Bentgrass Response to Dormant Applied Milorganite

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The primary benefits of dormant application of Milorganite in Wisconsin are hastening of the breaking of dormancy by turfgrass and earlier spring greenup. Experience has shown that the effectiveness of the practice varies from season-to-season and site-to-site, even within the confines of a given golf course. One reason is varying viewpoints on what constitutes a dormant fertilization and, therefore, the time of fertilizer application.

One definition of dormant fertilization is application of fertilizer after turf shoot growth has ceased. This occurs when the turf is subjected to several consecutive days whose mean daily temperatures are 50 degrees F or less. In southern Wisconsin, this often occurs around October 15 to 20. Fertilization at this time is what I call late fall fertilization. I view dormant fertilization as fertilizer application that does not take place until the turfgrass has truly gone dormant; the turfgrass shoots turn brown and dry due to nighttime temperatures well below freezing and the soil surface temperature is below 32 degrees F. This often does not occur in Wisconsin before the advent of permanent snow cover. Thus, I also include in my definition of dormant fertilizer that which is applied when the weather forecast leads one to believe that permanent snow cover is imminent.

With my definitions of late fall and dormant fertilization, the distinguishing feature is when fertilizer N uptake occurs. With late fall fertilization N uptake occurs yet that season. In dormant application of a SRN such as Milorganite, fertilizer N uptake most likely does not take place until the following spring. The purpose of the present study was to determine what influences release of N from dormant applied Milorganite and what are the spring responses of creeping bentgrass response to these influences.

The study was established in the fall of 1993 in an effort to define the factors that regulate bentgrass response to a dormant Milorganite application. One assumption made in designing the study was that turfgrass uptake of N from Milorganite must be preceded by microbial release of organic N. This assumption leads to the hypothesis that whatever enhances springtime warming of turf will favor microbial release of Milorganite N and, therefore, bentgrass response.

Absorption of radiant energy from the sun is what causes soil to warm in spring. Sunny days contribute more energy than do cloudy days and favor the warming process. But how rapidly soil temperature rises also depends on the nature of the surface that the solar radiation strikes and the heat capacity of the soil. Light-colored surfaces reflect more of the solar radiation than do dark surfaces and slow soil warming. Once the radiant energy is absorbed at the turf surface, the rate of soil warming is determined primarily by its moisture content. It takes much more energy to warm a wet soil than a dry soil because water has a very high heat capacity.

In the present study, I varied the color of the turf surface in two ways. One was as simple as mowing the bentgrass at two different heights in the fall. The more light, tan-colored grass on the surface after snowmelt, the greater the amount of radiant energy that is reflected. I also varied soil surface color by topdressing in the fall with sand, soil or charcoal. To create a difference in soil moisture in the spring, the study was conducted on two sites approximately 200 feet apart. One site was on a uniform 5% slope and the other on an area with virtually no slope. During snowmelt, water ponded to a depth of more than 6 inches on the flat site but quickly ran off the sloping site. Hence, while it was not measured, one can assume that a moisture differential existed between the two sites in early spring.

Ask any Soil Scientist and they'll tell you that for all practical purposes soil microbial activity virtually ceases when soil temperature drops below 50 degrees. If this were entirely true, then why snowmold? This line of reasoning led to the hypothesis that there is measurable microbial release of Milorganite under snow cover. To gain evidence for this, Milorganite was sealed in porous polyethylene packets that were placed on the turf surface at the time of dormant fertilization and again immediately after snowmelt. Several packets were placed in the plots to allow for removal at different times and analysis for the amount of organic N remaining in them. This technique allowed me to verify whether or not mineralization of organic N occurred prior to snowmelt and to track mineralization until such time that clipping N content could served that function.

To help explain the effects of surface drainage, turfgrass clipping height and color of topdressing material on spring response to dormant applied Milorganite, plot temperatures were measured at a ½-inch soil depth. This was accomplished with the thermocouples connected to dataloggers that recorded soil minimum, maximum and mean temperature on a daily basis.

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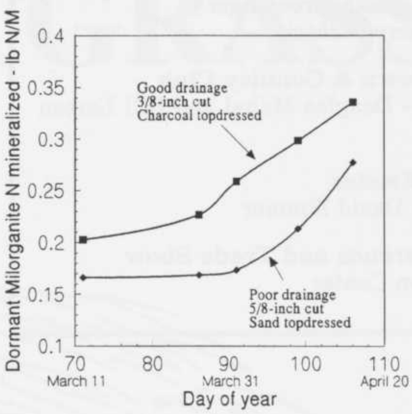
Mineralization of Dormant Applied Milorganite

Among the three treatments imposed, surface drainage had the greatest and most consistent influence on the amounts of Milorganite N mineralized during winter and the first 41 days following snowmelt on March 5, 6 and 7. As anticipated, N mineralization was greatest on the site with good surface drainage. Influences of height of cut did not become apparent until about April 1, when somewhat more mineralization was observed at the ⅜-inch cutting height than at the ⅝-inch height. The effects of the topdressings on Milorganite N mineralization were variable over time. As a general rule, topdressing with charcoal resulted in as much or more N mineralization as did topdressing with sand or soil.

The influences of surface drainage, height of cut and color of the topdressing material applied on Milorganite N mineralization were found to be additive. Therefore, mineralization was greatest on the site with good surface drainage in plots mowed at ⅜-inch and topdressed with charcoal. Conversely, N mineralization was slowest on the site with poor surface drainage on plots mowed at ⅝-inch and topdressed with sand. The magnitude of the differences in Milorganite N mineralization between these best- and worst-case situations is indicated in Figure 1.

Soil temperatures did not rise above freezing until March 16, which was 9 days after completion of snowmelt. Yet, by March 12, 0.16 to 0.21 lb/M of dormant applied Milorganite N had already been mineralized (Fig. 1). This is evidence that mineralization did occur between the time of application of the dormant Milorganite on November 23 and the time of snowmelt. The fact that soil freezing occurred 4 days after November 23 suggests that this mineralization took place primarily during the winter under the generous snow cover on the plots. It is of interest to note here that due to this deep and continous snowcover, soil temperatures at the ½-inch depth never dropped below 25 degrees. On a percentage basis, over-winter mineralization of the dormant Milorganite amounted to 10.5 to 12.3% of the N applied.

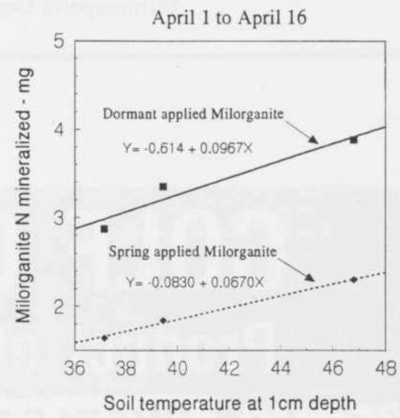
Fig. 1. Effects of surface drainage, height of cut and topdressing material on the mineralization of dormant applied Milorganite.



Rates of dormant Milorganite N mineralization increased noticeably between April 1 and April 16 (Fig. 1). This was a period during which daily average soil temperatures steadily increased from about 38 to 47 degrees.. By April 16, the amounts of dormant Milorganite mineralized ranged from 0.27 to 0.33 lb. N/M. It was at this time that there was sufficient regrowth of the bentgrass to begin clipping collection.

Unlike earlier in the season, between April 1 and 16 there was a linear relationship between Milorganite N mineralization rates and soil temperatures. This condition presented the opportunity to address another question I hoped the study would help answer. The question is, "Does the overwintering of Milorganite affect its springtime mineralization rates?" This is where analysis of the packets placed in the plots right after completion of snowmelt on March 7 came into the picture. By fitting equations to the mineralization of the dormant and spring applied Milorganite during this time frate (Fig. 2), I was able to derive rates of mineralization. These were 0.0967 mg N/degree rise in temperature for the dormant applied Milorganite and 0.0670 mg N/degree for the spring apllied Milorganite. What this suggests is that as soil temperatures rose, the rate of mineralization of dormant applied Milorganite was 43% faster than for spring applied Milorganite.

Fig. 2. Rates of mineralization of dormant and spring applied Milorganite.



Bentgrass Greenup

Regrowth of the bentgrass shoots commenced on or about March 28, when mean daily soil temperatures were in the range of 34 to 36 degrees. Periodic color ratings then served to characterize the effects of the study variables on greenup. As in the case of dormant Milorganite mineralization, the rate of greenup was fastest where there was good surface drainage, the grass had been mowed the previous fall at ⅜-inch, and it had been topdressed with charcoal (Fig. 3). Slowest greenup was where surface drainage was poor, the mowing height was ⅝-inch and the turf was topdressed with sand. However, differences in greenup between these "best" and "worst" sets of conditions disappeared by April 20. While they persisted, the best and worst condition differences in spring greenup amount to about one week in terms of how long it took to achieve the same level of color development.

Bentgrass Clipping N

Nitrogen concentrations in clippings

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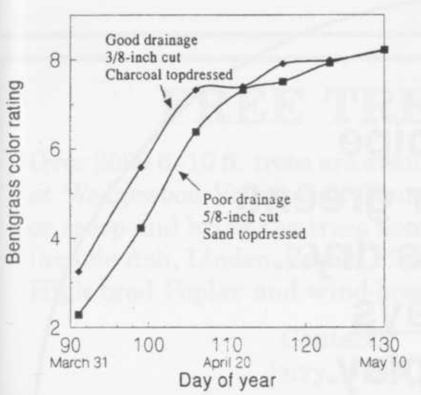
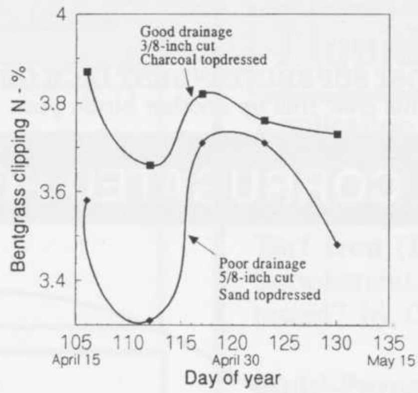
collected on April 15 (Fig. 4) reflected very nicely treatment influences on dormant N mineralization (Fig. 1) and on bentgrass color (Fig. 3). Differences in clipping N between the best and worst conditions for dormant

Fig. 3. Effects of surface drainage, height of cut and topdressing material on bentgrass color in the spring following application of dormant Milorganite.



Milorganite mineralization persisted throughout the sampling period of April 15 to May 10. This difference, however, varied from one sampling to another. This is believed to reflect variations in the bentgrass shoot growth rates. During the 5 days leading up to collection of clippings on day 112, air temperatures averaged nearly 10 degrees higher than in the 5 days leading up to the 106-day sampling and reached 85 degrees on day 110. This sudden and brief warm spell greatly stimulated shoot growth and, due to a dilution effect, may well account for the sharp reduction in clipping N concentrations between these two dates. Over the third and fourth clipping collections, air temperatures returned to more normal April values of around 50 degrees, shoot growth slowed, differences in clipping N concentrations increased, and differences between the best and worst conditions for Milorganite N mineralization declined. A rise in air temperatures likewise explains why clipping N concentrations increased, and differences between the best and worst conditions for Milorganite N mineralization

Fig. 4. Effects of surface drainage, height of cut and topdressing material on the N concentrations of bentgrass clippings in the spring following dormant Milorganite application.



declined. A rise in air temperatures likewise explains why clipping N concentrations decline again between days 123 and 130 (May 3 and 10). What these shifts in clipping N concentrations demonstrate is that the influences of surface drainage, mowing height and topdressing material on dormant applied Milorganite N mineralization are greatest during periods of rapid bentgrass growth.

Summary

The first-year results of this study provide evidence that microbial mineralization of organic N in dormant applied Milorganite can occur during winter and the N released stimulates spring greenup of creeping bentgrass. The amounts of N mineralized over the winter months averaged 0.18 lb N/M, or about 11% of the N applied. Early spring mineralization of dormant applied N is influenced by anything that affects soil temperature. In this study, surface drainage was more important in this regard than was height of cut the previous season or color of topdressing material.

The influence of these three factors were found to be additive. When good surface drainage was combined with a ⅜-inch mowing height and charcoal topdressing, spring greenup of the bentgrass prior to April 20 was approximately one week ahead of greenup in bentgrass growing on a poorly drained site, mowed at ⅝-inch, and topdressed with sand.

From these observations we can begin to enumerate conditions or reasons why turfgrass springtime response to dormant applied Milorganite is variable from site-to-site and year-to-year. Extent of snowcover is likely to be one such condition. Early and complete snowcover such as we experienced in the winter of 1993 prevents soil temperatures from falling to very low values and could well affect the extent of winter mineralization of dormant applied Milorganite. Anything that slows soil warming after snowmelt will also delay Milorganite mineralization. Frequent rains following snowmelt keeps soils wet and significantly slows soil warming, primarily because this keeps soil heat capacity high, but also because of reduced solar radiation. Poor soil drainage, surface or internal, has a similar effect. Of lesser importance is the color of the turf surface as modified by mowing height the previous fall or application of light-colored topdressing material. Barring a cold wet spring, perhaps the most important factor of all is timing of the application of dormant Milorganite. Mineralization of organic N does appear to be significant at soil temperatures around 40 degrees and certainly at temperatures in the range of 40 to 50 degrees. Two or more weeks of soil temperatures in this range after application of dormant Milorganite could well lead to sufficient microbial release of organic N to elicit a rapid rate of turfgrass greenup the following spring.

—Grass Roots

Acknowledgement

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