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Does death of turf make nitrate leach?

Nitrate leaching increases soon after turf death, but losses stabilize over time.

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Turf normally receives 1-5 pounds of nitrogen per 1,000 square feet per year, and research has shown that only 5-15 percent of that nitrogen leaches as nitrate to groundwater (4). Some nitrogen may also be lost as nitrogen gas (N_2) through denitrification, but most is retained within the turf-soil ecosystem in soil organic matter. If clippings are removed, much applied nitrogen is lost with the clippings, but if they are retained, most nitrogen remains on site. Land that has been in turf for 20 years or more can accumulate 2,000-4,000 pounds of nitrogen per acre within its soil organic matter (2,4).

This retention of nitrogen and other plant nutrients represents a major environmental benefit contributed by turf. Because of the relatively large amount of nitrogen stored in soil organic matter, concerns may arise over what happens to that nitrogen if the turf dies or is removed. Does all the nitrogen within a turfgrass ecosystem constitute a disaster waiting to happen for groundwater quality whenever the turf is killed? At the University of Rhode Island, we have been studying the

Photo courtesy of Richard Hull

Turf plots died 13 days after spraying with glyphosate.

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Key points

- Turfgrasses are highly efficient in capturing and retaining soil nitrogen.
- Re-establishing turf soon after a killing event should minimize nitrate leaching and permit the maintenance of an environmentally safe ground cover.
- Even if turf re-establishment is delayed, nitrate losses will increase, but most nitrogen within the turf-soil ecosystem will be retained until lost slowly over a period of years.

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stability of nitrogen in turf and decided to answer the question of nitrogen mobility and nitrate leaching potential following sudden turf death (1,3).

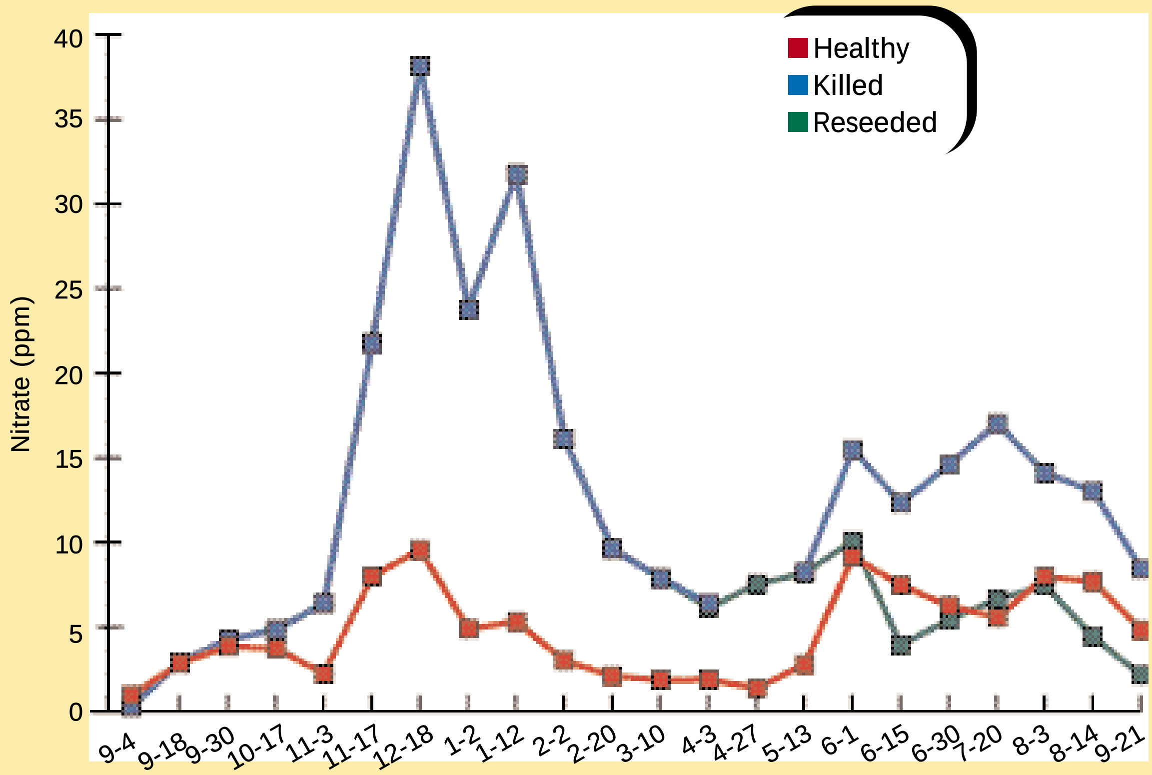
Methods

A 15-year-old set of turf plots used in a previous nitrate-leaching study was used for this investigation. The plots had received 3.5 pounds of nitrogen per 1,000 square feet applied as various nitrogen sources to four different turfgrass species. On Sept. 9, 1997, half of the plots were sprayed with glyphosate (Roundup), and the other half were retained as healthy plots.

Within two weeks, turf in the sprayed plots was dead. On March 30, 1998, three-fourths of the killed plots were overseeded with Palmer III perennial ryegrass (*Lolium perenne*). Plots that had been killed but not reseeded were kept free of vegetation by hand cultivation.

On eight dates during the year following turf death, soil samples were collected from the top 4 inches of each plot, and temperature, moisture content and pH were measured. These same samples were analyzed for extractable nitrate and ammonium as well as carbon mineralization (soil respiration) and microbial biomass. Suction lysimeters had been installed in half of these plots so ceramic sampling cups were at a depth of 2 feet, placing them below the turf root zone. Soil water samples were collected from the

Nitrate in soil



The levels of extractable nitrate in surface soil of killed and healthy turf plots, as well as reseeded plots, varied over time.

lysimeters approximately every two weeks (20 times) during the year following turf death. These water samples were analyzed for nitrate, and, using calculated water-percolation rates, estimates were made of nitrate leaching through the turf of each plot.

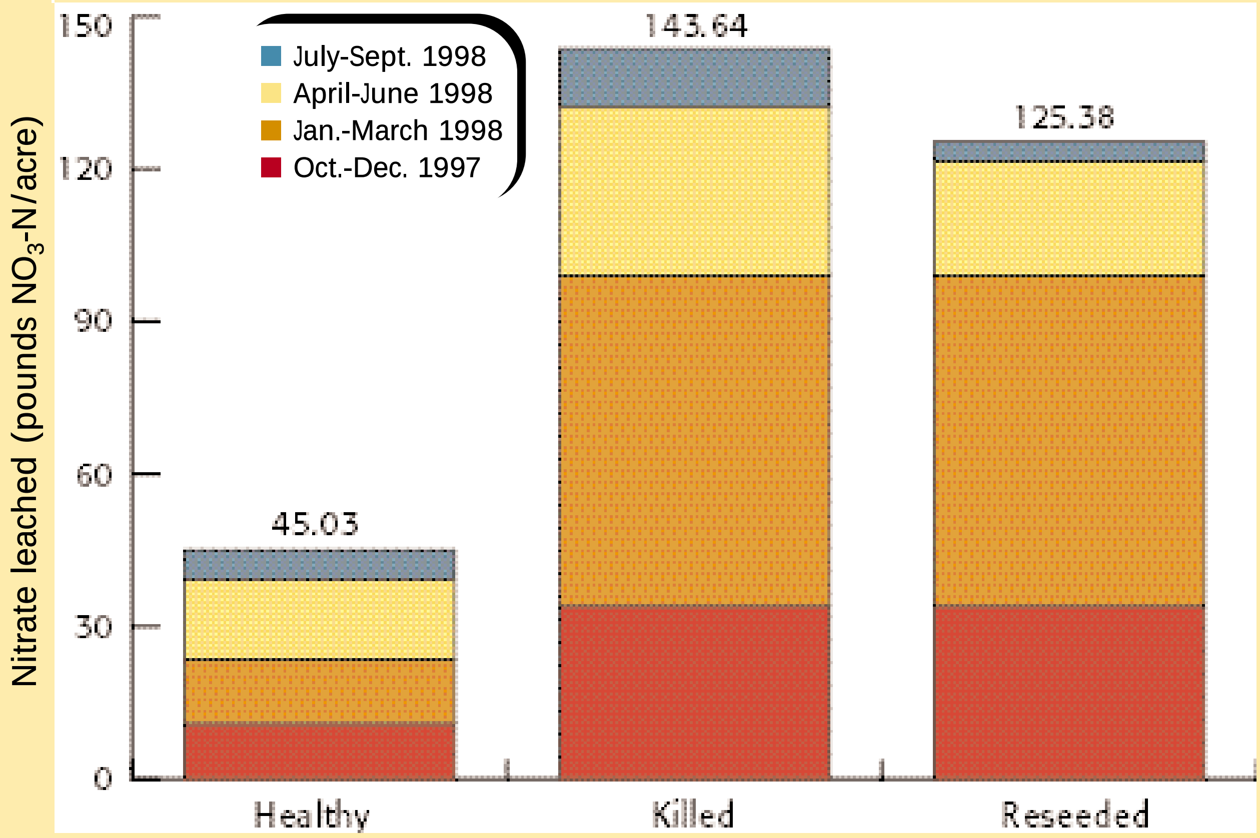
Soil properties

Throughout the year following turf death, no differences in soil temperature, water content or pH were observed between healthy and killed plots. This would indicate that any differences observed between plots were attibutable to living vs. dead turf, not to different physical properties resulting from turf death.

Extractable soil ammonium levels did not differ between living and dead plots, and overseeding in the spring also failed to influence the quantity of soil ammonium. Consequently, any additional nitrogen released from dead roots, rhizomes or other turfgrass tissues did not accumulate in the soil as ammonium.

By comparison, the amount of extractable nitrate in killed plots increased sharply within one month of turf death. Although the total nitrate content exhibited typical seasonal changes, the amount present in killed plots was consistently and significantly greater than that in healthy turf plots. However, within six weeks of overseeding perennial ryegrass on killed plots, the extractable nitrate levels declined to values no different from those of plots that had never been killed. This suggests

Nitrate leaching



From October 1997 to September 1998, estimates of leached nitrate were greater from killed turf plots than from healthy turf and plots that had been reseeded after the turf was killed.

that nitrogen released from dead turf and soil organic matter was rapidly oxidized to nitrate, and it accumulated in the soil when there were no living turfgrass roots to absorb it. Also evident was the speed by which seedling turf was able to absorb the excess nitrate and restore soil nitrate levels to those of mature, healthy turf.

Soil microbial activity

Throughout the year following turf death, surface soil from healthy and killed turf showed similar rates of microbial respiration (CO_2 release). Total soil microbial biomass also did not differ in living and dead turf plots. Following the overseeding of dead turf, soil respiration levels increased, but soil microbe biomass did not change.

These results indicate that the death of mature turf during the early fall did not release sufficient fresh organic residues to influence markedly the rates of total soil respiration. Apparently soil microbial activity is supported mostly by colloidal organic matter that can be 4-5 percent of a turf soil and thus represent a sizable pool of slowly degradable substrate. Turf death in the spring, when turf root systems are most extensive, would likely promote a significant increase in soil respiration. This might explain why spring-seeded perennial ryegrass did increase soil respiration. Primary seedling roots are often short-lived, and they release substantial amounts of organic residues, thereby contributing significantly to the pool of metabolizable substrates available for microbial growth (5).

Nitrate leaching

Soil water samples collected below the root zone of killed turf contained nitrate concentrations greater than those from healthy plots within eight weeks following turf death. This difference persisted for most of the year after turf had been killed. This resulted in annual nitrate leaching rates from killed turf that were three times greater than those from healthy turf (160 vs. 50 pounds of nitrogen per acre). Overseeding perennial ryegrass in late March reduced the nitrate content of leachate water to levels that were lower than those from unseeded killed turf plots within eight weeks of reseeding. By June, reseeded plots actually leached less nitrate than plots that had never been killed. From June through December 1998, nitrate leaching rates from reseeded plots were reduced to levels less than half those from plots that were killed but not reseeded.

Conclusions

This study indicates that nitrate leaching from turf increases following grass death, but the rates level off to values not much greater than those from healthy turf. One year following turf death, about 10 percent of the total nitrogen present within the turf-soil ecosystem leached below the root zone and likely would enter groundwater. If dead turf is reseeded quickly, nitrate leaching rates will return to pre-death levels within eight weeks. ■

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