

technician in charge of the turf plots, the Flotal treated plots were also easy to return to a suitable stage of tilth following a heavy rain which occurred shortly before they were to be seeded. Conversely, the manure treatments and check plots were difficult to rework into suitable condition for seeding. It would be interesting to see Flotal compared with other chemical soil conditioners on the market.

Manure Was A Failure

Under University of California, Los Angeles, conditions, steer manure used at the accepted rate of 25 pounds to 100 square feet failed to promote better growth than the untreated check plots. This confirms observations at other experiment stations.

Manure is too expensive when purchased for its fertilizer value. Heavy manure applications at the time of seeding can intensify disease. Under most conditions, turf growth furnishes ample amounts of organic matter to the soil.

Most manures available to our Member Clubs contain hidden costs. Rocks and foreign matter dull the mower blades. Noxious weed seeds are often planted through the use of manure. The bulk required to furnish any worthwhile amount of plant food means increased labor costs to apply manure. Because it is unsightly and messy, it causes player dissatisfaction for a considerable period of time following a direct application on fairways or tees.

The Danger Period for Putting Greens

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Most of the more serious putting-green troubles occur during the hot summer months when extended periods of heat and high temperatures occur. Diseases, excessive thatch, insects, wilting, drought, overwatering and other causes often result in the loss of turf. Under the classification of other causes we may list such things as poor drainage (surface, sub-surface, air and internal drainage).

Greens with built-in headaches, such as poor drainage, require special care during periods of high temperature and high humidity. While it is sometimes possible to get away with watering such greens in cool seasons with sprinklers, it is hazardous to attempt watering these greens except by hand when temperature and humidity are high. An experienced superintendent never sends a novice out to hand-water troublesome greens; only a veteran at the game fills this bill.

Disease troubles are also more bothersome during the hot, humid months. By and large, the superintendents who have followed a preventive schedule are the ones who usually come through in best shape. Disease organisms are ever present. They

may be in the soil awaiting the proper conditions for germination; they may be wind blown; they may be carried in on equipment or shoes or by other means. In whatever manner they arrive, they are in a resting stage, so to speak, awaiting the proper conditions to germinate and multiply, and multiply they do, at fantastic rates. Therefore, fungicides applied on a preventive basis keep the possibility of trouble from diseases to a minimum.

The most troublesome weeds over this period of high temperature and high humidity are crabgrass and silver crabgrass. The phenyl mercuric acetate products have been doing a nice job of controlling crabgrass in putting green turf if they are applied according to the directions of the particular product obtained.

Silver crabgrass, or goosegrass as it is sometimes called, is much more resistant to chemical treatment, and for the most part the laborious hand method is used for eradicating it as soon as it appears. Some superintendents have applied mixtures of herbicides at very light rates, with reportedly good success, on seedling silver crabgrass. Here again is an example of practical tests

preceding the research worker's findings, because the man on the job has to face such problems and do something about them, sometimes before researchers are able to get to the problem. It is hoped that the USGA Green Section's program of research on specific golf-course turfgrass problems will

help in bringing results to the superintendent sooner.

Bentgrass putting-green turf which goes into the hot humid months in healthy condition fares best. These months are good indicators of the limiting management practice on putting-green turf.

Cultivation of Turf

The cultivation of turf is one of the most important phases of modern turfgrass maintenance. For many years turf growers have felt that they were working at a disadvantage because it was not possible for them to till their soil in the same way that farmers used tillage to maintain good soil tilth.

Porosity has become an important word to the golf course superintendent. We are likely to think of soils in terms of the solid phase of the soil, yet the roots of the plant grow in the pores, not in the soil solids. Pore space makes up about half of the volume of a good soil.

Pore space is of two kinds; there is capillary pore space, which is usually filled with water when soil is reasonably moist, and there is non-capillary pore space, which provides drainageways for water that gravitates through the soil and air spaces when the soil is well-drained. We have come to believe a good soil should have about equal parts of the two kinds of pore space.

The pore space of the soil can be characterized in other ways. It can be textural pore space. These are the pores that result from a coarse soil texture. The sand particles, or larger particles of the soil fraction, fit together in such a way that there is a rather large space left between them. This kind of pore space cannot be changed by management. Only the addition of different size soil particles can change it.

The other kind of pore space with which we are concerned is structural pore space. Structural pore space results from the aggregation of the finer soil particles. This type of porosity can be effected by management of various kinds. Trampling when the soil is wet tends to reduce the amount of non-capillary porosity which depends upon structural characteristics of the soil.

The trampling causes the rearrangement of the soil particles which form the aggregates and a consequent fitting more closely together so that we do not have the larger non-capillary pore spaces through which excess water can move rapidly.

Non-capillary pore space of a structural nature can be affected indirectly by watering practices. If a small amount of water is applied at one time, the surface of the soil will have to be kept wet or grass will not live. When the surface is kept wet any kind of traffic will tend to rearrange the soil particles and compact the soil. On the other hand, if the turf is watered in such a way that the water soaks deeply into the soil, it will support turf without having to be watered so frequently. Therefore the top is allowed to dry and trampling does not affect it so severely.

Cultivation the Best Tool

Cultivation is perhaps the best tool for managing soils for maintenance of structural porosity. Cultivation of putting greens has been practiced for many years even though the practice was not considered to be cultivation in the days when hollow-tined forks were the chief implements for this purpose. Mechanical devices for cultivating turf have been of fairly recent origin. While many attempts were made prior to World War II to develop mechanical devices for cultivation, it was not until after the war that really successful machines for this purpose began to appear on the market.

There are several types of machines which have been designed to cultivate turf. The first attempts were solid-tined spikers; these were solid tines built on rollers so that when the roller was pulled across the green the solid tine would penetrate the