Dr. C. F. Mancino, Ms. Dianne Petrunak, and Mr. Douglas Wilkinson

Liquid N Shines in Turf Applications

Shows less N loss compared to granulars in 1999 Penn State University putting green trials.

Editor's note: This article has been adapted for the *Fluid Journal* from a research paper on golf course turf management. Though there are mostly granular trials in the discussion, the article has been tailored to focus on a portion comparing granular and fluid nitrogen losses in putting green turf management.

Summary: N loss with granular nitrogen fertilizers was greatest in the first and second mowings. Total percentages of N losses from granular fertilizers were: IBDU 31-0-0 (75.4%), Polyon 42-0-0 (70.8%), Milorganite 6-2-0 (55.7%), Nutralene 40-0-0 (47%), UHS Signature 15-0-30 (19.3%), and Isotek 11-3-22 (9.5%). Liquid N fertilizer (N-Sure Pro 30-0-0) showed a dramatic increase in N efficiency with only a 1.9 percent N loss when compared to these granulars. N loss appeared to be most related to water solubility of the fertilizer. Size and density also may have been factors.

Granular fertilizers are routinely used in golf course putting green establishment and maintenance. Smaller particle-size grades have been developed in order to improve the uniformity of the fertilizer application and to aid in mowing the fertilizer into the turf canopy. Typically, greens-grade granules are between 0.5 and 1.4 mm in diameter with a small percentage of the fertilizer <0.5 mm and >1.4 mm. However, despite their small size, it is often observed that fertilizer granules remain on the turf canopy surface after application and that some fertilizer is removed along with turf clippings during mowing.

General recommendations made to reduce mowing loss of granular fertilizers include 1) irrigation, 2) application of the fertilizer just after mowing, 3) skipping of mowing the day after fertilizer application, 4) mowing without baskets, and 5) spiking the green prior to fertilization.

The objective of this study was to determine the amounts of various greens-grade fertilizer that were lost along with clippings during routine putting green mowing.

Materials and methods

Location. Joseph Valentine Turfgrass Research Facility at Penn State University.

Study site. The studies were conducted on a sand-based, established 'Pennlinks' creeping bentgrass putting green.

Fertilizers. The N fertilizers used in this study are shown in Table 1. Each fertilizer is recommended for use on putting greens and other low-cut turf. Three 200-g samples of each granular fertilizer were sieved for particle size analysis. The uniformity coefficient and Blake's fineness modulus of each fertilizer were determined as specified by the U.S. Golf Association for a sand topdressing. This was done in order to compare the size characteristics of the granular fertilizer with those of acceptable topdressing sand that would be expected to fall down into the putting green turf canopy. All of the granular N fertilizers had acceptable uniformity coefficients with Isotek and IBDU being most uniform (Table 1). Liquid N fertilizer

Table 1. Sieve analysis, uniformity coefficient, fineness modulus and water solubility of greens-grade N-containing granular fertilizers. N-Sure Pro is a liquid N source.

	N	Sieve size (mm)								WS
	%	<0.5	0.5	1.0	1.4	2.0	2.8	UC	FM	%
		% retained								
Polyon	41	2.4	50.8	42.8	5.2	0.0	0.0	1.66	3.10	0.0
Milorganite	6	1.2	58.8	39.6	0.0	0.0	0.0	1.72	2.95	6.0
IBDU	31	1.2	79.2	19.2	0.0	0.0	0.0	1.55	2.89	4.0
Nutralene	40	1.2	58.0	40.4	0.0	0.0	0.0	1.81	2.99	32.0
UHS Signature	15	5.6	65.2	26.8	1.6	0.0	0.0	1.80	2.87	50.0
Isotek	11	0.4	9.6	36.8	46.0	7.2	0.0	1.45	3.72	66.0
N-Sure Pro	30	—	—	—	—	—	—	—	—	—

UC = Uniformity coefficient
FM = Fineness modulus
WS = Water solubility

(N-Sure Pro) was applied with a CO_2 powered boom sprayer mounted on bicycle wheels. The liquid N treatment was allowed to dry on the turfgrass foliage before irrigation was applied to the green.

Plots were 3 ft. by 8 ft. with four replications per treatment.

Design. The N study was a one-way factorial design arranged as a RCB design with the study repeated twice.

Timing. The first run of each study was initiated on June 30, 1999, when the putting green was mowed and the different fertilizer treatments were applied.

Fluid N excels

Loss of each fertilizer, except N-Sure Pro, decreased considerably from the first mowing, which was two days after treatment (DAT), and the second mowing, which was three DAT (Table 2). All treatment losses continued to decline for the remainder of the study, but small amounts of every fertilizer, except Signature, were found in clippings nine DAT. These final daily losses were usually <0.5 percent. Signature loss at nine DAT was zero.

Total fertilizer loss due to mowing was large for Milorganite, IBDU, Polyon, and Nutralene, with losses ranging from 47 percent for Nutralene to about 75 percent for IBDU (Table 2). Signature and Isotek losses were 19 and 10 percent, respectively. Total loss of N-Sure Pro was estimated to be only 1.89 percent.

Insolubility hurts. The higher losses measured in the N fertilizer trial are presumably due to the higher degree of water insolubility in the granular fertilizers. Fertilizer loss and water insolubility rankings were nearly identical for the granular N fertilizer treatments. The two 6.4 mm irrigations used in this study were not effective in dissolving and moving these fertilizers into the turf canopy before the first mowing removed the fertilizer with the clippings. The irrigation and mowing strategy used in this study was more effective in reducing the loss of Signature, Isotek, and, to a lesser extent, Nutralene. These N treatments had higher water solubilities than Milorganite, IBDU and Polyon.

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Solubility helps. N-Sure Pro, the liquid fertilizer, had very low losses in comparison to the granular N fertilizer because of its high water solubility, as well as the fact that it had been sprayed onto turf foliage that was below the mower's height of cut.

Conclusions

The loss of some greens-grade fertilizers through mowing was significant, particularly for fertilizers with lower water solubility. Our irrigation and mowing regime, although typical of what a golf course superintendent might do following a fertilizer application, was not adequate in preventing the mower from picking up fertilizer. It appears that more water soluble, finer granular fertilizers, as well as liquid fertilizers, have the lowest potential for being lost though routine mowing. It would be useful if fertilizer manufacturers and turf researchers could make specific recommendations about how much irrigation water is required to minimize mowing loss.

Dr. Mancino is senior scientist of lawns product development at The Scotts Company; Ms. Petrunak is a research specialist and Mr. Wilkinson was a former undergraduate research assistant, both at Penn State University.

Table 2. Percentage of applied greens-grade N-containing fertilizer lost due to mowing of a 'Pennlinks' creeping bentgrass putting green. N-Sure Pro is a liquid N source.

	Days after treatment								
Fertilizer	2	3	4	5	6	7	8	9	Total
	% of applied fertilizer lost								
Milorganite 6-2-0	41.46	7.32	2.54	1.89	0.99	0.61	0.57	0.30	55.68
IBDU 31-0-0	47.34	12.28	7.29	4.12	2.51	0.74	0.65	0.49	75.42
Polyon 42-0-0	50.67	10.16	4.89	2.14	0.97	0.65	0.65	0.65	70.78
Nutralene 40-0-0	31.05	8.57	3.56	2.20	1.05	0.74	0.42	0.42	47.01
UHS Signa.15-0-30	13.65	3.05	1.03	0.84	0.39	0.24	0.08	0.00	19.28
Isotek 11-3-22	7.06	1.15	0.49	0.32	0.23	0.11	0.04	0.06	9.46
N-Sure Pro 30-0-0	0.48	0.43	0.18	0.20	0.23	0.16	0.09	0.12	1.89