

What does the Future Hold?

Bob Taylor looks at the work that is going on in the wake of the tightening up of pesticide legislation.

With pesticide legislation becoming increasingly stringent, environmental issues dominating our daily routine and with growing pressures from statutory government bodies and environmental groups over the fate of nutrients, particularly with regard to the impact they may have on surface and ground water, it is perhaps not surprising that products and technologies are being developed to help turf managers in their quest for perfect putting surfaces.

These developments fall under the umbrella of "organic management" the strict definition of which relates to any product or compound supporting a carbon base derived from plants or animals. This definition embraces any substance of plant or animal origin and would include substances consisting of bacterial or fungal origin. It could and is being extended to include all vegetation management performed without reliance on chemicals. This may include the development of buffer zones around watercourses, and the extension and development of the rough grassland to accommodate predatory beetles to assist in pest control. It may include composting, organic weed and pest control, grazing, manual removal of weeds and improving light, air flow and other more routine cultural practices to remove water, reduce thatch and improve turf condition.

In fact, a different or a possibly more familiar way of approaching organic management would be to think in terms of Integrated Pest Management (IPM), not a new concept but one that is rarely fully adopted.

CULTURAL GREENKEEPING MANAGEMENT

The traditional art of golf greenkeeping is not dead or dying, it is however changing to embrace new machinery that will be equally or more effective in its particular job of work. It will hopefully make life that bit easier for the greenstaff. Aeration formerly undertaken by hand is now given over to slit, solid, hollow tine and Verti-drain machines. Scarification is now the preserve of thatch control and thatch removal equipment. Top dressing can be applied and "worked in" with very capable machines.

The essence of the above is that all of the cultural management techniques developed by our ancestors are probably more important now than they have ever been. The only consolation for the greenstaff is that, thankfully, life may be a little easier. Continuing this theme, if greenkeepers have a problem with thatch, they scarify, top dress, and reduce water and fertiliser input. If black layer or poor root development is the issue on a green, then aeration in whatever form, if deemed appropriate, is administered. All of the above however may be being lost in the hope that new revolutionary organic products are being produced which will "eat thatch", increase rooting, improve shoot growth, improve colour and destroy the black layer. Such products may also reduce disease so "saving our bacon" when the current round of pesticide reviews have resulted in a total revocation of all chemicals currently used to combat disease.

SO WHAT ABOUT BIO-STIMULANTS?

Microbial inoculants, it is claimed, increase soil-borne bacterial populations, leading to healthy plant growth arising from improved environment conditions around the rhizosphere. Research has shown that an average golf green contains between 0.001% and 2.0% of the microbial population usually found in healthy grassland. Relatively sterile then, you may think, time to switch to microbial products? The figures quoted are log values and therefore possibly somewhat misleading. It is, however, not unusual to find between 1 and 10 million colony-forming units per single gram of soil, averaging over 10 billion colony-forming units when additional species are added and even figures such as this only represent a small fraction of the soil microbe species that scientists can quite easily culture. Mike Kenna (USGA Green Section Record, May/June



Some of the articles on the subject

2001) has shown that repeated use of fungicides has not significantly decreased populations of soil micro-organisms. Even soil fumigation in trials carried out on Bermudagrass greens failed to sterilise the soil and as such is unlikely to kill all the beneficial soil organisms.

The lower levels encountered may be due to a combination of compaction, lack of oxygen, chemical use, sterile top dressings, sand rootzones, close mowing and removal of grass clippings.

Research undertaken to date has shown that there can be a stimulation of root mass with some products but this is relatively short lived. Thus, the products will need to be applied regularly to be effective. For example, Dr Joe Vargas has shown in trials using pseudomonas species that they need to be applied almost daily as this species commonly used in microbial inoculations has difficulty establishing in soil. Even using a BioJect system, the above has been shown to be the case. Some greenkeepers however have seen positive results, while others have reported negative results. Manufacturers claim that any result may not be immediately obvious, rendering measurements taken after application somewhat unreliable. There has been much discussion as to whether the bacteria and fungi used can be damaged or killed by ultraviolet

light but again the manufacturers suggest that the microbes washed into the surface work within the rhizosphere and rootzone and are therefore protected. Dr Noel Jackson (USGA Green Section Record, May/June 1999) showed that *Trichoderma harzianum* will establish within the rhizosphere and can supplement microbial communities sufficient to produce soil-borne disease. This occurred using two spring and two autumn applications of the fungus. Work continues with *Trichoderma* in biological disease control programmes. *Trichoderma* spores have been sprayed onto turfgrasses to reduce foliar disease. Research here again shows that frequent applications are required and any conventional fungicides applied are lethal to *Trichoderma*.

There have been several case studies reported in-house from product manufacturers supporting the beneficial effects of microbial stimulants.

The first concerned a bowling green where 6-7 cm of thatch was preventing water movement down into the rootzone. Scarification, hollow tining and overseeding gave reasonable results but fungi building up within the thatch layer prevented new grass establishment. The Parks Manager used microbial stimulants and found the results to be quite dramatic. New grasses came through and the original grass began to be sustained. By August they looked like brand new greens – no further treatments for fusarium have been necessary. Fertiliser applications have been reduced by 50%.

A study from an English golf club using microbial stimulants for three years in conjunction with a sound fertiliser and aeration programme has successfully controlled thatch levels, hollow coring is no longer required and wetting agents are not needed.

SO, WHERE DO WE STAND WITH MICROBIAL PRODUCTS – DO THEY WORK OR DON'T THEY?

STRI has recently conducted a commercial trial using microbial stimulant products on a fescue-bent turf growing on a USGA specification rootzone. The main plots received either low, medium or high fertiliser inputs and 16 separate commercial product treatments were applied within the individual sub-plots. These were randomised within each main plot, with applications repeated at ten to 20 day intervals between May and November 2002. Irrigation was applied on four occasions and aeration took the form of a single solid tine treatment and two light surface treatments using a Sarel-type roller. The whole of the trial area was subjected to simulated golf-type slip wear equipped with golf shoe studs and measurements were taken on a monthly basis. Live grass cover was assessed visually and the rooting depth from surface was measured. All of the results were subjected to a statistical analysis of variance and the results are outlined below.

Two products only produced a significant enhancement in turf colour, both however contain nitrogen (NPK 5-2-10) and this, particularly in the plots within the main plot supporting a lower fertiliser rate, is to some degree to be expected. In most cases, the visible assessment of turf cover showed no statistically significant effects from the microbial treatments when compared to the control. However, one treatment containing the above NPK fertiliser did produce a significantly greater density of cover in relation to the control. Towards the end of the trial, significant effects on visible turf cover were noted from two products providing greater live grass cover than the control.

The results for root depth measurements in all soil rootzones showed no significant effects either from fertiliser application or through microbial treatments.



In summary, the only effects on turf quality were obtained for the depth of turf colour and turf density. This was affected primarily by the fertiliser programme but two treatments containing some fertiliser did augment colour depth slightly. One product on one assessment date did produce a ground cover of 74% in comparison to 64% for the control.

IPM

Much of the hype around organic stimulants repeatedly calls for “use in conjunction with an intensive cultural maintenance programme” – an IPM strategy, for want of a more meaningful description.

Most greenkeepers tend to work towards creating an environment where slower-growing fine-textured grasses are favoured, the “Acid theory”, reducing the pH to acceptable “acidic” levels. Microbial products work best at pH values between 5.0 and 8.0, raising the pH to accommodate microbes would inevitably lead to greater nutrient availability (due to the microbes breaking down thatch!) which in turn would lead to slower green speeds through increased grass growth. Microbes added to the surface are light sensitive, so applications are advised in conjunction with aeration to ensure microbes enter the rhizome. With top dressing, research has shown that only 5% of the material enters the hollow core holes (assuming 50 mm spacings), so 95% potentially stays on the surface. Why should microbes work differently? A short period under high light conditions will effectively kill the microbes. It is therefore likely in such circumstances that it is the aeration work that is creating any visual improvement to the turf.

One could strongly argue that with adequate spiking, growing conditions will improve without the use of “beneficial microbe” products. If your problem is of a physical nature then it would make sense that a physical solution is necessary.

Clearly, environmental and site-based characteristics are so variable that it is difficult to make a definitive and qualitative judgment as to the benefits or otherwise of these products, although all of the available research does give quite a strong reserve to the overall benefits of microbial stimulants. To satisfy your desire once and for all, it may be possible to undertake small scale trials on a replicated basis but great care will be required as inconsistencies are not what managing putting surfaces is about. I have seen greenkeepers applying different stimulants at different rates which, on one course, resulted in a serious decline in turf quality and major disease problems on six greens which almost left him without a career. Trials therefore must be subtle and not overly impacting on putting or playing quality. Any trials should continue for at least one full growing season and assessments made for turf colour, root depth and incidence of disease. Nutrient status should be checked before, during and upon completion as was the case with the STRI trials. When considering purchasing micro-stimulants, ask:

- What research has been undertaken on the product and was this in-house or independent?
- Was the research field-based or laboratory-based?
- What was the nature of the growing medium and is it compatible with that of the golf club?
- Were statistical analyses used and how many replications were made?

KEEPING THE BALANCE

A healthy rootzone consists of 45% mineral, 3-5% organic, 20-30% air-filled pore space and no more than 20-30% water-filled pore space. This will provide an adequate growing medium for soil microbes. They are present and will fill all available niches. More importantly for Course Managers is just how the rootzone is being maintained and in this respect it is all about “keeping the balance”. Thus, we must look much more widely other than relying on soil stimulants or other quick-fix solutions. We need adequate sunlight, the drying effects of the wind, carefully monitored irrigation and nutrition, and sensible mechanical and cultural practices carried out during favourable ground conditions when the soil is growing vigorously. This is an extension of IPM techniques that when considered in relation to creating grassland buffer zones, ecological corridors for invertebrate and other wildlife movement, and a balance between putting surface conditions and the wider environment would be best thought of as holistic management.

Holistic management and ensuring a package of cultural techniques and an effective IPM approach will be an essential component of future golf course management, possibly seen by many as a step backwards into the historic past when such practices were commonplace. We are, to some extent, being seduced by the hype and this is out-pacing the basic science, leading to unreasonable expectations of what can be achieved without evidence to back up the claims.