Spoon-feeding with granular materials?

By M.J. Howieson and N.E. Christians

The increase in the popularity of sand-based greens provides a unique and interesting problem for a growing number of turf managers. While sand-based greens provide superior drainage and aeration compared to native, or push-up greens, their nutritional status is often less than satisfactory.

The low cation exchange capacity (CEC) inherent in sand-based systems, coupled with high water permeability rates, makes it difficult to provide adequate nutrition to turf and at the same time minimize fertilizer leaching and runoff.

Soil CEC is a measure of a soil's ability to retain basic cations, such as ammonium (NH4+), calcium (Ca+2), magnesium (Mg+2) and potassium (K+), which are essential for normal plant growth and development. The CEC of sand-based greens rarely exceeds 3-meq/100 g of soil, while the CEC of a fertile clay loam soil will generally be in the range of 25-30 meq/100 g of soil. As cations are removed from the soil solution, either by plant uptake or by leaching, they are replaced by elements from CEC sites.

Soils with low CEC are often deficient in several essential elements, as fewer sites are available to hold cations. As a result, sand-based greens have limited nutritional reserves, which could be detrimental to plant growth and development if special considerations are not made in fertilization.

By design, greens with high-sand root zones are very permeable. Sand-based greens are normally constructed using 80 to 85% sand, which reduces compaction and facilitates rapid drainage and water movement through the root zone. These properties are generally desirable as they limit the influence of excessive rainfall on sports play. However, a very permeable root zone may also increase the rate of leaching.

Spoon-feeding programs

Spoon-feeding fertilization is the frequent application of liquid fertilizers at low rates. It has become the standard means to fertilize sand-based greens and overcome their nutrient holding capacity shortcomings. In a typical program, nitrogen (N) is applied in the range of 0.10-0.25 lb. per 1000 sq. ft. every one or two weeks. Spoon-feeding affords versatility in a fertility program, as it allows turfgrass managers to rectify nutrient deficiencies quickly, while providing just enough nutrition to promote healthy growth. Judicious applications will also limit nutrient leaching from the root zone.

In a typical spoon-feeding program, nitrogen (N) is applied in the range of 0.10 to 0.25 lb. per 1000 sq. ft. every one or two weeks.

Historically, spoon-feeding programs have necessitated the use of liquid fertilizers to produce uniform turf response. Dry materials applied at low application rates of N generally produce a spotted appearance on the green surface because they cannot be applied uniformly. New production methods and formulations have resulted in granular materials that can potentially be used for spoon-feeding.

To be considered for use in spoon-feeding, a granular material must have a relatively low N analysis and a large enough volume to be applied uniformly to the surface. The particle size should also be relatively small for uniform application and to decrease the possibility of removal by mowers.

Liquid vs. granular materials

Public perception, personal preference and the cost of the product fuel the debate between liquid and granular fertilizers. Liquids are thought to provide more flexibility. With liquids, turf managers can easily change the N-P-K analyses and include micronutrients and different pesticides in the same application. With granulars, mul-

Traditionally limited to liquid fertilizers, spoon-feeding may also be possible with dry materials if the right fertilizer formulation is used.

tiple products and applications would be needed to achieve the same flexibility.

New granular production techniques allow for custom formulation for each application. Custom blended granular fertilizers can be manufactured with micronutrients and pesticides.

The public generally assumes that granular materials are safer for them and the environment. Phrases such as "spray drift" and images of applicators wearing respirators and protective suits reinforce this belief. The public may react more favorably to granulars because they can relate to it as something they may do on their own lawns.

Cost and storage space may also affect a decision between granular and liquid materials. The initial cost of granular materials is often higher than liquids. But application equipment is more expensive when using liquid materials due to the initial investment in sprayers. Storage space can also be an issue, as granular materials take up a larger volume than liquids for a comparable amount of product, increasing the room required for storage.

The principal objective of recent research performed at the Iowa State Horticultural Research Station was to determine the effect of granular fertilizers on turf color and uniformity when applied in a spoon-feeding regimen as compared to a liquid fertilizer comprised of urea and potassium sulfate.

Materials and methods

The trial was arranged on a 'Penncross' creeping bentgrass (Agrostis palustris Huds) green built to USGA specifications. The green was mowed daily at 0.150-in. and irrigated as necessary to prevent desiccation. A randomized complete block design with three replications was used.

Each individual block consisted of nine fertilizer treatments and an untreated control. The nine fertilizers used in the study included eight granular, controlled-release urea fertilizers and a liquid fertilizer composed of urea and potassium sulfate (Table 1).

All of the fertilizers were applied at a rate of 0.25 lbs. of N/1000 sq. ft. at 10-day intervals. Granular fertilizers were applied to 5X5 ft plots by hand, and in two different directions, to ensure uniform coverage.

The liquid fertilizer applications were made using a CO2-powered backpack sprayer calibrated to deliver 3.0 gallons of material/1000 sq.ft. The first fertilizer treatment applications were made on May 22, 2000 with subsequent applications made at 10-day intervals.

Weekly, visual turf evaluations of color and uniformity were made on a scale from 1 to 9, with 9=best, 6=lowest acceptable and 1=worst. In addition, tissue samples were taken from each treatment plot every thirty days and analyzed for total nitrogen content. The Iowa State University Horticulture Nutrition Laboratory used the Kjeldahl method to determine the total nitrogen content.

Results

Weekly color ratings indicate that all three of the Novex materials and the Sustane/Novex 12-2-12 fertilizer produced high color ratings, with the liquid fertilizer consistently producing the best color ratings (Table 2).

The UHS 14-14-14 fertilizer and the untreated control resulted in the lowest color ratings and the Sustane/Nutralene 10-2-10, Lesco PPSCU 29-0-0 and Scotts Contec 19-3-19 produced intermediate ratings. The liquid fertilizer also consistently produced the highest uniformity ratings (Table 2). At the other end of the spectrum was the UHS 14-14-14 treatment. The UHS 14-14-14 treated plots at times exhibited several small green spots of over-stimulated turf and poor nitrogen distribution characteristics. Only the untreated control received lower uniformity ratings than the

TABLE 1

FERTILIZERS EXAMINED IN THE STUDY

Fertilizer	Analysis	Designation	Manufacturer
Liquid[1]	NA	Soluble	NA
PPSCU	29-0-0	Sulfur-coated urea	Lesco
Novex	18-2-18	Aminoureaformaldehyde	Lesco
Novex	19-2-19	Aminoureaformaldehyde	Lesco
Novex	32-0-0	Aminoureaformaldehyde	Lesco
Contec	19-3-19	Methylene urea	Scotts [2]
Sustane/Nutralene	10-2-10	Organic-methylene urea	Sustane
Sustane/Novex	12-2-12	Organic-aminoureaformaldehyde	Sustane
Signature	14-14-14	Methylene urea	UHS
Untreated Control	NA	NA	NA

1 COMPRISED OF UREA (46-0-0) AND POTASSIUM SULFATE (0-0-50)
2 NOW HANDLED BY THE ANDERSONS FERTILIZER COMPANY
NA INFORMATION IS NOT APPLICABLE

TABLE 2

AVERAGE VISUAL QUALITY AND TOTAL NITROGEN CONTENT OF 'PENNCROSS' CREEPING BENTGRASS OVER THE 14 WEEKS OF THE STUDY

Treatment	Color	Uniformity	Total Nitrogen
Liquid3	8.8	8.5	2.9
Lesco PPSCU 29-0-0	8.0	7.7	2.8
Novex 18-2-18	8.5	7.9	2.9
Novex 19-2-19	8.6	7.9	2.9
Novex 32-0-0	8.4	8.0	2.8
Scotts Contec 19-3-19	7.9	7.9	2.9
Sustane/Nutralene 10-2-10	8.0	7.8	2.8
Sustane/Novex 12-2-12	8.6	8.0	3.0
UHS 14-14-14	6.9	6.6	3.0
Untreated Control	5.6	5.8	2.3
$LSD_{0.05}$	0.3	0.6	0.4

1 VISUAL RATINGS WERE ASSIGNED USING A 1 TO 9 SCALE, WITH 9=BEST, 5=LOWEST ACCEPTABLE AND 1=WORST.
2 REPORTED AS PERCENTAGE OF NITROGEN PER GRAM OF DRY WEIGHT TISSUE
3 COMPRISED OF UREA (46-0-0) AND POTASSIUM SULFATE (0-0-50)
NS - MEANS BETWEEN TREATMENTS ARE NOT STATISTICALLY SIGNIFICANT PER FISCHER'S LSD TEST.

UHS 14-14-14 fertilizer. The remaining seven fertilizer materials achieved uniformity ratings that were intermediate between the liquid and UHS 14-14-14 fertilizer treatments.

Plant analysis of the total N content of grass tissue indicates no significant differences between any of the fertilizer treatments (Table 2). This suggests that all of the fertilizers were equally effective supplying the grass with N. As expected, the grass in the untreated control had the lowest total N content.

The liquid fertilizer treatment resulted in the highest color and uniformity ratings of all the treatments. The three Novex and Sustane/Novex 12-2-12 materials also produced high color and uniformity visual ratings. They were similar in color to the liquid treatment, with only a slight reduction in uniformity. Based on these results, we believe that these fertilizer materials can be used in a spoon-feeding program.

The Scotts Contec 19-3-19, Sustane/Nutralene 10-2-10 and Lesco PPSCU 29-0-0 produced plots of intermediate overall quality and may also be considered for use as spoon-feeding materials.

The only fertilizer tested that we would be hesitant to include into a spoon-feeding regime would be the UHS 14-14-14. The authors acknowledge that this product was not designed for spoon-feeding. This fertilizer would simply not be capable of providing acceptable color and uniformity if utilized in this manner.

The UHS 14-14-14 fertilizer particle is large and was designed primarily for use in higher mown turf and at higher application rates. Under these conditions this material performs well, producing turf of more desirable color and uniformity, but when applied at low application rates it was unable to produce an even turfgrass nitrogen response.

Conclusion

Spoon-feeding represents a precise form of nutrient management as it allows for great versatility and flexibility in a fertilizer program. Turf managers can correct nutrient deficiencies quickly, while negating the possibility of nutrient leaching and runoff from the site of fertilizer application. Traditionally limited to liquid fertilizers, spoon-feeding may also be possible with dry materials if the right fertilizer formulation is used.

With the advent of new technological improvements, however, granular fertilizers have been created that can potentially be used in a spoon-feeding program. The Novex and Sustane/Novex fertilizers utilized in this study produced excellent turf color and uniformity when applied at light, frequent applications. This implicates that these materials could be incorporated into a spoon-feeding fertilizer program and offers another management option for turfgrass professionals.

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