean	DMRT
Vlach	7871	7286	5813	5352	6580	a
PX1	1673	2431	1800	1870	1944	b
AX1	1037	1691	1132	1846	1426	bc
VX211	1212	1306	1300	1409	1307	bc
UZ229	959	633	621	707	730	c

$P = 0.05$

# Field Examinations, year 1



First-year tree height of 9 paradox clones with and without *P. vulnus*

Rootstock	Height w/o Pv	Height w/Pv	DMRT $P=.05$
RX032	136 cm	132 cm	ns
RX1	119	95	*
VX211	117	128	ns
AZ025	110	80	ns
AX1	92	86	ns
Vlach	84	56	*
WIP 3	80	37	*
PX1	75	86	ns
UZ229	62	82	ns

One of the elite *Juglans* spp.  
provided us with nematode  
resistance in 5 of 11 plants!!!

*Juglans cathayensis*

Chinese walnut, a type of  
butternut

Results of two-year screening for nematode resistance among elite *Juglans* spp.

<i>Juglans</i> spp.	nematodes/250 cc <b>soil</b>		nematodes/gr <b>root</b>		
	<i>P. vulnus</i>	<i>M. incognita</i>	<i>P. vulnus</i>	<i>M. incognita</i>	
<i>J. ailantifolia</i>					
seedling # 1	426	19	5188	0	
# 4	624	0	6384	0	
# 6	1960	0	9072	0	
# 9	2576	0	14568	0	
# 10	2009	0	12304	0	
# 12	17	644	41	1295	
# 15	1768	0	17708	0	
# 16	1672	0	30144	0	
<b>mean nematodes</b>	<b>1381</b>	<b>83</b>	<b>11,926</b>	<b>162</b>	
<i>J. cathayensis</i>					
seedling # 1	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	removed
# 2	145	0	105	0	removed
# 3	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	removed
# 10	484	0	493	13	
# 11	8	0	36	0	
# 19	1108	0	9296	0	
<b># 20</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
<b># 21</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	largest
<b># 24</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	
# 26	0	45	1	112	
<b>mean nematodes</b>	<b>228</b>	<b>6</b>	<b>993</b>	<b>12</b>	
note: we refer to root counts less than 0.2 as resistant					

## In Summary

- NX and UZ Seedlings offer protection from nematode entry unless too many are present. Our studies encourage more study of UZ229.
- VX211 clone offers vigor and some tolerance to nematodes because fewer feeding sites are available—but fumigate!
- To plant without fumigation we will need: Garlon > wait one year> then replant on different parentage having nematode resistance such as *J. cathayensis* #21.