Note 6

Some Physical Aspects of Sports Turfs[1]

P. BOEKEL

ABSTRACT

The playability of turf for football and field hockey in autumn is a very important property. This is especially true in countries like The Netherlands where rainfall exceeds evapotranspiration, resulting in a wet, unstable top layer. To find how such situations can be improved, turfs around Groningen, The Netherlands, were investigated for topsoil stability, groundwater table, soil humus, clay content, and bulk density.

By graphical and numerical analyses of the results it was found that the stability increased as the bulk density and depth of the groundwater increased. An interaction between the effects of these two factors was found, indicating that the effect of bulk density became smaller as the groundwater depth increased. For maintenance it is important to know how to control the bulk density. This can be done by changing the content of humus, clay, and sand or by changing the arrangement of soil particles through compaction. An indication of the acceptable humus content in combination with the density of the topsoil for situations varying in depth of the groundwater table is given.

INTRODUCTION

Turf playability in fall or winter is a very important property of turf use for football and field hockey. In climates where rainfall exceeds evaporation during the fall and winter, as in The Netherlands, wet, weak surface layers often result unless an acceptable balance is maintained between groundwater level and soil physical condition without reducing grass growth. To avoid such situations, the topsoil of the turf must be brought or held in such a condition that even in a wet period stability can tolerate intensive use. At the same time the physical condition of the soil should be favorable for turf growth.

To attain and maintain good playability of turf the factors affecting surface layer stability must be known and, if possible be quantified. To more clearly define the relationship of factors affecting surface layer stability, observations and measurements were made from 1970 to 1975 on a number of sports turfs around the City of Groningen in The Netherlands.

[1] A contribution from the Inst. for Soil Fertility, Haren, Groningen, The Netherlands.

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MATERIALS AND METHODS

Topsoil stability was estimated from 1 to 9 by pushing the heel of a shoe into the sod (4). A rating of 1 indicated an unstable surface and 9 indicated a stable surface. A rating of 7 corresponds to ideal stability, while 6.5 was barely acceptable, and above 7 was unacceptability hard. This so called "heel method" works very quickly, but requires some experience.

The following factors that were expected to affect soil stability were assessed: (i) groundwater table depth was determined in the autumn and winter by observing the water level in perforated plastic tubes placed in the soil (these observations were made at the time of soil stability estimates); (ii) soil composition of the top 5 cm was determined for humus, clay, and sand particle size; (iii) soil density was determined from soil cores sampled from the top 5 cm.

RESULTS

Groundwater table and soil stability influenced by rainfall and surface evaporation, varied greatly with time. For further interpretation of the results, mean values for both properties in rather wet periods were calculated.

A positive correlation was found between the stability and the depth of the groundwater and the bulk density. Furthermore, there was a negative correlation between the stability and both the humus and clay contents (Table 1).

Table 1 shows strong mutual correlations between the factors of humus and clay content and bulk density. This makes conclusions concerning the real effect of the individual factors very difficult.

Interactions were also found among factors affecting topsoil stability. For example, the effect of the groundwater table increases as the organic matter increases. A graphical procedure was used to determine the effect of groundwater table depth and bulk density of topsoil stability (Fig. 1).

Soil bulk density had little effect on topsoil stability in soils with a deep groundwater table, but soils with shallow drainage were greatly affected by soil bulk density. Thus, a high water table was acceptable if bulk density was high, while a low bulk density was acceptable if the water table was deep. A combination of high water table and low bulk

Table 1. Correlations between different soil factors.

	Groundwater table	Humus content	Clay content	Bulk density
Humus content	−0.15			
Clay content	−0.16	+0.62		
Bulk density	+0.11	−0.77	−0.68	
Stability topsoil	+0.44	−0.42	−0.44	+0.52

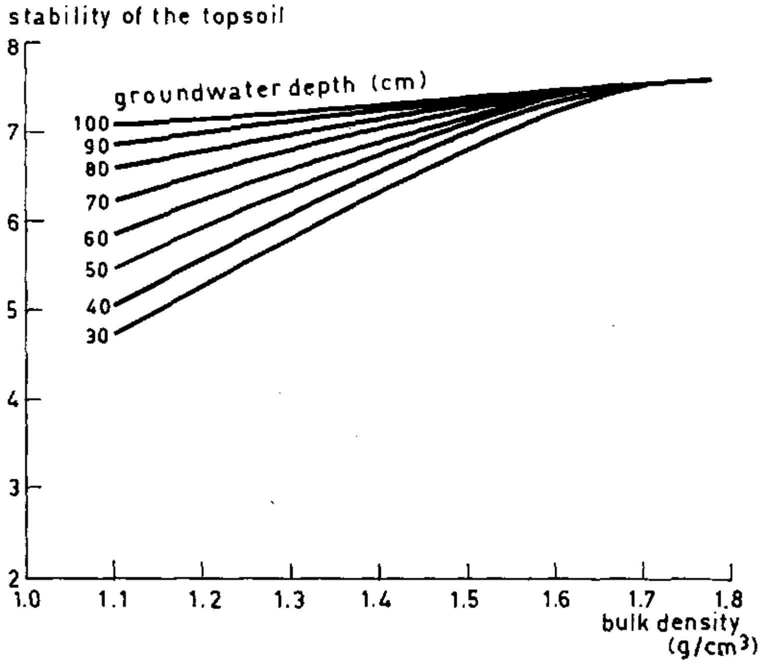

Fig. 1. Topsoil stability in relation to groundwater depth and bulk density.

density does not provide sufficient stability. This condition is graphically presented in Fig. 2 where, for two groups of turfs with a good and poor topsoil stability, the bulk density and the groundwater depth are given. Conditions required for an acceptable topsoil stability can be deduced from Fig. 1 and 2.

DISCUSSION

The results mentioned would indicate that good topsoil stability can be obtained by deep drainage or by producing a rather high bulk density. Generally, a deep groundwater table is preferred to the second possibility because it is somewhat easier and is cheaper in the long run. Also, many systems of drainage are available (1, 3).

However, conditions do exist where a high groundwater table or poor drainage must be accepted. These can sometimes be solved by optimizing the bulk density of the soil. Bulk density depends mainly on the humus and clay composition of the soil and on the arrangement of soil particles which is influenced by the intensity of compaction. Figure 3, gives the relation between bulk density and humus content for soils with a low clay content. This gives an impression of the decrease in bulk density with increasing humus content and of the divergence of the points due to

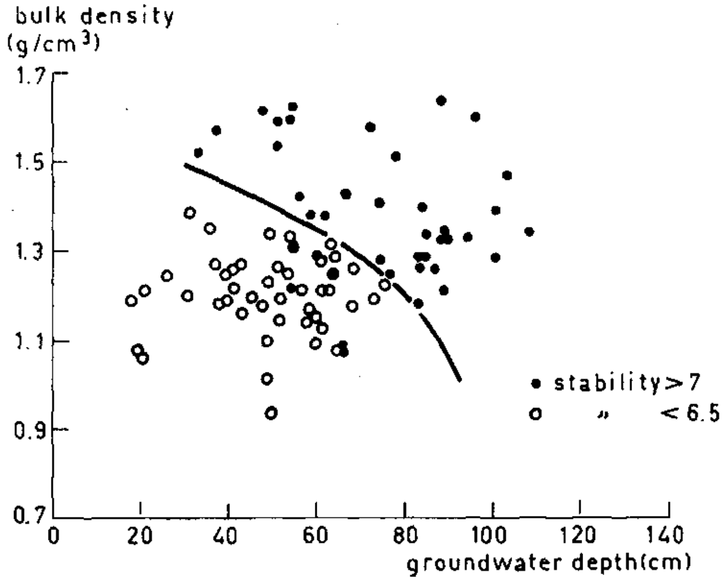

Fig. 2. Topsoil stability in combination with different groundwater depths and bulk densities.

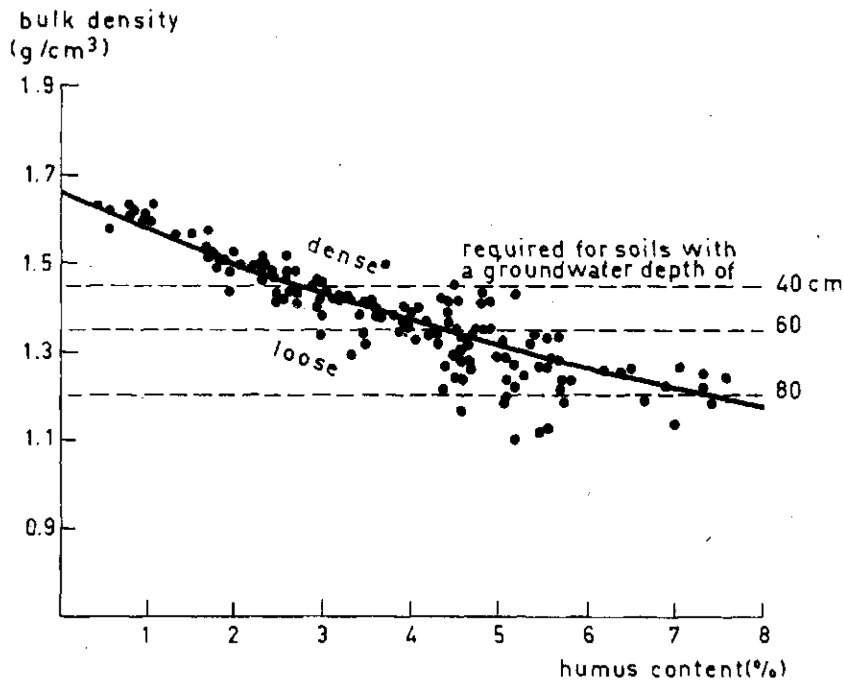

Fig. 3. Bulk density in relation to humus content and the required situation for a good topsoil stability.

the arrangement soil particles (above the curve equal to dense, under the curve equal to loose). Furthermore, three horizontal lines have been drawn which present the desired bulk density for soils with different groundwater tables.

It can be concluded from Fig. 3 that for soils with a high water table at a depth of about 40 cm under wet conditions, the humus content should not exceed 3% and only 2% if the soil particles should be loosely arranged.

In the presence of a water table at 80 cm, the acceptable humus content is 4.5% on rather loose soils and 7.5 to 8.0% on dense soils. The results indicate that maintaining a high relative density is important because a somewhat higher water table or humus content is then acceptable. A high relative density can be realized by a sufficient intensity of play. Many main fields are not used very often and as a result have a loose unstable top layer. The risk that the soil becomes too dense for good growth of the grass is minor since grass suffers more often from a shortage of water than from a shortage of air (2).

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