Nitrogen and Organic Amendment Effects on the Grow-In of Simulated Bentgrass Putting Greens

By Christopher Kleinsmith

As pointed out by Dr. Kussow in the last two issues of THE GRASS ROOTS, there is widespread concern about the level of microbial activity in newly constructed sand putting greens. Low microbe populations have been implicated in the extremely high rates of nitrogen found necessary for grow-in and in the occurrence of Pythium root rot.

This greenhouse study was conducted to satisfy one of the requirements for a major in Soil Science with specialization in Turf and Grounds Management. The purpose was to observe the effects of four different N fertilization programs and organic amendments added to a commercial sand-peat root zone mix on creeping bentgrass grow-in. The organic amendments added were selected for their potential for stimulating buildup of microbe populations in the root zones.

METHODS

Simulated putting greens were established in 6-inch diameter PVC cylinders in the greenhouse. Each green consisted of 12 inches of root zone mix overlying 3 inches of pea gravel. The experiment consisted of 14 treatments (Table 1), each replicated three times. After packing the columns with the mixes, each was seeded to Providence creeping bentgrass after application of starter fertilizer. As soon as the grass began to emerge, the greens were lightly watered ona daily basis. Clipping was at a 1/2 inch height every 3 to 7 days. The experiment was concluded after a period of 3 months.

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Table 1. Treatments tested.

ROOT ZONE MIX AMENDMENT *			
Treatment number	Type	Rate per yd^3	Nitrogen application
1	None	—	SRN as needed
2	None	—	0.1 lb N/M/week
3	None	—	.4 lb N/M/week
4	None	—	0.8 lb N/M/week
5	Inoculum	5 lb	SRN as needed
6	Sustane		SRN as needed
7	Milorganite	5 lb	SRN as needed
8	Milorganite	10 lb	SRN as needed
9	Milorganite	20 lb	SRN as needed
10	Sand-Aid Carbo-Aid	10 lb 10 oz	SRN as needed
11	Milorganite + Carbo-Aid	10 lb 10 oz	SRN as needed
12	Milorganite + Sand-Aid Blend	10 lb	SRN as needed
13	Milorganite + Sand-Aid Granular	10 lb	SRN as needed
14	Milorganite + Sand-Aid + Inoculum Blend	10 lb 5 lb	SRN as needed

* yd^3 of a commercial 85/15 sand-peat blend.

Table 2. Root zone mix characteristics.

Treatment	Moisture retention 30-cm tension	Bulk density	Relative bioactivity ‡ 2 week	Relative bioactivity ‡ 3 month	Ignition weight loss * Initial	Ignition weight loss * 3 month	Infiltration rate	Cation exchange capacity
	% vol	g/cc		——— %	———	inch/hour	me/100 g	
1-4	14.8	1.67	8.1	55.3	1.20	1.23	57.3	1.18
5	20.7	1.63	11.1	49.1	1.46	1.19	46.7	1.29
6	18.4	1.64	7.8	55.7	1.66	1.25	45.1	1.32
7	15.5	1.64	8.3	53.9	1.71	1.23	46.2	1.49
8	16.1	1.61	11.4	41.6	1.73	1.47	37.5	1.50
9	14.5	1.63	13.4	40.2	2.01	1.38	41.0	1.62
10	18.6	1.50	22.4	75.0	1.75	1.05	44.4	1.66
11	17.9	1.63	13.6	57.3	1.75	1.00	40.3	1.27
12	17.0	1.64	12.4	76.1	2.45	0.95	42.9	1.61
13	19.1	1.62	22.9	57.0	2.06	0.93	38.3	1.40
14	17.8	1.58	34.6	53.6	1.82	1.07	39.8	1.53

* 600°C.
‡ Maximum = 100.

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RESULTS AND DISCUSSION

The commercial root zone mix employed was an 85/15 sand-peat blend that meets USGA standards for putting green construction. Adding the various organic amendments increased moisture retention in compacted cores at 30-cm tension from 14.8 to as high as 20.7% by volume (Table 2). Amendment of the original mix also reduced bulk density somewhat. There was no consistent relationship between moisture retention and bulk density.

During the 3 months of the study, root zone mix samples were periodically removed from a 3-inch depth in the root zone mixes. These samples were placed in closed containers for 6 days and the carbon dioxide evolved trapped in sodium hydroxide. The amounts evolved were assumed to be an index of the amount of microbial activity in the mixes. As shown in Table 2, 2 weeks after seeding, there were fairly low levels of microbial activity in the un-amended root zone mixes (treatments 1-4). Some of the organic amendments appeared to have stimulatory action, the most effective being a combination of Milorganite, Sand-Aid, and an inoculum prepared from fish meal and dried, granulated kelp. By the end of the study, only the root zones mixes amended with Sand-Aid+Carbo-Aid or Milorganite+Sand-Aid had more microbial activity than did the unamended root zone mixes.

Weight losses of the root zone mixes ignited at 600oF were determined at the beginning and end of the study to estimate changes in organic matter content. Comparison of the two sets of numbers (Table 2) suggests that the organic amendments decomposed very rapidly. Not only did some appear to decompose completely, but reductions of weight loss to less than that of the original root zone mix signifies that in treatments 10 through 14, the amendments also promoted decomposition of as much as 22% of the peat originally present.

Addition of the organic amendments to the root zone mix reduced the putting green infiltration rates somewhat (Table 2), but not to levels considered unsatisfactory by the USGA. The amendments had the positive effect of increasing the cation exchange capacity of the root zone mix by as much as 40%.

The amendments had variable and sometimes dramatic effects on visual assessments of bentgrass establishment (Table 3). After 6 days, additions of the inoculum, Sustane, Milorganite at <20 lb/yd3 of root zone mix, Sand-Aid+Carbo-Aid, and Milorganite+ Sand-Aid+inoculum appeared to hasten bentgrass establishment as compared to the nitrogen treatments. In contrast, 20 lb/yd3 of Milorganite and Milorganite+Carbo-Aid were clearly detrimental. On the seventh day after seeding, the bentgrass in the greens containing 20 lb Milorganite/yd3, the Milorganite+ Carbo-Aid or Milorganite+Sand-Aid+inoculum suddenly turned brown. By the eighth day, all of the bentgrass in these greens was dead. Re-seeding of these greens was only partially successful. After 18 days, establishment ratings showed that the bentgrass stands in the nitrogen treatments were as good as, and often better than, where the root zone mix was amended with the organic materials.

The total weights of bentgrass clippings collected during the study and roots isolated after 3 months to a depth of 12 inches are shown in Table 3. The first thing to notice is the fact that in the nitrogen treatments, application of 0.4 lb N/M/week was optimum for shoot growth. At the 0.8 lb/week N rate (equivalent to 30 lb N/M over a 24-week season), shoot growth was reduced. This is reflected in the slightly lower establishment rating of this treatment at 18 days. This treatment also produced bentgrass discoloration that could only be partially corrected with applications of potassium and micronutrients. Bentgrass root growth progressively declined as the N rate was increased.

Table 3. Bentgrass responses.

Treatment	Establishment ratings 6 days	8 days	18 days	Total biomass production Shoots*	Roots‡	Shoot:root
	Scale 1-5			mg		
1	2.5	4.3	3.9	871	643	1.35
2	2.0	4.2	4.7	1214	891	1.36
3	2.3	4.2	4.7	1520	573	2.65
4	2.5	4.3	4.5	1157	306	3.78
5	3.5	4.1	4.4	1025	664	1.54
6	3.0	0.7	2.7	690	515	1.34
7	3.5	2.4	4.1	935	572	1.63
8	3.5	1.0	2.7	1076	349	3.08
9◊	0.5	0	4.3	1550	293	5.29
10	4.0	3.4	4.2	921	504	1.83
11◊	1.5	0	2.2	1082	365	2.96
12	2.7	3.8	3.9	1305	635	2.06
13	2.7	2.7	2.7	1110	242	4.59
14◊	3.5	0	0.7	979	166	5.90

* Sum of 11 harvests.
‡ After 3 months.
◊ Grass died, reseeded day 8.

Treatment 1, that in which the intent was to apply primarily SRN on a need basis, produced low bentgrass shoot growth and an intermediate amount of root growth (Table 3). It was found with this treatment that SRN alone could not maintain adequate bentgrass color and periodically had to be supplemented with soluble N.

Among the organic amendment treatments, the 20 lb rate of Milorganite produced the most bentgrass clippings, but root growth was relatively low (Table 3). Root growth was also strongly restricted in the homogenous Milorganite+Sand-Aid and Milorganite+Sand-Aid+inoculum treatments. The reason for this became evident at the end of the study. Samples taken from the full depths of the root zone mixes revealed that the bottom 4 inches of these mixes were chemically strongly reduced. This was very evident from the gray rather than normal reddish color of the root zone mix and the strong odor characteristic of soil from swamps.

CONCLUSIONS

The results of this greenhouse study provide strong indication that caution must be used in amending putting green root zone mix with readily decomposable organic materials to stimulate microbial activity. There appeared to be no clear advantages to doing so, and death of the newly seeded bentgrass is a possibility. The best approach observed for rapid grow-in was application of 0.2 lb/M/week of soluble (urea) nitrogen. Going to 0.4 lb soluble N per week was not advantageous and 0.8 lb N/week actually slowed the grow-in and markedly reduced root growth.

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