Growing A Vigorous, Strong Root System On Cool Season Turfgrass

BY R. E. SCHMIDT
Assistant Professor of Agronomy, Virginia Polytechnic Institute, Blacksburg

The sod producer is very cognizant of the importance of grass root development. The stronger and more rapid a root system can be developed, the sooner a sod can be rolled and the crop harvested. Early harvesting minimizes production cost and creates a higher monetary return.

Certain environmental conditions and maintenance practices will enhance root development. Controlling environment to influence favorable growth is limited for large-scale operations. However, employing certain management functions will augment root growth. Timing is an important factor to consider in initiating some management practices. Implementation of practices must be performed to favor the root system as well as the top growth in an efficient sod production operation.

Mowing procedure, soil pH, nutrition, and moisture are some of the factors that must be programmed to enhance grass root development. It is well established that clipping height and frequency influences root growth. Juska and Hanson[1] have shown that Kentucky bluegrass root development was inhibited when the tops were mowed at ½ inch as compared to 2 inches. They also gave evidence that mowing bluegrass five times a week restrained bluegrass root growth in contrast to once a week mowing. There is also some indication that root pruning (deep vertical mowing) may enhance root growth.[2]

Moisture influence is critical on root development. This may be illustrated by an experiment run by one of our turf management students. He obtained 6-inch plugs, 1 inch thick, of Seaside bentgrass and planted them in number 10 cans filled with a sandy soil. The cans were watered to field capacity (FC) and separate cans were watered after they were permitted to dry as follows: 90% of FC, 80% of FC, 60% of FC, 30% of FC, and 10% of FC. In addition, one can was maintained at 30% FC. That is, only the top 1/3 of the can was kept moist. The data in Fig. 1 show that the infrequent heavy watering enhanced root development. Whereas, continuous light watering or frequent heavy watering inhibits root development.

Nutrition is of utmost importance in root development. Soils near neutral acidity yield more roots than those with low pH. Liberal fertilization with phosphorous and potash enhances root development.

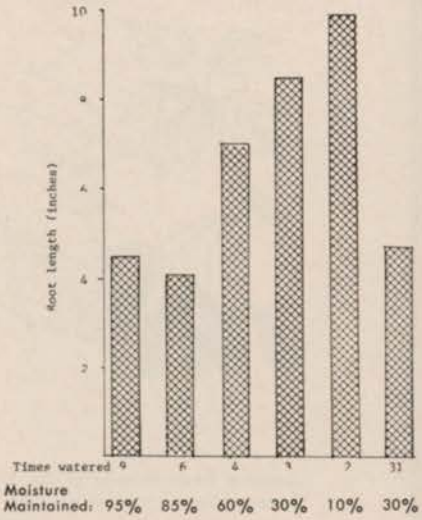
The fertility element that exercises the greatest influence on root development is nitrogen. Root yields will increase with increased nitrogen fertilization to a point, then further nitrogen fertilization will cause root reduction. Generally, the nitrogen rate applied to turf will inhibit root development.

When managing for maximum root production, the interaction of nitrogen nutrition and temperature must be considered. Consider the effect of temperature on cool season grasses. As temperature increases, the respiration of the plant increases. That is, increased CO_2 is given off as the temperature increases (Fig. 2). Carbon dioxide fixation also increases as temperature increases to a point (about 80 F). An increase of temperature beyond this point inhibits photosynthesis causing greater amounts of CO_2 to be given off than fixed by the grass. The reserve carbohydrates are then utilized rapidly to sustain the grass.

Top growth may continue at high temperatures until the carbohydrate reserve is substantially reduced (Fig. 3). However, root growth is inhibited by either high respiration or rapid top growth. Evidently, respiration and top growth have priority over root development in utilizing carbohydrates. Generally, root growth appears to be enhanced only when carbohydrates are accumulating.

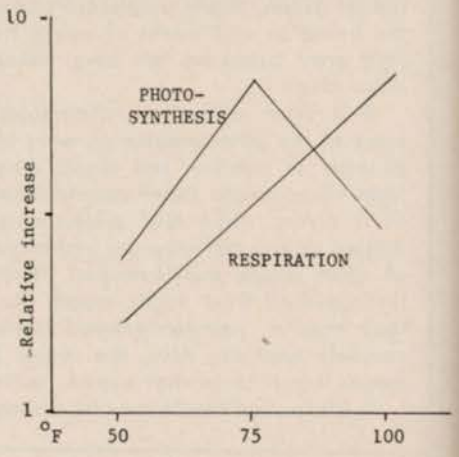
Nitrogen fertilization enhances photosynthesis and normally stimulates respiration and top growth causing a net reduction of plant carbohydrate reserves. Therefore, root growth is gener-

Fig. 1. Effects of Water on 31 Days of Bentgrass Root Development.



Moisture range maintained was from field capacity at 95% with 9 waterings down to 10% with 2 waterings. With 31 waterings moisture was maintained continuously at 30%.

Fig. 2. Influence of Temperature on Respiration and Photosynthesis.



ally inhibited with high nitrogen fertilization.

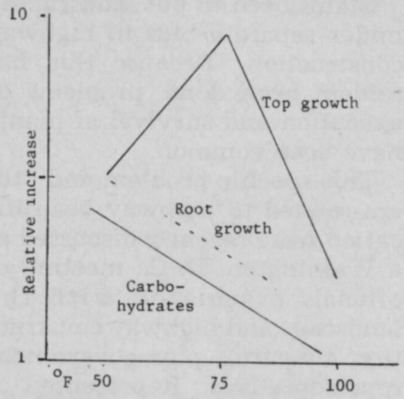
Normally the carbohydrates of cool season grasses increase during the fall and early winter. In the spring top growth is stimulated and the reserve carbohydrates are rapidly utilized. During the summer months, the carbohydrates remain relatively low.

Several workers [3,4] have shown that some root growth of cool season grasses initiate during the fall and winter with the greatest development occurring in early spring (evidently prior to the flush spring top growth). No appreciable root growth occurs during the summer months. Seasonal root growth essentially follows the seasonal pattern of carbohydrate content.

It has been observed in some of our field experiments that liberal winter nitrogen fertilization did increase the carbohydrate content of cool season grasses during the winter. It has also been reported that winter nitrogen fertilization increases bluegrass root development.[3]

Further studies[5] at V.P.I. have shown that carbohydrate content and root growth were enhanced with winter nitrogen fertilization of bentgrass. This phenomenon was attributed to the increased net photosynthesis rate that occurred with liberal winter nitrogen fertilization.

Fig. 3. Inflence of Temperature on Carbohydrate Reserves and Top and Root Growth.



From these results it seems reasonable to program for heavy N fertilization in the fall and winter and light N applications in the spring and summer for best root development of cool season grass. Liberal nitrogen fertilization evidently is beneficial when the applications coincide with the season the plant naturally builds carbohydrate reserves and develops roots. This deviates from the idea of continuous N feeding, but true turf quality can only be obtained if management improves root development as well as top growth.

References

1. Juska, F. V., and A. A. Hanson. 1961. Effects of internal and height of mowing on growth of Merion and common Kentucky bluegrass (*Poa pratensis* L.). Agron. J. 53:385-388.
2. Jacques, W. A. and Edmond, D. B. 1952. Root development in some common New Zealand pasture plants. V. The effect of defoliation and root pruning on cocksfoot (*Dactylis glomerata*) and perennial ryegrass (*Lolium perenne*). N.Z. J. Sci. Technol. Sect. A. 34, 231-48.
3. Hanson, A. A. and F. V. Juska. 1961. Winter root activity in Kentucky bluegrass (*Poa pratensis* L.). Agron. J. 53:372-374.
4. Stuckey, Irene. 1941. Seasonal growth of grass roots. Amer. J. Bot. 28:486-491.
5. Powell, A. J., R. E. Blaser, and R. E. Schmidt. Physiological and color aspects of turfgrass with fall and winter nitrogen. (Agron. J. in press).