Avocado Soil Testing – Interpretation of Mehlich3 Trace Element Levels

Introduction

In mid-2017, NZ Avocado raised concern at the way Hill Laboratories histogram reports portray most Mehlich3 Cu (m3Cu) soil test results as being very high or excessive. This was causing alarm with some growers and some resistance to using copper-based sprays for fungus control. We could see a problem existed, and we believe there is a solution that will satisfy everyone's concerns.

Hill Labs' (HL) bar graphs are controlled by four data points (L1 to L4) that are held in our reference file for each soil and plant test. These are used to define the various 'zones' of the bar graph:

Bar Graph Position	Interpretation
Far LHS of Low Range (L1)	Deficient, seriously low. Is of concern.
Low Range (L1 - L2)	Lower than normally found. May be a concern.
Medium Range (L2 - L3)	Optimal. Non-limiting production.
High Range (L3 - L4)	Higher than normally found. May be a concern.
Far RHS of High Range (L4)	Excessive, seriously high. Should be of concern.

Table 1: Data Points used to determine Histogram bar graphs.

The values assigned to L1 to L4 dictate the appearance of the bar graph. In assigning these levels, the first preference is to use research data generated in New Zealand, based on field trials. However, such data is available for only a limited number of crops, and we are having to use our best judgements in many cases, based on a variety of factors. As a general rule, the levels have been set to ensure adequate plant supply, and to identify when toxic levels may be encountered. A secondary consideration is the levels typically observed in NZ grown crops.

When originally setting L1 to L4 for soil test Cu in avocado soils, we considered the very limited data generated in NZ for other crops and information from overseas sources for the Mehlich-3 (M3) tests. We did raise the levels significantly (2-5x) in 2004, recognising that copper sprays were widely used, but this has had only a small effect on the bar graphs, as many levels still appear as very high.

The Solution

We now appreciate the primary interest in soil copper levels in avocado soils is not sufficiency of supply to the plant, but monitoring that the levels are not so high as to preclude alternative land uses in the future or potentially adversely affect soil ecosystems. We propose that the interpretive levels for M3 Cu in avocado soils now be based on the risk for soil contamination, and the Levels L1 to L4 be adjusted upwards. This 'deviation' in interpretation philosophy will be highlighted in an Analyst's Comment on each report.

The standard way to assess copper in soils for environmental contamination is based on total levels, whereas our routine agronomic test (M3) is an extractable level. We have looked at samples for which we have both total and M3 Cu levels (n = 119), and found there was a correlation (see Figure 1). This indicates that the M3 test extracts approximately 25% of the Total Cu.

The most relevant level for interpretation would be that proposed by BOP Regional Council *(Ref 1)* i.e. Total Cu <325 ppm, as an eco-logic soil guideline value. This would approximately equate to a M3 level of 80 ppm. (For

interest, the soil guideline value proposed in the National Environmental Standards *(Ref 2)* for residential land use is much higher at 10,000 ppm.)

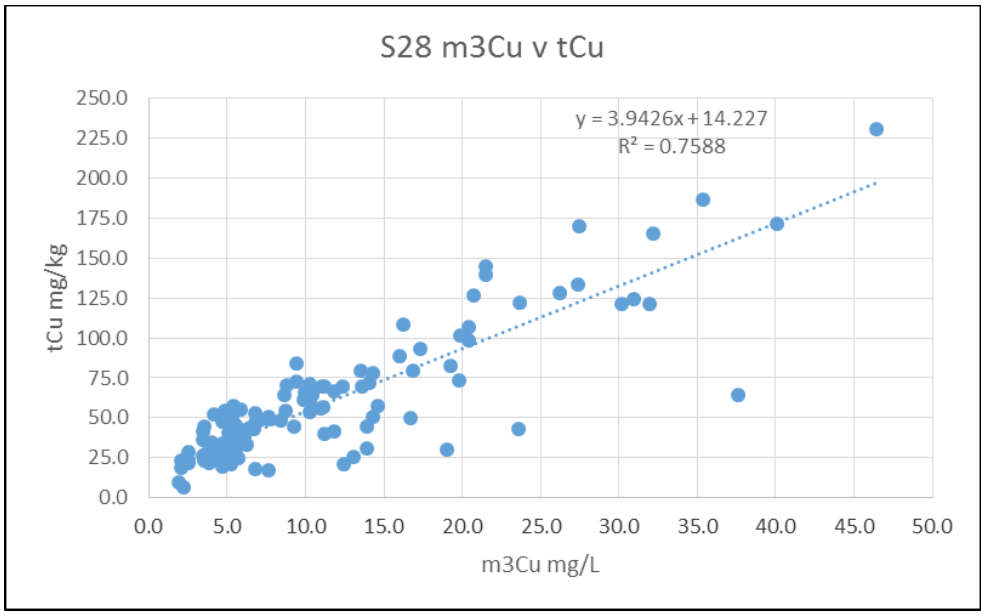

Figure 1. Relationship between Total Cu and M3 Cu.

The distribution of M3 Cu results found in avocado soils at Hill Labs over several years (n = 5952) is shown in Figure 2:

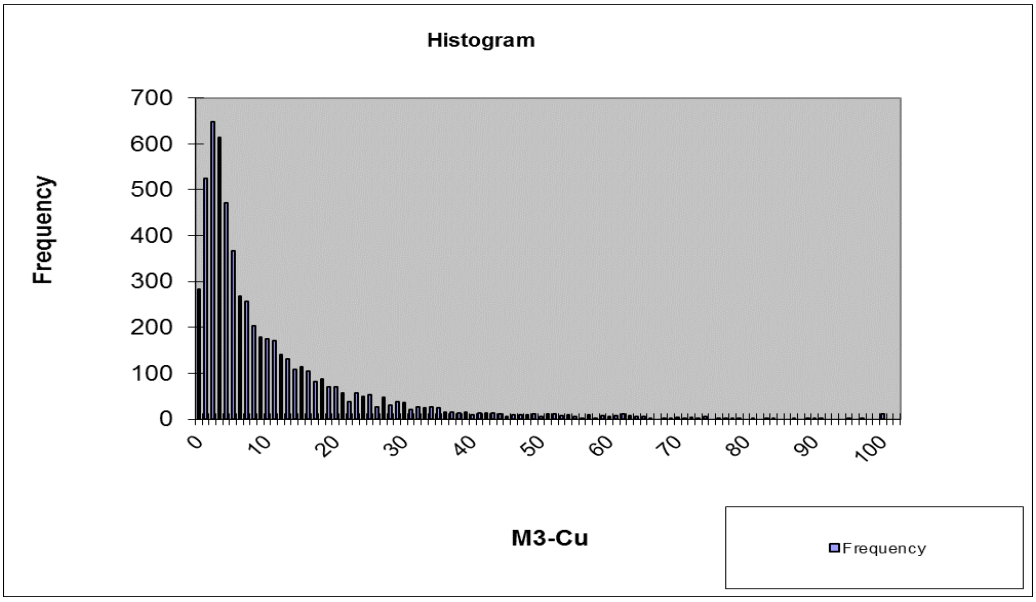

Figure 2. Distribution of M3 Cu levels found in avocado soils.

The median value is 6.2 mg/L, and the distribution is not normal, with most data points at the lower end, and a long tail at the upper end.

We have decided that L1 and L2 should remain as currently set, in order to identify any low Cu status orchards, but L3 be increased, to bring more results in to the Normal range, and that L4 be greatly increased, to align with the published eco-toxicity level promulgated by BOP Regional Council . This will dramatically reduce the number of samples being shown as either High or Excessive.

The adopted changes are shown in Table 2:

Bar Graph Position	Current Levels	New Levels
Far LHS of Low Range (L1)	0.5	0.5
Low Range (L1 - L2)	0.5 – 2	0.5 – 2
Medium Range (L2 - L3)	2 - 5	2 – 20
High Range (L3 - L4)	5 – 10	20- 80
Far RHS of High Range (L4)	10	80

Table 2: Changes to the Reference levels for graphing soil M3 Cu in avocado soils.

These changes will significantly alter the way results are graphed (see Table 3):

Bar Graph Position	% of samples falling in the Current Range	% of samples falling in the New Range
Far LHS of Low Range (L1)	1	1
Low Range (L1 - L2)	12	12
Medium Range (L2 - L3)	29	50
High Range (L3 - L4)	21	35
Far RHS of High Range (L4)	36	0.4

Table 3: Effect of changes on the bar graphs for M3 Cu in avocado soils.

The most striking change is that samples graphed as excessive now reduces from the current 36% to <1%. These have moved in to the High Range (35%), and within that range, the vast majority will fall below the midpoint of the range.

Conclusion

By recognising copper build up in avocado orchard soils occurs as a result of the standard practice of using fungicide sprays, it is appropriate to adjust the interpretation criteria from plant requirements to reflect potential soil contamination. The upper histogram range levels for Mehlich3 Zn have also been adjusted upwards due to a similar issue arising with typical soil test levels for zinc.

This Technical Note refers only to Mehlich3 extractable copper and zinc, and are only indicative of potential accumulation of these elements in terms of their eco- toxicological effects. It is recommended that soil 'Total' trace element tests be carried out on samples collected by a suitable qualified or experienced consultant where requirements under the National Environmental Standards are to be met.

References

1. *Sarah Sorenson, NZ Avocado (Pers. Comm.) The Proposed Auckland Unitary Plan, Table1 (notified 30 September 2013)*

2. *Ministry for the Environment. 2012. Users' Guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment)*