TURF FOR PROTECTION OF GUTTERS AND SLOPES

BY

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It is recognized that turf gives effective and economical protection to gutters and slopes along highways wherever conditions are favorable for its growth. Unfortunately many efforts to develop a suitable turf have failed miserably. A large proportion of these failures no doubt are due to a lack of understanding of the basic principles of turf establishment and care. Too often grass is taken for granted simply because it develops naturally in many neglected areas.

In laying down concrete or black top, the engineer has a definite formula to work with and he can feel reasonably sure of his results. However, the methods for the development of turf can not be easily standardized.

The successful growth of turf is dependent on a great many factors. The physical characteristics of soil are important in the stabilization of soil under road surfacing, and they likewise have an important bearing on the development of turf. In connection with the establishment of turf one must consider the fertility of the soil as well as its physical properties. There are also many biological and climatic factors that have a direct bearing on successful turf production. The inter-reactions of these factors determine the success or failure of efforts to establish turf along highways.

In the northern humid region, for instance, fescue grasses will grow well on well-drained, sandy soil but will fail on a poorly-drained heavy clay soil. In the same region, Kentucky bluegrass produces desirable turf where there is a high fertility level but will not give satisfactory results on soils extremely low in plant food. Much of the grass seed that is sown along highways is wasted no doubt because the seedling plants are unable to obtain sufficient plant nutrients from the soil to develop properly.

One of the first and most important factors to be considered in the establishment of roadside turf, therefore, is that of fertilization. No set rules can be followed in applying fertilizer since

soil fertility levels vary widely from place to place. Soil analyses may be used as aids in determining the amounts of fertilizer to be applied in each particular case. The fertilizer requirements of turf grasses, however, are usually very different from those of most farm crops. This is due at least partially to the fact that losses of phosphorus due to leaching, erosion and crop removal are not nearly so great on turfed areas as they are on similar crop producing areas. This is illustrated graphically in Figure I, which is based on records of agricultural scientists. Here it is shown that where soil in continuous corn may lose 40 or more pounds of phosphoric acid per acre due to erosion, the same acreage in bluegrass sod loses less than one pound. The loss of phosphorus in cropland due to crop removal averages close to 20 pounds to the acre whereas when turf is mowed and the clippings are left where they fall there is no crop removal. Similar differences occur with other plant nutrients.

It may be seen, therefore, that even on similar soils the type of fertilizer recommended for crop use is not usually the best fertilizer for turf. Fortunately, we do know something of the nutrient requirements of grass and this knowledge provides a general index as to the best types of fertilizer to use. For best growth grasses apparently require rather large amounts of nitrogen since that is the element which is most needed for leaf or grass blade production. Therefore, a fertilizer with a fairly high percentage of nitrogen is recommended. One with approximately twice as much nitrogen as phosphoric acid and a relatively small amount of potash, such as a 12-6-4 or a 10-6-4, is satisfactory in most cases.[1]

The competition between different grasses and weeds often results in complete changes in the quality of turf in comparatively short periods. Some mixtures of grass seed that are in common use are ineffective from the standpoint of permanent turf. Orchard grass, for instance, is sometimes planted with mixtures as an aid to slower growing grasses such as bluegrass and fescue. Actually, however, instead of helping these other grasses, the orchard grass often completely crowds them out. Likewise, ryegrass is often used in mixtures with the seed of the more expensive and more durable grasses. Under many conditions fast-growing ryegrass is distinctly harmful to the slower-growing grasses.

1. A 10-6-4 fertilizer contains the equivalent of 10 pounds of nitrogen, 6 pounds of phosphoric acid, and 4 pounds of potash per cwt. of fertilizer.

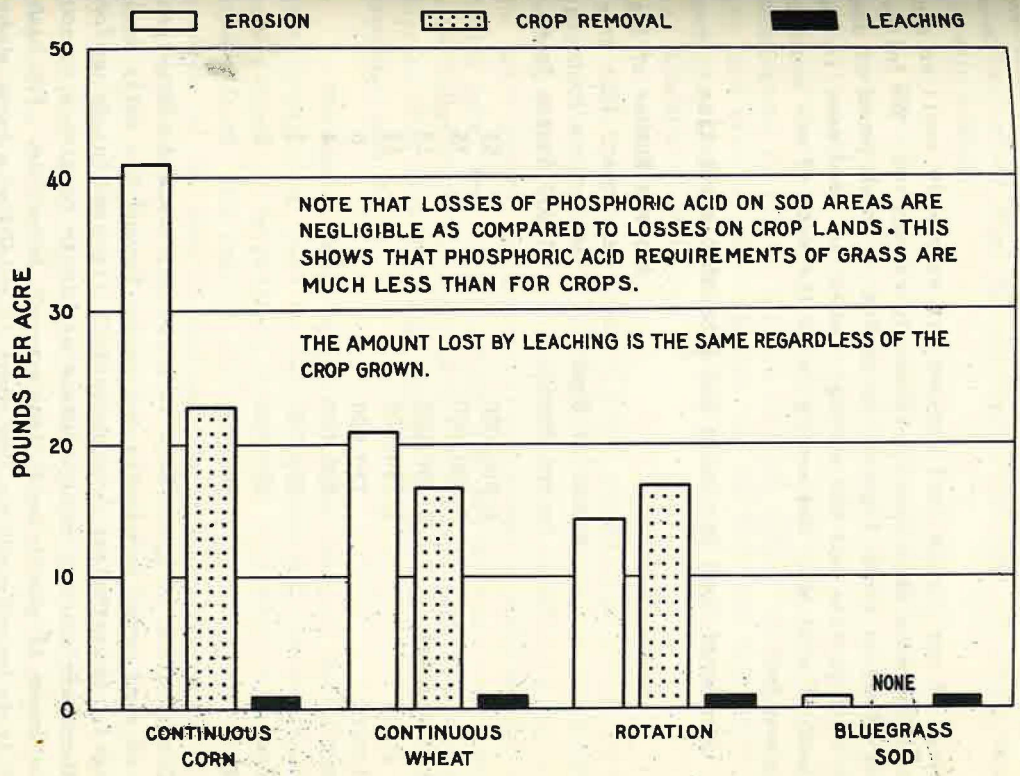


FIGURE 1

PHOSPHORIC ACID LOST FROM SOIL DUE TO EROSION, CROP REMOVAL AND LEACHING.

On road shoulders and in the drainage areas, speed of establishment of grass is of utmost importance. Perhaps one of the most common errors is to plant more liberal quantities of seed in the effort to speed up the establishment of turf. Far better results can be obtained by the proper combination of seed and fertilizer.

Seed of our common turf grasses are extremely small so each pound contains more seed than is ordinarily recognized. The following table gives in round figures the number in each pound of seed of a few turf grasses and the average number of seed sown to the square inch of soil when the sowing is at the rate of one pound to 1,000 square feet.

Number of Seed Per Pound And Rate of Distribution

	Number of Seed in one Pound	Average Number of Seed Per Square Inch When Seeded one Pound to 1,000 Square Feet
Bents	8,000,000	55
Redtop	5,000,000	35
Kentucky bluegrass	2,000,000	14
Bermuda grass	1,750,000	12
White clover	750,000	6
Red fescue	500,000	4
Ryegrass	250,000	2
Meadow fescue	250,000	2
Lespedeza	250,000	2

Distribution of grass seed is never uniform and a large proportion of seed never germinates and passes beyond the early seedling stages. Nevertheless from moderately light and fairly uniform sowing there are usually enough surviving plants to give a reasonably good cover if growth conditions are made favorable. For highway work it is usually not so important to establish a large number of weak plants as it is to be able to establish a sufficient number of vigorous ones quickly.

Most of the soil used for grass along highways is low in fertility and the seedlings are starved from the start. Increasing

the number of individual plants in areas where only starvation rations are available will not solve the problem. Many tests have shown that establishment can be speeded up more economically and the quality of the permanent turf improved to a greater extent by increasing the amount of suitable fertilizer used in the original seed bed rather than by increasing the rate of seedling beyond a certain minimum.

The results of one set of such tests with Kentucky bluegrass are given graphically in Figures 2 and 3. These tests were conducted in triplicate series in cooperation with the National Capital Parks of the National Park Service, on a poor clay loam soil near Washington, D. C. At the top of each column in Figure 2 is given the unit cost in round figures for the seed and fertilizer used in each case based on recent prices listed in the Government's 'General Schedule of Supplies.'

The coverage six weeks after planting is shown for November 1939 in the upper part of Figure 2. The columns indicate the extent to which fertilizer aided the grass in making a quick growth. The grass plants in the fertilized plots in addition to making a better cover were more vigorous and had stronger root systems and were therefore much better able to withstand washing or adverse conditions than were the weak plants in the unfertilized plots that provided less cover.

The best results by the following June, as indicated for June 1940 in Figure 2, were in the plots which had received the heaviest applications of fertilizers with two or more pounds of seed to 1,000 square feet. The poorest covers were in the unfertilized plots regardless of the rate of seeding. Increasing the amount of fertilizer, moreover, costs much less than increasing the amount of seed used. The addition of 15 cents a unit for fertilizer greatly increased the efficiency of the seed at each sowing rate. Some of the interesting comparisons of costs for different combinations are indicated by the broken lines in the Figure. It is also interesting to compare the effect of adding 15 cents for fertilizer as compared with 20 cents for seed to the lowest seeding rate of one pound to 1,000 square feet, as is shown in the first column on the left. At the other end of the Figure it will be noted that the results obtained at a cost of $3.60 a unit for 15 pounds of seed and 40 pounds of fertilizer were no better than were obtained with the combination

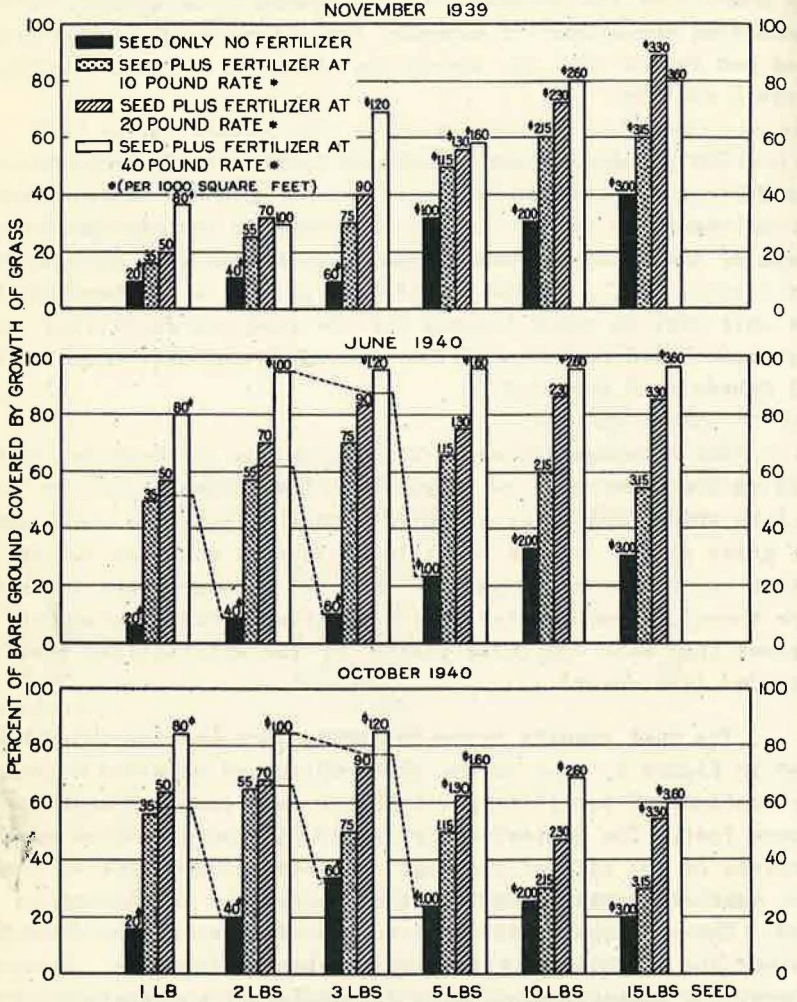
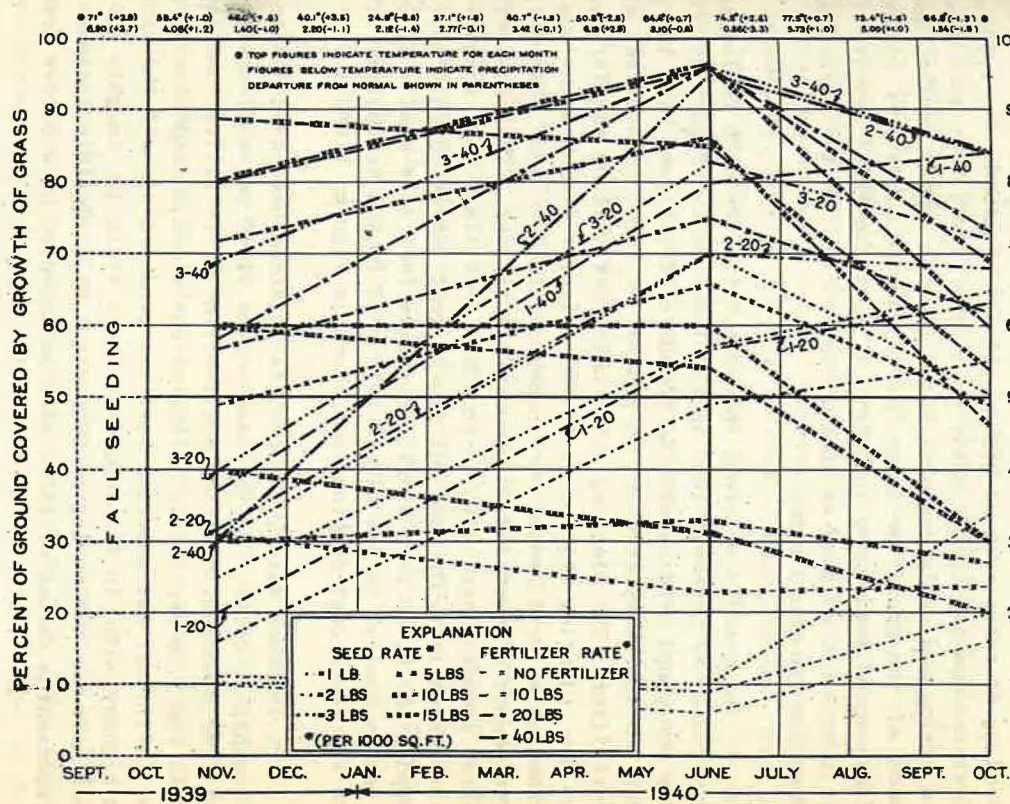

NOVEMBER 1939
JUNE 1940
OCTOBER 1940
SEED ONLY NO FERTILIZER
SEED PLUS FERTILIZER AT 10 POUND RATE *
SEED PLUS FERTILIZER AT 20 POUND RATE *
SEED PLUS FERTILIZER AT 40 POUND RATE *
*(PER 1000 SQUARE FEET)
PERCENT OF BARE GROUND COVERED BY GROWTH OF GRASS
0
20
40
60
80
100
1 LB
2 LBS
3 LBS
5 LBS
10 LBS
15 LBS SEED
DENSITY OF TURF FROM DIFFERENT RATES OF SEED AND FERTILIZER
PER THOUSAND SQUARE FEET UNIT OF AREA
(40 UNITS APPROXIMATE 1 ACRE)

FIGURE 2



DENSITY OF TURF FROM DIFFERENT RATES OF SEED AND FERTILIZER
FIGURE 3

of two pounds of seed with 40 pounds of fertilizer at a cost of only $1.00 a unit.

The best results over the 12-month period following seeding in September were obtained from a combination of three pounds of seed with 40 pounds of 10-6-4 fertilizer to 1,000 square feet. Seeding at rates even as high as 10 and 15 pounds to 1,000 square feet accompanied by the heavy amounts of fertilizer gave good turf in spring and early summer. Later in the summer months, however, much of the grass in these heavily seeded plots was killed with disease and weeds came in later, at that the final results in the fall were not as good as those from seeding at the three-pound or even the two-pound rate.

The results obtained throughout the 12-month period are indicated as of October, 1940 in the lower part of Figure 2. Compare the two-pound seeding with 40 pounds of fertilizer with the planting at the heavy rate of 15 pounds to 1,000 square feet without fertilizer. The planting with a unit cost of $1.00 was far superior to the planting which cost $3.00. Figures 2 and 3 include other examples of performance as compared with the same combination of two pounds of seed and 40 pounds of fertilizer. The combination of three pounds of seed with 40 pounds of fertilizer gave results which were essentially the same but at a 20 cent increased unit cost. The seed alone at 10 pounds to 1,000 square feet at a cost of $2.00 gave results similar to the higher rate of $3.00 and definitely inferior to the lower cost combinations shown in Figures 2 and 3.

In other words, the results attained have no definite relationship to costs. In the case of the $1.00 per unit seeding rate of five pounds without any application of fertilizer as compared with the $.50 per unit planting of one pound of seed plus 20 pounds of fertilizer far superior turf was produced at half the cost. On a highway with 10 ft. shoulders there would be roughly 100 units per mile so the saving of 50 cents a unit in this instance would represent a saving of $50 a mile accompanied by a better cover.

Most commercial grasses have been developed primarily for forage purposes. In the case of highway work, tall-growing grasses with large yields are undesirable. Therefore, many of the low-growing grasses that produce dense mats of turf are more desirable than are the grasses ordinarily used. Two species of zoysia, namely

Japanese zoysia and Manila zoysia, are examples of grasses that are worthy of more extensive investigations for highways. (Figure 4.)

Japanese zoysia is the coarser of these species. Some strains are winter hardy and one planting in Boston, Massachusetts, has survived several severe winters.

Manila zoysia has a narrow leaf and produces a finer textured turf than does Japanese zoysia. It apparently is less hardy, although it has been able to survive southern New England winters. These grasses are still in the experimental stage but have demonstrated some interesting possibilities for turf purposes. The entire season's growth is only a few inches high and therefore for many situations, such as roadsides, they need no mowing. They are slow in becoming established but when once they form a thick turf they compete successfully with weeds. Commercial supplies of seed are not available at present but they propagate readily by the vegetative method. The turf of each of these species will stand heavy wear and rather prolonged droughts.

Among the bluegrasses there are a number of low-growing strains of Kentucky bluegrass which are much better adapted for use as turf than are the ordinary commercial strains. (Figure 5.) The common commercial bluegrass tends to produce a maximum of leafy top growth whereas in the selection of some of the strains for turf purposes, emphasis has been placed on density of turf and ability to spread rapidly.

Experiments indicate that for use in the southern part of the United States several selected strains of Bermuda grass have promising possibilities. Some of these 'cover up' more rapidly than does commercial Bermuda grass and they also tend to hold their color late into the fall.

The possibilities of using bent grass for roadside plantings in the North should be investigated. In the past a large number of bent grass selections have been made, primarily for use on putting greens. Unfortunately those plantings of bent grass that have been made on roadsides have consisted of putting green strains. Consequently poor results have been obtained. Due to the extreme variability among the bent grasses, however, it should be possible to develop strains specifically adapted to roadside use.

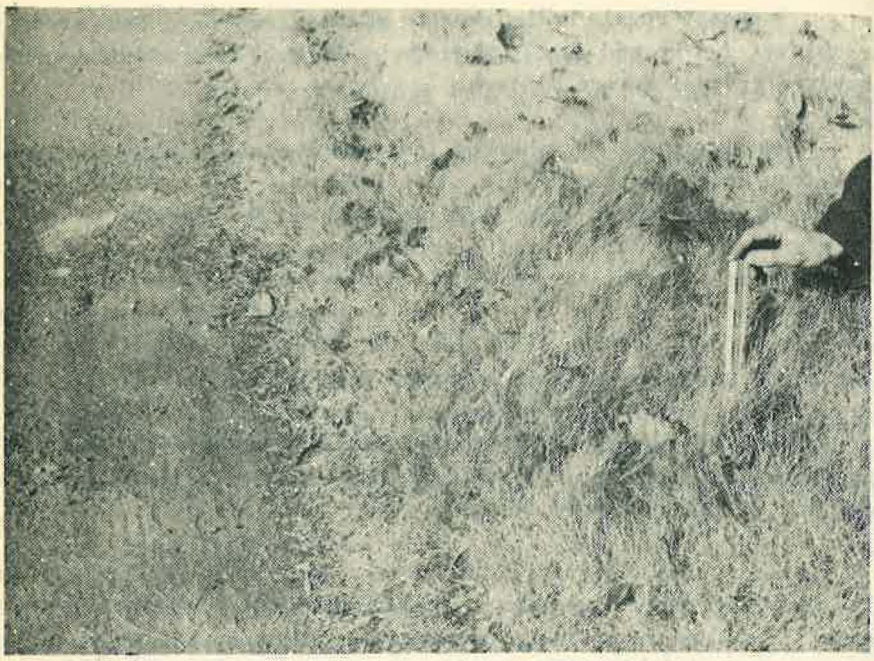


Figure 4. Manila zoysia growing along roadside. This grass forms a dense, durable turf in the South and in the intermediate zone between the northern and southern states. This particular planting was not mowed throughout the year yet the entire season's growth was only about six inches, as indicated by the ruler on the right.

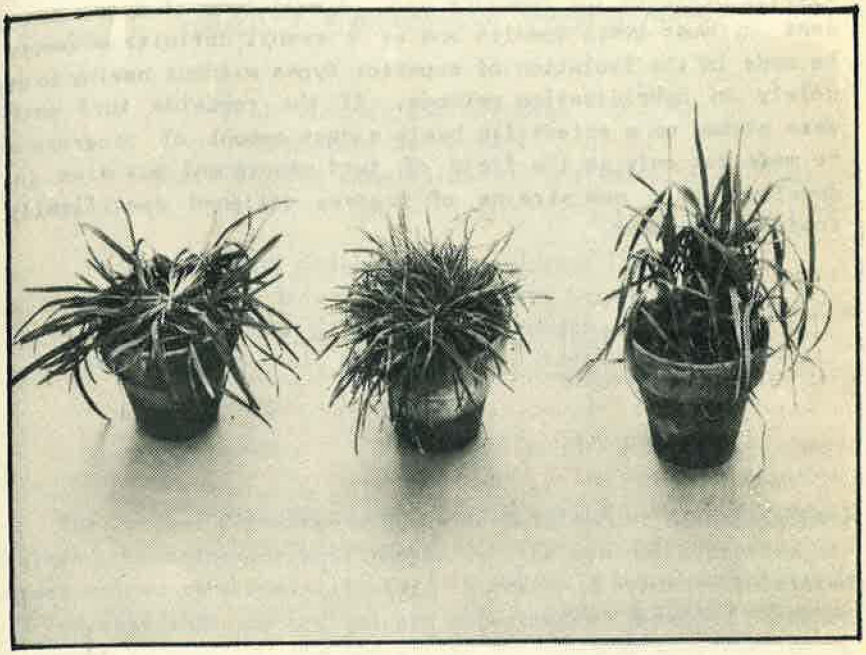


Figure 5. Variation in Kentucky bluegrass. Low growing, spreading strains similar to the one pictured on the left are far better adapted to roadside turf use than the upright, pasture type on the right. Several turf strains of bluegrass have been selected and need only to be increased before they are available for roadside use.

The grasses as a whole present a wealth of material which might well be utilized in the future development of strains specifically designed for roadside use. A multitude of types are present in most grass species and as a result definite advances can be made in the isolation of superior types without having to depend solely on hybridization methods. If the roadside turf problems were placed on a scientific basis a vast amount of progress could be made not only in the field of turf management but also in the development of new strains of grasses designed specifically for roadside purposes.