^{15}N in the November regimen compared to the September and October regimens (Fig. 1A). However, the opposite occurred in run No. 2 (Fig 1B). Root fertilizer nitrogen concentrations accounted for an average of 17 percent of total nitrogen taken up, averaging 0.1 lbs. nitrogen per 1,000 sq. ft. (data not shown).

Additionally, root growth was not consistently affected by nitrogen application rates (Table 2), indicating that although root growth may increase in response to cooler soil temperatures, this trend is not stimulated further through nitrogen fertilization.

Our finding is consistent with previous research (Powell et al., 1967; Kussow, 1988; Mangiafico and Guillard, 2006). It may not be surprising that we found few differences in root growth among the treatments, because only 10 days passed between application and harvest. While additional longer-term or field research would be desirable to test the hypothesis that fall nitrogen does not affect root growth, our data preliminarily indicate that nitrogen applied at these rates in these temperature regimens has little effect on short-term root growth.

When turfgrass uptake and nitrogen immobilization decline, high rates of nitrogen fertilization increase the potential for fertilizer loss through denitrification and leaching.

We were unable to conclusively document the effect of nitrogen partitioning between shoots and roots for nitrogen applications in cold temperatures. It appears that shoot: root partitioning was not significantly different between the September and October temperature regimens. However, in run No. 1, strong partitioning of nitrogen to roots was observed in November, while in run No. 2 it wasn't.

Conclusion

Our results suggest that some of the widely held views on the importance of fall fertilization may not be as understood as thought. The nitrogen uptake capacity of creeping bentgrass, annual bluegrass and Kentucky bluegrass declines substantially as temperatures decrease, although nitrogen uptake potential appears to be relatively high after shoot growth stops.

Waiting after this period greatly reduces nitrogen uptake potential. Because of the increased risk of fall nitrogen loss in humid, temperate regions with seasonally high precipitation rates and low evapotranspiration rates, agronomic recommendations for late-fall fertilization need to be re-evaluated. Additional field research is required to confirm the results of this controlled environment evaluation.

Editor's note: The units for aboveground and root biomass in Tables 1 and 2 were intentionally left as grams/metered squared.

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