

observations on the effects of rolling from research in North Carolina and conducted by Beard and golf course superintendents in northern Michigan. The benefits of rolling and double mowing are obvious in increasing ball roll. Double mowing had rather inconsistent responses, giving increasing numbers as the season progressed. The increase in ball roll may have resulted from a decrease in turf density with continued double mowing. Double mowing should not be considered as a regular practice. This study will continue in 1995.

MULCHING TREE LEAVES INTO TURF

A separate report on this study was presented at the turf conference last year and the study will be continued through the 1995 growing season. The fifth annual treatment of tree leaves was applied in October, 1994. As in the past there has been no detrimental effect on the turf of mulching the leaves. In the studies we have conducted the leaves decompose within a few weeks with no apparent leaf material by the next spring. A report from Virginia Tech indicated there was some detrimental effect of the tree leaves on turf when very high rates of leaves were mulched. It is important to be sure the grass leaves are not buried by the leaf material so they are exposed to sunlight so photosynthesis can take place during the fall.

This study received wide spread exposure in the Fall of 1994. With the ban on yard wastes being sent to land fills many are looking for other alternatives for disposal of leaves. Presently many golf course and parks superintendents are mulching the leaves into the turf with no problem. For good success, the leaves should be dry, the area should be mowed frequently, and the rotary mower blade should be sharp so the leaf particles are fine enough to fall into the thatch layer and give little shading effect on the grass.

HYDROJECT STUDIES

Evaluation of the Hydroject as a cultivation and injection tool continued in 1994. Chris Miller completed his M.S. degree and moved on to gain experience in golf course management. Doug Karcher, a graduate from Ohio State University is continuing this research.

As we continue to conduct research and visit with golf course superintendents, there are varying patterns of use which superintendents are following. The following comments are based on research, discussions with superintendents, and a survey conducted by the Toro Co. Typical use for those who own their own Hydroject are treating from 4 to 10 times per year with an average of about 6 treatments per year. This use is normally concentrated during the summer months when other cultivation would not be feasible due to intensity of play. About half of the courses are using the Hydroject on sandy greens and half on native soil greens although the latter were not described. As we have stated in the past, the best cultivation program for a given turf depends on the soil problems which need to be addressed. So, the appropriate frequency of use of the Hydroject depends on these same problems.

Some superintendents have utilized the Hydroject for frequent treatment of special problems such as localized dry spots or high compaction areas. Such areas may be treated every 1 to 2 weeks when needed. A high traffic area such as where there is concentrated traffic on or off greens or on tees. Some have even used it on smaller areas of fairways which are compacted or subject to localized dry spots.

The other area of use of the Hydroject is injection of nutrients, wetting agents or insecticides. We have demonstrated that phosphorus and potassium can be placed deeper in the soil with the Hydroject. Sometimes the levels of these nutrients deeper in the rootzone are very low because deeper roots extract the nutrients at that depth, while fertilizers are placed on the surface. This is especially true for finer-textured soils with higher cation exchange capacities. Even though there were very low levels of K deeper in the root zone we did not see any increase in the amount of roots growing in that zone when potash were injected with the Hydroject. There was even some tendency for lower root weights when high rates of phosphorus were injected deeper in the rootzone.

The Hydroject is very useful for treating localized dry spots. In some cases injecting water alone can correct a dry spot. If the condition is more severe, injection of a wetting agent has increased the wettability of the soil and reduced the severity of the dry soil condition.

Among the studies conducted by Doug Karcher was one to examine the effects of injecting nitrogen with the Hydroject on fairway and putting green turf. Treatments included three rates of urea, either injected or surface applied. Plots that received subsurface injections of urea had consistently quality and color ratings than plots receiving surface applications. Injected plots had consistently higher clipping yields and nitrogen content in plant tissues than surface applied plots. This difference in response could be a result of volatilization of ammonia from the surface applications of urea. This could have occurred in spite irrigating the plots shortly after application. Interestingly, plots which received surface applications were more susceptibility to wilting than those receiving injected treatments.

Another study was on how cultivation practices affect annual bluegrass encroachment on a creeping bentgrass putting green. There was no effect of cultivation on the amount of annual bluegrass after one year. Treating with the Hydroject increased ball roll 20 cm (8 inches) immediately after treatment.

Other studies include the effect of Hydroject and other cultivation on rooting of sod on compacted subsoil and another one was initiated in August, 1994, to examine the effect of Hydroject treatments on the rooting of Kentucky bluegrass sod. No treatment was effective in improving rooting in this first study.

In 1995 we will be looking for a putting green which has about a 2-inch layer of sand topdressing overlying a native loam or clay loam soil below. A practice putting green or a nursery would be possible sites. If a golf course superintendent has such a turf condition which we could treat, please contact Paul Rieke.

MANAGEMENT OF SOD ON SUBSOIL

One of the studies in which there is great interest is the management of Kentucky bluegrass sod growing on compacted subsoils. We had hoped to initiate treatments this year, but because of regular and heavy rainfall through much of the growing season we were unable to finish the final smoothing process before beginning the studies. This plot area is in a very low part of the field plots at the Hancock Center. Obviously the soil does not drain and water collects on one portion of this research block.

IRRIGATION MODELING

Charles Kome is finishing his Ph.D. degree utilizing the plot area originally developed by Mike Saffel. While this project is not currently being funded by MTF, the plot area was developed with funds provided by the Foundation. Charles is utilizing data from these plots to study irrigation programming with the use of several different irrigation modeling programs.

Table 1. Bentgrass Green Phosphorus Fertilization Study
1994 Quality Ratings

Pounds of Phosphorus per Acre 0-3"
Depth

Treatment	May 2	May 24	July 15	July 28	Aug. 5	Sept. 19	Fall 1993	Fall 1994
1	2.0 c	1.7 d	2.0 e	2.0 d	1.8 b	2.0 c	3.7 b	4.0 b
2	6.2 b	3.0 c	3.0 d	4.7 c	5.0 b	7.0 ab	4.0 b	3.3 b
3	7.5 ab	4.3 b	4.7 c	5.8 b	6.8 a	7.0 ab	5.0 b	8.3 b
4	7.8 a	7.0 a	5.7 b	6.8 a	6.5 a	6.7 b	12.3 a	32.3 a
5	7.2 ab	7.2 a	5.8 b	6.7 a	6.3 a	7.0 ab	14.7 a	9.3 b
6	6.7 ab	6.5 a	6.2 ab	7.3 a	6.5 a	7.0 ab	14.7 a	26.3 a
7	7.5 ab	6.7 a	6.7 a	6.7 a	7.0 a	7.3 a	11.7 a	29.3 a

Means followed by the same letter are not significantly different at the 5% level using the LSD mean separation test.

Treatments Applied On July 27 And September 19 in 1994.