due to leaching in the fall or that Poa annua does not compete as well with Merion in the fall.

The balance between P and K did not affect the amount of Poa annua in the turf (Table 4), although there was some variability in the data. There was a marked effect of P treatments when calcium arsenate had been applied to the turf (Table 5). Thus heavy phosphorus applications can overcome the influence of calcium arsenate. Since calcium arsenate is not being used today as a somewhat selective control for Poa annua the practical application of these data is that if one wishes to negate the effect of past treatments of calcium arsenate the easiest solution is high phosphorus applications. This has been suggested by Daniel and others.

In his Ph.D. thesis here at M.S.U., Bob Carrow reported that soil pH had a significant influence on the effectiveness of a calcium arsenate in controlling Poa annua based on his greenhouse and lab studies. Table 6 shows that when the turf had been treated with a very modest amount of calcium arsenate (10 pounds per 1000 square feet since 1971) applying limestone raised soil pH sufficiently to increase the amount of Poa annua in the turf. Raising the pH reduces the solubility of the arsenate thus reducing its toxicity to Poa annua. But when a higher rate of calcium arsenate had been applied (20 pounds total) soil pH was not important. Practically this means that maintaining soil pH near neutral is important in preventing the arsenate from having a continuing toxicity to Poa annua (and other species). The combination of phosphorus applications and keeping the pH near neutral should be most effective. One should not use sulfur to acidify the soil where calcium arsenate has been used in the past.

The results of 12 years of nitrogen fertility treatments at Traverse City are given in Tables 7 and 8 for Merion Kentucky bluegrass and Pennlawn creeping red fescue, respectively. Multiple applications of ammonium nitrate and Milorganite gave slightly better quality ratings than when all the nitrogen was applied in April on the Merion.

The higher nitrogen rates increased the amount of Poa annua slightly in Merion but significantly in the red fescue turf. Obviously the red fescue does not compete as well with Poa annua as does Merion. The Poa annua encroachment was natural with seeds carried on mowers from adjacent fairways. The use of Milorganite resulted in markedly increased percentages of Poa annua in the turf, especially in the Merion block.

Returning the clippings to a Merion Kentucky bluegrass turf over a 13 year period has resulted in considerable encroachment of Poa annua when mowed at 1 inch (Table 9). When clippings are removed at the 1 inch height or when mowed at 2 inches (regardless of clipping removal or return) there was no appreciable Poa annua. Poa annua is more competitive with Merion at the shorter mowing height. Returning clippings provides a continuing source of Poa annua seeds once the grass has begun encroachment. There may be some disease relationships as well since greater stripe smut injury was observed in 1975 on the plots where clippings were returned than where clippings are removed. Nitrogen rate has had no effect on the amount of Poa annua in the turf in this study.

Although no wetting agent treatments were applied during 1976 the residual effects of 1975 treatments of wetting agents at Boyne Highlands near Harbor Springs continue to substantiate earlier results. Hydro-Wet and Aqua-Gro are the only wetting agents among those studied which have any residual effects in correcting the hydrophobic soil condition. Hydro-Wet is slightly more effective than Aqua-Gro when applied at comparable rates. These two wetting agents provide short-term turf recovery if the treatment is applied before the hydrophobic condition has become serious. If some of the turf has already died from moisture stress, however, the recovery will require a longer period of time - up to several months. In addition, the hydrophobic condition apparently redevelops with time necessitating retreatment every year or two depending on the severity of the problem, and the effectiveness of the treatment.

In 1964 Merion Kentucky bluegrass plots were established with sod or seeded. Nitrogen treatments were applied at rates ranging from 0 to 14 pounds (each divided into 6 monthly applications) per 1000 square feet annually. The study was concluded in 1976. There has been differential encroachment of weedy grass species into the plots. The plots which were originally seeded (Table 10) have had considerable weedy grass encroachment at the lower nitrogen rates. Under the conditions of clipping removal from these plots an annual nitrogen rate of 6 pounds was necessary to keep at least 90% Kentucky bluegrass in the turf. The plots which had received no nitrogen at all had a high concentration of timothy with some orchard grass and red fescue. When 2 or 4 pounds N were applied annually red fescue increased while other volunteer species decreased. These volunteer grass species were not apparent in the turf during the first 7 or 8 years of the study.

The sodded plots had essentially no weedy grasses present at the conclusion of the study (Table 11). These results substantiate that Merion is a cultivar which responds well to higher nitrogen rates. This applies when there is no disease development. Merion is susceptible to Fusarium blight and stripe smut, both of which tend to increase in severity with higher nitrogen fertilization.

Another conclusion is that the sodded turf was more resistant to weedy grass encroachment than the seeded turf. Throughout the study the sodded plots required about 2 pounds less nitrogen annually to attain a similar quality of turf.

Nugget Kentucky bluegrass plots were sodded in 1974 in the M.S.U. Shade Trial area. The treatments shown in Tables 12 and 13 were initiated in 1975 and continued through 1976. Better turf resulted (Table 12) when the turf was mowed at 2.5 inches (compared to 1.5 inches); when annual nitrogen rates of 1.5 pounds per 1000 square feet were applied (compared to higher nitrogen rates); and when the plots were treated with fungicides for powdery mildew and Fusarium blight.

Applying the nitrogen in March improved turf cover slightly over plots receiving a comparable nitrogen rate split in to April and September treatments (Table 13). But the highest percent of turf cover occurred when the nitrogen was all applied in October. These results need to be substantiated before October fertilization under heavily shaded conditions can be recommended but it would seem wise to fertilize shaded turfs at an appropriate time so the turf could take advantage of those periods when there is more sunlight penetration (before leaf development in the spring or after leaf fall in autumn). Certainly a 3 pound nitrogen treatment at one time (as used in this study) would not be recommended. If one application of nitrogen is desired per year perhaps 1 to 1.5 pounds could be applied under shaded turfs after leaf fall. Remember that leaf removal is essential for maintaining the best turf density possible under the shade conditions.

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