Some Experiments With Turf On Granular Materials

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The maintenance of turf on shoulders, berms, and ditches of our highways and on airports has received little attention until very recent years. Frequently a good turf is desirable where the soil has been stabilized or where granular materials are necessary to obtain sufficient supporting power for the anticipated load. Under such conditions attention must be given to the factors which influence plant growth. To obtain a satisfactory environment for the growth of turf, we must have an understanding of the requirements of the species in that turf. The need for sufficient pore space (voids), proper pH, sufficient plant nutrients, and available water supply are factors which need much study before satisfactory recommendations can be made for the establishment of turf under such conditions.

This paper is a brief summary of the research being conducted co-operatively by the Agricultural Experiment Station and the Joint Highway Research Project of the Engineering Experiment Station, Purdue University; the State Highway Commission of Indiana; and the Division of Forage Crops and Diseases, U. S. Department of Agriculture. The work is in a preliminary stage, but a review of the factors under study and our present observations may help those engaged in the construction and maintenance of our highways and airfields.

Greenhouse Studies

The greenhouse is utilized frequently for preliminary studies of plants during periods of the year when it is not possible to grow them in the field. In February, 1943, an experiment was started in the greenhouse to determine whether Kentucky bluegrass would grow on compacted granular materials when the materials were modified to meet the requirements for plant growth. A technique was devised for compacting the materials in six-gallon crocks. A density of 130 to 140 pounds per cubic foot was obtained. The variables studied were:

(1) soil-aggregate mixtures, (2) fertility, and (3) movement of water through granular material. Figs. 1 and 2 illustrate the most significant finding from this preliminary study.

Fig. 1 shows the response to fertilizer placement. In treatment No. 4 a 10-10-10* fertilizer was applied to the surface soil (used as a

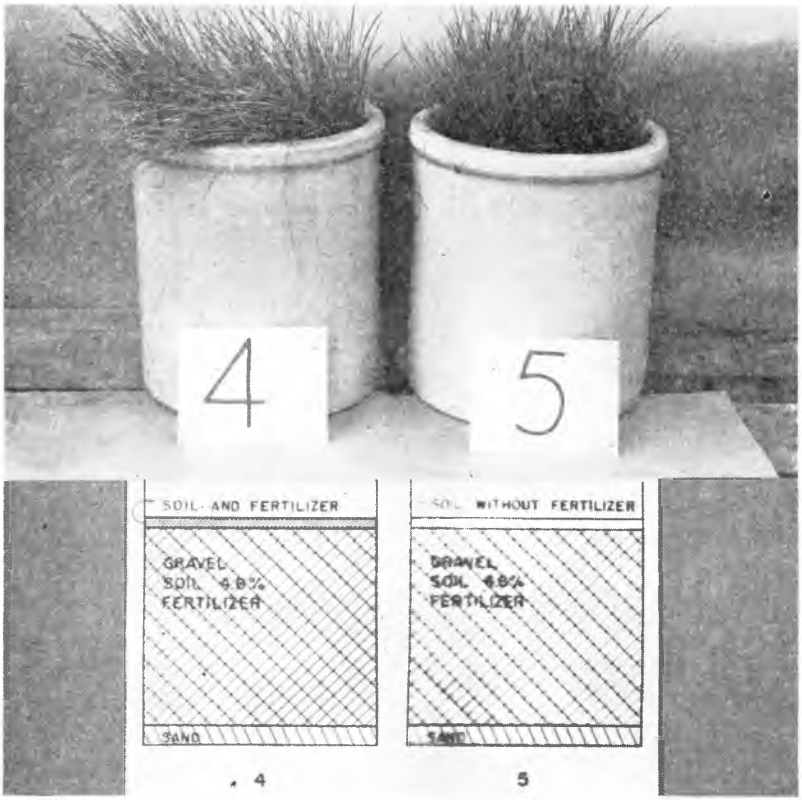

Fig. 1. Treatment Nos. 4 and 5 differ only in the application of fertilizer in the surface half-inch of soil used as a seed bed. Treatment No. 4 received a 10-10-10 fertilizer applied at the rate of 2,000 pounds per acre in the surface soil. The stabilized section consisted of a mixture of pit-run gravel (all passing a one-inch sieve), 4.6 percent soil, and a 10-10-10 fertilizer applied at the rate of 2,000 pounds per acre.

Note the more rank growth and broader leaves in treatment No. 4. The bluegrass in treatment No. 5 showed potash and nitrogen deficiency symptoms. The roots were confined to the surface in treatment No. 4 and penetrated to the bottom of the crock in treatment No. 5.

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* A fertilizer mixture containing 10 percent N (nitrogen), 10 percent P_2O_5 (phosphorus), and 10 percent K_2O (potash).

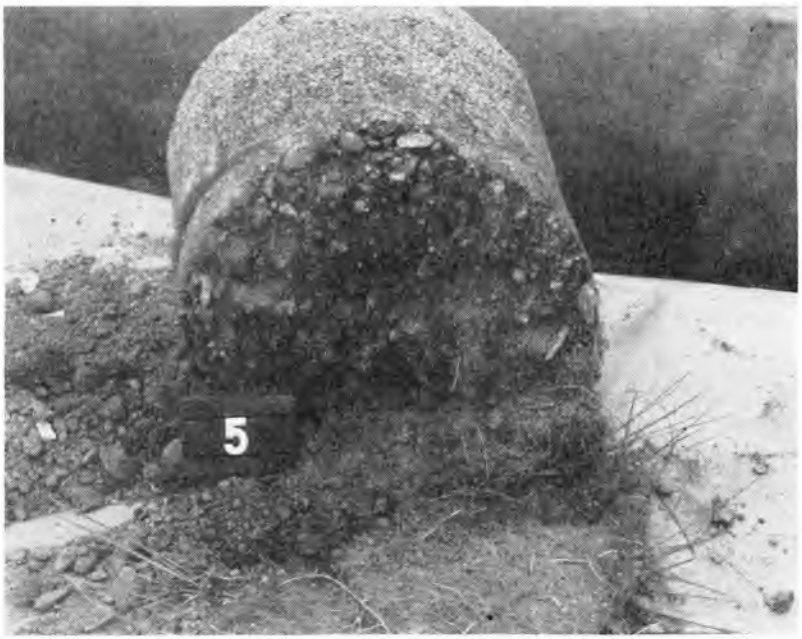

Fig. 2. The surface soil and sod layer has been removed from the underlying aggregate. Note the mass of roots penetrating the compacted material. With this treatment the root system penetrated the depth of the material.

seed bed) at the rate of 2,000 pounds per acre; and an equal quantity was mixed with the underlying granular material, which was compacted to a 10-inch depth. Treatment No. 5 was similar to treatment No. 4 except that the fertilizer was not applied to the surface soil. The bluegrass in treatment No. 5 showed nitrogen and potash deficiency symptoms very early in its growth, but no such symptoms appeared in treatment No. 4. The root systems of the bluegrass in treatment No. 4 were confined mainly to the surface layer of soil, where plenty of plant food was available. In treatment No. 5 the roots penetrated through the entire layer of compacted granular material, and the concentration of root systems was much less in the surface layer (Fig. 2). This finding may be very important when the moisture supply is considered. A shallow root system will surely result in a deficiency of moisture for the plant during periods of drought, whereas a deep root system may be able to supply sufficient moisture for plant growth.

Field Experiments

Experiments have now been established in the field to determine some of the factors influencing the establishment of turf on granular materials and the influence of turf upon the bearing capacity. The factors being studied are: (1) depth of stabilized layer, (2) percentage of soil required in stabilized mixture for satisfactory plant growth, (3) depth of surface layer of soil and the use of fertilizer amendments, (4) the use of mulch, and (5) variety of grass best suited for growing on

Fig. 3. View of the experiment where various mixtures of aggregate materials are being installed to study the factors influencing establishment of turf. Note that the materials were weighed, mixtures were prepared with a power mixer, and mixtures were compacted by hand tamping.

stabilized mixtures. The foregoing factors are being studied by installing stabilized mixtures in concrete tile two feet in diameter. Fig. 3 shows a general view of the experiment during the installation of the granular materials. Fig. 4 is a close-up showing the procedure in installing the aggregate mixtures. The experiment consists of sixteen different treatments on three different aggregate materials commonly used in road-bed construction in Indiana. Fig. 5 illustrates graphically the sixteen treatments as they were or are to be applied to (1) crushed

Fig. 4. Close-up of experiment shown in Fig. 3, illustrating the title and method of installing fixtures in the tile.

limestone, (2) pit-run gravel, and (3) sand. The materials were placed about the middle of August of 1943, and the seedings were made at that time. The seedings on treatments Nos. 1 to 12 were Kentucky bluegrass; treatments Nos. 13 to 16 have been reserved for sod strips of other species and varieties of grasses which may be adapted to growing on stabilized mixtures. Excellent stands of grasses were obtained on all the treatments, and the plants became well established before growth was checked by cold weather. Some very interesting and valuable information should be available from these experiments next year.

Another experiment using two materials, crushed limestone and pit-run gravel, was established at four different depths to determine the influence of turf upon the stability and bearing capacity of stabilized-granular material. The mixtures used consisted of aggregate, soil, and fertilizer, and the proportions used are considered satisfactory for the growth of turf and for highway construction. Depths of 6, 12, 18, and 24 inches were installed to determine the influence of depth upon turf growth and upon the bearing capacity.

From these studies it is expected that satisfactory methods will be devised to establish turf on stabilized shoulders on our highways and also upon stabilized sections on airports.

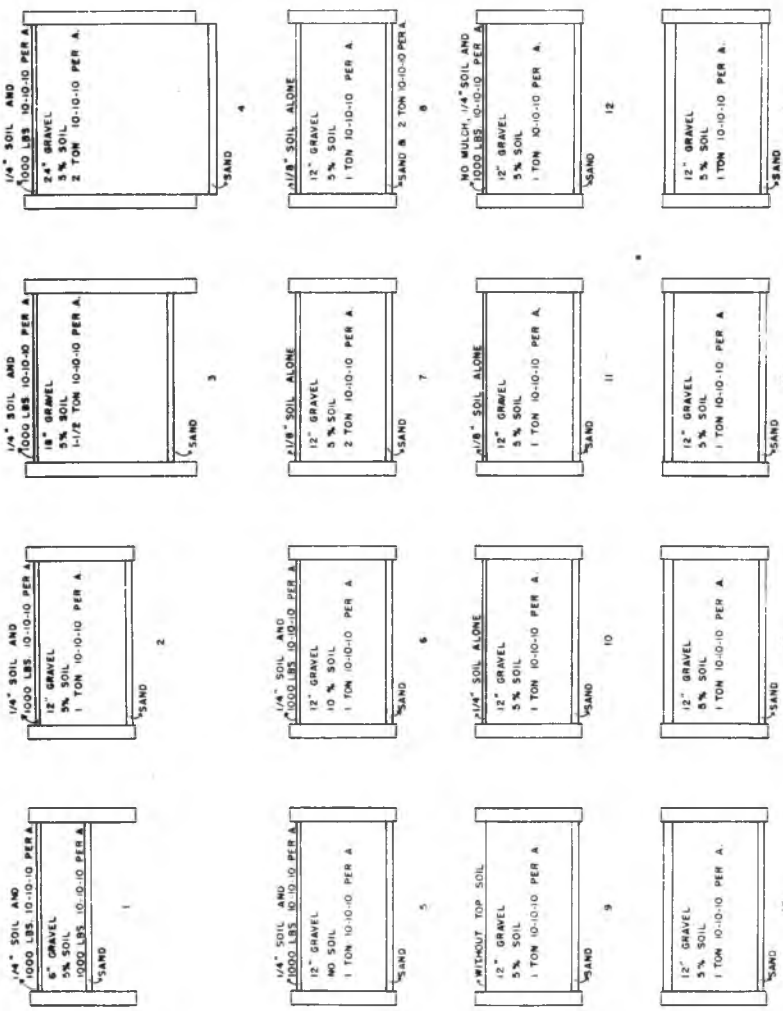

Fig. 5. Factors influencing the establishment of turf on stabilizing materials. The cross-sectional diagram shows the sixteen treatments applied to gravel. The same treatments were used on crushed limestone and sand.