Estimating Non-Gaseous Nitrogen Losses from Established Turf

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ABSTRACT. Preserving the quality of ground water resources has become a serious concern for those responsible for intensively managed turf operations in suburban and rural areas of the humid eastern U.S.A. Nitrate leaching from Kentucky bluegrass (*Poa pratensis* L. cv. Baron) and Chewings fescue (*Festuca rubra* ssp. *commutata* Gaud. cv. Jamestown) turf managed at different fertility levels was estimated and compared with nitrogen (N) loss through clipping removal. Urea was applied at 72, 144 and 288 kg N ha^{-1} yr^{-1} in increments throughout the growing season or as a single treatment in mid-May. Turf intensively managed for eight years was compared with minimally fertilized turf 18 months old. Clippings were collected, analyzed for N and found to contain amounts equivalent to 51 to 102% of the N applied. Percent N recovery in clippings was inversely related to application rate. Nitrate (NO_3) leaching during the growing season was estimated from a hydrologic mass balance model

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and the nitrate content of soil water collected in suction lysimeters installed 60 cm in the soil. Leaching accounted for <1 to 8% of applied N. Vigorous healthy turf is a strong sink for N but its capacity may decrease after prolonged periods of intensive fertility management.

KEYWORDS. Leaching, nitrate, *Poa pratensis*, *Festuca rubra*

Contamination of drinking water by pesticides and fertilizers applied to agricultural crops has been studied intensively for the past twenty years. Contamination from chemicals applied to golf courses, home lawns and sod farms is of special concern in the densely populated Northeast. The increased availability of commercial lawn care has prompted many home owners to elevate their turf maintenance programs to more intensive levels than in the past. This, coupled with the greater visibility of lawn care companies, has resulted in greater public awareness of the potential for surface and groundwater pollution from turfgrass management practices. Early reports, such as the one produced by the Long Island Regional Planning Board (1978) directly implicate turfgrass fertilization as a source of aquifer contamination. Because of this, some municipalities are beginning to restrict the development of golf courses and the application of chemicals to home lawns within critical watershed areas.

Losses of N from turfgrass through leaching and recovery of N by clippings have been studied independently (Reike and Ellis, 1974; Morton et al., 1988; Hummel and Waddington, 1981 and 1984; Geron et al., 1993). Petrovic (1990) reviewed the fate of N applied to turf including leaching losses and clipping removal. Few studies, however, have attempted to quantify both avenues of N loss from turfgrass concurrently. Mosdell and Schmidt (1985) studied losses through both leaching and clipping recovery from Kentucky bluegrass grown in growth chambers. Their data showed that increased irrigation enhanced both plant uptake and leaching of N. In the field, Starr and DeRoo (1981) determined that N equivalent to 45 and 61% of the fertilizer N applied at rates between 180 and 195 kg N ha^{-1} was recovered in clippings while virtually no N was lost through leaching.

The objective of this research was to estimate growing season N losses from a turfgrass system through clipping removal and leaching. Nitrogen removal in clippings and seasonal nitrate leaching were extrapolated from clipping harvests and a hydrologic mass balance model. All extrapolated values were derived from actual data taken in the field on a particular year and at a particular site. The influence of fertilizer rate, turfgrass species and the history of fertilization practices on the fate of applied N was considered.

MATERIALS AND METHODS

Field Plot Design and Management

Nitrogen loss data were collected on two separate plot areas at the Turfgrass Research Farm of the Rhode Island Agricultural Experiment Station, Kingston RI. The soil type at both sites is Enfield silt loam (Coarse-silty over sandy or sandy-skeletal, mixed, mesic, Typic Dystrochrepts). The first site contained a mature stand of Baron Kentucky bluegrass turf seeded in 1976. Data were collected from this site during the 1984 growing season. In 1983 and 1984, the plot area was maintained under the three N fertility regimens (high, medium and low) outlined in Table 1. The experimental design was a randomized complete block with eight replications. All N applications were made as urea. From 1969 to 1982, high, medium and low fertility plots had been maintained on this plot area at N rates of 122, 244 and 488 kg N ha^{-1} yr^{-1}, respectively, applied as urea or NH_4NO_3. The high, medium and low N plots of the current study corresponded to those established in 1969. Soil from these plots was not analyzed at the outset of this study but the grass stand was of good quality except for some stand thinning of the high N plots due to periodic disease infections. Plots were mowed at a height of 3.8 cm and most clippings were removed.

At the second site, two turfgrass species were utilized: Baron Kentucky bluegrass and Jamestown Chewings fescue. Data from this site were collected in 1986. Each grass was seeded into a 10 by 20 meter plot in October, 1984 on land that had been fallowed the previous two years. In 1985, the plots received 97.8 kg N ha^{-1} yr^{-1} as urea applied in the spring and fall. In 1986, each plot was divided into three completely randomized N treatments with three replications and a single unfertilized subplot. The latter established a baseline for the N status of turf and soil water. As at the first site, the three N rates were