Biostimulants Encourage Strong Root Growth

By Christina Wells, Adrienne LaBranche, L. Bert McCarty and Horace Skipper

Increasingly stringent environmental regulations and negative public perceptions of pesticides and fertilizers have stimulated interest in alternative methods of promoting turfgrass health.

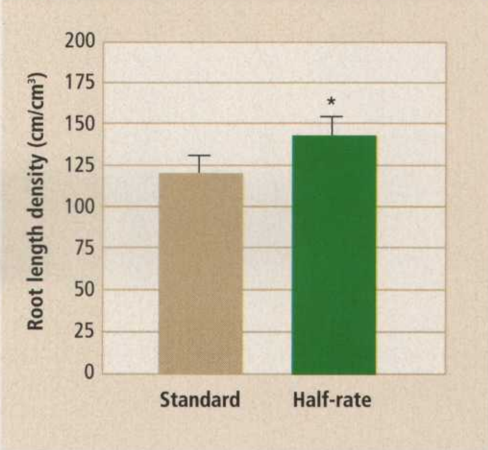
Numerous biostimulant products have emerged, many of them promising better turf quality and stress tolerance, even under conditions of reduced pesticide and fertilizer inputs. The variety of ingredients in these products is remarkable (Karnok, 1993). In most cases, the primary ingredients in biostimulant products have proved beneficial to plant growth in controlled laboratory and/or greenhouse experiments. Whether these same benefits will be consistently obtained under real-world conditions on the golf course is an unanswered question.

One ingredient common to many biostimulant products is seaweed extract. While the idea of applying seaweed to turfgrass may seem far-fetched, many studies attest to the potential for seaweed extract to improve plant growth. Seaweed extracts are rich in micronutrients and often exhibit auxin-, cytokinin-, and/or giberellin-like activity. In addition, they may contain chelating compounds such as mannitol that can increase soil micronutrient availability.

The application of seaweed extract has been shown to increase seed germination, root growth, yield and cold hardiness in a variety of crop plants (Verkleij, 1992). In fact, during the 17^{th} to the early 20^{th} centuries, seaweed was used extensively in coastal areas as a means of maintaining soil productivity.

Humic substances are another common component of biostimulant products. Humic substances are complex mixtures of high molecular weight organic compounds that result from the decomposition of animal and vegetable matter. They can be extracted from a variety of materials, including coal, peat and leonardite (an oxidized form of coal), and their exact chemical composition varies depending on the material from which they were extracted (MacCarthy et al. 1990).

FIGURE 1



This chart shows the mean root length density (cm/cm3) in monthly soil cores taken from plots receiving standard or half-standard nitrogen fertilization. Data from all sampling dates and OPGS treatments are combined.

Many decades of lab experiments on crop plants indicate that the use of humic substances as media amendments or foliar sprays can promote greater root and shoot growth; root branching; leaf chlorophyll content; and rates of nutrient uptake, photosynthesis and respiration (Chen and Aviad, 1990). However, the physiological mechanisms underlying these benefits are poorly understood. Humic substances do appear to possess auxin-like activity, but the specific chemical fractions responsible for this activity have not been identified.

Do positive results in lab studies on crop plants justify applying seaweed extract and humic substances to turf? Some recent studies suggest the answer is a cautious "yes."

Liu and Cooper (2000) recently demonstrated that a granular humate application increased root growth and iron uptake by field-grown creeping bentgrass, although there was no improvement in visual quality. Zhang and Schmidt (2000) reported greater root and shoot

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TABLE 2

OPGS treatment	Month					
	Apr	May	Jun	Jul	Aug	Overall
Control	82[a]	212[a]	152[a]	108[a]	96[a]	121[a]
Full foliar	71[a]	217[a]	149[a]	128[a]	82[a]	93[a]
Half Foliar	62[a]	192[a]	141[a]	95[a]	90[a]	117[a]
Double Foliar	61[a]	283[b]	158[a]	141[a]	92[a]	150[a]
Granular	82[a]	236[ab]	154[a]	97[a]	101[a]	120[a]

Here's the mean root-length density in monthly soil cores taken from plots receiving five OPGS treatments. Cores were taken from the top 10 cm of soil and contained 7.8 cm^3 total soil volume. Data from standard and half-rate fertilizer programs are combined. Within a column, means followed by different letters are significantly different.

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growth, improved leaf water status, and higher levels of antioxidants when greenhouse-grown tall fescue and creeping bentgrass were treated with seaweed extract and humic substances.

In light of the research outlined above, we investigated whether the application of an organic plant growth stimulant (OPGS) to a bentgrass green would maintain commercially acceptable turf quality under reduced nitrogen fertilization. Given that both humate and seaweed extract have been reported to promote root growth, we hypothesized that treated turf would have a larger root system capable of more efficiently intercepting applied nitrogen.

Testing products on bentgrass

We tested the effects of fertilization and OPGS on visual turf quality and root growth at Clemson University's Walker GC nursery. The nursery consists of a Crenshaw bentgrass green built to USGA greens specifications in Clemson, S.C.

We used a split-plot experimental design with nitrogen fertilizer level as the main plot factor and OPGS treatment as the subplot factor (Table 1). Foliar OPGS was applied biweekly from April through August using a backpack sprayer. Granular OPGS was applied once in April using a drop spreader and watered in after application. All treatment combinations were replicated three times.

The OPGS products we used were Plant N.O.G. concentrate (foliar) and Seaumic granules (granular), both manufactured by Senn, Sharman and Senn (Clemson, S.C.). The foliar product included both *Ascophyllum nodostum* seaweed extract and homogenized humic substances. Biochemical analyses indicate that it contains .01 percent cytokinin (kinetin) by weight.

The granular product consisted of humate granules encapsulated in a quick-release coating of the foliar OPGS product. The OPGS coating dissolves immediately upon watering, while the humate granule decomposes more gradually after application.

During the 2002 season, we assessed turf quality and root growth in our experimental plots. Monthly turf quality ratings were based on a numerical scale from 1 (dead) to 10 (ideal) and were based on color, vigor and leaf density. Monthly root growth data were collected by measuring the root-length present in three soil cores (3.9 inches deep, with 3 cubic inches of soil volume per core) taken from random locations within each subplot. Roots were washed free from each soil core and scanned on a flatbed color scanner. Total root-length was measured using WinRhizo software (Regent Instruments, Quebec). Data from three cores per subplot were averaged on each sampling date.

There were no significant differences in turf quality among any of the experimental treatments. Turf quality was high throughout the experiment, regardless of nitrogen fertilization rate or OPGS treatment. While the Walker Course typically applies 6 pounds of nitrogen per 1,000 square feet per year to its bentgrass nursery green, our results strongly suggest these rates could be halved without appreciable reduction in turf quality. The OPGS did not significantly influence turf quality, either under the standard or the half-rate fertilization program.

Root-length density was significantly greater in plots that received half the standard nitrogen fertilization rate (Fig. 1). This result is not surprising: Lower rates of nitrogen application have long been known to encourage turf root growth.

A double-strength foliar OPGS application also significantly increased root-length density on one sampling date during the experiment (Table 2). Granular OPGS and lower rates of foliar OPGS had no significant effects on root-length density on any date. In general, root-length density reached a seasonal peak in May and dropped continually thereafter (Fig. 2).

Our data suggest that OPGS treatment promoted root-length production only during the May period of maximum root growth. We will continue this research to determine whether similar seasonal trends occur in subsequent years.

Management implications

Our study showed that OPGS products can influence turfgrass root growth under real-world conditions when applied at high rates. However, the lack of influence of OPGS treatment on turf visual quality leads us to question whether the products were truly cost-effective.

Under conditions of heavy foot traffic or greater environmental stress, the increase in rooting due to OPGS treatment may have translated into healthier turf and higher visual quality ratings. In our nursery green, however, the turf experienced relatively little stress and turf quality ratings were consistently high. Under these conditions, OPGS application may not be warranted.

Our work suggests two points to bear in mind when considering OPGS application: (1) OPGS treatment may be most beneficial on sites where root growth is known to be the primary factor limiting turf performance; and (2) OPGS treatments may be most effective when applied early in the season when roots are actively growing. Biostimulant products are not cure-alls. But with continued research it's likely that they will find a place in environmentally friendly turf-management programs.

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