Fertigation:

The legacy of a Florida Success story

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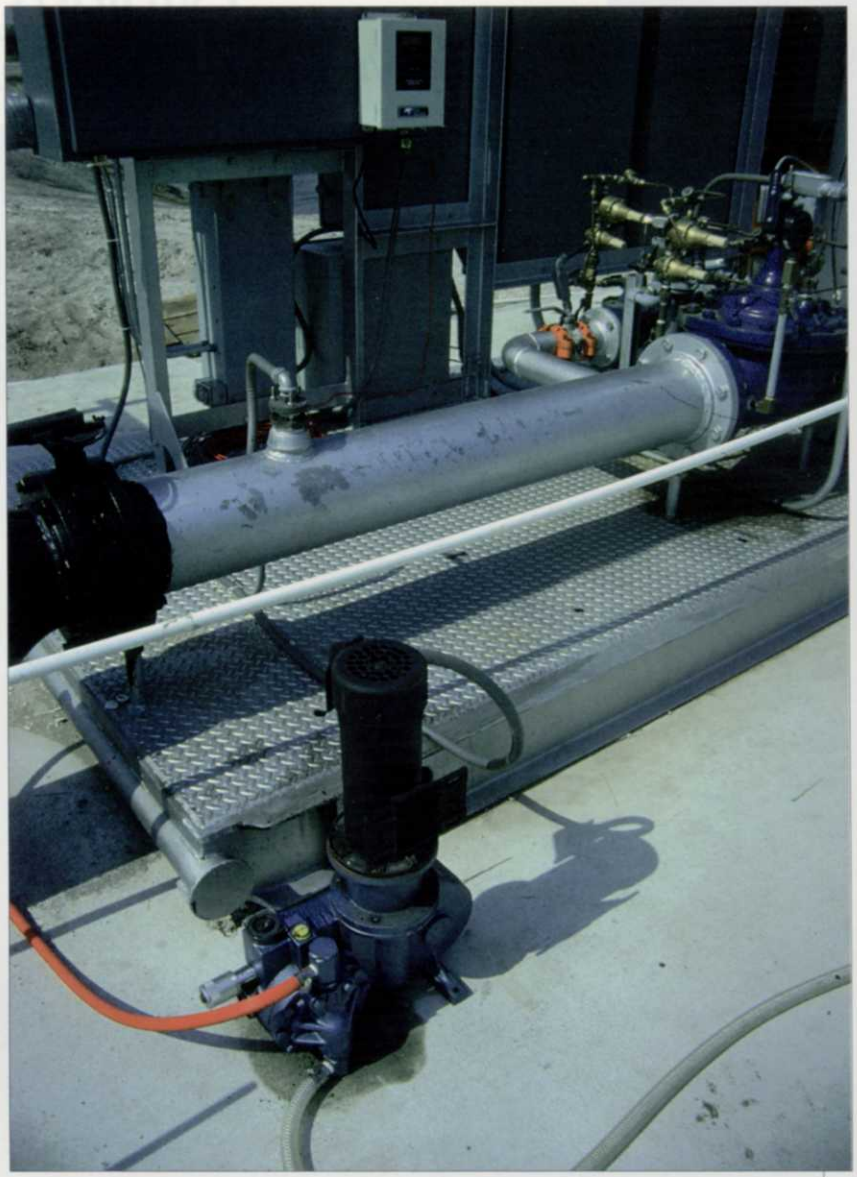

The liquid fertilizer delivery rate of the pump in the foreground is regulated by the controller in the background to provide a preset ratio of fertilizer to irrigation water regardless of the amount of water being applied. Photo by John Cisar.

In Florida, fertigation systems are almost as common as PCs are in the home, or in a golf course manager's office. Yet not that long ago, both fertigation systems and the PC were relatively new technologies that were not universally adopted or accepted (*Bengeyfield, 1972*). Go back a few more years and these present-day necessities were just someone else's dreams.

Actually, it was nearly 50 years ago that Dr. Roy Bair (1949, 1950), a University of Florida agronomist located at the Everglades Experiment Station in Belle Glade, first discussed the successful use of turfgrass fertigation, the practice of applying fertilizers through the irrigation system.

Thirty years later, Dr. George H. Snyder, professor of Soil and Water Science at the same institution but unaware of Dr. Bair's work, verified fertigation as an agronomically-sound approach to fertilization of turfgrasses (*Snyder and Burt, 1976*).

Dr. Snyder, who worked on turfgrass with Dr. Evert Burt at the Ft. Lauderdale Research and Education Center, was inspired by an aggressive and progressive member of the Boca Raton Yacht and Country Club, John Church, who himself was inspired by the fertigation work being conducted by Ed Darlington and Dr. Max Brown of Liquid Ag Systems in Pompano Beach.

Prior to Dr. Snyder's involvement, no one had conducted turfgrass fertigation studies in a scientific manner that permitted a statistical analysis of the results.

Drs. Snyder and Burt, with the assistance of a high school student, Lloyd Purdy Jr. (now with Duda Sod, Oviedo), developed a turfgrass fertigation facility in Ft. Lauderdale having randomized, replicated, plots and later, having instrumentation for measuring nutrient leaching.

Work conducted at this facility provided a scientific basis for evaluating certain commercial trials by golf courses and fertilizer companies that played a large part in the expansion of golf course fertigation in Florida.

Florida and fertigation a perfect fit

Why was Florida such a good candidate for fertigation?

Frankly, the severe turfgrass growing conditions in Florida are almost ideal for adopting fertigation strategies.

First, in order to obtain the maximum benefit of fertigation (i.e., optimal nutrition from frequently applying small amounts of fertilizer) frequent water application is needed. Our climate provides that opportunity because of the high evaporative demand which requires frequent irrigation to replace evapotranspiration losses.

Second, Florida's sandy soils hold little water, making it necessary to irrigate frequently with an efficient irrigation sys-

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tem that provides uniform water application over the turf area, even during the traditional rainy season.

Third, Florida soils generally are infertile, and have little capacity to retain the many essential fertilizer elements that must be available over an extended period of time.

Poor nutrient retention by rapidly-draining, coarse-textured soils, high Florida turfgrass fertility requirements, high annual precipitation, and shallow potable groundwater resources, all combine to focus concern from the public on the environmental impacts associated with turfgrass management practices.

Fertigation offers the opportunity for superintendents to accurately control the quantity and timing of required fertilizer in an environmentally-responsible manner.

Initial experiments conducted by Snyder et al demonstrated how fertigation could conveniently provide small amounts of inexpensive soluble fertilizer nutrients, such as nitrogen, to maintain high quality turf (*Snyder and Burt, 1976*).

Later tests confirmed the utility of the application method to stabilize turfgrass nutrition by keeping a consistent amount of fertilizer within the relatively shallow turfgrass root system and available for absorption by the grass (*Snyder et al., 1989*).

Finally — and perhaps most importantly — because fertigation permits low rates per application, it has been proven through research to reduce nitrogen leaching better than water soluble fertilizer applied less frequently at higher per-application rates (*Snyder et al., 1977*), providing results similar to those obtained with expensive controlled-release fertilizers (*Snyder et al., 1984*).

Thus, since fertigation provides a practical solution for agronomic, economic, and environmental concerns it is clearly understandable why it is so widely adopted by Florida golf course managers today.

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Fertigation methods

Fertigation is best used to apply fertilizer to turf in frequent, but low per-application rates. Total fertilizer application over time may remain the same as is used for conventional fertilization with dry sources, although many users have reported that lower fertilization rates can be used when fertigation is employed.

The key advantage of fertigation is that the total application of fertilizer can be split up into light, frequent doses of nutrients that can be readily absorbed by the turf without requiring much more labor than is needed for the irrigation itself.

Since the turf is fertilized frequently, growth is consistent over time, and since the per-application rates are low, uptake is rapid, efficient, and there is little unadsorbed nutrient left in the soil solution to leach into the groundwater.

The cost of fertilizers for fertigation should be very competitive with their dry counterparts, and, in fact, should be much lower than controlled-release sources.

The fertilizer can be delivered in liquid form directly to a storage tank, or in some cases via an inlet pipe connection conveniently located near an access road some distance from the storage tank. Liquid fertilizers can be pumped over distances and elevations without the manual effort required for moving dry fertilizers.

Generally fertigation should be used for nutrients that are difficult to manage in the soil, i.e., that are not retained well in the soil. Examples include nitrogen in virtually all soils, potassium in sand soils, and micronutrients such as iron and manganese in calcarious soils.

Nutrients such as calcium, magnesium, and phosphorus are retained well by many soils and can be applied infrequently at relatively high rates. Fertigation is less advantageous in these cases, par-

ticularly if these nutrients lead to a less soluble and stable liquid mix.

Fertigation does not have to be the sole fertilization method.

It often is better to use fertigation to provide a uniform rate of fertilization over a golf course, and then supplement greens, tees, and other high-use areas with foliar, drench, or dry fertilizers, as opposed to attempting to apply varying rates of fertilizer by fertigation differentially over the course.

Additional instructions and suggestions for using fertigation on golf courses have been published elsewhere (*Snyder and Burt, 1974; Snyder and Burt, 1977; Snyder and Burt, 1978; Snyder 1979; Snyder 1987; Snyder, 1994*).

New and innovative uses of fertigation for turf

What about the current research trends and uses for fertigation systems?

Actually, the method of fertigation hasn't changed too much, although the newer injection systems are more sophisticated and often use flow-sensing devices to maintain a constant, though adjustable, concentration of fertilizer in the irrigation water.

But the original concept remains. What has changed is the array of chemicals injected with fertigation systems. Initially designed to inject inexpensive, soluble, inorganic nutrient sources, fertigation now is being considered for application of various soluble organic-based nutrients, organic matter extracts, and biostimulants.

Such studies are under consideration for study at the FLREC.

Fertigation has been adopted for solving other turfgrass agronomic problems as well.

In certain parts of Florida, high calcium carbonate levels in irrigation water from dissolved limestone along with appreciable lime in the soil can result in high-soil-pH-induced micronutrient deficiencies, and in reduced percolation due to precipitated carbonates.

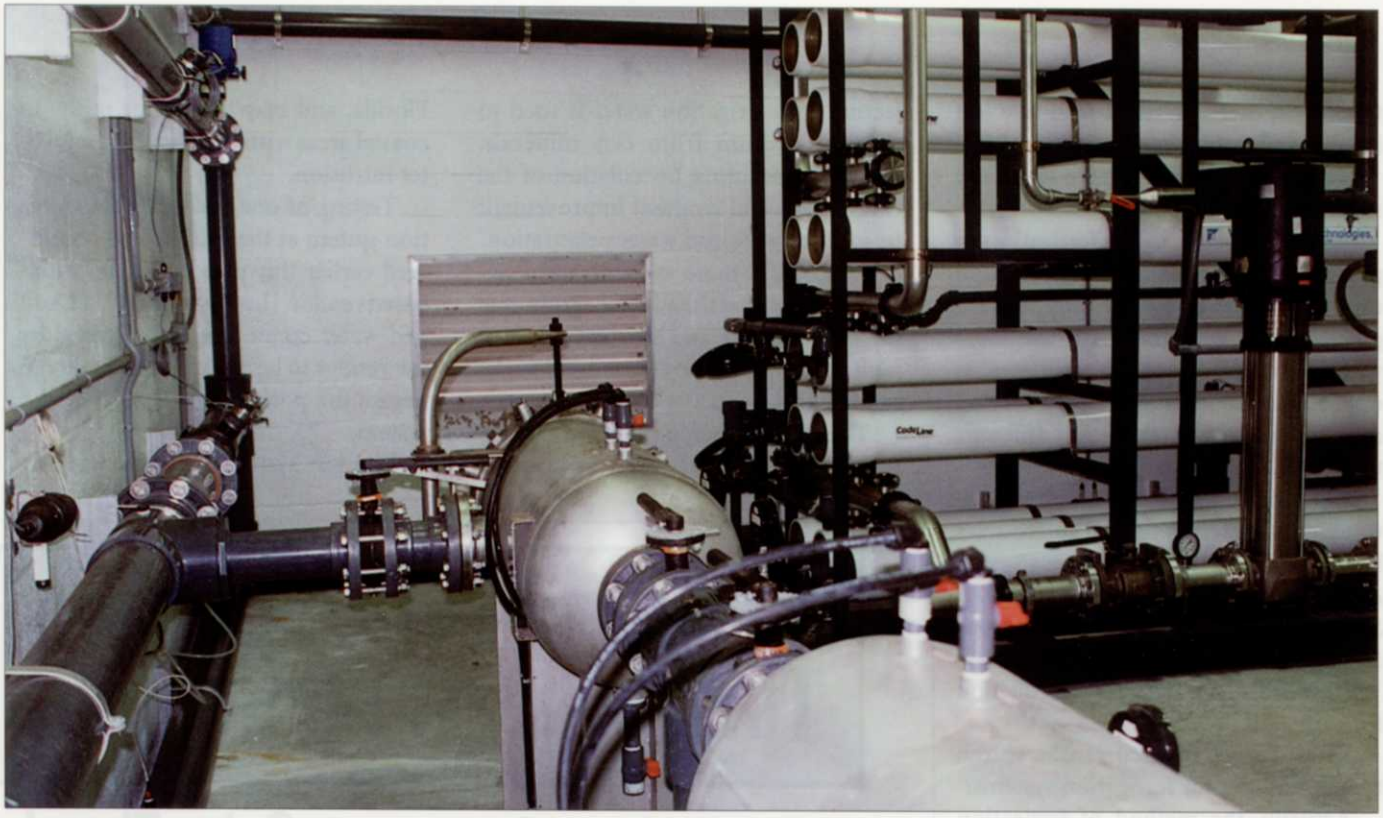
Fertigation systems have been designed to monitor irrigation water pH and automatically inject pH-reducing chemicals into the water to obtain a desired pH. Gypsum (calcium sulfate) injection into irrigation water is used to displace sodium from clay minerals, thereby promoting flocculation of the clays with a concomitant improvement in soil structure and water penetration.

Originally, these systems were designed to combat the adverse agronomic impacts on crops, and now turf grown in high sodium-affected clay soils throughout the arid west.

They now are being marketed to combat sodium-affected turfgrass areas in Florida, and may have some utility in coastal areas with high levels of saltwater intrusion.

Testing of one such gypsum injection system at the FLREC was considered earlier this year by a California-based vendor. However, the FLREC soil and water conditions were judged by the vendor to be of sufficient quality to negate the potential usefulness of the system.

The test system was, however, in-



Make your own water

Since 1996, Peter Brooks at the Everglades Club has been making his own irrigation water from salt water by using a reverse osmosis process. There are two units each capable of producing 300,000 gallons per day. Pete's pump station can deliver 15,000 gpm, but the RO plant can only make 4,100 gpm. So, Pete stores some of his water in a four acre irrigation holding lake. He tries to match flow projections from his Network 8000 to the water needs on the course.

stalled in early 1997 at a golf course in Jupiter, and we await the results of that test.

Conclusion

Fertigation has evolved from a questionable golf course fertilization technique to a commonly-used method of maintaining high-quality turf. Fertigation has been shown to stabilize turfgrass nitrogen nutrition and minimize nitrogen leaching.

Today, fertigation systems are being used to apply chemicals for various purposes other than fertilization. The future may see the use of fertigation systems for applying various organic and biological compounds that assist golf superintendents in providing quality turfgrass.

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