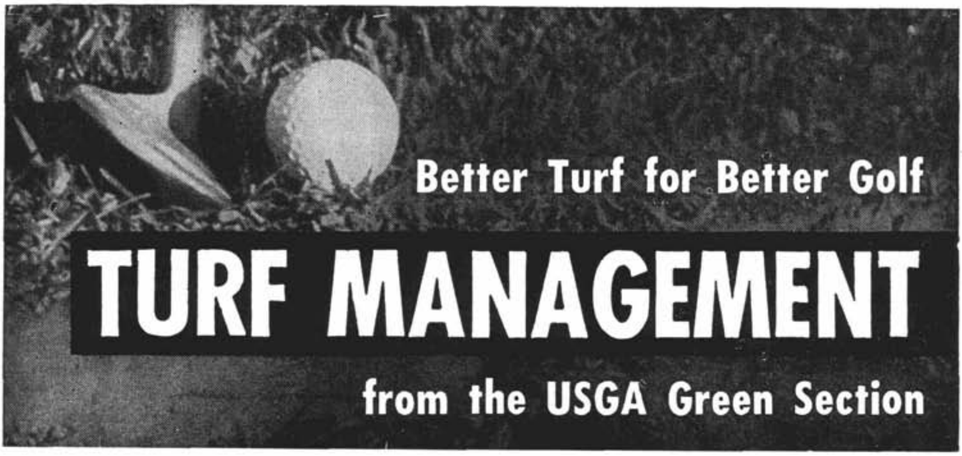

THE EFFECTS OF COMPACTION ON GOLF GREEN MIXTURES

by R. J. KUNZE, M. H. FERGUSON, and J. B. PAGE

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ONE of the difficulties encountered in building a golf green is the choice of the proper sand-soil-peat ratio. When preparing a soil mixture for use on golf greens, one must consider a host of factors. Not only should this material produce a turf with a good putting surface, but it should also possess a resiliency that will be suitable to the players. It should hold moisture, yet allow any excess of water to drain in a short period of time. After much play and frequent applications of water, the soil mixture should retain its porosity and permeability to air and water. Preferably the mixture should be of such a nature that the maintenance costs of the green are at a minimum.

Nature has endowed very few soils with the chemical and physical properties that meet all the specifications of a good golf green soil mixture. Although man has found reasonable means of controlling and maintaining the fertility of the soil, he has had very little success in the alteration of its physical properties. When a soil is subjected to compaction, high moisture applications, and nutrient levels that accelerate the decomposition of organic materials, experimental evidence indicates that the physical properties will not be maintained at a level that will produce turf with a desirable playing surface.

One way to overcome this undesirable change in soil structure is to create a soil mixture that will resist the effects of compaction but otherwise possess the qualities that are conducive to good turfgrass growth. The objective of this investigation was to evaluate experimental mixtures and to find a sand-soil-peat mixture that would be superior to all others in the experiment. This evaluation was made by measuring the clipping yield and total root weight of grass grown in various soil mixtures. Physical measurements were made of each mixture at the conclusion of the experiment. An attempt was made to relate the magnitude of these measurements to the clipping and root yields produced.

Commercial concrete sand was used as the skeletal agent for the soil mixtures. It was used in a natural form and in five sieved sizes. Houston Black clay soil and a black cultivated sedge peat were the other constituents. Mechanical analysis indicated that the soil was 57 percent clay, 34 percent silt, and 9 percent sand. A soil aggregate analysis by the Yoder wet sieve method showed 91 percent aggregation. The soil aggregates like the sand were sieved into 5 separate sizes.

An experimental green with adequate subsurface drainage was constructed. Metal containers (five-quart size) were buried in the green so that the tops of the containers were level with the surface of the soil. Drainage from the container to the porous material below was facilitated by three ½-inch holes in the bottom of each container. These containers were filled with different mixtures containing sand, soil, and peat.

A single core of Texturf 1F (formerly T-35A) Bermudagrass with all the soil was planted in each container. Before compaction treatments commenced, the grass became well established in each container and completely covered the surrounding area. During the course of one summer seven compaction treatments were applied with an impact device. A high moisture treatment was applied for a period of 40 days the following spring before the conclusion of the experiment. Six lots of clippings were taken during the 21 month experiment to be used for growth analysis purposes.

Prior to compaction, the clipping weights indicated only very small differences in yields between mixtures of different particle sizes. After compaction these differences were found to be quite large. It was found that the 1-0.5 millimeter and the mixed particle size gave by far the largest clipping yields. This is indicated by Figure 1. The lower yield of the 0.5-0.25 millimeter size corresponds to decreases in non-capillary porosity and permeability rates.

The root weight on the other hand increased with a decrease in particle size. This is shown in Figure 2. The roots in the finer mixtures had a long thin appearance while the roots in the larger particle size mixtures were thick and short. This lack of correlation between root and top growth had not been anticipated. Temperature, aeration, moisture, nutrient supply and other plant environmental factors have been shown to have a differential effect on root and top growth. Additional work is necessary to help clarify this phenomenon.

With the more desirable particle sizes (1-0.5 millimeter or mixed) it was found that compacted soil mixtures of 5 to 10 percent Houston Black clay soil by volume or 2 to 4 percent clay by weight produced the largest yield of top growth and in most instances also produced the largest amount of root growth. Larger amounts of clay soil reduced the amount of non-capillary porosity and decreased the permeability of the mixtures.

The amount of total porosity is not as important as a graduation and continuity of pore sizes. The presence of the proper amount of large or non-capillary pores in the soil is needed for the removal of excess water, exchange of gases in the soil and for the growth of a deep rooted system. Small pores on the other hand act as

COMING EVENTS

November 18-22
American Society of Agronomy Annual Meetings
Atlanta Biltmore Hotel
Atlanta, Ga.

December 4-5-6
12th Annual Oklahoma Turfgrass Conference
Oklahoma State College, Stillwater, Okla.
Dr. Wayne W. Huffine

December 9-10-11
12th Annual Texas Turfgrass Conference
Texas A. & M. College, College Station, Texas
Dr. Ethan C. Holt

1958

January 13-14-15
Second Annual Meeting of Weed Society of America
Peabody Hotel, Memphis, Tenn.
Leonard Lett, P. O. Box 9905, Memphis 12, Tenn.

January 20-23
Rutgers University Turf School
Rutgers University, New Brunswick, N. J.
Dr. Ralph E. Engel

February 2-7
29th National Turfgrass Conference and Show
Shoreham Hotel, Washington, D. C.
Agar M. Brown

February 17-28
Penn State Turfgrass Conference
Nittany Lion Inn, University Park, Pa.
Prof. H. B. Musser

February 24-25
Southern Turfgrass Conference
Chickasaw Country Club
Memphis, Tenn.
Reg Perry—P. O. Box 2057 DeSoto Station

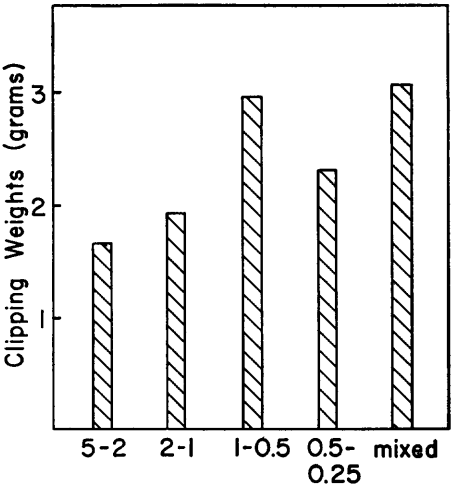

Figure 1

Clipping weights produced by the indicated particle sizes. Each bar represents an average of 16 measurements.

water reservoirs which may be utilized by the plant as needed. Except in very sandy soil mixtures or soils with good structure the larger pore sizes usually are limited in quantity. In turn aeration is reduced, and this impairs root respiration. Consequently absorption of water and nutrients is reduced, followed by a resulting reduction in plant growth. Baver(1) gives an

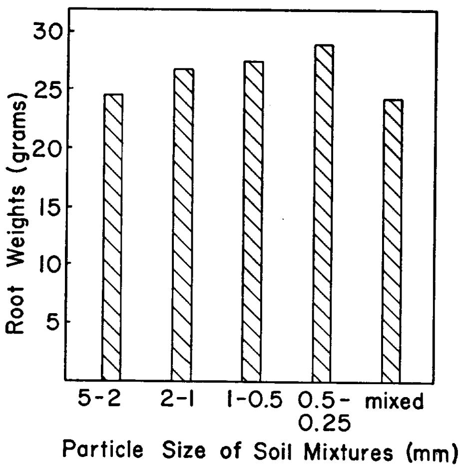

Figure 2

Root weights produced by the indicated particle sizes. Each bar represents an average of 8 measurements.

excellent discussion of soil porosity and its importance in soil-plant relationships in his text. Figure 3 shows the relationship between the percent of non-capillary porosity of various mixtures and the amount of clippings produced by these mixtures. With each added increment of soil, the amount of larger pore space is reduced with a corresponding reduction in yield. On the basis of this work it appears that 10-15 percent non-capillary porosity is sufficient for good plant growth.

Permeability data indicate that mixtures with ratios of 8-1-1 or 8½-½-1 regardless of particle size were highly permeable to water. Only with the very fine mixture sizes (less than 0.25 millimeter) was there any

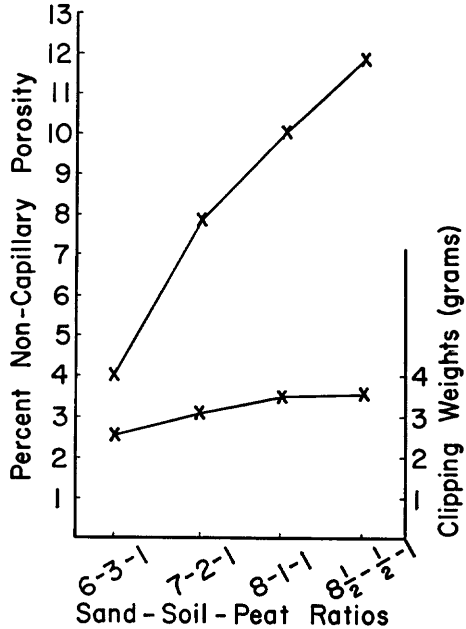

Figure 3

Variations in clipping weights and non-capillary porosities obtained from mixed particle size mixtures. The reduction of the non-capillary porosity indicates a corresponding decrease in clipping weights.

difficulty in getting water through the mixture. This is in general agreement with the work of Lunt(2) who suggested that fine sands—0.25 to 0.10 millimeter—may be satisfactory, provided they are relatively free of silt and clay.

The bulk density determinations were

of very little significance in evaluating the over-all fitness and productiveness of the soil. Evidence was found that the variable amounts of roots found in the soil cores was a major factor in the inconsistencies found in the bulk density measurements.

The heavy rates of water applied during the last 40 days of the experiment did not appear to limit growth. Clippings weights before and after the moisture treatment exhibited the same general trend of growth. This seemingly indifferent response was not anticipated; however, subsurface drainage appeared to be quite adequate so that no harmful effects resulted.

Because of the wide variations in the physical and chemical properties of soils presently used on golf greens, it would be foolish to suggest that these findings should apply to all situations. Every possible effort should be put forth to have the selected soils analyzed for their various physical and chemical properties before any green construction is attempted. Much additional work with other soils and skeletal agents, with other climatic environments, and with other grasses, is needed so that a more abundant and diversified library of information may be made available.

References

(1) Baver, L. D. Soil Physics. Third Edition. John Wiley and Sons, Inc., New York. 1956.

(2) Lunt, O. R. Minimizing Compaction in Putting Greens, United States Golf Association Journal and Turf Management. 9:5, 25-30, 1956.

SNOWMOLD CONTROL

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SNOWMOLD probably causes more damage to golf course turfgrass than any other disease in the snow belt—northern United States and Canada. The disease is most serious on the green proper, the aprons, approaches and shoulders. Bentgrass tees and fairways are likewise attacked, but in general, damage is less severe than on greens. Under extreme environment—heavy and persistent snow packs with temperatures around freezing—snowmold may cause damage on tees and fairways.

Two organisms—*Typhula itoana,* the "gray snowmold," and *Fusarium nivale,* the "pink snowmold," are responsible for this disease. These organisms are active between 28° and 42° Fahrenheit, when excessive moisture is present. This environment exists as the snow pack melts in late winter and early spring. The common name, "snowmold," has developed because of this association with melting snow. It should be pointed out, however, that the disease will develop whenever temperature and moisture are favorable, irrespective of snow coverage.

Several fungicides have been reported and are known to be effective against the snowmold organisms. The list includes Calo-Clor*, Phenyl Mercury, (Liquaphene, PMAS, etc.), Teresan, Semesan, Cadminate, and straight corrosive sublimate. This latter material has proven especially effective against the virulent strain of snowmold found in the Prairie Provinces of Canada.

The major problem associated with control of the disease is one of longevity and persistence of the applied chemical. This develops from the *necessity of applying the fungicide in late fall or early winter, after the soil is frozen and prior to the first snowfall which will remain.* Another problem is that of holding the fungicide in place when thaws occur in late winter or early spring. Often snow may melt, partially or completely, thus washing out or dissipating the material.

In an effort to find a material which would prolong the effectiveness and persistence of the fungicide, a snowmold test was located on an experimental green at the Toro Research and Development Center in the fall of 1953. This study was con-

* *Trade names of chemicals and carriers included in the study are used for purposes of clarity and convenience.*