are probably the most popular bentgrasses at this time. Their management costs have not been greater than that of their predecessors. The previously mentioned putting green Bermudas should not increase management costs, either.

Ureaform Fertilization on Putting Green Turf

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The advent of ureaform has opened the door to a whole new era in turfgrass fertilization. Because of the critical importance of nitrogen in the development and maintenance of turf areas, research work has been initiated with respect to the relatively new methylene urea compounds commonly referred to as ureaforms. Fuller and Clark, Yee and Love, and McCool did much of the pioneering work on the breakdown and availability of the ureaform materials. In general, their early studies showed that ureaform materials, if properly formulated, were effective slow-releasing nitrogen sources.

It remained to be determined just how effective ureaform fertilizers would be as a source of nitrogen for putting-green turf where grass clippings are removed. An experiment was started in 1956 to evaluate the effectiveness of ureaform fertilizers as nitrogen sources on putting green turf. This paper summarizes the results of this study as observed throughout the 1957 growing season.

Methods and Materials

The investigation was conducted at the turf plots of the R. I. Agricultural experiment station on a soil classifed as Bridgehampton silt loam of pH 6.2. Experimental plots were each 50 sq. ft. in area and were replicated three times. Plots were located on three separate areas, each a different species of green turf, namely Piper velvet bent, R. I. Colonial and Seaside. All were mowed at one-quarter in. and maintained to simulate putting green conditions as nearly as possible.

Three commercially available ureaform fertilizers, Borden's "38", Nitroform, and Uramite, each containing 38 per cent nitrogen, were applied at the rates of 2, 4, 6, and 8 lbs. of nitrogen per 1,000 sq. ft. in a single application. In addition, these same fertilizers were applied at the rates of 4, 8 and 12 lbs. as split applications. Since no appreciable variation in response was observed from the three ureaform materials used at the same rate, the turf scores of all three materials were averaged and are reported as ureaform here.

For comparison the fertilizer used for general turfgrass purposes and designated as standard R. I. 8-6-2 turf fertilizer was used in this experiment. This fertilizer, which was based on previous experimentation, derives 30 per cent of its total nitrogen from natural organic

sources; the remaining 70 per cent is from quickly available nitrogen sources. In addition, an activated sludge, Milorganite, with analysis of 5.5-4.0-0 was applied in split applications at the rates of 4 and 8 lbs of nitrogen per 1000 sq. ft. Phosphorus and potash for all the fertilizer plots were adjusted to 3 and 1 lbs, respectively, per 1000 sq. ft. including the check plots which received no nitrogen. All materials were applied uniformly with a mechanical spreader.

Scoring Explained

Supplemental irrigation water was applied when needed, or about every 4 to 5 days. Turf quality ratings based upon density, color, uniformity, vigor, and general appearance were taken every two weeks throughout the growing season and are designated as turf score.

The R. I. turf scoring system is scaled from 0 to 100. A breakdown of this system is as follows: 0 to 49 is poor quality, 50-59 fair, 60-69 fairly good, 70-79 good, and 80 or above excellent.

The first fertilizer treatment was applied May 3, following the recording of the first turf scores for the 1957 season. The second application was on Aug. 2. During 1956, single and split applications were applied to the same plots, Apr. 27 and June 20.

Results and Discussion

When applied at the rate of 12 lbs. of nitrogen per 1,000 sq. ft. as a split application there was no apparent difference between the three ureaform materials as measured by the resulting turf quality. There was a large difference between the treated plots and the check during the first week. This was especially true when ureaform was used at higher rates. This difference in turf quality, recorded the day before the fertilizer treatments were applied, is due apparently to a considerable holdover in residual nitrogen from ureaform applied the previous year. An average of all turf quality ratings shows all three ureaform fertilizers produced excellent quality turf throughout the entire growing season at the 12-lb. split application rate.

As for results of using a split application of 8 lbs. of nitrogen per 1,000 sq. ft. from ureaform materials, R. I. 8-6-2 turfgrass fertilizer, and activated sludge (Milorganite), the standard 8-6-2 turf fertilizer, containing largely water-soluble nitrogen, gave a quick growth response and produced a fairly good turf in a short period of time. However, turf quality steadily declined until the second application in early Aug. Following the second application the same general response was noted as was observed after the first application. Milorganite required a month's time to produce a fairly good turf which then declined until second application. After the second treatment, Milorganite produced an excellent quality turf during the months of Aug. and Sept. and declined in Oct. to fairly good turf.

Ureaform as a split application of 8 lbs of nitrogen per 1,000 sq. ft. produced fairly good turf during May, June and July. Following the second application on Aug. 2, the turf quality improved to excellent during the months of Aug. and Sept.

An average of all turf scores throughout the growing season at the 8 lb. split application level of nitrogen shows that ureaform produced good quality turf rated at 72 per cent whereas the standard 8-6-2 rated 67 per cent and the activated sludge rated 68.8 per cent. A study of data indicates that the turf quality resulting from a split application of 8 lbs. of ureaform nitrogen although showing some variation, does not have the wide fluctuation as does the R. I. 8-6-2 fertilizer and Milorganite. The ureaform fertilizers appeared to undergo a more gradual nitrogen release thereby providing a longer feeding period throughout the growing season. In addition, the split application of 8 lbs. of nitrogen per 1,000 sq. ft. from either activated sludge or water soluble fertilizers is not advisable since high nitrogen levels necessitate extremely large quantities of fertilizer, and the application of such large quantities is likely to cause turf injury. Ureaform fertilizers, although containing 38 per cent nitrogen, may be applied at high nitrogen rates without danger of turf injury, because of controlled nitrogen availability.

Single vs. Split Application

Comparative value of single versus split application of ureaform at the 8-pound nitrogen rate shows that the differences are small. Those plots receiving the split application had an average turf score of 72 per cent as compared to 75 per cent for those plots receiving a single treatment. No appreciable benefit was obtained

by splitting the treatment into two applications when using the 8-lb. level of nitrogen.

Quality Fluctuation

In a comparison of ureaform, the standard R. I. 8-6-2 turf fertilizer, and Milorganite using a split application of 4 pounds of nitrogen per 1000 square feet, the R. I. 8-2 once again produced turf which fluctuated in quality throughout the growing season. Milorganite was slow to produce a growth response until the advent of warm weather. Ureaform produced a turf which improved steadily as the growing season progressed. An average turf score for ureaform was 60 per cent, for the 8-6-2, 59 per cent and for Milorganite, 62 per cent. This shows that all three of these fertilizer materials produced only fairly good turf, indicating that 4 lbs of nitrogen is inadequate.

Average Turf Score

In comparison of turf quality following the single applications of 2, 4, 6, and 8 lbs. of nitrogen per 1000 sq. ft. from ureaform sources, the average turf score for the 2-lb. rate was 54.2 per cent; 4 lb. rate 64.9 per cent; 6-lb rate 68.2 per cent; and 8-pound rate 75.1 per cent. The single application of 8 lbs. produced a good quality turf throughout the growing season, and the 4 and 6-lb. rates gave a steady response. The 2-lb. rate was unsatisfactory since it produced only fair quality turf throughout the six months of observation.

The check plots improved slightly in turf quality as the season progressed but the quality of these plots was far below that of the treated plots.

Conclusion

The results of this study indicate that ureaform fertilizers are well adapted for fertilizing green turf. Although ureaform fertilizers gave slower response than fertilizers which are largely water soluble, they gave a quicker response than the activated sludge. In addition, ureaform materials have been demonstrated to provide long seasonal feeding and have shown a residual holdover of nitrogen to the following year. Such fertilizer as the R. I. 8-6-2 and Milorganite did not possess these qualities and must be applied at lower rates of nitrogen more often throughout the growing season.

Something's Wrong Here

In the report of the GCSA convention that appeared in March GOLFDOM it was stated that dallisgrass was controlled at a Houston club with an application of 10 lbs. of DSMA per 200 gals. of water and cost of eradication was $40 per hole. K. D. Flanders, supt. of Brae Burn CC, has corrected our scorecard on this. The cost was $40 per acre and 21 lbs of DSMA per 200 gals. of water were used.

It appears that the most desirable rate of ureaform nitrogen application for putting-green turf is between 8 and 12 lbs. per 1,000 sq. ft. It is doubtful if the five per cent increase in turf score of the 12 over the 8-lb. rate justifies use of the higher rate. However, it appears that for best results ureaform fertilizers should be applied at not less than 8 lbs. of nitrogen per 1,000 square feet on green turf. There was no advantage in applying ureaform fertilizers in split applications.

Improving Your Fairway Irrigation System

By ROY W. NELSON

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When I was at Golden Valley CC in Minneapolis, I wasn't very happy with the fairway irrigation system because I thought it was inadequate. So, after some negotiation with my green committee, I got the go-ahead to improve it.

I didn't rush into the thing. I checked with other supts. to find out how their systems were set up and I talked to as many local irrigation men as I could to determine what would be the best approach to improving our setup.

Keep Budget in Mind

What I found out, came down to this: The first thing to do was to determine the capabilities and limitations of our existing facilities.