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Vine Decline Syndrome

Introduction

There have been recent reports of a 'mystery disease killing Italy's kiwifruit'. The syndrome, dubbed *moria* (die off) or kiwifruit vine decline, causes the leaves to wither and fall. Within a year or two the plant dies. The syndrome has been described in Italian orchards since 2012 and is now estimated to affect 25% of orchards (50% in the hardest hit area of Verona) and is costing the industry millions of Euros in losses.

Scientists suspect there are a number of factors at play, combining to cause the syndrome, but they are yet to identify the cause or, importantly, a cure.

New Zealand scientists and growers will be looking on with concern. Kiwifruit growers know only too well the devastating impact a new disease or syndrome can have on the industry.

Growers have seen similar leaf symptoms, sometimes attributed to drought, wind or Psa in New Zealand orchards.

Figure 1 severe leaf breakdown symptoms

I hypothesise another cause for the symptoms in New Zealand, as seen in Figure 1: magnesium deficiency caused by long term, excessive fertiliser use particularly potassium. Whether this is the same root cause as the syndrome seen in Italy, I cannot be sure but the vines are clearly under stress which may be due to nutrient imbalance – this stress may be allowing opportunistic infection by disease organisms to take hold and cause the extreme symptoms seen in Italy.

Figure 2. Early to late stage symptoms

Figure 3. Vine decline symptoms, Katikati, 3rd week of February 2021.

Later in the season when more severe symptoms including necrosis develop it is difficult to be certain of the cause as the symptoms can be confused with wind, drought, PSA or other nutrient related symptoms.

Background

Interestingly, I wrote to NZ Kiwifruit way back in Sept 1987 about similar symptoms in Hayward vines:

I feel there is another reason for the leaf damage reported and illustrated in photographs by Smith and Buwalda in New Zealand Kiwifruit, June issue. It is due to magnesium deficiency in the leaf.

The symptoms

As magnesium is relatively mobile within the plant, deficiency first appears in the lower, older leaves. The symptoms often appear towards the end of the vegetation period (December) when nutrient has been removed by the more active part of the plant (young shoots and seeds). If the plant is deficient in Mg the carbohydrate production falls because of reduced photosynthesis (1).

The best description and illustration of Mg deficiency symptoms is given by Ulrich, Mostafa and Allen (2). They say:

"Scorching of mature blades from magnesium deficiency begins as yellowing and browning of the upper margins of blade tissues. Progressing inwardly, the interveinal areas become chlorotic, then necrotic, to form a blotchy leaf pattern. This is followed by further scorching, with the basal portion of the blade remaining light green and turgid to the last. The young leaves remain green. The short petiole sections be tween blades and leaf stalk instead of darkening and drying, remain turgid and green. Scorching increases with increased deficiency and leaf age. Magnesium deficient roots appear normal, except for overall reduction in quantity."

Where and when it occurs

Even when adequate Mg is present in the soil deficiency symptoms will develop under the following conditions:

- *Rows close to shelter - where there is a reduction in fruit load an imbalance of vegetative growth occurs. The highly mobile Mg moves into the actively growing leaf tissues and deficiency symptoms appear on the older or mature leaves.*
- *Young plants also display the above imbalance in vegetative growth and Mg deficiency symptoms may appear on older leaves. In the past these leaves may have been dismissed as "wind damage in a young orchard."*
- *Plants low in nitrogen have recently been proven to show the fruiting/vegetative growth imbalance by scientists at Pukekohe Research Station. I observed Mg deficiency symptoms in these plants.*
- *Excess of calcium (high PH) will cause a shortage of Mg in plants.*
- *Excess of potassium in soil (greater than0.8 me/100g) will lead to Mg deficiency in plant tissue.*
- *Use of muriate of potash causes Mg deficiency in older leaves. The chloride in this fertilizer causes sappy or succulent growth. The Mg which is highly mobile moves with the sap into the succulent growing shoots leaving the older leaves depleted of Mg.*

It is important to realise that even with adequate Mg levels in soil, leaves may develop deficiency symptoms. This occurs because Mg is highly mobile in the plant, or because of the suppression of uptake of Mg into the plant by the high levels of calcium or potassium in the soil.

The effect of chloride in increasing the sap content in young shoots may also cause Mg deficiency to

occur in older leaves.

References

1. Helger. E.U., Fritz A. and Irschick H. The role of secondary and trace elements in plant nutrition. B.A.S.F.

2. Ulrich A. Mostafa M.A.E. and Allen W.W. (1980) Strawberry deficiency symptoms, A VISUlll and Plant Analysis Guide to Fertilisation . University of California publication no. 4098.

3. Downtowwn W.J.S. (1978) Growth and Flowering In Salt-Stressed Avocado Trees. Aust. J. Agric. Res. 29, 523-34.

Treatment

Marginally affected orchards can be managed by using Primazest/Agrizest.

Severely affected orchards can be managed by foliar application of 20Kg of magnesium sulphate which can be mixed with Agrizest. This is a short term management solution to directly apply magnesium while increasing overall health and resilience but it is not a long term solution – the root cause must be addressed.

In the long term the industry needs to review the excessive use of fertilizers and foliar nutrients and adjust back to levels recommended for orchards, for example apples.

Immediate Treatment

To reduce stress, improve plant health and improve fruit quality and yield we recommend the 4 spray Agrizest programme. Agrizest will reduce the severity of leaf breakdown disorder/vine decline syndrome.

Figure 4 Control on left, Agrizest treated on right. Note the control vines have less canopy cover due to early season leaf loss.

In severe cases apply 20kg/ha of magnesium sulphate (technical) with each of the 2 pre blossom applications of Agrizest.

The kiwifruit industry has been applying very high levels of nutrients for over 25 years. The photos in figure 5 demonstrate that Agrizest treatment can mitigate premature leaf fall induced by high nutrient levels.

Figure 5. 19 May 2011. Note the control block (left) Agrizest treated block (right).

As seen in figure 5 the control blocks lost their leaves by late March/early April. The canopy opened up and allowed grass to grow beneath the canopy. In the Agrizest treated block leaf fall has been delayed until May. Very little grass growth is evident.

Although the treated block was treated with 4 sprays of Agrizest post blossom (rather than the recommended 2 pre blossom and 2 post blossom) the treatment still delivered an increase in Orchard Gate returns of $1462.

Agrizest can reduce high soil nutrient stress factors which are known to promote bacterial infection.

Long-term Treatment: addressing the root cause.

Long-term we must review the amount of fertiliser we are applying.

The following table is derived from a PhD project by Allan Morton (Effects of fertiliser nitrogen on fruit quality of kiwifruit fruit, PhD project, Massey University)

Orchard Type	Yield (t/ha)	Nutrient Applied (kg/ha)				
		N	P	K	S	Mg
Hayward	45	226 (83)	72 (11)	405 (144)	162 (9)	83 (7)
Apples	70	30 (29)	10 (6)	30 (168)	___	2 (6)

Figure 6 *Example of Annual Fertiliser Nutrient Inputs for Different Orchards and Estimated Quantities of Inputs Removed With Harvested Crop*

Morton's analysis shows that, despite a much lower yield (t/ha), the fertiliser application rates on kiwifruit orchards are often far greater than that applied in apple orchards and, crucially, far greater than that removed with the harvested crop i.e at high rates of fertiliser application salinity and nutrient imbalance is likely to occur.

Below is leaf analysis from an orchard that suffered severe leaf damage and necrosis after application of fertilizer and subsequent of substantial rainfall in Mid February 2021.

MACRO ELEMENTS		Units	Results	◆Plant Range	◆Plant Nutrition Desired
NU251	Nitrogen	%	3.0	1.3~3.8	
NU268	Phosphorus	%	0.18	0.1~0.22	
NU279	Potassium	%	2.6	1.2~2.2	
NU341	Sulfur	%	0.40	0.24~0.4	
NU056	Calcium	%	2.4	2.1~3.7	
NU187	Magnesium	%	0.38	0.3~0.44	
NU324	Sodium	%	<0.01		
◆ NU069	Chloride	%	1.7	0.3~0.8	
TRACE ELEMENTS					
NU196	Manganese	mg/kg	82	60~130	
NU108	Copper	mg/kg	16	4~11	
NU046	Boron	mg/kg	43	25~38	
NU394	Zinc	mg/kg	19	7~25	
NU168	Iron	mg/kg	63	36~73	

Figure 7. Kiwifruit orchard leaf analysis, February 2021.

The analysis shows potassium, manganese, chloride, copper and boron are at toxic levels. Nitrogen and phosphorus are nearing toxic levels. The combined effect of high potassium and the constraint placed on biological nutrient uptake by these high levels could have induced the leaf damage/vine decline.

The above is based on current standard levels set for kiwifruit. The industry's recommended standard itself is a problem. The high levels prescribed came about due to a monumental error made by a government research institute scientist. Although a review and report was commissioned and produced after complaints from growers, advisors and scientists, the standard recommended levels were not changed. The standard levels should be reduced closer to that of apple orchards.

The kiwifruit industry must also review the use of copper. High copper levels in the soil affects the uptake of nutrients through the soil biological system. The majority (85%) of nutrient uptake in well managed soil is through the biological system.

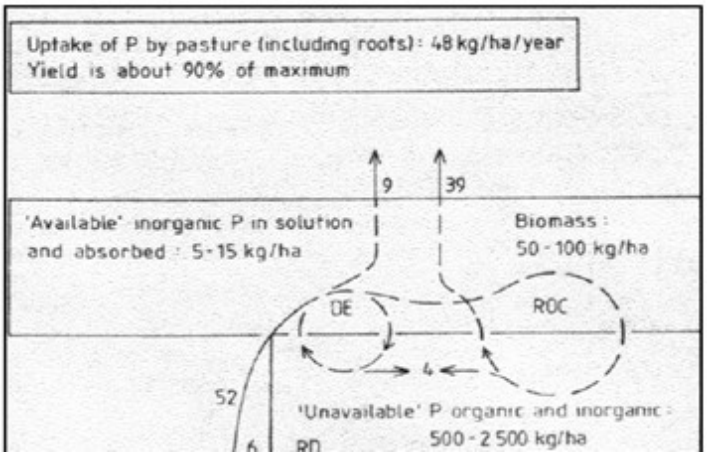

Figure 8. Diagram reproduced from During.C.1984. Fertilizers and soils in New Zealand farming. Government Printer, New Zealand

Conclusion

PSA (and possibly kiwifruit vine decline as seen in Italy) is a stress induced disease. Symptoms of high salinity or nutrient imbalance are signs of stress: sub-optimal conditions that can allow PSA to re-emerge. Perhaps we are seeing some early warning signs that we are trying to push the vines too hard? If so, we have an opportunity to reduce stress in our vines, re-examine our practices and perhaps avoid an extreme situation like we are seeing in Italy now.

Unlike PSA, this physiological disorder affecting the kiwifruit industry can be managed in the shortterm and in the long term can be mitigated by addressing the root cause.

Figure 9 Grafted G3 Vines

Standard Management

Primazest only Management

Figure 10 Mature G3 Vines

Standard Management

Primazest, Agrizest, Magnesium Sulphate
No Foliar Copper