THE MEHLICH 3 SOIL TEST

There is growing international interest[1 - 5] in the Mehlich 3 ('M3') test, primarily because it is a multi-element extraction. Since many elements can be determined from the one chemical extraction, the resulting laboratory efficiencies can then be passed on to farmers and growers through lower soil test charges.

The M3 test was originally developed in 1984 by Dr Adolph Mehlich[6]. It is very similar to the Bray P-1 test[7] (a dilute acid and fluoride extraction for assessing phosphate), but also has a chelating agent (EDTA) to enhance the extraction of trace metals. This test is popular in the United States[8], and is used to assess phosphorus, potassium, calcium, magnesium, sodium, manganese, zinc, copper, aluminium and boron.

Hill Laboratories is pleased to offer the M3 soil test to complement our existing soil tests, by providing useful additional information for little extra cost.

M3 Enhances Basic Soil Test

Many overseas laboratories offer only the M3 test, with pH, as their basic soil test profile. However we have decided that cations (K, Ca, Mg and Na) and CEC obtained from the ammonium acetate extraction must remain as part of our Basic Soil test, as many of our clients find the CEC results and derived % Base Saturation data extremely useful.

Our clients also have comprehensive fertility histories of their properties based on the Olsen P test, and so for the sake of continuity we are retaining the Olsen P test in our Basic Soil test.

Consequently we are offering the M3 test as an **additional** option with our current **Basic Soil** test, to provide **M3 determinations of P, Ca, Mg, K, Na, Al, Mn, Zn, Cu, Co and B.**

Soil Phosphorus: M3 vs Olsen P

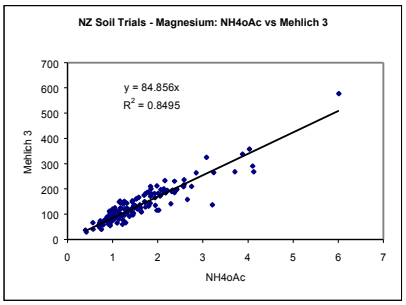
Soil testing services in New Zealand have been relatively unchanged for some 25 years. The Olsen test[9] has been the dominant soil P test, with only a few alternative tests (Resin P, Bray) being performed.

While the Olsen test is internationally recognised as being a very good soil P test, some shortcomings have been identified with it:

- It does not include reactive phosphate rock (RPR) residues, and will therefore under-estimate soil P status for properties with a history of RPR use.
- The pH of the soil affects the amount of P extracted by the Olsen method. High pH soils give lower Olsen P levels, whereas low pH soils will yield higher Olsen P levels, often over-estimating the soil P status.
- The Olsen test is also not "universal" in that the response curves vary with soil type, and this must be taken into account when interpreting the result.

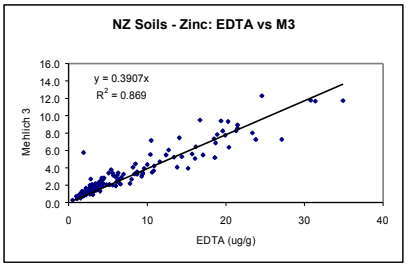
The M 3-P test is very similar to the Bray P1 test, and gives essentially an identical P result. As an acid extractant, it will include RPR residues, in contrast to the alkaline Olsen test. But as for all acid extractants, the test can over-estimate P on recently formed soils (e.g. some sedimentary soils), due to dissolution of free apatite. Caution is therefore necessary when interpreting the M3-P levels for these soils.

Both tests have advantages, and limitations, and so we suggest that the M3-P result be regarded as being complementary to the Olsen P test, providing a second perspective on this important element.



Cations (K, Ca, Mg, Na)

The M3 extractable cations showed very good correlations with ammonium acetate extractable cations, and normal range levels have been derived from these.

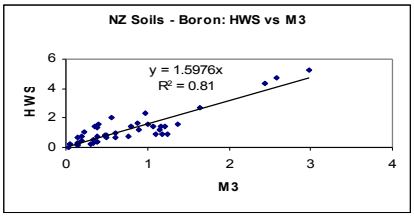


M3-Trace Metals (Manganese, Zinc, Copper and Cobalt)

As with all soil trace element tests, the relationship between soil extractable levels and plant uptake is not strong. Interpretation should be made with caution, without undue weight being placed on the soil trace element levels.

In-house investigations have shown good correlations between the M3 test with the standard EDTA test that is currently being used in NZ [10]. Normal range levels for the M3 trace metals have been cross-calibrated from this existing test.

We have also added cobalt into the standard M3 test, because of the importance of this element in NZ agriculture.



M3-Boron

The hot water soluble boron (HWSB) test is regarded as the standard soil test for assessing B status. The M3-B test correlates well with the HWSB test at elevated levels. Like trace element tests in general, both the HWSB and M3-B tests are not particularly reliable. This is especially so at low levels, when B deficiency may be suspected. In contrast, both tests are more reliable at higher levels, to identify possible B toxicity, or to monitor soil B levels for B-loving crops (e.g. avocados, olives).

We believe the M3-B test can replace the HWSB test when the B levels are elevated (>1-2 ug/g). For lower levels, the relationship with the HWSB levels is poor, and we are not yet confident that these low-level M3-B results have any diagnostic value.

M3-Aluminium

The solubility and therefore the toxicity of aluminium in the soil is very dependent upon the soil pH. As the M3 test is an acid extraction, it is not measuring plant available Al, but the dilute acid soluble Al. This tends to be the amorphous, non-crystalline Al, i.e. that Al likely to fix applied soluble P. In-house investigations have shown reasonable correlation between M3-Al and the Anion Storage Capacity (ASC) test. High M3-Al (>1600 mg/L) can be taken to indicate high phosphate fixation and consequently good sulphate retention. Conversely, a low M3-Al (<900 mg/L) indicates a lower anion retention and the potential for greater leaching losses of sulphate. It is recommended that an ASC% test is requested to more accurately measure this soil attribute.
M3-Al does not determine the likelihood of aluminium toxicity.

Method Outline

The Mehlich3 extractant is a mixture of ammonium fluoride, ammonium nitrate, EDTA and acetic and nitric acids

Soil is shaken in a volume of Mehlich3 extract (pH 2.6) and elements are analysed by ICP-OES.

Expression of Results

The Mehlich3 results are expressed as mg/l of soil (i.e. ppm on a volume basis). The interpretive criteria used to generate our bar graphs have primarily been derived by cross-calibration of the M3 test with currently offered tests.

Conclusion

Hill Laboratories believes that this test will be particularly useful for the following situations:

- as a cost-effective soil test for fertility mapping;
- where soil trace element tests are required, e.g. for crops such as avocados
- as an additional soil P test, to complement the standard Olsen P test.
- to provide an indication of the sulphate and phosphate retention properties of the soil, from the M3-Aluminium level.

References

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