

evaluated in turfgrasses. Crops research has demonstrated that root surface area, root growth rate and photosynthate partitioning to roots are all factors which contribute to greater water and nutrient recovery and overall increased efficiency.

It has long been assumed that the genetic base for many of our turfgrass species is limited, and large differences in basic physiological functions would not be found. Our results indicate this may not be the case, and suggest that future efforts at turfgrass improvement might profitably explore such differences.

For such efforts to be effective, we need to understand the basic biology underlying plant efficiency. We have explored the properties of roots which directly influence nutrient uptake from soil solutions. Once in the plant root, many other processes influence the efficiency of nutrient use. Rate of delivery into the xylem and transport to shoots, rate of incorporation into functional enzymes, turnover rate among metabolites and retention within the plant body are just a few of the factors which contribute to efficiency of nutrient use.

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Guest Commentary

The research mill

By Richard J. Hull

My statement in the accompanying article that the ten years of research devoted to increasing the efficiency of turfgrass management has had little practical effect requires some explanation. It does not suggest criticism of the research initiatives undertaken. Quite the contrary. The organizations sponsoring such research are to be commended for their farsightedness, and the researchers

involved for their imagination and persistence. It is in the nature of research that practical results are slow to emerge.

I said "ten years is not a long time for research..." I also said "our fundamental understanding of what constitutes efficient nutrient and water use by turfgrasses remains limited."

The turf research enterprise is like a mill. Basic scientific understanding is brought to bear on a practical problem, the two are processed together for a period of time and, with luck, a realistic solution to the problem emerges. The most valuable product of such research often is a deeper understanding of the problem being studied. This greater knowledge and insight make future problems easier to handle. The grist for this mill is basic science, without which practical problem solving is difficult if not impossible.

The weakness of basic science related to turfgrasses and their environment is a serious problem for turf researchers. The turf industry has been reluctant to support basic research which offers little prospect of immediately useful information. The federal government has for many years given research on turfgrasses and other ornamental plants a low priority for funding. Universities have not encouraged their faculties to undertake research projects with little opportunity for substantial external support. Most turf research programs are small and only a few universities have enough faculty devoted to turfgrass studies that the luxury of basic research can even be considered. Thus, the basic science grist necessary for sound turf research is often lacking, or at best very thin. This seriously limits the ability of turfgrass research to address fundamental issues like resource use efficiency, tolerance of environmental stresses or long-lasting resistance to diseases and insects.

This problem will be resolved only when turfgrass professionals recognize the importance of maintaining strength in basic research, and insist that their industry leaders commit resources to its support. Deans and other university administrators must be persuaded that basic research on turfgrasses is worth funding, and that it has the support of industry and the professions.

It comes down to investing in the future. Is the turf industry concerned only with solving immediate problems and maximizing profit margins, or does it also recognize the need for taking a broader view and committing resources to strengthening the scientific base on which turfgrass science is built? A sustainable future for the turf industry may very well depend on the answer to that question.