Fumigation, rootstocks and other tools useful for walnut replanting

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Feb 2, 2012

(1)

How can a walnut grower DRY the ground out enough to make fumigation work?

Using Telone or Pic the fumigant will not move into soil that is >12% H_20content

Tools for deep drying of the soil

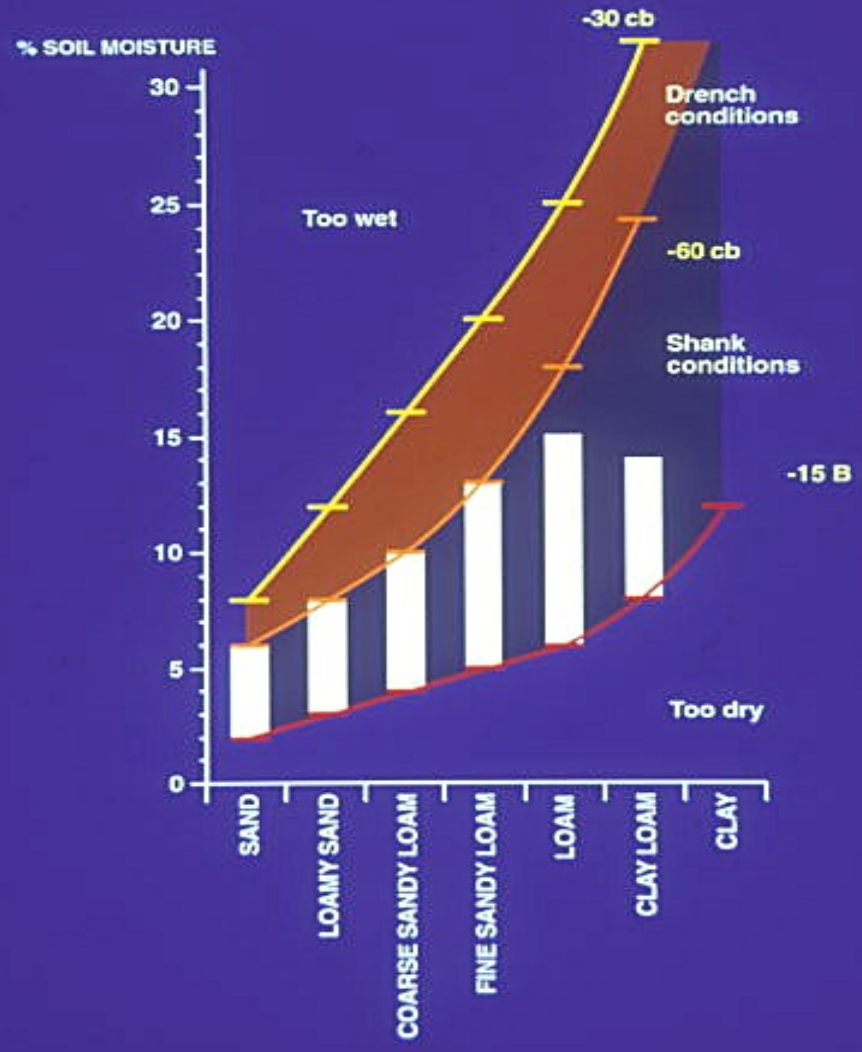
1. Deep ripping with several days of airing between each pass.
2. Use of winter wheat as a winter cover
3. Planting of true sudan grass in mid April with no subsequent irrigations/mow and remove for silage/till under by Sept 1/ then deep rip. Fumigate by mid November after < 2 inches rain

Performance of tarped Telone II in sandy loam soil-Kearney						
		root lesion	pin	other	% of untreated	
332 lb/acre, tarped						
1 ft		0	0	0	100%	
2 ft		0	0	0	100%	
3 ft		0	0	0	100%	
4 ft		0	0	0	100%	
5 ft		0	0	0	100%	
332 lb/acre, no tarp						
1 ft		1	0	0	99.60%	
2 ft		0	0	0	100%	
3 ft		0	0	0	100%	
4 ft		0	0	0	100%	
5 ft		0	0	0	100%	
untreated	actual #'s					
1 ft		351	4			
2 ft		391	11			
3 ft		7	1			
4 ft		14	0			
5 ft		9	0			

Performance of tarped Telone in clay loam soil-Yuba City after 3 months						
		root lesion	stunt	free-living	% of untreated	
332 lb/acre						
1 ft		0	0	0	100%	
2 ft		0	0	0.5	100%	
3 ft		0	0	21	100%	
4 ft		5	2	63	94%	
5 ft		8	5	27	28%	
500 lb/acre						
1 ft		0	0	1	100%	
2 ft		0	0	2	100%	
3 ft		0	0	3	100%	
4 ft		4	2	8	95%	
5 ft		12	5	3	0%	
664 lb/acre						
1 ft		0	1	1	99.70%	
2 ft		0	1	0	99.80%	
3 ft		0	0	1	100%	
4 ft		8	1	7	94%	
5 ft		12	0	0	33%	
untreated	actual #'s					
1 ft		23	360	946		
2 ft		12	436	428		
3 ft		52	45	167		
4 ft		36	81	229		
5 ft		5	13	13		

Performance of tarped telone in clay loam soil-Davis after 3 months (2 reps only)								
		root lesion	stunt	dagger		free-living	% control	
332 lb/acre								
1 ft		4	0	0		481		99.00%
2 ft		1.5	0	0		23		99.00%
3 ft		39	26	0		41		0%
4 ft		27	6	1		18		0%
5 ft		6	3	5		74		
500 lb/acre								
1 ft		0	0	0		94		100%
2 ft		0	0	0		24		100%
3 ft		0	0.5	0		20		98.40%
4 ft		1	16	0		25		33%
5 ft		0.5	0.5	0		12		86%
664 lb/acre								
1 ft		0	0	0		26		100%
2 ft		0	0	0		3		100%
3 ft		0	0	0		7		100%
4 ft		0.5	1	0		19		93.00%
5 ft		0	0.5	0		26		93%
untreated	actual #'s							
1 ft		366	14	8		319		
2 ft		128	8	7		126		
3 ft		20	9	1		7		
4 ft		13	8	1		1		
5 ft		4	3	0		0.5		

Fig. 1d. Optimum Treatment Conditions for dual application 1, 3-D started at 18"d 35 gpa. flip in 2-4 weekend retreat at 15 to 20 gallon at 18".



(2)

Three years of yields from two paradox seed sources, NX having more resistant seedlings than DN, when replanted after three fumigation treatments

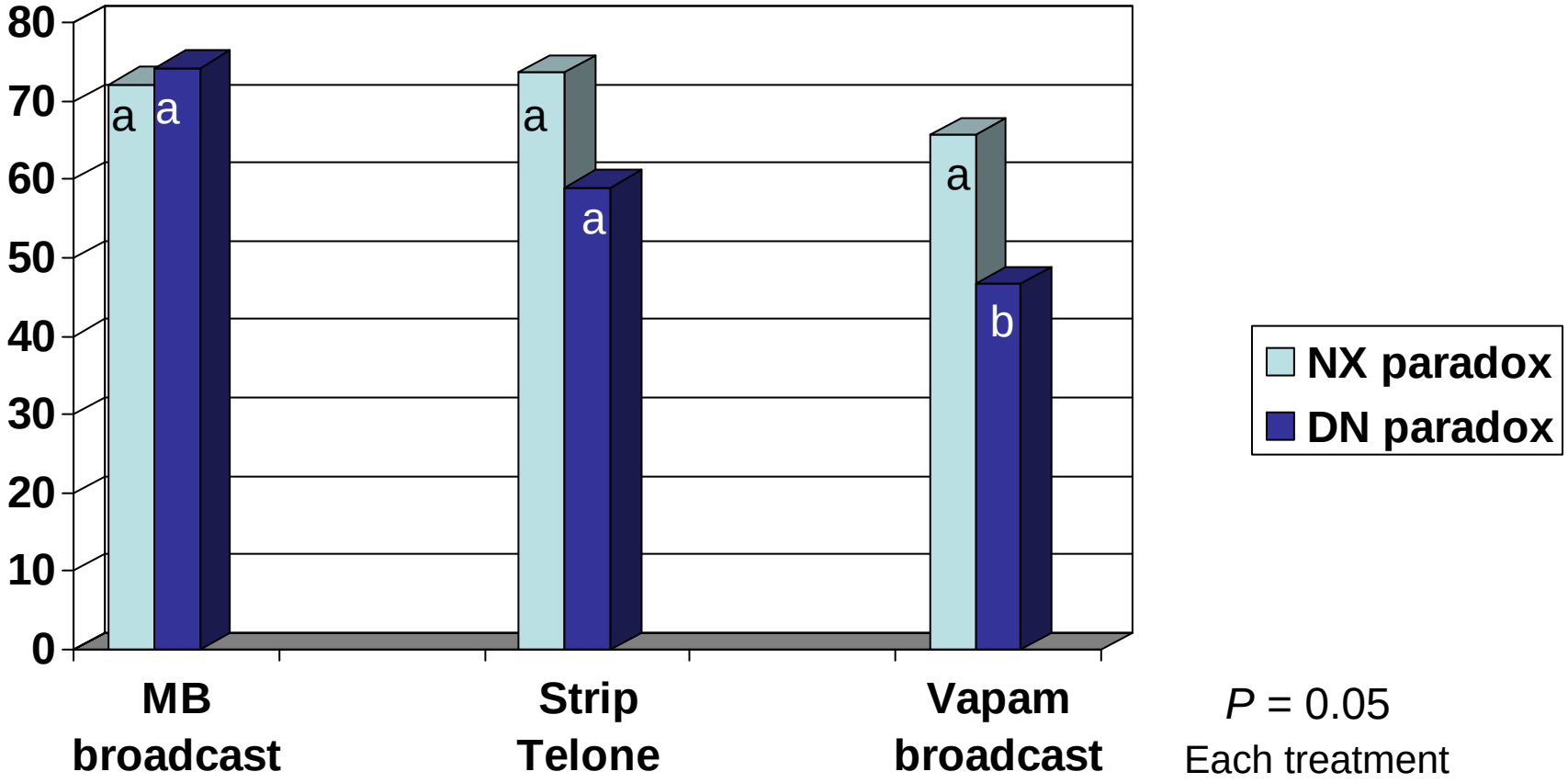
NX vs DN Paradox seedlings in fall 2006 after planting in 2001

Ninth year Chandler /NX* vs DN Seedling Rootstocks following broadcast [methyl bromide], [metam sodium] or stripped Telone II. Photo on Sept 29, 2010.

NX and DN Paradox seedlings at 9 years
after replanting after three soil treatments

Note the general variability of tree growth depending on treatments

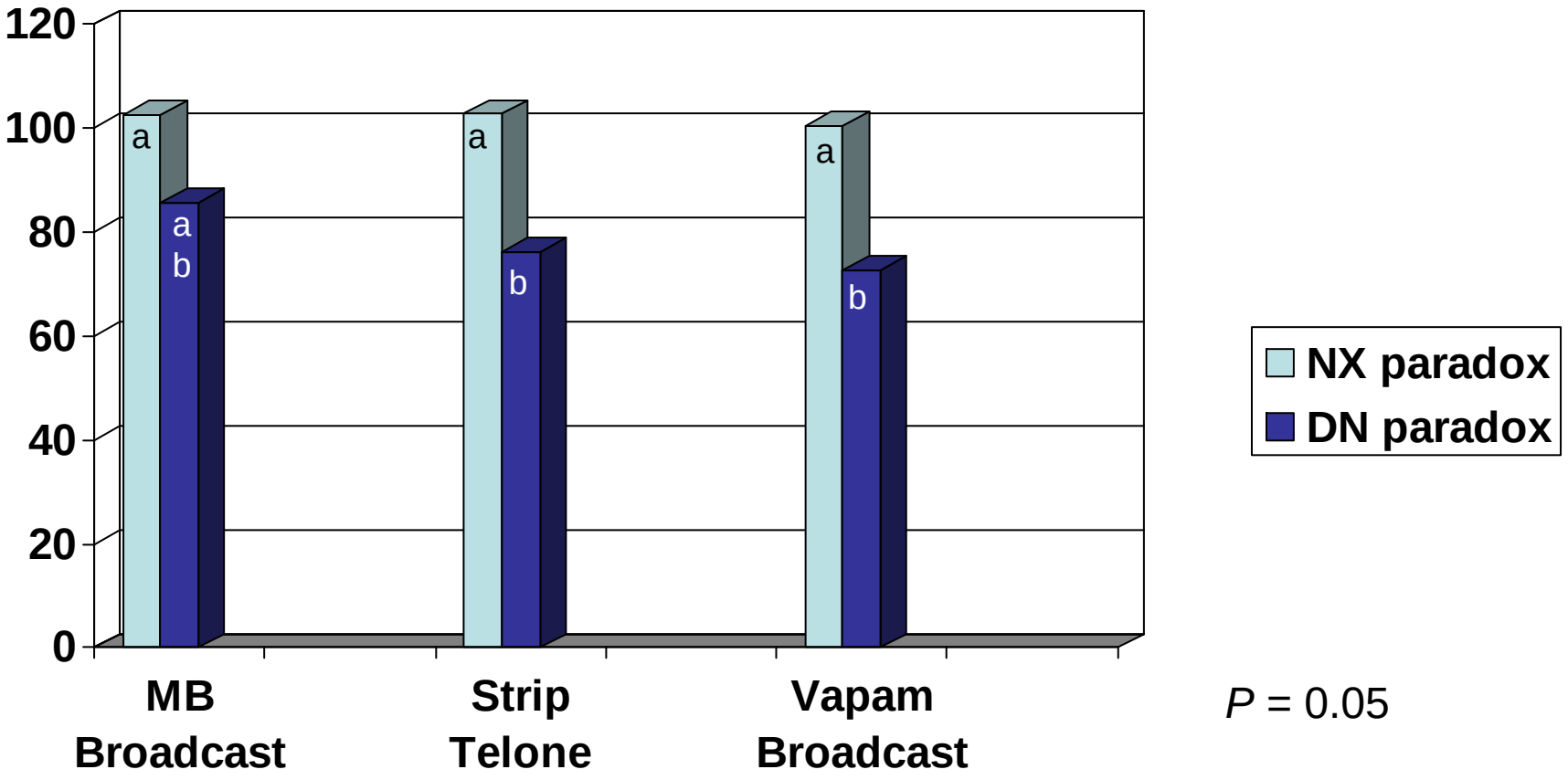
Eighth-Leaf Yield (lb/tree) of Chandler on Two Rootstock Seedlings



P = 0.05

Each treatment analyzed separately

Ninth-leaf yield (lb/tree) of Chandler on Two Rootstock Seedlings



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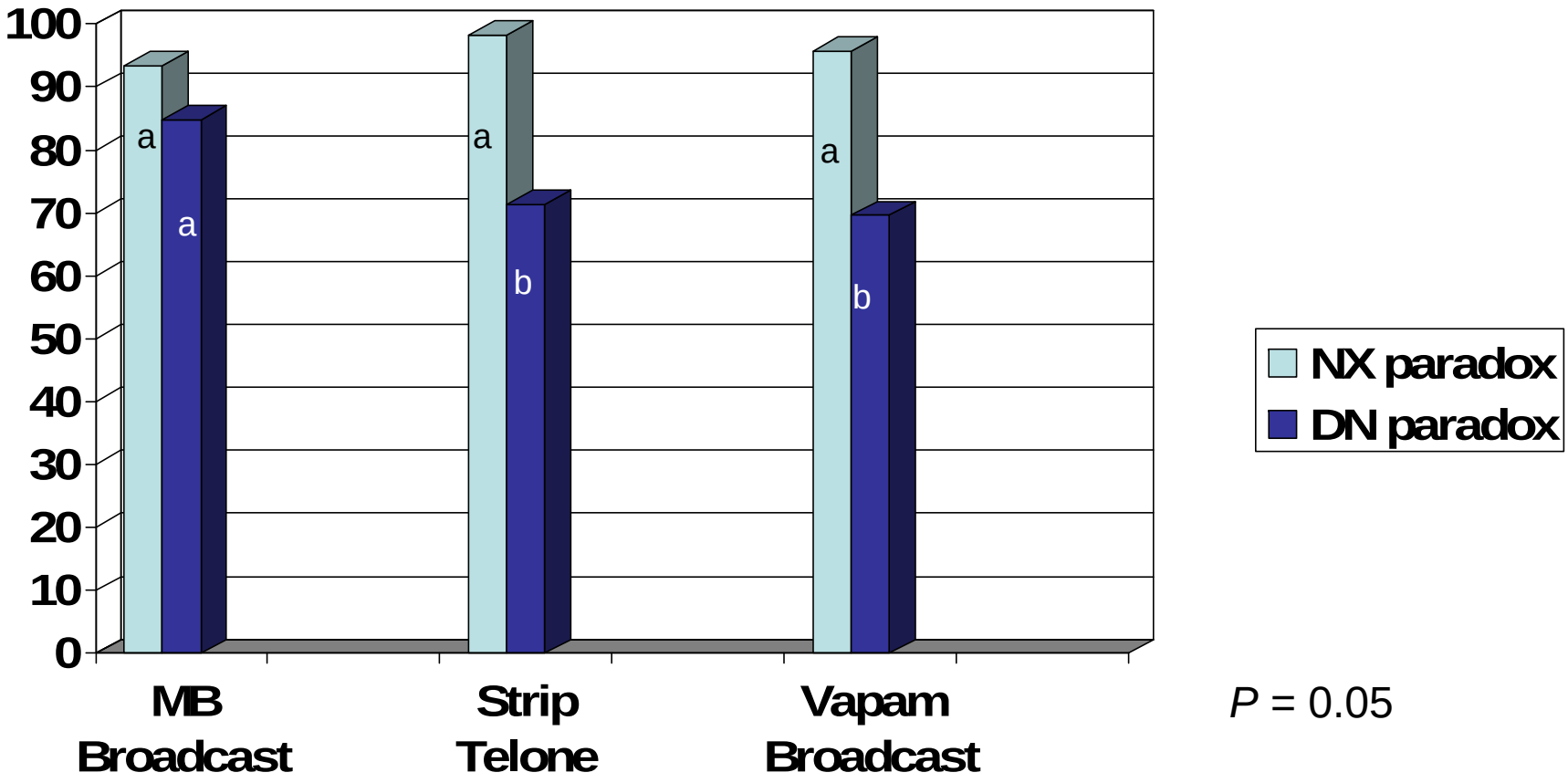
Tenth-leaf (lb/tree) of Chandler on Two Rootstock Seedlings following Movento in fall 2010 and spring 2011



P = 0.05

First-year benefit of Movento nematicide sprayed to all the trees in fall 2010 and spring 2011 indicates minimal visible benefit.

Farm-gate dollars returned from the orchard's first three harvests

Treatment	NX rootstock	DN rootstock
MB 400lb/ac, tarp broadcast	$21,375.	$19,433.
Telone II strip 500 lb/ac + 110 lb/ac Metam	$21,943.	$16,440.
Metam 332 lb/ac drench broadcast	$20,922.	$15,157.

This orchard’s tree trunks had been treated with Garlon prior to tree removal

Use of Garlon paint plus one year waiting can starve the old soil ecosystem. It will not replace soil fumigation but can be useful when combined with switching to a different rootstock.

Does painting of stumps with herbicide really help and work?

How and When is a stump treatment made?

Paint on Garlon and MorAct soon after the last harvest.
Do it any time between July and mid November.
Trunks can be cut at any height above or below the union

Why?

1. Without Garlon old roots still appear alive 2-3 years after tree removal. With Garlon root death begins by April of the next year.

What does root death look like?

1. By April 95% of nematodes and their eggs are gone from the roots. This number is 99.5% by August.
2. By mid July a deep ripper can be pulled through soil with greater ease. Efforts to dig up and remove old roots will make no sense by October.
3. By September roots finally show internal browning.
4. Walnuts do root graft so this is not a desirable treatment if desirable walnut trees are nearby.

What did this stump treatment plus waiting 1 year accomplish?

- Dead roots to 13 feet while fumigants kill roots 4 to 6 feet deep.
- No nematodes hiding within old walnut roots.
- Soil ecosystem changed from microbes living on live plants to those living on dead plants.
- The root rejection component of RP is reduced in one year rather than four years.

What was not accomplished?

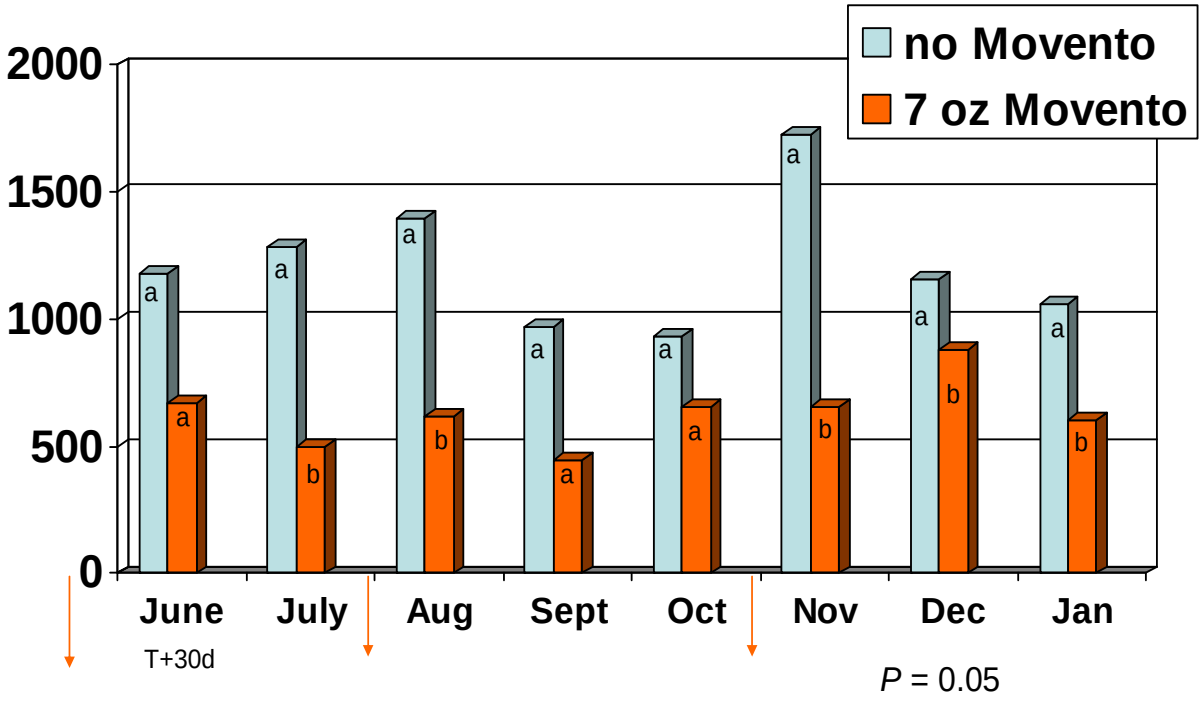
- The soil as deep as 13 feet is still full of *P. vulnus* and 5% of those will still be alive five years later.
- This treatment by itself will not accomplish much! Its value is most notable when the replanted trees are of the same parentage as the previous trees eg. NCB replanted to NCB.
- If the field is to be fumigated anyway the value of the stump treatment will be mostly invisible.

(3)

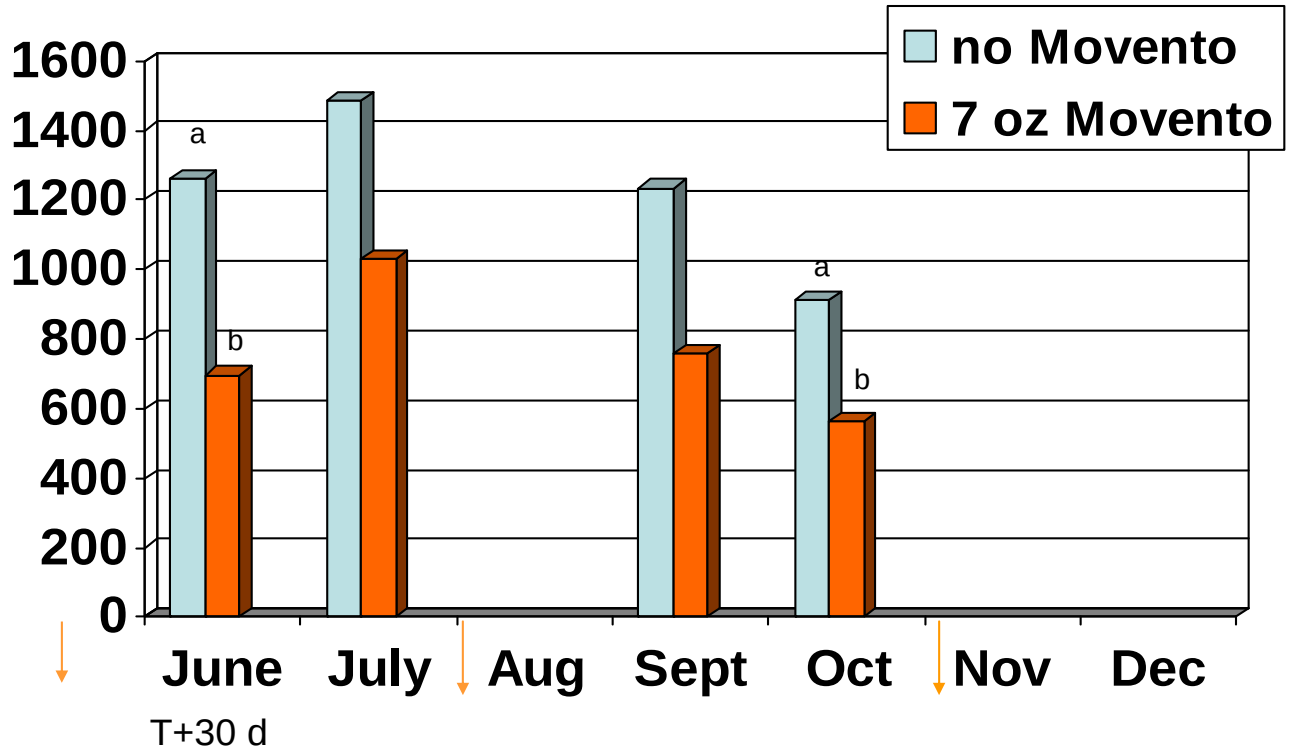
More on Movento for Walnuts

Applying a Nematicide, 7oz/ac in 300gpa water, 25 yr old walnuts

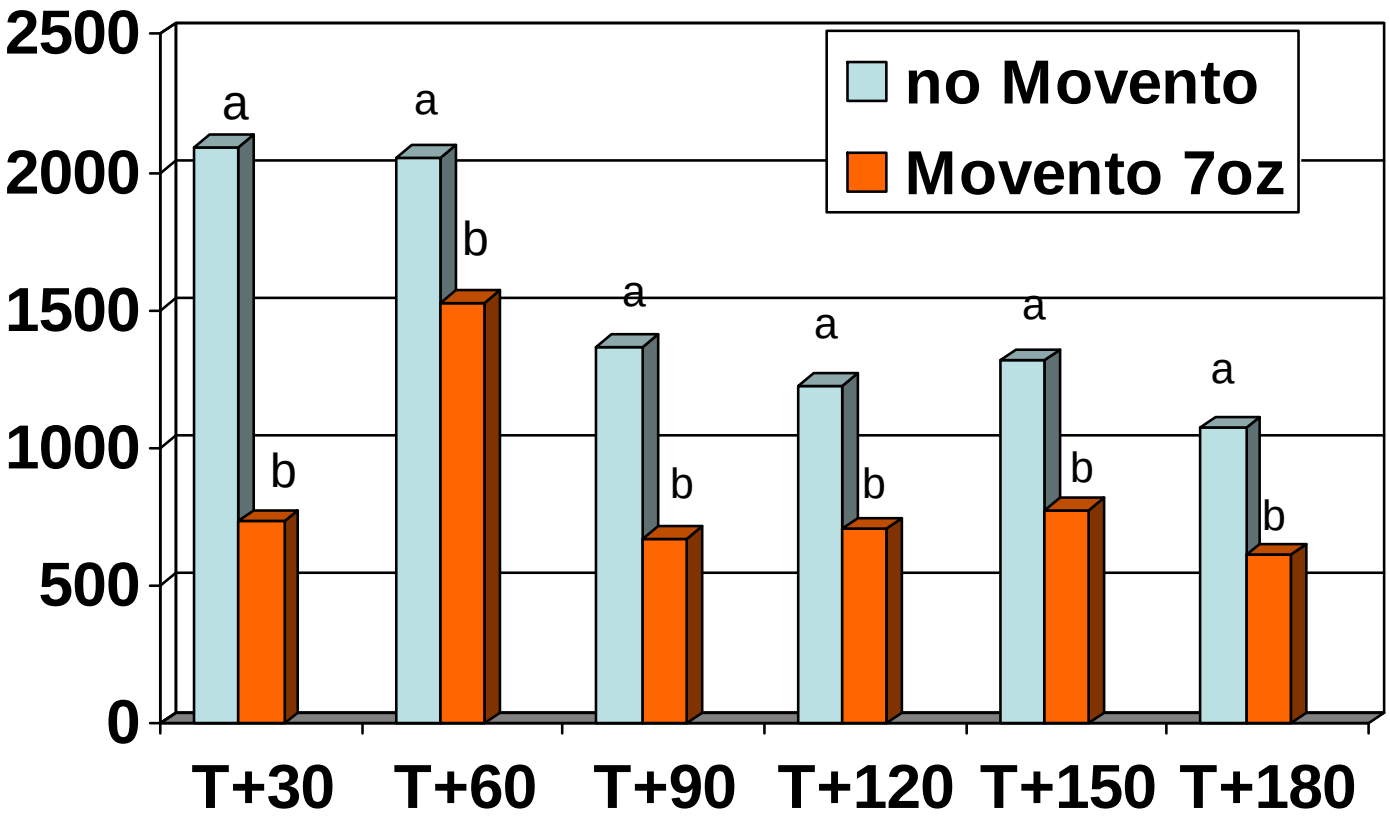
P. vulnus / 250 cc Paradox walnut rhizosphere soil, flood irrigated but not till14 days after treatment, 2009



P.vulnus / 250 cc Paradox rhizosphere soil, 2010



P.vulnus /250 cc in surface 18” of walnut rhizosphere soil



P = 0.05

= 50% control for 6 mo.

But, still no yield improvements from Movento are available for walnuts!

SYMPTOMS

1) high nematode counts, 2) lesions present, 3) missing roots, 4) halted tree growth

Excavated root systems of VX211 and AX1 rootstocks grown 7 years without *P. vulnus*

VX211 and AX1 root systems grown in the presence of >1 P. vulnus/250 cc soil

Root lesions on 7th-leaf VX211

But also note that feeder roots are dramatically absent

For Movento we wait anxiously for second-year yields at Rio Oso

But, when new research is carried out with Movento it should be timed to when new roots are most abundant.

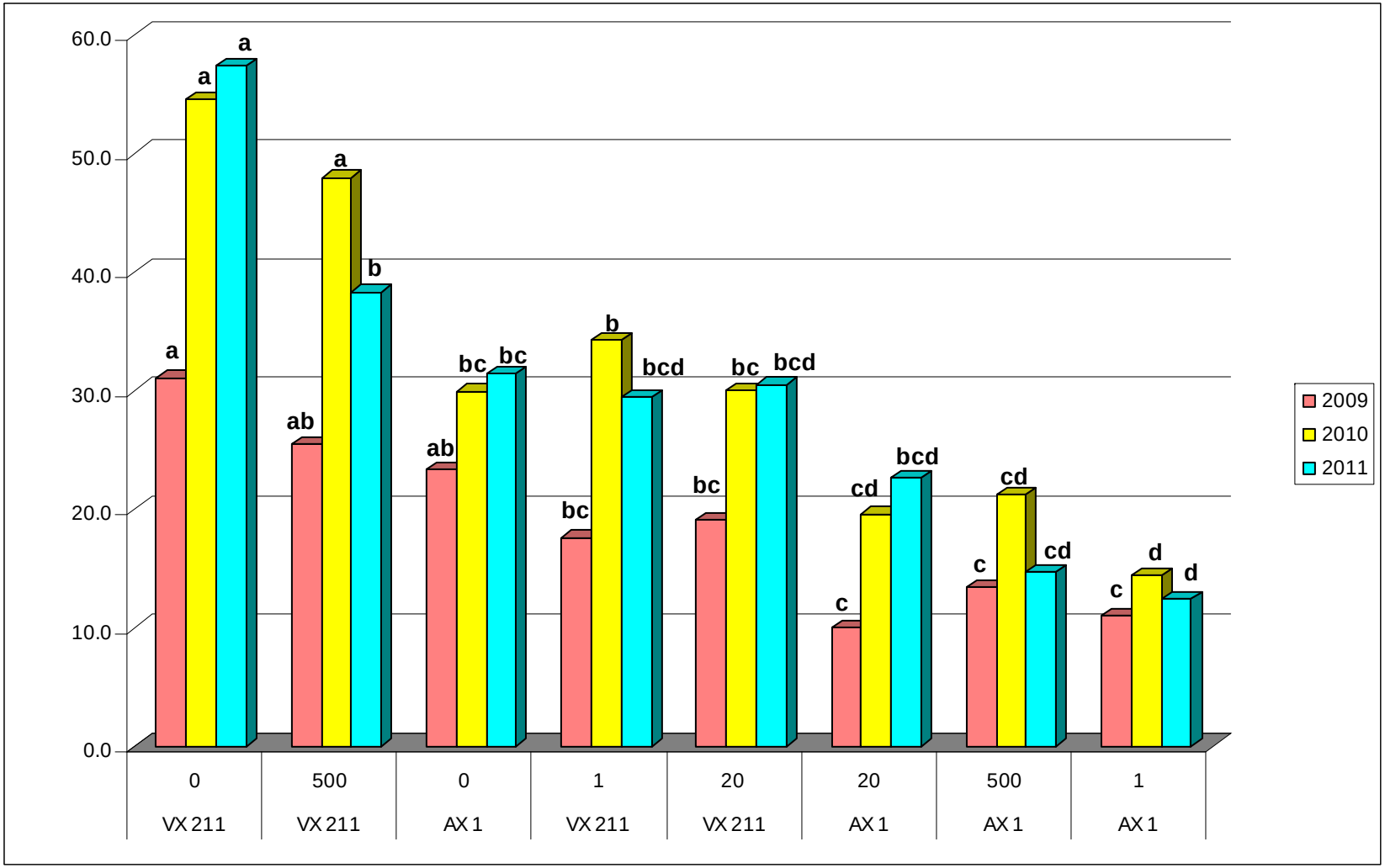
Also, use of Movento as a replacement for fumigation is asking too much of this product.

(4)

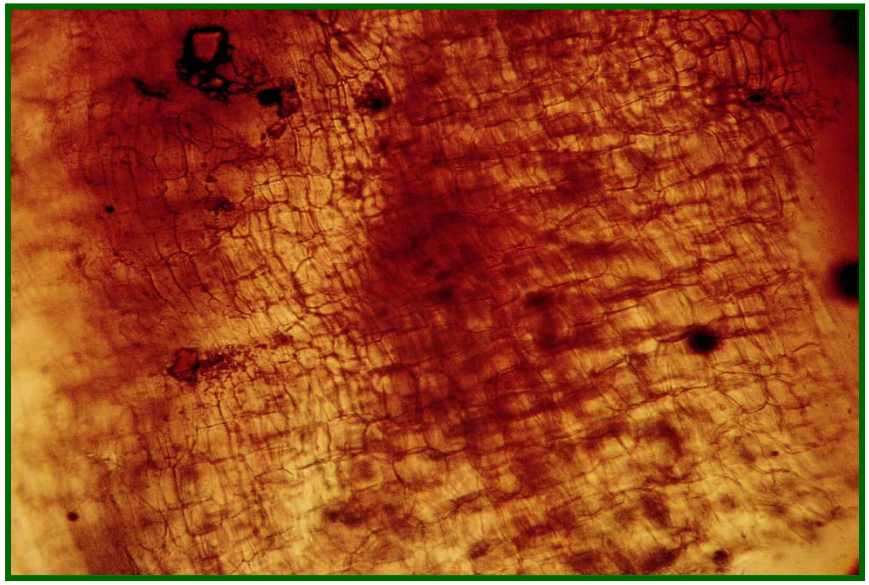
Update on cloned
Paradox VX211

Yields for Chandler grafted to clones of VX211 versus AX1

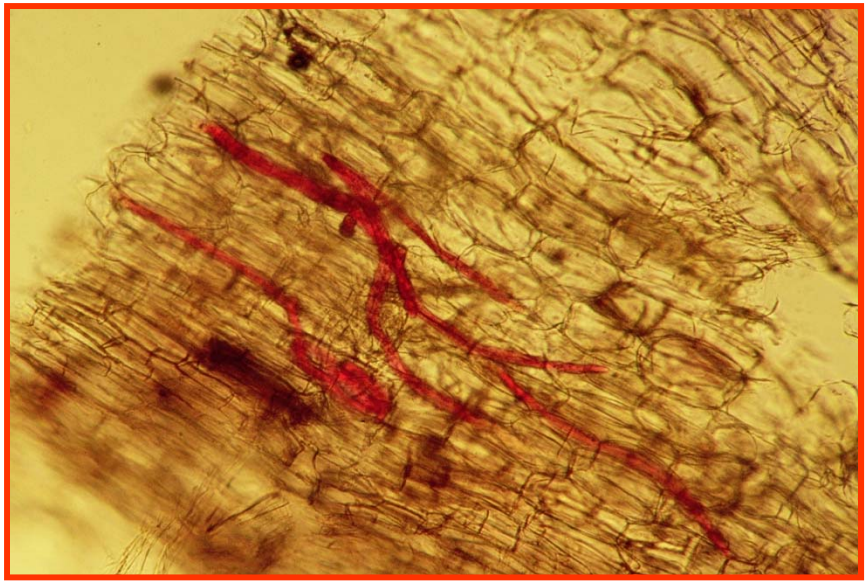
Yields of Chandler walnut on two rootstocks planted at four nematode population levels



But remember, VX211 has a nematode resistance mechanism at its tips causing them to feed mostly external to the roots.
The result is a degree of tolerance to their presence.
VX211 is still the best rootstock for combating nematodes.



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



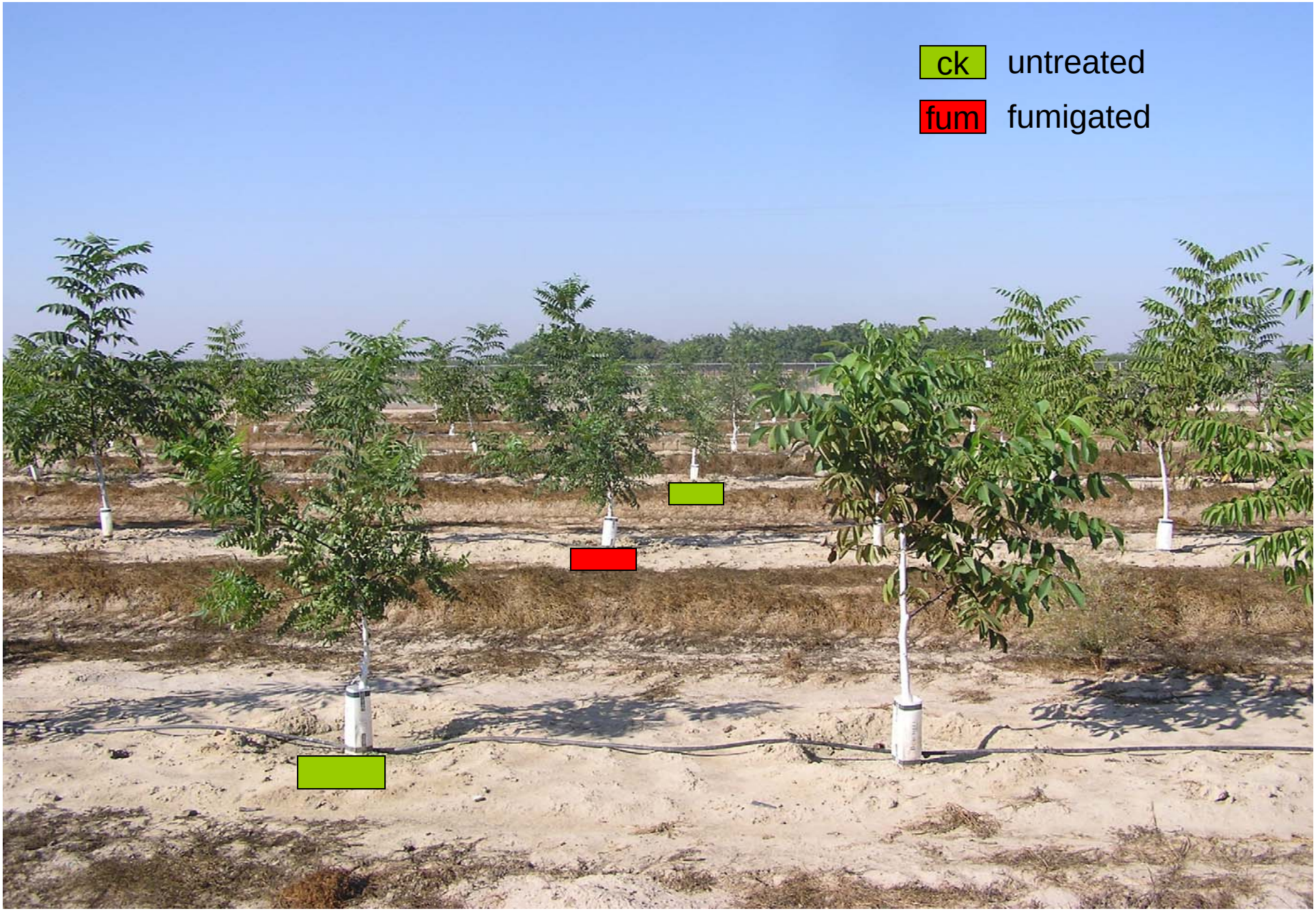
AX1-nematode in cortex throughout new roots including samples >9 cm back from the root tip

(The Future with less fumigant, item #1)

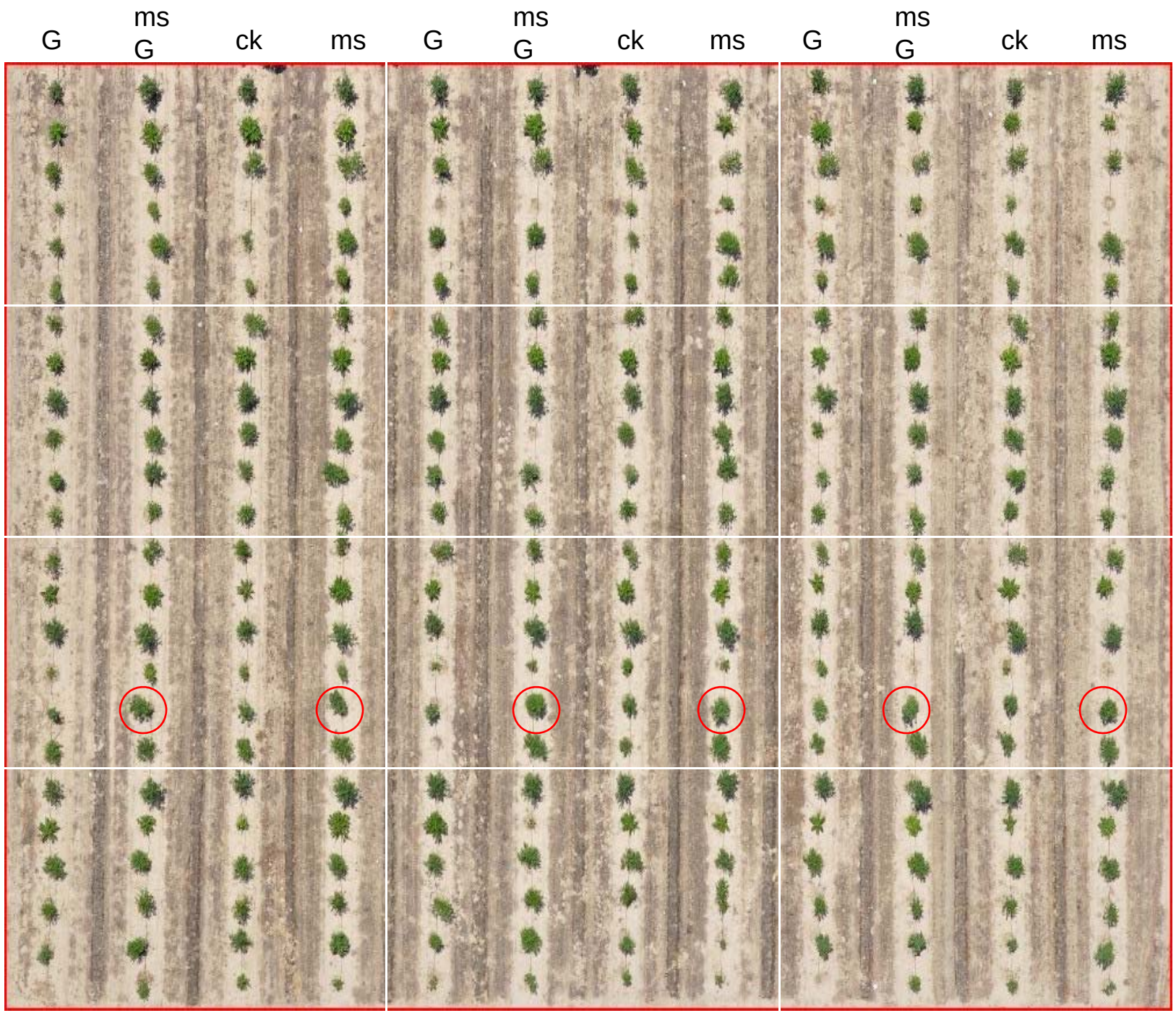
Tolerance to root rejection is available in walnut

Root rejection (first 2 years of poor growth) can be solved by switching to rootstocks that are of a different Juglans species

NCB seedlings replanted after NCB seedlings



May 11, 2011
2nd leaf walnuts



Second-year trunk diameters (cm) a measure of tolerance to root rejection and root lesion nematodes

Rootstock	*n*	non-fumigated	Vapam drenched	% difference
UZ229, yr 1	12	4.20 a	5.55 b	+ 32%
VX211 yr 2	12	7.25 a	8.40 b	+ 16%
NCB seed yr1	9	5.50 a	6.85 b	+ 25%
Tulare/NCB yr 2	3	4.75 a	5.70 b	+ 20%
Serr, yr 2	3	5.65	5.65	0
Chandler, yr 1	9	3.50	3.95	+13%
J. cat seed, yr 1	12	4.40	4.40	0
RX1, yr 2	12	5.10	5.35	+ 5%

(The Future with less fumigant, item #2)

When to consider tree site fumigations for walnuts

Spot or strip fumigation could assist our ‘starve & switch’ approach

1M BTU mobile heater can steam one backhoe site in 20 minutes.

DMDS must be treated in strips rather than individual Tree sites.

A New formulation of Telone is easier to work with but a new delivery system needs development.

1) Deliver steamed soil

2) Use bucket to compact soil as sites are refilled

3) Leave extra soil on top because the hole will further subside with irrigations

DMDS

Strip applications (not spot applications) will be necessary because of odors

Nematode control, all species, at 1 ft increments to five foot deep

Treatment	Mean / 250 cc	DMRT	%control
Untreated	403.5	a	none
DMDS 500lb/ac	4.5	b	98.8%
DMDS+Pic 600lb/ac	0	b	100%
Telone C35 490lb/ac	0	b	100%

P = 0.05

Plot failure due to 47% poor trees at time of planting but treated rows stand out compared to those non treated, August 2011