Finding balance

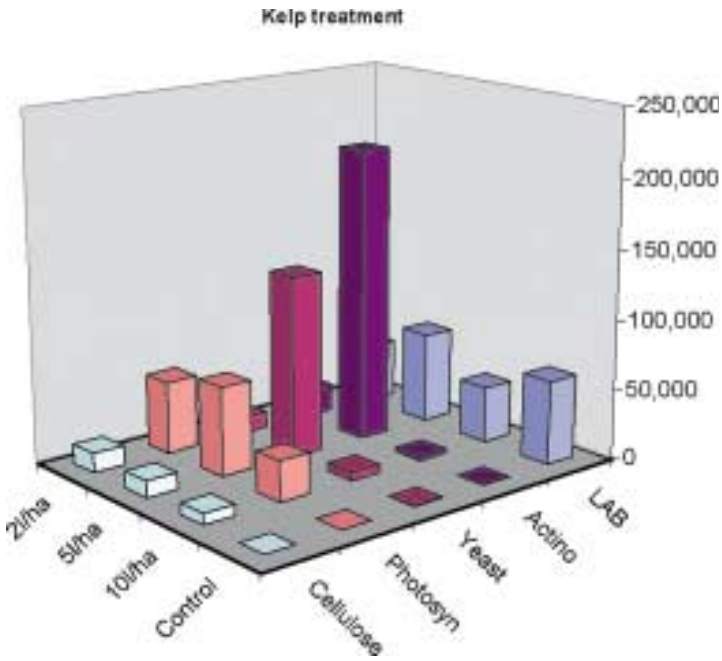
Bioactive materials for sustainable soil management

For some time now, the number of products described as soil conditioners or soil improvers has been growing.

Makers of things such as kelp extracts, humic acid, fish emulsion make numerous claims about improving the soil and reducing fertiliser bills, but it has been unclear whether or not there is any real basis to these claims.

Some people have had amazing results with one thing or another, but for many the results have been slight or imperceptible and the reason for this variability has remained elusive.

Recent research by SWEP laboratories, however, has begun to shed light on this issue by looking at soil biology from a balance perspective (according to the principles of the Mikhail System). Since the release of their Complete Soil Balance Analysis, they have been able to look more closely at what happens when various materials are applied to soil. While still in its early stages, results from this research are pointing to real effects that should give more predicable results.



KELP EXTRACTS

These materials are among the oldest on the market and, like most others, began by being marketed as fertiliser alternatives. Although containing a wide range of elements and possibly beneficial as trace element supplements, it is clear that they have too little of any nutrient (especially once diluted for application) to ever be thought of as fertilisers. Some manufacturers have tried to compensate for this by fortifying their products with dissolved fertiliser, but this has seldom been entirely effective.

Another strategy has been to increase the concentration of the solutions applied. This did produce results, but contrary to most expectations, it often produces a negative response. In other words, it stopped plants growing.

Subsequent research by many people confirmed a high concentration of plant hormones in many kelp products. This explained the overdose response and led to a change to foliar application in preference to soil treatment.

SWEP research has shown that these hormones also have strong effects on soil microbes. In particular, it has been shown that kelp extracts stimulate activity in fungi, yeast, photosynthetic bacteria and actinomycetes.

The research also showed a critical concentration that appears to be related to the concentration of the product. For most established brands, this appears to be around five litres (concentrate) per hectare, with the response falling off rapidly both above and below this level.

The graph clearly shows this change in the microbial profile of a treated soil at the critical concentration – untreated levels are shown at the front of the graph.

FISH EMULSIONS

These materials also have a long history, but with a number of different manufacturing methods. Again, they have been treated as fertiliser alternatives in spite of the low concentrations of most nutrients in the diluted solution applied and fortified products have also been developed to compensate for this. However, they differ from kelp extracts in being able to be used at higher concentrations and in usually having reasonable amounts of nitrogen. The result is that they are more likely to green things up and look as if something useful is happening.

This background made results from SWEP research something of a surprise. The most significant result came from the specialised Fungi termed cellulose utilisers. A surprise because this group had been expected to be intolerant of added nitrogen. Other fungi also showed significant increases in activity.

However, unlike kelp extracts, there appeared to be two critical concentrations. Fungi and cellulose utilisers responded at the lowest application rate – two litres per hectare, while at 10 litres per hectare the response was more like that of kelp – actinomycetes, photosynthetic bacteria and yeast.

Interestingly, the activity of lactic acid bacteria appeared to be suppressed by fish emulsion, with this suppression increasing as the application rate decreased.

Each material has its own effect on soil biology. There are appropriate and inappropriate uses and application rates … there is unlikely to be any simple rule-of-thumb

HUMATES

These materials are usually produced by liquefaction of brown coal, although solid and soluble products have also appeared recently. They have never been regarded as fertilisers, but rather as soil conditioners, with effects on soil structure, presumed to be due to their high carbon content. However, many criticisms about the use of humates have pointed to the small amount of carbon actually applied, compared with the increases in soil organic carbon that manufacturers claim. Others dismiss these criticisms, saying that humates act as catalysts for biological processes which lead to accumulation of organic matter in the soil, rather than simply adding carbon to the soil.

Research by SWEP may actually support this latter contention, as it showed humates produce a similar change in microbial profile to kelp extracts, but with a strong suppression of lactic acid bacteria and an additional stimulation of cellulose utilisers. In a sense, these materials appear to work as if they were some kind of hybrid between kelp extracts and fish emulsions, but generally at higher application rates. This finding also appears to support the general feeling among both manufacturers and users that combination products between two or more of these three materials can be more effective than each alone.

Due to the wide range of product formulations, there is probably no single effective application rate, but again the lower application rates appeared to be the more effective.

MOLASSES

The use of sugar and molasses to boost soil microbial activity has been talked about for some time and the theory has been that it provides an energy source that can be utilised equally well by all soil organisms. However, field applications have not tended to produce many convincing responses.

SWEP research with molasses has shown significant effects on soil biology, but they are more complex than expected.

Again, the best results appeared to be at the lowest application rate (two litres per hectare), with lactic acid bacteria and yeast predictably giving the strongest response, but with fungi and cellulose utilisers also responding (at the lowest rate). Interestingly, photosynthetic bacteria showed the opposite response, with activity increasing as the application rate increased.

WORM LEACHATE

This material is relatively new to the market, with comparatively little research to support it. However, when applied to soil it does produce changes in the microbial profile somewhat reminiscent of molasses. However, the research suggests that it may be a better than molasses as a stimulant of fungi and cellulose utilisers (at low application rates) and better for stimulating photosynthetic bacteria at high application rates. Interestingly, it did not appear to influence the lactic acid bacteria at all.

OTHER MATERIALS

There are many other materials that are yet to be tested and the predominance of results at low rates of application raises the possibility that even everyday materials such as superphosphate and urea could behave as bio-active materials if used at suitably low rates. However, there is a lot of research left to be done in order to fully understand how best to manage soil biology – at least we have now a good start.

It is clear, however, that each material has its own effect on soil biology. Indicating that there are appropriate and inappropriate uses and application rates.

Unfortunately, there is unlikely to be any simple rule-of-thumb to apply for the use of any bio-active material. The only way to know what will be effective for any soil is to base decisions on the results of a suitable soil test.

Here too, SWEP research has clearly demonstrated that the results of soil biology testing can only be properly assessed in the context of both cation and nutrient balance – otherwise the cell counts are just numbers.

The "take-home" message from all this appears to be that once you have improved soil fertility to the point where fertiliser responses are becoming less apparent, you should focus on optimising the exchangeable cation balance in the soil.

As a means of accelerating this process and subsequently maintaining proper soil balance, the use of bio-active materials could be very helpful, but only if you are able to determine the right ones and use them at the best application rates. ■