Biostimulants: Time for a Change in Attitude?

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Biostimulants abound in the marketplace. Nelson(1998) appropriately described biostimulants as a broad group of turf products that include microbial inoculum, energy sources for microbes, soil conditioners, plant hormones, and other non-nutritional growth-promoting substances. I include in this list vitamins, amino acids and homeopathic applications (frequent treatment at very low rates) of essential plant nutrients and micronutrients in particular. If biostimulants have one common claim, it is to reduce biotic and abiotic stresses in turfgrass. The primary target is golf putting greens.

The scientific community views biostimulants with a high level of skepticism. The products are developed with some type of rationale that generally has some science backing. But all too often that science involves research remotely related to field-cultured turfgrass. The research has often been conducted with very different plant species under very artificial conditions. Another issue is the paucity of field research that substantiates when and if use of the biostimulant results in significant benefit(s). We now need to dwell for a moment on the word "significant". To be successful in getting their work published in technical journals, researchers have to subject their data to very rigorous statistical analysis and from this establish when the influence of an experimental treatment can rightfully be declared significant and not simply a random occurrence. In the scientific world, statistical significance is generally set at what is known as the 5% probability level. What this means is that if the treatment in question were applied 20 times under conditions similar to those under which the experiment was conducted, we can reasonably expect a significant

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treatment effect 19 out of the 20 times the material is applied. This is a very stringent requirement that gets relaxed a bit when taking the research findings out into the real world or when companies are asked to submit to the Department of Agriculture, Trade and Consumer Protection scientific evidence that their product performs as claimed. The requirement becomes one in which a significant plant response to the product is expected "only" 9 out of every 10 times that it is applied.

As long as the rates of application are reasonable, no one questions the value of N-P-K fertilizers in turf management. The prevailing perception is that some benefit will always be realized when fertilizer is applied. Yet, we've long known that in the case of perhaps all nutrients other than N, as we build up levels of plant available forms of nutrients in soil, the point is eventually reached where the soil is supplying all that the plant can productively utilize. We then interpret the soil tests for those nutrients as being "high", "adequate" or "sufficient".

As the soil test level of any particular nutrient increases from low to high, the probability of plants benefitting from additional quantities in the form of fertilizer progressively decline. When soil test levels are high and the nutrient is applied, the chances of seeing a positive plant response are in the range of 5 to 30% (Kelling, et al. 1998). To put this in perspective, if your all 18 of your greens test high in P and you apply fertilizer P every year, the fertilizer can be expected to benefit the turfgrass on as few as one or two of the greens, or none of them.

When soil test levels of nutrients rise above the "high" or "sufficiency" category, the probability of obtaining a significant response by turfgrass to an application of that nutrient drops to less than 2% (Kelling, et al.1998). In 2002, soil and tissue samples were collected from 590 golf putting greens in Wisconsin. Based on the analyses of those samples, phosphorus applications likely produced a beneficial bentgrass response on just 2% of the greens. The potential for K response was somewhat greater. Estimates are that 2 % of the greens had a 30 to 60 % probability of the bentgrass responding to K fertilizer and another 3.9% had a 5 to 30 % chance of responding. For

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all the rest of the 590 putting greens, soil and tissue levels of P and K were at levels where the probability of obtaining a bentgrass response to fertilizer P and K was essentially zero.

In your turf management program, do you routinely budget for, purchase and apply nutrients even in those instances where the chances of benefitting the turf in any way are 2% or less? I'd venture to say that you do and justify the practice on the basis that it doesn't cost that much and its good "insurance".

Let's take the "insurance" concept one step further. The golf course superintendent who deals with a demanding clientele, has the necessary resources, and wishes to remain employed, applies fungicides on a preventative basis. I have the memorable experience of annually making the rounds of regional turf seminars in the state with the likes of Dr. Gayle Worf. On more than one occasion the question was asked, "If I'm on a preventative fungicide program, how often are those fungicide applications beneficial?". In his usual measured and respectful way, Dr. Worf's response was, "If I had to guess, and mind you its only a guess, I'd say about 25% of the time". Having heard this, would you back away from a preventative fungicide program even though the suggestion is that 3 out of every 4 applications made have dubious value? No, I think you'd continue on a preventative program for "insurance" purposes.

Now, back to the biostimulants. The major problem with them is not knowing if and when they'll have beneficial effects. What would it take for researchers to establish, for example, the conditions under which product X lives up to its claim that it significantly increases bentgrass root mass and will do so in 9 out of 10 times that it is applied? First, the researcher would have to consider all of the factors that curtail bentgrass root growth. One of these factors might be heat stress. Then the researcher would have to consider the fact that the amount of heat stress varies depending on things such as radiation levels, soil moisture status, the duration and intensity of the stress-inducing conditions, season-to-season fluctuations in weather, and interactions with other cultural practices being employed. The picture that emerges is one of great complexity, possible multiple interactions, and a mind boggling number of scenarios in which product X may or may not mitigate the effects of heat stress and actually improve bentgrass root growth. I believe its fair to say that, given the wide array of biostimulants being marketed and the scenario portrayed above, it is highly unlikely that we'll ever arrive at the point where one can predict with 90% reliability the conditions under which the products will perform as claimed.

I'm not suggesting all is hopeless when it comes to researching the efficacy of biostimulants.

But if the research is to have predictive value, it is incumbent upon the researchers to characterize in detail the conditions under which the studies were conducted. We need to know what types and levels of stresses were operative when the products were applied. These cannot simply be the classical "spread and measure" studies. The studies will be costly and I'm not sure where the necessary financial support will come from.

I am suggesting that is unreasonable to apply to biostimulants the same efficacy criteria that we apply to the more traditional products such as fertilizers and fungicides when it comes to registration for sale in Wisconsin or in recommending use of the products by superintendents. Fertilizers are being applied when the probability of turfgrass response is near zero and fungicides when there's possibly only a 25% chance of benefit. To demand a 90% response probabililty on the part of those who manufacture biostimulants seems both unreasonable and unrealistic to me.

A more reasonable approach is the "buyer beware" philosophy. Put the burden on the user to decide whether or not to purchase and apply a given product and encourage them to set up control areas that will provide evidence that the product was or was not beneficial.

Life is a continuous series of compromises. If my arguments for viewing biostimulants in a new light seems reasonable, this is a concession that elicits reciprocity on the part of the purveyors of the products. They have to be more forthright in their claims, many of which are backed by little or no field research. Inferences and assumptions need to be recognized for what they are, and there has to be acknowledgment that, depending on the circumstances, the benefits claimed may of may not be realized. A liberal dose of terms such as "indications are", "may", "might" and "sometimes" on the labels would go a long way toward presenting these products in a way that is much more palatable to turf researchers, professional turf consultants, and to superintendents in general.

References

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