Poa Annua Invasion of a Bentgrass Fairway

By Dr. Wayne Kussow, Emeritus Professor, Department of Plant Soil Science, University of Wisconsin-Madison

When you retire, one of the things you have to do to maintain domestic tranquility is get rid of those boxes and boxes of stuff. Some things are easy to toss because you can't for the life of you remember why you kept them in the first place. Other items have nostalgic value. And, in my case, there are all those folders full of research data that appeared in bits and pieces in annual research reports or The Grass Roots but have never been pulled together into a summary report. This is one of those summary reports.

This research project pre-dates the Noer Facility. It was conducted between 1987 and 1990 on a site graciously provided by Tom Harrison and maintained by his crew at the Maple Bluff Country Club. The primary purpose of the study was to investigate the claim that application of Milorganite to creeping bentgrass encourages Poa invasion by elevating soil test levels of P. This was at a time when two highly reguarded d turfgrass researchers had cited research conducted in the late 1930's at Rutgers University. One claimed the research showed that high levels of P encouraged Poa invasion of bentgrass while the other claimed the research gave no such evidence. A secondary objective of this study was to determine how N rates and type of fertilizer influence selected characteristics of a creeping bentgrass fairway.

Sod was stripped from the experimental site, the soil prepared, and the site seeded to 'Penncross' creeping bentgrass in August 1987. The area was divided into four blocks of 7 x 10 feet main plots that received bi-weekly applications of fine grade Milorganite (FM) or 7 monthly applications of regular grade Milorganite (RM), urea, or IBDU at annual N rates of 2.4, 4.8, and 7.2 lb/M. To ensure a wide range in soil test P, the main plots were split for periodic applications of triple superphosphate. By the spring of 1988 the bentgrass was grown in and being mowed at a height of 7/16 (0.44) inches. The plan was to uniformly overseed the site that fall with Poa annua. This plan was set aside because Poa begun to naturally invade the plots that year. But because the Poa populations from this natural invasion were so low, the plots were overseeded in August of 1989 with seed collected from a Poa infested Madison fairway. The overseeding rate was 0.1 lb/M of viable seed.

Starting in 1988 all plots were rated weekly for color and clippings collected for N analysis. Verdure (the weight of above ground green material remaining after mowing) and root samples to 6 inches were periodically collected. Poa populations were determined by counting the number of inflorescences at times of seed set. For reasons that will become evident later in this report, numbers of earthworm casts were also periodically counted.

OBSERVATIONS

Poa Annnua Invasion

Over the course of the study Poa populations ranged from 5 to 132/m2 (464 to 12,400/M) and soil test P ranged from 36 to 188 mg/kg (ppm). Yet, there was never any meaningful relationship between the two (Fig. 1), clearly demonstrating that at least in this study soil test P levels had no influence on Poa invasion. Poa populations were several times higher in the Milorganite plots than in those fertilized with urea and IBDU. Careful scrutiny of the plots revealed two things. One was that the Milorganite plots had much greater earthworm activity (more casts) than the urea and IBDU plots. The other was that Poa was establishing almost exclusively in those casts. This made sense given that the casts were providing gaps where the Poa had minimal competition from the creeping bentgrass while providing moist, well granulated, nutrient enriched soil as the growth media.

Not surprisingly, Poa populations were strongly related to numbers of earthworm casts, even in the urea and IBDU plots (Fig. 2). This reflects the well known fact that gap development by any means in closely mown bentgrass enhances Poa invasion, particularly when the gaps are present when the Poa is setting seed.

Is the elevation of earthworm activity and subsequent accentuation of Poa invasion unique to Milorganite? Absolutely not. Researchers at Michigan State University have clearly shown that for soils with properties that favor earthworms, repetitive application of any natural organic fertilizer stimulates their populations. A likely reason is that the fertilizer actually serves as food for the earthworms.

Earthworm activity did not account for all the variability seen in Poa invasion of the plots. Another factor that came into play at times was bentgrass verdure. This was particularly true for the Milorganite plots (Fig. 3). While the data presented in this figure suggest that the reductions in Poa populations with increasing verdure in the urea and IBDU plots were not significant, increases in verdure was associated with over 50% lower Poa populations over the single 1990 season. Hence, verdure cannot be ignored as factor that influences Poa invasion of a creeping bentgrass fairway.

Fertilizer Influences on Bentgrass Fairway Characteristics

Verdure was influenced by N rate and the type of fertilizer applied (Fig. 4). Fine grade Milorganite applied monthly resulted in consistently lower verdures than did the monthly applications of regular grade Milorganite, urea or IBDU and IBDU produced higher verdure than any other fertilizer. Why did these differences arise? The answer appeared to lie in the relationship of verdure with bentgrass clipping N content and how this varied with the type of fertilizer applied.

Averaging across all sampling dates, verdure was strongly dependent on clipping N, so much so that clipping N accounted for all but 15% of the variation in bentgrass verdure (Fig. 5).

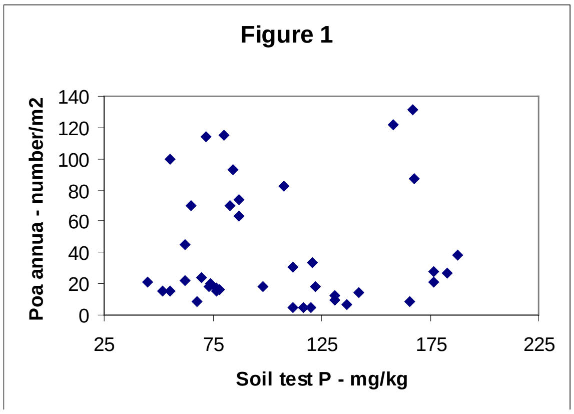

Figure 1: Phosphorus Levels had no influence on poa invasion.

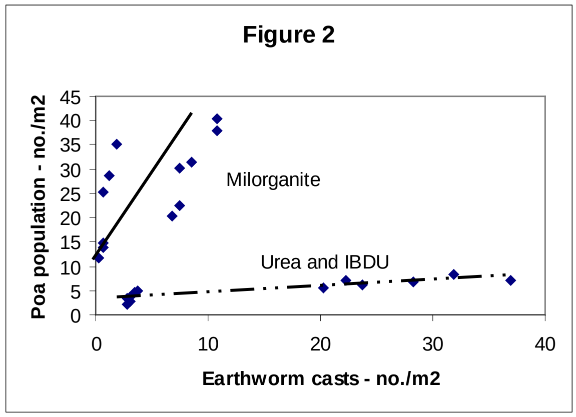

Figure 2: Poa Annua populations were strongly related to the number of earthworm casts.

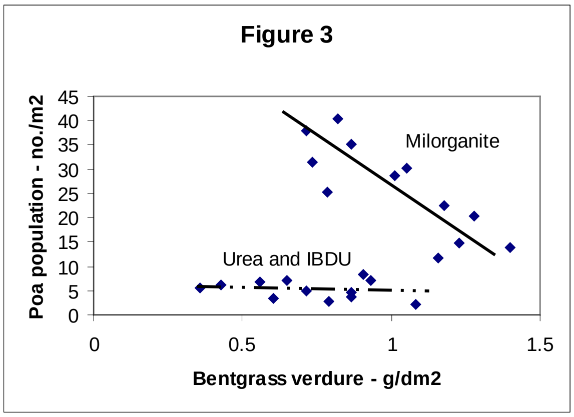

Figure 3: At times bentgrass verdure is a factor in earthworm activity.

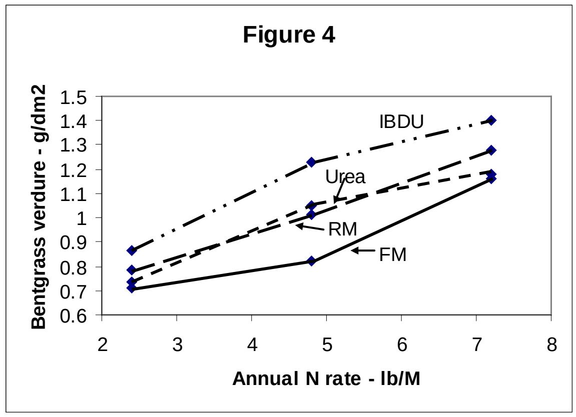

Figure 4: Bentgrass verdure was influenced by N rate and the type of fertilizer applied.

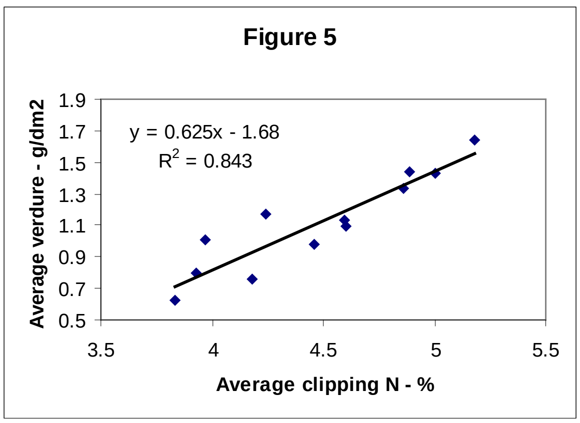

Figure 5: Clipping N accounted for all but 15% of the variation in bentgrass verdure.

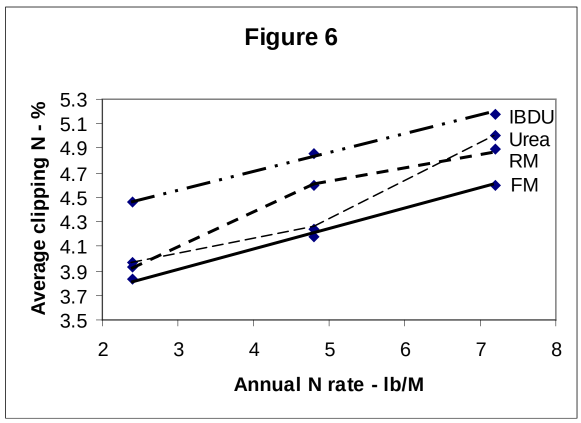

Figure 6: Annual N rate from different products does not equal clipping N.

Judging from figure 6, among the four fertilizers N utilization by the bentgrass was lowest for the fine grade Milorganite and highest for IBDU. These differences in bentgrass response to the various fertilizers N and the dependency of verdure on clipping N explain the joint influences of N rate and type of fertilizer on verdure (Fig. 5).

The bentgrass verdure also showed a seasonal trend that was consistent across the three annual N rates (Fig. 7). Verdure was highest in late season and lowest in the summer months. The low verdure values in July and August likely facilitated Poa invasion at that time of year and may explain in part why Poa populations typically increase in the fall months after declining during summer.

Tiller densities were determined on 8 dates during the course of the study to provide yet another measure of bentgrass stand density that might relate to the rate of Poa invasion. These densities increased with annual rate of N application, varied with the type of fertilizer applied, and displayed the same seasonal patterns as verdure. Yet, tiller density did not appear to have any consistent influence on Poa populations (Fig. 8). If anything, higher Poa populations were associated with the higher tiller densities. More detailed inspection of the data revealed what other researchers have observed – the higher tiller density the lower the weight per tiller. Increasing tiller density did not compensate for these reductions in tiller weights. As a result, the increases in tiller densities did not necessarily translate into comparable increases in verdure.

Thatch thickness had no influence on Poa invasion of the creeping bentgrass fairway. This came about because thatch thickness did not vary with annual N rate or type of fertilizer applied. Thatch thickness averaged 6.4 mm in 1988 and 1989, but inexplicably increased 64 % to 10.5 mm (0.4 inch) in 1990.

Root densities were observed, not with the idea that this in some way related to Poa invasion, but to record the effects of N rates and types of fertilizer applied on root growth. The data corroborated the well known fact that any cultural practice that stimulates turfgrass shoot growth results in reduced root development. In this study, root density linearly decreased with the annual N rate that accounted for 87% of the fertilizer treatment effects on root density (Fig. 9).

Seasonal cycling in root densities was also evidenced. The seasonal pattern of root development was basically the same in all fertilizer treatments. Data from the IBDU treatment at the 4.8 lb annual N rate illustrate the seasonal pattern of root density (Fig. 10). As expected, root density was lowest in August. The tremendous increase in root densities between November and May was not anticipated. What this tells us is that this is a crucial period for root system regeneration and may indicate the importance of late season N fertilization. In this study N applications extended into mid-October.

CONCLUSIONS

Application of Milorganite to a creeping bentgrass fairway where soil properties are favorable for earthworm growth can promote invasion by Poa annua. This has nothing to do with the influence of Milorganite on soil P levels. Rather, the key causative factor is increases earthworm populations. Research tells us that this phenomenon is not unique to Milorganite, but will result from repetitive applications of any natural organic fertilizer.

High turfgrass verdure retards bentgrass fairway invasion by Poa annua. Turfgrass verdure linearly increases with annual N rate. Verdure can also vary with the type of fertilizer applied. Differences among fine and regular grades of Milorganite, urea and IBDU in the level of verdure produced were solely the result of how efficiently bentgrass utilized the N from the fertilizers. Among the four fertilizers, IBDU produced the most verdure and resulted in the highest bentgrass clipping N concentrations.

Fertilizing to maintain a high verdure in a creeping bentgrass fairway is not advisable because of the detrimental effects of high N rates on root development. According to the results of this study, maintenance of a moderate annual verdure level of 1.0 g/dm2 could have been achieved with annual applications of 6.2 lb N/M in the form of fine grade Milorganite, 4.0 lb N/M as regular grade Milorganite, 2.6 lb N/M as urea, or 2.2 lb N/M as IBDU. These annual N rates translate into 0.3 to 0.6 lb N/M/month.

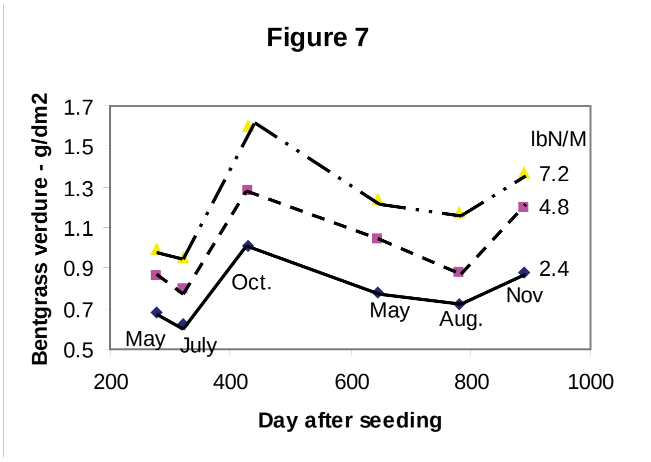

Figure 7: Verdure was highest in late season and lowest in the summer months.

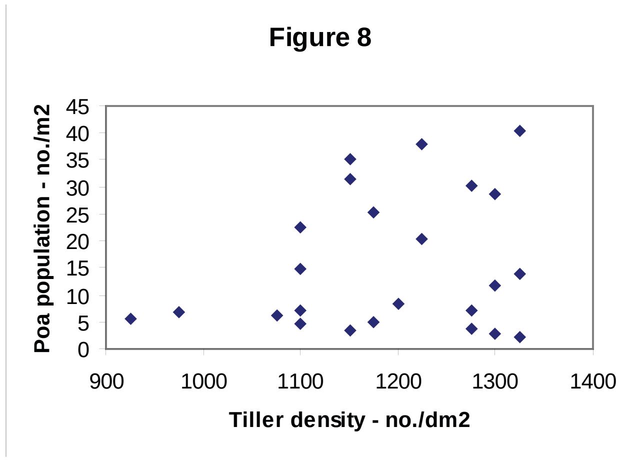

Figure 8: Tiller density did not appear to have any consistent influence on Poa populations.

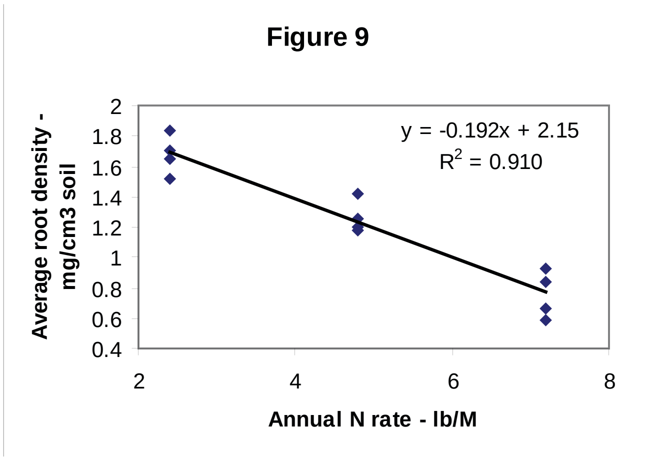

Figure 9: Root density linearly decreased with the annual N rate.

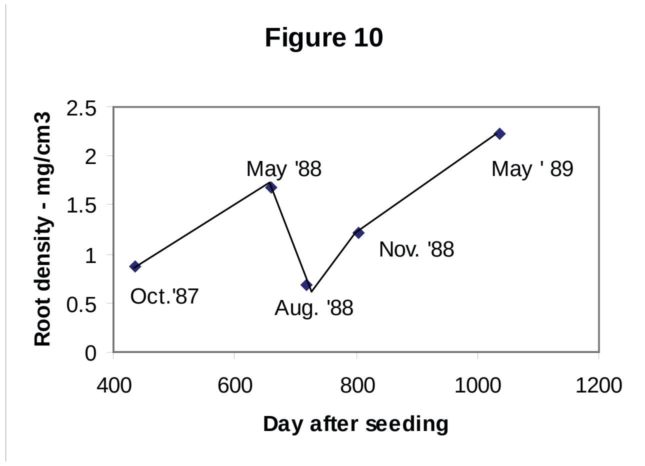

Figure 10: The seasonal pattern of root development was basically the same in all fertilizer treatments.