THE RESIN P SOIL TEST

Hill Laboratories has offered the Resin P test since 1993. It is based on a sound scientific model and is gaining in credibility among users as a complement to the Olsen P test. This Technical Note outlines some of the background issues and results of observations made in the laboratory.

Phosphorus is arguably the most important element in New Zealand agriculture, as nearly all New Zealand soils are naturally low in plant available P. It is present in both inorganic and organic forms, with most of the total soil P being unavailable to plants.

Much research has been focused on the development of suitable soil tests for the inorganic form of P, and in the early 1970s the National Series[1] of trials conducted by MAF compared a range of these tests. This work revealed only small differences in reliability between the tests, but the Olsen was slightly better. (Note: The Resin P test was not available at that time). In 1976 the Olsen P test was adopted as the standard in New Zealand soil testing[2]. It specifically minimises the measurement of P from acid soluble sources such as soil apatite and slow release P fertilisers, by using an extraction procedure buffered at pH 8.5.

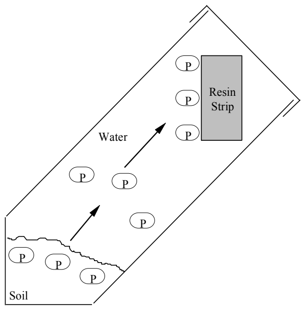
A summary of the more common tests used here and overseas is shown in Table 1. It shows the chemical composition and the pH of the extractant.

Test	Extractant	pH
Olsen	Sodium Bicarbonate	8.5
Bray	Ammonium flouride & hydrochloric acid	2.6
Truog	Sulphuric acid & ammonium sulphate	3
Resin	Water & anion/cation exchange membranes	Soil pH

Table 1: Common Soil P Tests

In more recent times, research at Massey University has demonstrated the use of ion exchange technology in the measurement of P in a range of soils with different fertiliser treatments[3]. This research has built on soil fertility research in USA, Brazil and Canada, and has shown favourable results as a P test under New Zealand conditions. This is now known as the Resin P test[4,5].

How it works



Nutrients in the soil are in equilibrium with those in the soil solution, and plant roots, using an ion exchange mechanism, take up nutrients from the soil solution as required.

In the laboratory the Resin P test uses a mechanism that closely mimics the soil/soil solution/plant root model. Soil, water and ion exchange membranes are shaken overnight. During this process, phosphate in the soil moves into the water phase where it is efficiently taken up by the ion exchange membranes. The amount of P adsorbed onto the membrane is proportional to the soils ability to replenish P into the water phase.

Figure 1: Resin P Extraction in the Laboratory

Benefits

We believe the Resin P test overcomes some of the anomalies observed with the Olsen P test.

For example:

- Under conditions of low soil pH, free aluminium and iron may immobilise P in the field[6]. Because the Olsen extraction is performed at a high pH, some of this bound P will be released during the extraction, thus overestimating the plant available P. As the Resin P extraction is performed at soil pH, this effect will not arise.
- Soils with high pH, or recently limed soils[7], tend to have higher levels of calcium. When the Olsen extraction is performed at pH 8.5, some calcium phosphate precipitates during the extraction process[8] and does not get measured. Other sources of calcium phosphate, such as RPR, are also insoluble. Consequently the Olsen test underestimates plant available P.
- Target Olsen P levels vary with the P retention of the soil[9]. We surmise that, as the Resin P test is primarily a simple water extraction, the P Retention will directly affect the amount of P being extracted. The need to consider the P Retention when interpreting the extractable P result should not be as critical for the Resin P test.
- The yield response curves for Resin P are similar for different soils types, unlike those for Olsen P[3]. This simplifies the interpretation of the soil test, as it is not so dependent on soil type.
- As a multi-nutrient extraction technique. The resin technology has been successfully used for sulphur[10], potassium, calcium, magnesium and sodium, and it is suspected it may also have application for some trace elements.

Limitations

Being a relatively new test, there is only a limited amount of interpretation data available. The tendency has been to relate the Resin P result to the Olsen P and interpret it using established Olsen P experience. Investigation has shown a good correlation with the Olsen P results, with a constant *average* Resin P:Olsen P ratio of 2.5. However, on an *individual* test basis, the relationship varies according to many factors. This emphasises that the Resin P has unique properties that differentiate it from the Olsen P test.

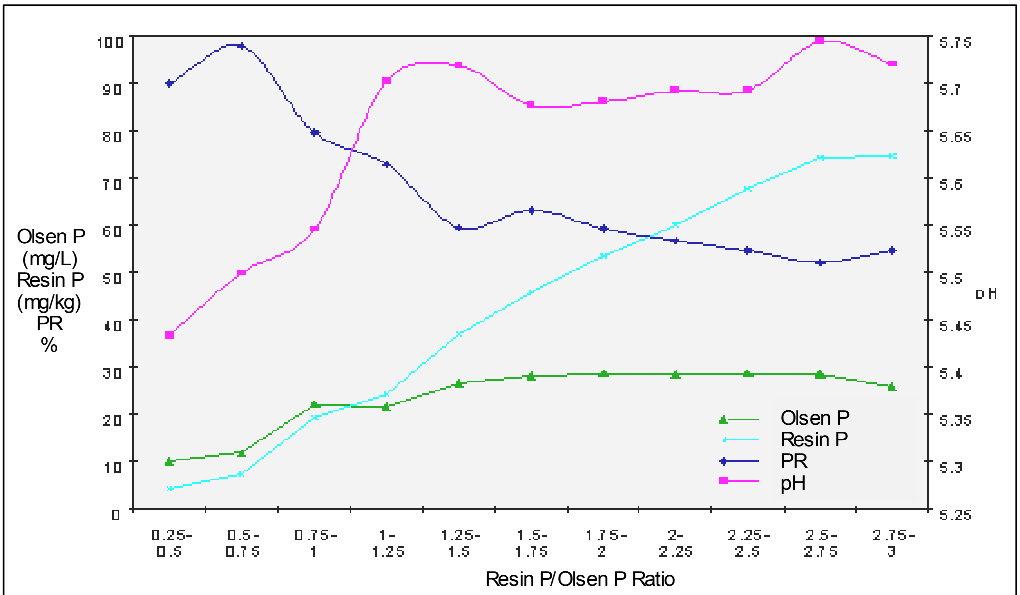


Figure 2: Characteristics of soils giving varying Resin P:Olsen P ratios

Laboratory Observations

A thorough survey of our database was conducted in an attempt to find possible relationships between available soils test results and the Resin:Olsen P ratio. These tests included Olsen P, Resin P, pH, Base Saturation and Phosphate Retention (PR). The most interesting findings are represented in Figure 2.

The graph shows that soils where the Resin P:Olsen P ratio is significantly less than the overall *average* of 2.5 have a:

- **Low pH**

The relatively low Resin P levels found in soils of low pH suggests that that this test does not overestimate the available P like the Olsen P test does. We suspect that at the pH of the Resin P extraction, aluminium and iron do not release bound P.

- **High Phosphate Retention**

Soils with high PR also show a relatively low Resin P, confirming that less P is available from these soils. This means that target P levels do not have to be adjusted for soils of different P retentions.

- **Low P Status**

The lower the amount of P in the soil, the more dramatic is the affect of the different soil properties on the plant availability of P. The Resin P test appears more sensitive to these affects, particularly those of pH and PR.

Conclusion

The model on which the Resin P test is based is one that seems intuitively and scientifically sound. While the initial research and investigations are very promising, we also realise that this is still a new test, with limited field trial data at this time. Consequently, the Resin P should not be regarded as a replacement for the Olsen P. Despite the identified limitations of the Olsen P test, the experience invested in it by scientists and consultants justifies its continued use. We regard the Resin P as an important development in soil testing which complements the Olsen P test.

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