

**USGA Annual Report
November 1999**

Characterization of Leaching at the Coeur d'Alene Resort Golf Course

W.J. Johnston, C.M. Kleene, W.L. Pan, and E.D. Miltner
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This research is being conducted on the floating, 14th green at the Coeur d'Alene Resort Golf Course, Coeur d'Alene, Idaho, which allows for direct observation by the public. The project aims to further open lines of communication between the golf course industry and the public and provide scientific research for the development of BMPs regarding N management in the Pacific Northwest.

Materials and Methods

A small 60°-trapezoidal flume attached to the main drain line located below the back green-side bunker is used for sampling leachate and flow analysis. Leachate samples are taken daily and stored within an ISCO 6700FR refrigerated sampler at 34°F to insure sample stability, transported to WSU, and frozen until analysis (Alpkem segmented flow analyzer).

November 1998, six microlysimeters were installed in the 14" rootzone at three different locations on the green. Each location (high and low contour sites, and a high traffic area located at the entrance to the green) included two microlysimeters.

A foliar fertilizer, 24-0-24 Nitro-K Plus II (RSA-Microtech), is currently applied at 0.1 lb N 1000 ft⁻² (1.75% ammoniacal N, 3.0% nitrate N, 19.3% urea N) and 0.1 lb K 1000 ft⁻² (100% K₂O) every 7 to 10 days. In addition, Ferromec (15% urea N, 3% sulfur, and 6% iron sulfate) is added to the foliar fertilizer at a rate of 2 oz 1000 ft⁻². The total N applied annually is approximately 4.0 to 4.5 lb N 1000 ft⁻². For research purposes, N rate was increased to 0.3, 0.6, and 0.9 lb N 1000 ft⁻² (one application at each rate) to observe the leachability of higher rates of N. Nitro-K Plus II was applied at the rate of 0.3 and 0.6 lb N 1000 ft⁻² on August 5th and September 4th, 1998, respectively. Scott's 26-4-13 with minors was applied at the rate 0.9 lb N 1000 ft⁻² on April 8th, 1999 following spring aerification.

Grass clippings are collected daily from the whole green (7000 ft²), weighed, sub-sampled, and frozen for later tissue analysis. The clippings samples are dried in a 60°C oven for 3 days, then weighed. A seed density sorter is used to separate topdressing sand from the clippings.

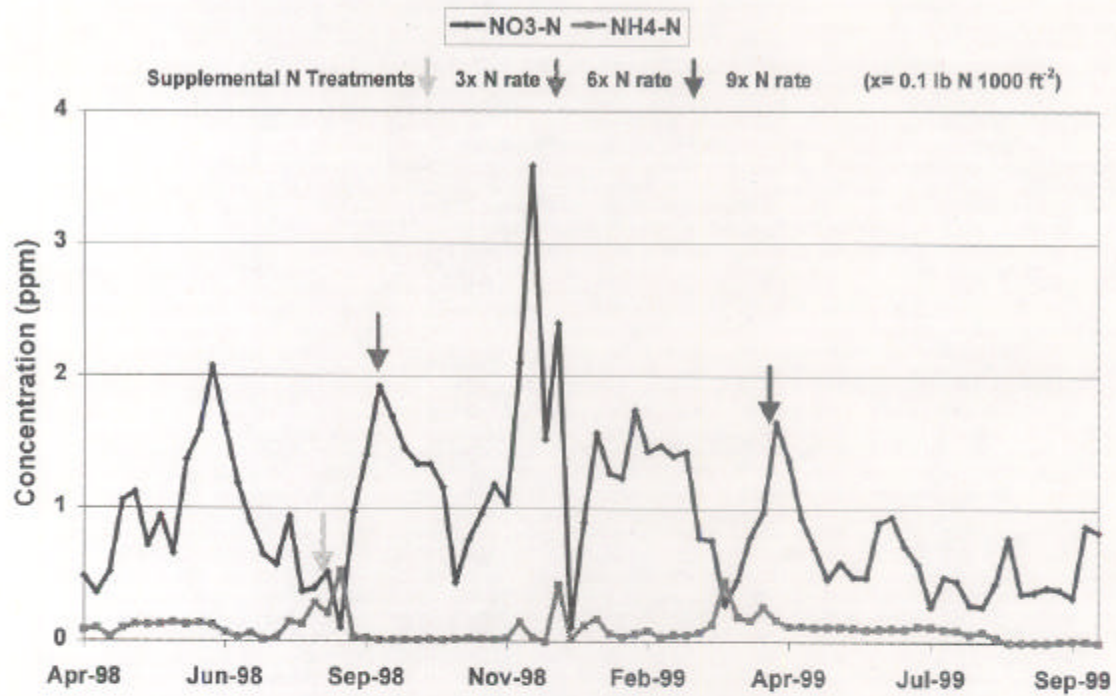


Fig. 1. Weekly mean nitrogen leachate concentration,

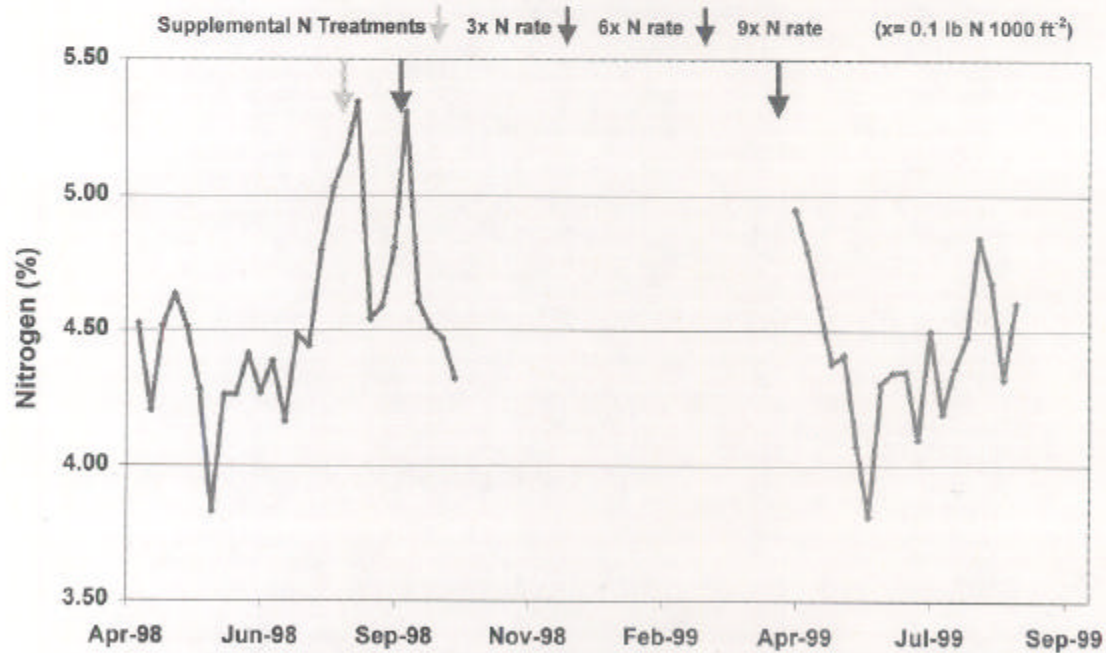


Fig. 2. Weekly mean nitrogen in clippings, 1998

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Clippings are then ground to pass a 40-mesh screen, weighed, and analyzed for N using a LECO combustion auto-analyzer.

Results and Discussion

Analysis for $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ in the leachate indicated low levels of N (**Fig. 1**). On a daily basis (data presented as weekly mean) $\text{NO}_3\text{-N}$ ranged from 0.11 to 5.18 ppm, well below the EPA limit of 10 ppm and $\text{NH}_4\text{-N}$ levels ranged from 0.01 to 1.19 ppm. Low levels of $\text{NO}_3\text{-N}$ may be attributed in part to frequent foliar N applications. Increased rates of 0.3, 0.6, and 0.9 lb N 1000 ft² had no noticeable effect on either the $\text{NO}_3\text{-N}$ or $\text{NH}_4\text{-N}$ leachate concentrations. Flow rate through the green ranged from 0 to approximately 17.2 gpm (daily basis) (**Fig. 2**). Peak flow rates can be attributed to rainfall events. The highest total N levels (grams) occurred during late fall and early winter 1998 when water flow and N leachate concentrations were high (**Fig. 3**). Microlysimeter N leachate concentrations showed no significant differences with respect to location within the putting green and were numerically comparable to those from the whole green (**Table 1**).

Clipping dry wt. variation throughout 1998 and 1999 can be attributed to frequent sand top dressing, mowing height variation, and environmental factors (**Fig. 4**). The daily bentgrass clipping N ranged from 2.98 to 5.64% with a mean of 4.53% (**Fig. 5**). Low leachate concentrations combined with high leaf tissue (clippings) N suggests efficient N uptake by the plant and a low potential for negative environmental impact. Total recovered N (leachate and clippings) represents a low amount in comparison to unrecovered N (**Fig. 6**). Unrecovered N could be present in unavailable forms in both the soil and thatch with some potential loss to volatilization, but is believed not to be an environmental concern (Miltner et al., 1996; Starr and DeRoo, 1981).

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- Starr, J.L., and H.C. DeRoo. 1981. The fate of nitrogen fertilizer applied to turfgrass. *Crop Sci.* 21:531-536.

Proposed Research Schedule and Anticipated Results

Nov. 1999 to Feb. 2000 - Site visits as needed. Sample collection and analysis as weather permits. Data analysis and publications preparation. Presentations at turfgrass meetings.

Mar. 2000 to Oct. 2000 - As funding permits, continue sample collection and analysis. ¹⁵N-labeled N application to trace applied N through the whole green system. Publications and presentations will be made as needed

Publications and Presentations - November 1998 to October 1999

- Kleene, C. M., W. J. Johnston, W. L. Pan, C. T. Golob, E. Miltner, J. Anderson, and M. Moneymaker. 1999. Characterization of nitrate leaching on the floating green at the Coeur d'Alene Resort Golf Course. GCSAA Conf. Orlando, FL. (poster).
- Johnston, W. 1998. Characterization of leaching at the Coeur d'Alene Golf Course floating green. *Golf Course Management* 67(2):74.
- Johnston, W. J., C. M. Kleene, C. T. Golob, W. L. Pan, J. Anderson, and E. D. Miltner. 1998. Characterization of leaching at the Coeur d'Alene Golf Course floating green. *Turfgrass Management in the Pacific Northwest* 2(1):34.
- Johnston, W. J., C. M. Kleene, W. L. Pan, and E. D. Miltner. 1998. Characterization of leaching at the Coeur d'Alene Golf Course floating green. *Turf Line News* 149:16-17.
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- Kleene, C. M., W. J. Johnston, E. D. Miltner, W. L. Pan, and C. T. Golob. 1999. Characterization of nitrate leaching at the Coeur d'Alene Resort Golf Course. USGA May 20 site visit. Puyallup, WA. (presentation).
- Johnston, W. J. 1999. The floating green research project and its impact on all sand grown turf. Western Canada Turfgrass Assoc. Res. Field Day. Pitt Meadows, BC, Canada. July 14, 1999.
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- Kleene, C. M., W. J. Johnston, W. L. Pan, E. D. Miltner, and C. T. Golob. 1999. Characterization of nitrate leaching in the floating green at the Coeur d'Alene Resort Golf Course. p. 135 *In* Agronomy abstracts. ASA, Madison, WI.

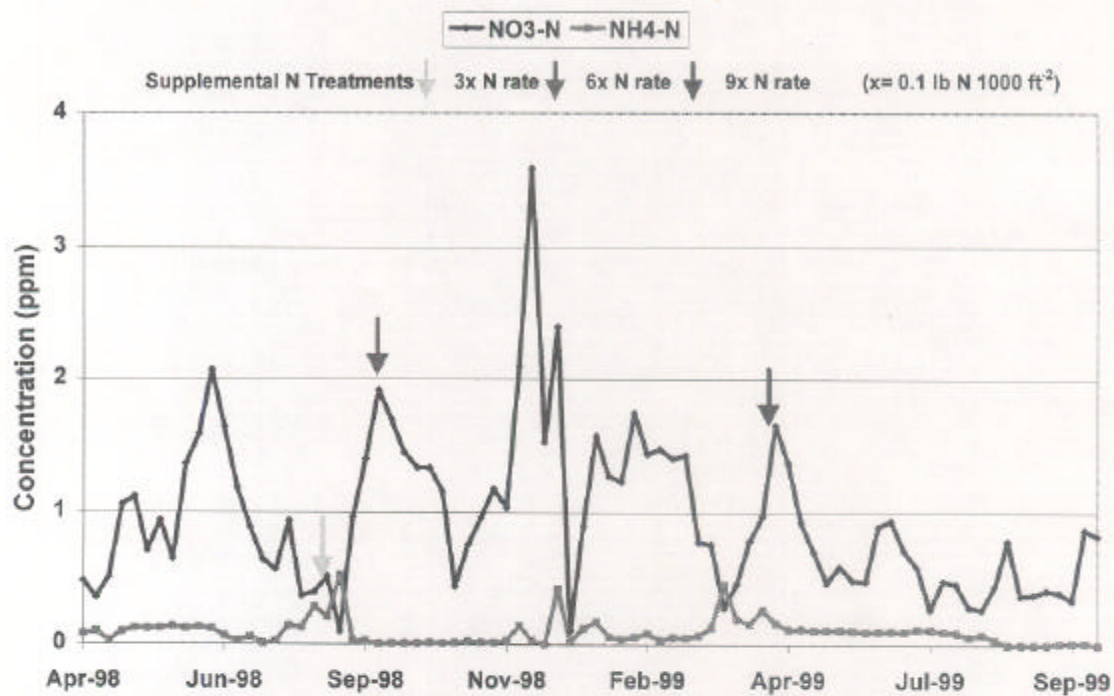


Fig. 1. Weekly mean nitrogen leachate concentration, 1998 and 1999.

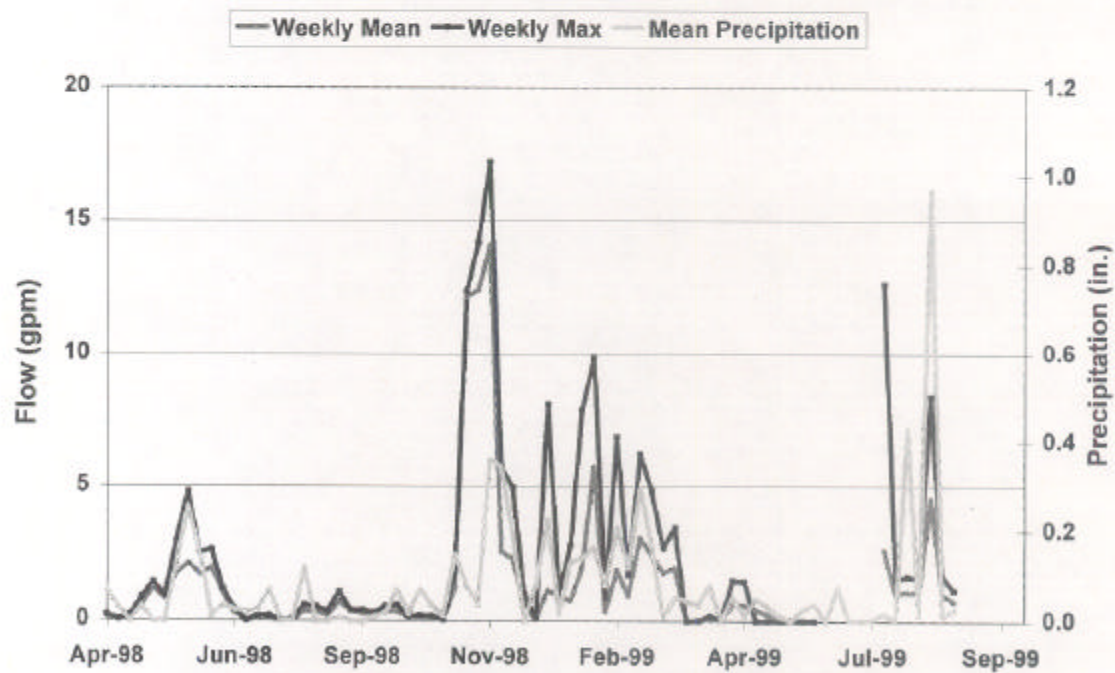


Fig. 2. Weekly Mean Flow Rate and Precipitation, 1998 and 1999.

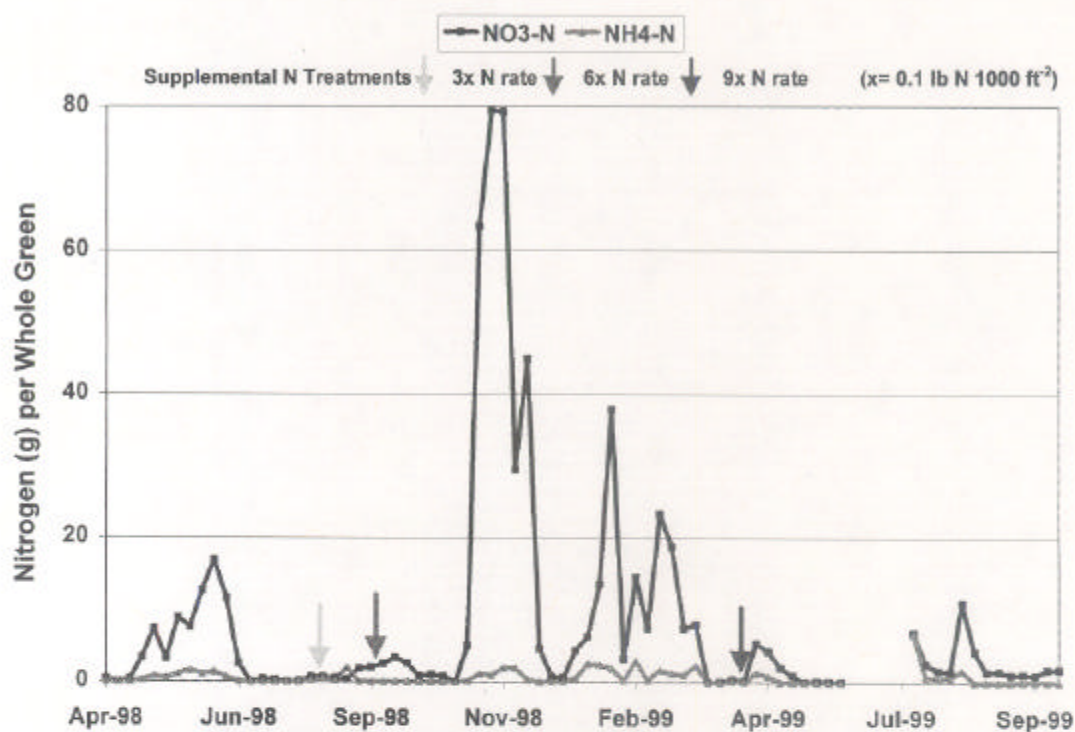


Fig. 3. Weekly mean nitrogen in leachate, 1998 and 1999.

Location	13 Mar	30 Mar	7 Apr	10 Jun	18 Aug
	-----ppm-----				
High contour	0.74	0.55	0.93	0.66	0.20
High traffic	1.06	0.44	1.98	0.53	0.34
Low contour	0.90	0.49	1.46	0.59	0.27
LSD (P<0.05)	ns	ns	ns	ns	ns
Whole green ¹	1.02	0.85	0.33	0.33	0.38

¹ Whole green leachate not included in analysis due to single replication.

Table 1. Comparison of microlysimeter locations and whole green leachate, 1999.

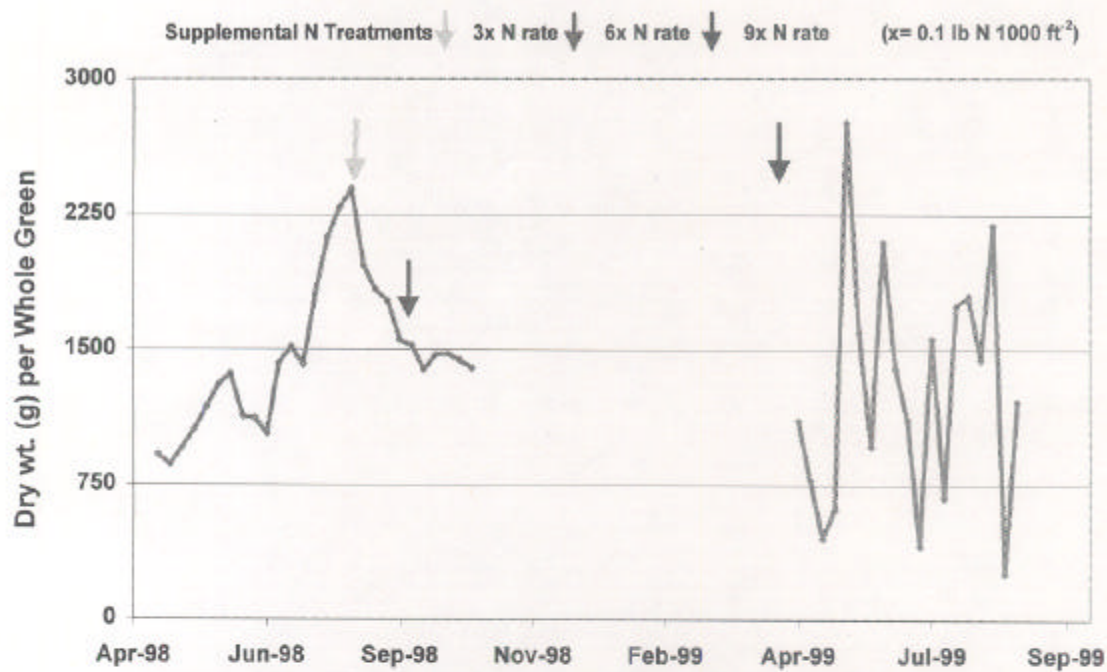


Fig. 4. Weekly mean clipping dry weight, 1998 and 1999.

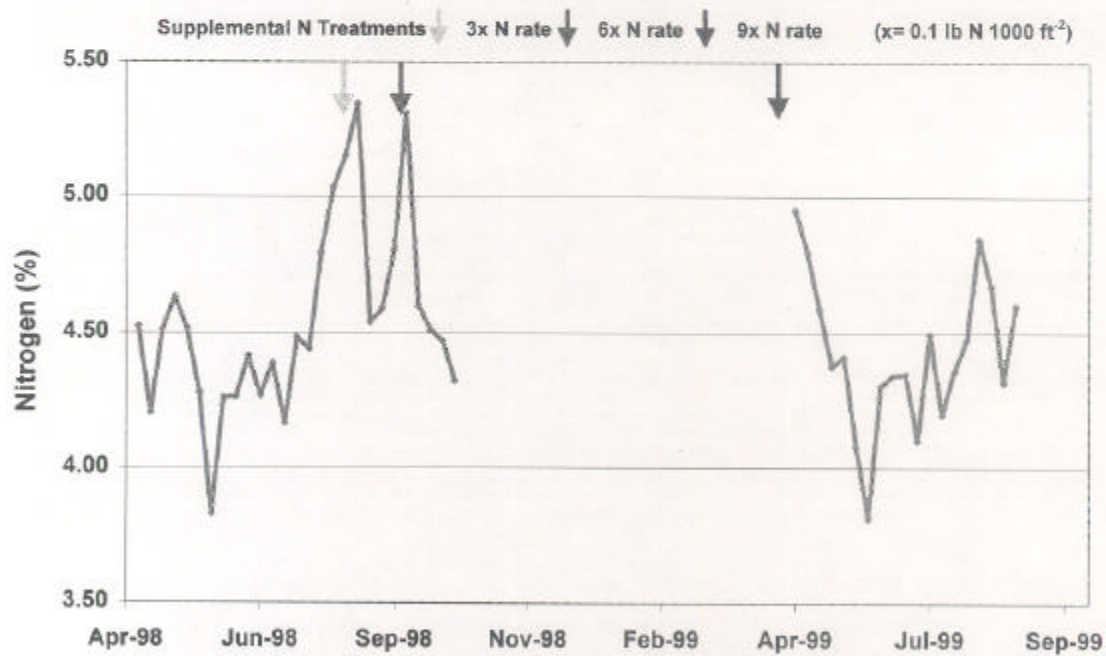


Fig. 5. Weekly mean nitrogen in clippings, 1998 and 1999.

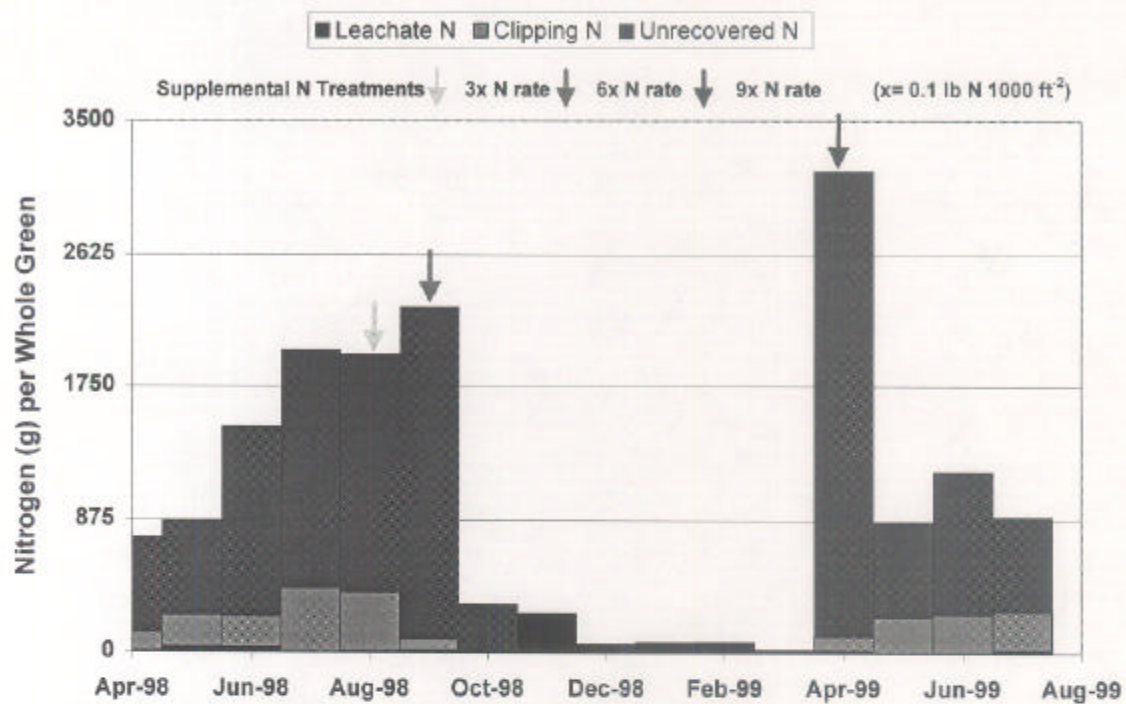


Fig. 6. Recovery of applied nitrogen, 1998 and 1998.