maturity, applicable wastes, advantages and disadvantages/limitations, and operation. While these discussions are not extensive, they provide the basic information needed. Diagrams or flow-charts are provided for most processes, outlining basic steps and procedures. Chapter 4 is devoted to product quality specifications, and some case studies are given in Chapter 5. The handbook is attractive, well organized and written, and easy to follow. Sufficient references are given to direct the reader to sources of more detail.

Those concerned with recycling and reuse of industrial wastes will find this handbook a useful quick reference to potential technologies to consider under a category. Detailed information will need to be obtained elsewhere. The handbook does not discuss relative costs, risks, or health and environmental risk. However, those who want a list of alternative technologies will find it very easy to use in that it serves as a practical guide in explaining technologies and in identifying the strengths and weaknesses of each.-J.F. POWER, USDA-ARS, University of Nebraska, Lincoln, NE 68583 (jfpower@unlinfo.unl.edu).

**LETTER TO THE EDITOR**


Dear Editor:

Recently, Beard and Green (1994) have extolled the benefits of turfgrasses to the environment and subsequently to humans. Using data of Falk (1976), the authors indicate the high potential that turfgrasses have to contribute to the buildup of soil organic matter due to annual root system turnover. In light of the global concern over increased atmospheric CO₂ and anthropogenic contributions to this phenomenon, it is worthwhile to look at the potential carbon-sequestering ability of turfgrasses, including the carbon cost of gasoline usage to realize this potential. Are turfgrasses net sequesters of carbon, or does their maintenance and dependence on fertilizers preclude this global benefit?

Regular mowing of turfgrass results in negligible aboveground sequestering of carbon because of the rapid decomposition of clippings. This is obviously tempered by any amounts that are composted, but on a continental scale, it is likely that this is quite small. However, in a typical Kentucky bluegrass (Poa pratensis L.) lawn, approximately 6.8 (oven-dry) t of turfgrass root biomass per ha (42% of the standing crop) are turned over on an annual basis (Falk, 1976). Beard and Green (1994) indicate that all of this is turned over into soil, but actually only a portion would become complexed into the recalcitrant forms of carbon resident in the soil beyond the estimated residence time of 2.4 yr. This amount will obviously depend on fine root decomposition and productivity, root consumption by soil animals, and cultural practices that enhance root productivity. About 1.5 t per ha per yr of carbon, or about 18 kg per yr of carbon, or about 1 t of CO₂ released per yr. (More recent estimates would be lower, perhaps to increased efficiency; estimates at higher latitudes would also differ because of reduced mowing and growth.)

A well-managed turfgrass plot would thus be capable of sequestering CO₂ at a gross rate of about 1 t per ha per yr. All of this would be permanent only if it were incorporated into passive soil organic matter to the highly stable fraction with a turnover time of about 3.85 yr (Wallace, 1994). As indicated, the turnover of root biomass in turf systems is currently only about 3.85 yr; Dahlman and Kucera, 1965), indicating that domestication and breeding of turfgrasses with qualities and use has been at the expense of an important soil building property. In fact, Fisher et al. (1993) found that deep-rooted grasses introduced into South American savannas and the time being that all of the annually sequestered CO₂ in this pool. This will be offset by the carbon cost of mowing, which in itself will maximize root production due to increased efficiency; estimates at higher latitudes would differ because of reduced mowing and growth.

How does the carbon-sequestering ability of turf compare to that of other common land management activities? The contribution of turfgrasses to this phenomenon, it is worthwhile to look at the potential carbon-sequestering ability of turfgrasses, including the carbon cost of gasoline usage to realize this potential. Are turfgrasses net sequesters of carbon, or does their maintenance and dependence on fertilizers preclude this global benefit?