

ROOTS MATTER MOST

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A LARGE PORTION of the attention given to greens, tees, and fairways affects the grasses favorably or unfavorably through soil conditions and root behavior. Drainage, rolling, spiking, watering, fertilizing, and liming are beneficial or harmful as the case may be, by reason of the effect exerted on the grass plants through their root systems. Top-dressings, treatments for control of insects and diseases, and mowing, indirectly influence the vigor of the turf because of their influence on root development. Whether grasses are destined to succeed or fail on a given location depends largely on whether soil conditions are suitable for root growth and activity of the particular grass species planted.

In spite of the great importance of grass roots, there is a surprisingly small amount of reliable information available. Much is heresay and opinion and must continue to be so until more careful research is directed along these lines. Enough is known to indicate that information on roots of trees, shrubs, flowers and similar plants cannot be assumed to apply to grasses. Grasses have root systems which are finely fibrous in nature instead of possessing a central tap-root with branches, as in most plants. Moreover, the root systems of grasses are largely annual in nature and must be regenerated wholly or in part each season. This is not generally realized since the sod is perennial, though recognition of this fact is necessary to thoroughly understand turf culture. In addition, grass roots penetrate to depths of at least 4 to 6 inches on putting greens and to a foot or more on fairways when the soils and treatment are suitable.

The type of development differs within the type of grass. Thus, the working depth of red fescue was 11 in., that of bluegrass 9 in., and redtop 7 in. where these species were grown under identical soil conditions, with the turf mowed regularly at a 19-in. length. The total weight of roots below the first inch showed a similar relationship. *Poa annua*, which is popularly believed to be very shallow

rooted, showed a root development fully as great as any of the permanent grasses, when grown under similar conditions. On loose soil the root growth of *Poa annua* exceeded that of all other grasses except red fescue. Further experiments not quoted here have shown us that *Poa annua* comes in on turf, not because of its shallower root system, but through its habit of propagating itself so readily from seed each year.

Development Depends on Soil Temperature and Moisture

The seasonal development of roots is closely related to soil temperature and moisture. We have found that Kentucky bluegrass will begin root and*top growth much earlier in spring than redtop or the bent grasses. Also that regeneration of the root system is completed earlier with bluegrass than with the bents. Thus, new bluegrass roots penetrated to a depth of 9 in., by April 20, in contrast with May 18 for similar penetration of bent grass roots. No new roots were developed from either type of grass after May 25, and the turf was dependent on such spring growth during the remainder of the season. It is obvious that conditions and treatments given in spring are of prime importance, if the root system developed at that period determines the extent to which the soil is utilized for moisture and nutrients during the playing season.

There is a similar seasonal relation to the development of new creeping stems and shoots. Evans and Ely in northern Ohio have recently shown that new creeping stems of bluegrass usually develop from June to August, and that new shoots grow from these rhizomes in late fall and early spring. A similar relation exists for redtop and Canada bluegrass. No data is available on the other grasses at present. It is clear, however, that efforts to thicken poor turf must consider a gradual improve-

ment extending over a year or more, rather than any rapid recovery. The immediate response to fertilizers consists mostly in more luxuriant development of leaves on stems and shoots already in existence, particularly on fairway grasses. Even on creeping bent the restoration of thin or mangy turf to full vigor is a task of many months because of this seasonal relation of the development of roots, new stems and shoots.

Soil Factors and Water Govern Roots

The natural condition of the soil and the treatment given the turf, have a pronounced effect on root occupation of the soil and activity during the growing season. Adequate sub-surface drainage is particularly important in spring if new roots are to penetrate deeply into the soil.

If excess moisture limits the supply of oxygen in soil air in early spring, roots will be confined largely to the upper layers of soil and be unable to draw on lower depths for moisture and plant food in critical periods during the adverse weather of summer. Even though drainage be adequate for deep root growth in spring, unwise watering or excessive rains in summer may waterlog the soil to the extent that the roots in the lower levels are unable to function or may actually die.

We have rather conclusive evidence that strong soil acidity is injurious to grass roots. Under controlled conditions the roots of both Kentucky bluegrass and colonial bent grass were greatly reduced in depth and abundance by pH values of 5.0, particularly where sulfate of ammonia was used as a source of nitrogen. Although nitrates were less harmful to root growth, the use of this form of nitrogen did not overcome the effects of an acid growth medium.

Under field conditions, acid soils are responsible for the sod-bound condition frequently seen under Eastern conditions. This develops as a result of an accumulation of dead roots and stems. In spite of the fact that the plant continues to produce such parts yearly as long as it survives, the older roots and stems fail to decompose in strongly acid soils. Consequently, an accumulation occurs which prevents water and nutrients from penetrating the soil readily, and otherwise interferes with maintenance of turf. Plants which spread by surface creeping stems may become so badly matted that the turf dies from failure to root properly.

The remedy is to correct acidity by liming. However, lime is most difficult to work into the soil after the felty mass of stems and roots has accumulated.

Grass should be credited with being one of the most valuable types of vegetation in permanent soil fertility. It has been shown that soils gradually improve in structure and value under grass cover. In a two-year experiment at New Jersey the actual increase in humus content was 1,350 lbs. per acre, in addition to a large accumulation of living roots and stems. Cultivated crops, trees, flowers, and shrubs—none of these produce an increase of humus within the soil itself. Thus, it is possible to gradually build up a poor soil by proper management of grass.

Treatment Balances Root and Top Growth

The effect of acid soils has been noted above. It should be remembered that certain fertilizers, particularly those containing ammonia, develop acidity in soil rather rapidly. Unless this is corrected by supplies of lime naturally present in the soil, or by additions of lime, the soil will soon become dangerously acid. We may then expect accumulations of roots and stems and the development of a sod-bound condition, failure of the sod to permit rapid penetration of rains and water, and an actual toxic effect from further fertilization with ammonia carrying plant foods.

Heavy feeding with nitrogen fertilizers in any form limits root growth and stimulates development of tops, thus producing a less favorable balance between roots and tops for grass which must endure unfavorable weather and heavy use.

Finally, height of cut has a tremendous effect on roots of all grasses. Even the bent grasses which tolerate close mowing, develop only 50 to 60 per cent as many roots under putting green conditions, than when cut at a length of 1 in. or more. This reduction is reflected in a greatly reduced working depth, which necessitates frequent watering and careful feeding to satisfy the requirements for growth. Although cutting at a length as short as 1 in. is harmful to root development of redbtop, Kentucky bluegrass, and the better turf grasses are fully adjusted to these heights. Regular mowing at 1 in. or 1¼ in., permits maximum root development of the better fairway and lawn grasses, with consequent increase in vigor and tolerance of adverse conditions.