

Stylar End Lesion in pistachio

Jianlu Zhang

Part 2. Elemental Analysis

Testing has shown that stylar end lesion on nuts is not caused by a disease organism (Wong, 2004) and mainly occurs on trees grafted on *P. terribinthus* and *P. atlantica* rootstock. Trees on Pioneer Gold rootstock (*P. integrimia*) did not have this problem (Joyce, 2004). An attempt was made to relate the symptoms of the disorder to plant mineral nutrients between the trees on the different rootstocks.

Materials And Methods

1 Data collected in season 1999-2000

1 Nut samples

Nut samples of good nuts and stylar end lesion nuts in two blocks were taken on 13 December 1999, respectively. Two-way analysis of variance (ANOVA) was used for statistical analysis of the data from nut chemical analysis.

2 Leaf samples

Eight pairs of samples of leaves close to good nuts and stylar end lesion nuts were taken on 5 and 24 January, 9 February and 8 March 2000. The samples were taken of leaves above the nut cluster, i.e., not the standard method for taking nutrient leaf analysis samples. No clear trend was found between the four sampling times. Two-way ANOVA was used for statistical analysis.

2 Data collected in season 2003-2004

1 Nut samples

Two samples of stylar end lesion nuts and two samples of good nuts were taken on 22 December 2003. To accurately analyze results from hull, the kernels were removed before they were sent for testing.

2 Leaf samples

Two leaf samples from trees with stylar end lesion nuts and two leaf samples from trees without stylar end lesion

nuts were taken on 22 December 2003. The samples were taken of leaves above the nut clusters.

3 Statistical analysis

One-way ANOVA is used for samples of nuts and leaf analysis.

Results

1 Nuts

Normal statistical analysis recognizes significant differences when $p = 0.05$. Sometimes biological tests consider differences when $p = 0.25$. Anything with $p > 0.25$, larger than once in 4, is similar to toss of a coin.

From Table 1, calcium (Ca) contents of good nuts were significantly higher than that of stylar end lesion nuts in the samples from season 1999-2000. In season 2003-2004, p-values of difference of Ca contents between good nuts and stylar end lesion nuts were not within 0.05 level but < 0.25 . For Ca content readings, season 1999-2000 is almost 10 times larger than season 2003-2004. This is probably due to different sampling methods. In season 1999-2000, whole nuts (hull + shell + kernel) were set for the test. In season 2003-2004, "nut" samples only included the hull and shell but not kernel. This implies that the kernel contains higher percentages of calcium.

In both seasons, p-values of difference of magnesium (Mg) contents between good nuts and stylar end lesion nuts were < 0.25 . For Mg content readings, season 1999-2000 is almost 5 times larger than season 2003-2004 probably for the same reason as Ca.

In season 1999-2000, copper (Cu) content in stylar end lesion nuts showed a significant higher value than good nuts but this difference was very weak in season 2003-2004.

Table 1 Summarised nut analysis data (P-values of element contents between normal nuts and stylar end lesion nuts in different test sources)

Elements	Season 1999-2000			Season 2003-2004		
	Good nuts	Stylar end lesion nut	p-value	Good nuts	Stylar end lesion nut	p-value
Ca (%)	1.510	0.990	0.049	0.170	0.105	0.248
Mg (%)	0.505	0.360	0.066	0.095	0.075	0.106
Mn (ppm)	66.500	61.500	0.605	18.350	12.800	0.166
Cu (ppm)	148.500	175.500	0.047	18.200	18.950	0.195
B (ppm)	68.500	58.500	0.126	21.200	26.250	0.223
Fe (ppm)	72.500	69.000	0.500	90.800	102.050	0.142
Zn (ppm)	73.500	79.000	0.272	34.350	35.800	0.808
P (%)	0.180	0.165	0.205	0.270	0.275	0.808
N (%)	2.420	2.240	0.205	2.675	2.600	0.725
NO ₃ (ppm)	104.000	48.000	0.488	164.500	42.500	0.186
Cl (%)	0.240	0.225	0.924	0.165	0.144	0.320
Na (%)	0.015	0.015	N/A	0.010	0.010	N/A
K (%)	1.255	1.180	0.824	1.715	1.745	0.778
S (%)	0.145	0.140	0.500	0.150	0.145	0.698

Table 2 Summarised leaf analysis data (P-values of element contents between normal nuts and stylar end lesion nuts in different test sources)

Elements	Season 1999-2000			Season 2003-2004		
	Good nuts	Stylar end lesion nut	p-value	Good nuts	Stylar end lesion nut	p-value
Ca (%)	2.016	1.425	0.000	2.040	1.410	0.088
Mg (%)	0.525	0.376	0.005	0.530	0.395	0.052
Mn (ppm)	63.380	56.125	0.309	176.950	103.050	0.040
Cu (ppm)	152.380	143.250	0.638	103.050	97.400	0.779
B (ppm)	140.370	137.000	0.582	86.950	100.500	0.606
Fe (ppm)	111.370	108.380	0.799	63.250	68.000	0.189
Zn (ppm)	58.250	53.250	0.458	92.750	102.050	0.548
P (%)	0.133	0.130	0.451	0.145	0.150	0.698
N (%)	2.054	2.106	0.451	2.855	2.630	0.391
NO ₃ (ppm)	88.750	72.125	0.250	828.500	181.500	0.271
Cl (%)	0.363	0.311	0.208	0.274	0.294	0.537
Na (%)	0.031	0.034	0.685	0.015	0.020	0.423
K (%)	2.108	2.119	0.898	1.505	1.420	0.732
S (%)	0.135	0.136	0.732	0.145	0.150	0.423

From Table 2, leaf calcium contents of leaves from symptom free trees were significantly higher than that of stylar end lesion nuts in samples of season 1999-2000. In season 2003-2004, p-values of difference of leaf Ca contents between good nut trees and stylar end lesion nut trees were just beyond 0.05 level but < 0.25. In both seasons, p-values of difference of leaf Mg contents between good-nut tree and stylar end lesion-nut trees were < 0.05.

Manganese (Mn) concentrations in leaves on trees without stylar end lesion nuts in season 2003-2004 showed a significantly higher value than that on trees with stylar end lesion nuts, but no clear difference about this was found in season 1999-2000. For leaf analysis, no significant difference of copper contents was found between trees with or without stylar end lesion nuts.

To summarize, Ca and Mg may be the important nutrients in the development of the stylar end lesion nut symptoms. Other elements seem to have no direct involvement from this analysis.

Calcium seems to be the key factor. At this stage the reason for the low calcium movement into the nuts has not been identified, but we are exploring the possibilities that it may be either soil related, or influenced by an aspect of water movement into and through the trees. In the mean-time we have planned an experiment to see if calcium foliar sprays, timed correctly can be helpful in preventing the symptoms. This experiment will be carried out in the 2005/2006 season.

If calcium supply to the fruit at a critical stage of development is the cause of the stylar end lesion problem, it may be that the rootstock 'Pioneer Gold' is able to take up and supply calcium to the nuts better than the rootstocks *P. terribinthus* and *P. atlantica*. To understand this problem, comparison of element uptake between rootstocks will be necessary.

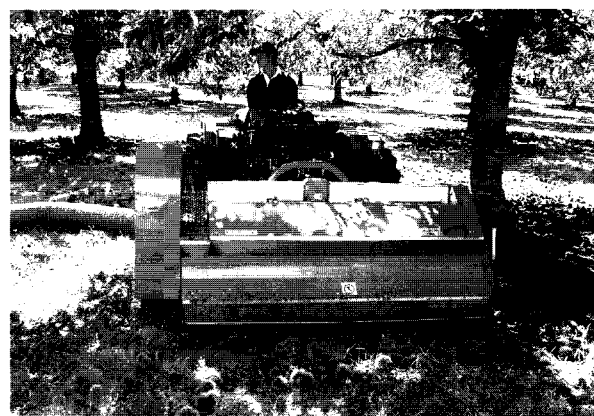
Acknowledgements

The author would like to acknowledge the data collection and paper editing of Andrew Bowring, orchard manager of Kyalite Pistachios, and Ben Robinson of Scholefiled Robinson Horticultural Services Pty Ltd.

References:

- Joyce, C. 2004. 2004 crop produces excellent quality. *Pistachio Growers Association Incorporated Newsletter*. May: 2.
- Wong, J. 2004. Crop Health Services - Service report. 31 January 2004. □

THE JOLLY 1800 NUT HARVESTER



*For all types of nuts or fruits - Collection into a bin.
Front tractor hitch mounted - PTO or hydraulic drive.
1.8 metre width - one man operation*

ORDERS TAKEN FOR MARCH DELIVERY

for details contact

TAVCO AUSTRALIA PTY. LTD.

PH: 07 5474 5995 FAX: 07 5474 5069

Email: info@tavco.com.au