Fertigation Overview

PRIME TURF

Introduction

Fertigation is the practice of fertilizing through irrigation. It can be viewed in several ways:

1. The injection of liquid fertilizer into irrigation mainlines.
2. The blanket coverage over all irrigated areas with nutrient-bearing water.
3. The frequent application of light amounts of nutrients that are not easily stored in the soil such as nitrogen, potassium, and sulfur.
4. The controlled release of fertilizer via the controlled application of fertilizer.

Fertigation has been seen as a tool that can help accomplish the goals of agronomic and aesthetic lushness with relative ease. It enhances the efficiency of meeting the nutritional needs of both turf and ornamentals.

Simple to use, a Fertigation set-up can simplify application of needed plant-available nutrient inputs. A proper system can give the Superintendent the ability to manage nutrient inputs as needed, in required ratios. It allows the turf professional to select exactly what he needs. Whether it is nothing but Nitrogen, or Potassium, or even a few micronutrients, Fertigation allows the selection of nutrient inputs as needed or whatever fits the "prescription" to match stage of growth, use-purpose of turf, time of year, as well as saving operating money.

Irrigation and Fertigation systems are becoming more advanced and easier to use because of new technology. Combined with the knowledge that light, frequent applications of nutrients are an effective nutrition-management strategy, the technique is becoming more popular in the turf industry. Fertigation can stabilize fertilization programs by keeping nutrients in the root zone. Users report both environmental and economic benefits and allowing them to concentrate on other priorities.

Golf course superintendents have actually been using a form of Fertigation for years as they boom sprayed greens with soluble fertilizers. It is well accepted that delivery of soluble nutrients to greens yields the dual benefit of foliar absorption as well as root absorption of nutrients. The applied fertilizer is kept within the root zone and is replaced with another application as the plant uses the nutrients and as subsequent irrigation leaches nutrients past the root zone. This technique is an excellent example of the controlled release of fertilizer via the controlled application of fertilizer.

Benefits of Fertigation

When applying fertilizers through a Fertigation system, there are several benefits. Applications can be targeted to specific areas, less equipment is used and fertilizer is applied into the soil, where it will be most effective. This means fertilizer can be applied at a lower rate and be more efficient and inexpensive to suit the exact needs of the plant.

In the situation of golf courses and large turf areas, the irrigation layout is divided into sections or stations. Each station can cover a specific green, tee or section of fairway. With this in mind the chemicals can be applied to specific areas. In a golf course scenario if your greens or a any other specific area needs a boost but everything else does not, you can run the irrigation with added fertilizer on just those specific stations. You can supplement the areas without worrying about over-fertilizing into other areas.

The worse thing to see on the greens of your course is tire tracks that can effect putting. When fertilizing through your irrigation, there is really little need to go out on the course for fertilizer applications. With Fertigation, compaction due to equipment travel is eliminated. Also, since heavy spreader equipment isn't needed out on the course, equipment costs are lowered drastically. The one time cost of a Fertigation system out weighs the multiple costs of spreading equipment and labor costs heavily. Not having to be out on the course also means that you can apply chemicals in conditions that would make conventional application damaging or impossible. Suppose it's the rainy season in your area and your grass is in desperate need of nitrogen. The light application of nitrogen can be applied without having to go out onto the soft ground, without the possibility of tire tracks or getting equipment stuck in the mud. This is also a key consideration in what many believe is the "*sweetest spot*" for Fertigation: The Grow-In. Fertigation can significantly shorten grow-in time while reducing damage to the golf course. During this period, plant growth can be accelerated to maximize coverage to minimize runoff and erosion. Further new turf refinements such as hardening of the plant can also be achieved after the coverage phase via the addition of nutrients.

With direct penetration of the fertilizer, a lower rate of application is more effective. Through a combination of soil samples and tissue samples, the grasses can actually be "spoon fed" the nutrients they need without excess wastes. Most users of fertigation prefer to do multiple applications at a lower rate. This suits the needs of the plant at the time, which produces a better yield in turf density, quality and heartiness. There is also the factor of eliminated overcast. Sprinklers are usually adjusted to only water in the turf areas and not in surrounding fields, woods, lakes or roads. This eliminates overcast of essential nutrients that may come with use of mechanical spreading equipment or operator error. Taking this into consideration and the fact that only the needed amounts of fertilizers are applied, the amount of fertilizer used is reduced. Since less fertilizer is applied your cost application is lowered.

Microprocessor control of the fertilizer injection rate to match the flow of irrigation water is so precise that application rates are substantially lowered. When fertilizing through fertigation with a well planned and monitored schedule, there is less chance of leachable nutrients not being absorbed by the plant and overcast into non-target areas is eliminated. Usually, the application can be applied with irrigation schedules so that the liquid fertilizer will only penetrate the first two to three inches of the soil. If timed right, deep percolation at application time is avoided meaning less likelihood of leaching.

Some of the advantages of fertigation include the following:

1. It eliminates the danger of burning turf.
2. Each application costs nothing in equipment or manpower.
3. Efficiency of nutrient utilization is excellent.
4. Distribution of fertilizer is uniform.
5. Micro-nutrients and soil conditioners can be very effectively applied.
6. Poor quality irrigation water can be treated.
7. Cost of liquid fertilizers is less than "slow release" fertilizers.
8. There is no conflict with golf play.
9. Nutrient leaching losses are minimized.
10. Ultimate control of turf color and growth rate is possible.

The most important rule is that all nutrient application rates are controlled by superintendents, and they can apply nutrients lightly at close intervals automatically. You are not storing in the soil large quantities of nutrients that can cause uncontrolled plant growth, or be leached away by rains. Feed for color, and control the plant-growth rate based on nutrition diagnostics.

In order to determine the quantity of nitrogen needed to provide the proper growth and color desired for the particular facility, it is necessary to make a light application, say 0.25 pound of nitrogen, and observe the response. Only after this observation will it be possible to determine the proper application rate. The ideal level should be approached from the low side. You can always add more - it is hard to take it off.

The “spoon feeding” approach system is the proper tool to make the very small application rates necessary to be able to control the rate of growth. The hardest thing to get people to do is to shut off the injection system and allow the plants to respond to the previous applications. It must be remembered that, with the concept of “spoon-feeding” the application of a quarter pound of fertilizer should take an extended period of time to apply.

The application at very low concentrations allows the fertilizer to be placed deeper in the soil and more evenly than ever before possible. Because of the low concentration of the

fertilizer in the irrigation water, it is possible to make very even placement of the fertilizer, even on soils that vary greatly in clay content. When the nitrogen is placed deeper, the conversion of ammonium ion to nitrate can take place at a more controlled rate. This is possible because the temperature is lower in the deeper regions of the soil, and the rate of conversion is slower at the lower temperature.

Granular vs. Liquid

The prevailing strategy for granular fertilizer revolves around "quick release" and "time release." Fertilizer manufacturers have, over the years, developed some interesting techniques to retard the release of nutrients. These protective coatings started over ten years ago after complaints from turf managers about the lack of control over nitrogen release. They were concerned about the high labor component after each fertilizer application. The new formulations started with sulfur-coated urea and have evolved to polymer coatings and plastic coatings of various assortments. These processed fertilizers have become expensive in the process.

Liquid fertilizers can be custom formulated based on diagnostics and can be delivered to provide a minimum level of acceptable fertility to control growth. But if additional color or growth is desired (for a special tournament, for example) a push of a button on the injection station can deliver more nutrients. Furthermore, the release factors associated with some slow release granular products such a watering rates, microbial activity and temperature are not considerations with Fertigation. Leaching of nutrients is minimized because of the low application rates. Excess fertilizer is stored in a tank, not in the soil where it may leach out.

Equipment

Installing Fertigation systems into existing irrigation systems for golf courses or playing fields is easy and fairly inexpensive. The technique is to tie liquid fertilizer tanks into the main irrigation lines to evenly distribute fertilizer into the system. Injection rates are managed by a heavy duty chemical metering pump. This pump is controlled by a controller which is tied into the irrigation control panel and monitors the rate of flow of irrigation water.

The metering pump is then calibrated to rates dependent on the specific fertilizer being applied. There are also control valve options and multiple head systems which allow multiple tanks to be on the same system. The fertilizers can then be applied separately or combined for a specific blend.

The successful application control of liquid fertilizer revolves around the nutrient Control and Injection station. The better injectors come as a complete system and include a microprocessor controller; an in-line water-flow sensor that controls the pump motor speed for proportional injection; stainless steel main-line injection lances, pumps capable of pumping out of bulk-storage tanks or drums. These systems should be fully integrated into an easy-to-use, flexible configuration.

Prime Turf Fertigation and Chemigation stations are compact, skid mounted systems that accurately pace the dosing of liquid treatment products into irrigation water automatically. Proper proportional dosing assures that the investment in these treatments is maximized and the intended benefits are fully realized.

The system operation uses a sensor to measure flow in the main irrigation line. An optically isolated flow signal is transmitted to a flow proportional microprocessor which adjusts the pump output to assure precise delivery of proper chemical dosage.

The patented Chem-Check chemical Injection Lance and Check Valves are the simplest, most efficient way to inject chemicals in a broad range of applications. This unique O-Ring, multi-port design is superior to the traditional "angle cut" quills in it's ability to more completely disperse the chemicals and provide backflow protection. This new design eliminates the well known problems caused by springs, ball checks and other retaining devices used by conventional designs.

A customized, easy to use, timer / event feature is ideal for managing various feed profiles for a wide array of programs and applications. All programmable logic is managed with a few simple commands entered via an operator friendly touch screen.

The Fertigation Series pumps are corrosion resistant with 316 stainless steel in all wetted areas. This has been proven to provide reliable service under even the most rigorous conditions.

Two standard configurations (30 and 80 gph) cover a broad range of applications. Larger applications (up to 160 gph) require the dual head option. This option will also allow for the feed of two separate products and offers the superintendent maximum flexibilty in the fertilty program.

Prime Turf installs and services this equipment and supports it with a comprehensive one- year warranty, on-site service and toll free technical support**.**

This a typical worksheet illustrating the calculations used to determine intial feed rates and pump settings.

Required Information:

(A) = Number of acres to fertigate: _____

(B) = Fertilizer Density (lbs./gallon): _____

(C) = Fertilizer Analysis (%): _____

1). _____ **x 43.56 (1000 ft^2/ acre) =** _____**(D)**
(A) **(# of 1000 ft^2 units to irrigate)**

2). _____**x** _____ **=** _____ **(E)**
(Lbs. of nutrient to treat one 1000 ft^2 unit) **(D)** **(Total Lbs. of Nutrient required)**

3). _____ **x** _____ **=** _____**(F)**
(B) **(C)** **(lbs. Nutrient / Gallon of Fertilizer)**

4.) _____ **÷** _____ **=** _____ **(G)**
(E) **(F)** **(Total Gallons of Fertilizer required)**

5). _____ **÷** _____ **=** _____**(H)**
(G) **(# of hours to Fertigate)** **(Fertilizer feed rate in GPH)**

6.) _____ **÷ ((Pump Capacity GPH) x 100 =** _____
(H) **(Pump Stroke Setting)**

Other Things You Should Consider

Like any other form of technology, some aspects of Fertigation require you to learn a few principles so you'll use it most effectively and without experiencing significant problems. Knowing a little about the potential problems before using Fertigation prevents a lot of frustration later.

Differences in fertilizer materials.

Most of the problems encountered in the use of Fertigation relate to the quality of the fertilizers you use. A large part of the problems revolves around phosphorus fertilizers and their solubility. Depending on formulation, phosphorus-fertilizer solubility may range from 30 percent to almost 100 percent. Most potassium and inorganic nitrogen (N) fertilizers are almost 100 percent soluble.

Blending fertilizer materials can induce another set of problems. A poorly blended fertilizer material may not stay in solution. It can precipitate, settling to the bottom of the tank to form a messy sludge. This can result in a fouled system and incorrect fertilization rates. The best way to prevent this occurrence is to ensure that the fertilizer is high-quality and soluble. The best way to do this is to buy from reputable suppliers that stand behind their products.

However, even high-quality fertilizers designed for Fertigation systems can precipitate or salt-out under certain conditions. Temperature variations can cause this occurrence, and you should consider the potential for this problem before storing fertilizers for extended periods. Check with your supplier to ensure that the fertilizer you've chosen is formulated for the time of year you'll be using it and the expected temperatures in your area.

In the event that salt-out problems occur, dilute the concentration in the tank with water until the problem dissipates. In extreme cases, you'll need to remove solid material at the bottom of the tank either manually or by suction pump.

Compatibility can be a problem.

Keep in mind that not all liquid-fertilizer materials are compatible. It is important to rinse the tank before you introduce new materials into it. For example, phosphorus can be a particularly difficult nutrient to use in Fertigation systems when other nutrients are present. Phosphorus will react with magnesium sulfate and calcium sulfate to form insoluble precipitates. When a precipitate forms, your system may clog up and stop working properly.

You can prevent this from becoming a problem by taking a couple of different steps. One solution is to have separate tanks for reactive materials such as phosphorus. A second,

less costly solution is to carefully rinse out the tank before and after using different materials. This is especially effective and less costly because you may only apply some materials a few times a year.

You can add many materials to the fertilizer holding tank without negative results. For example, many turf managers add micronutrients through fertigation systems. Due to solubility problems, micronutrients are often chelated to help them stay in solution. You'll also often see surfactants added directly to the fertilizer mixture.

Before adding anything to the tank, test the compatibility of materials using the jar test. To do this, take some fertilizer solution from the holding tank and put it into a jar. Then add the material in question at the recommended rate. Shake the jar thoroughly and, over the next several days, watch for any change in composition. If no change occurs, it is most likely safe to add the material to the fertilizer holding tank at a similar concentration.

Check the pH of any materials you add to the holding tank. They should have a neutral pH (6.5 to 7.0). If the pH is too low, then the material could be corrosive to your equipment. When the pH is high, the micronutrients, as well as other additives, may be insoluble. Most suppliers will adjust the pH to prevent problems, especially if they are mixing and providing a prescription fertilizer analysis for you.

Know your irrigation system. You shouldn't install a Fertigation system without first consulting an industry specialist. In computer terms, the "plug-and-play" concept does not apply to hooking up a new Fertigation system. Irrigation efficiency and system design are two areas you may need to address before attaching Fertigation components to an older irrigation system.

Also keep in mind that because a fertigation system distributes fertilizers, it is important to only irrigate areas that require nutrients. Over time, Fertigation can cause problems such as algae growth on sidewalks or other surfaces. In some instances, nutrient-rich water can cause algae to grow on the sand in green-side golf-course bunkers. Also, ornamental plants typically do not require as much fertilization as turf areas, so you should adjust a fertigation system to meet the end-use demands.

Calibrating your fertigation system. When using a Fertigation system, the pumping rate per unit time or irrigation cycle is of major importance. Once you calibrate the system, you can apply exact quantities of nutrients with confidence. To properly calibrate a fertigation system, you don't need to understand advanced mathematics or the hydrology of the irrigation system. You simply need basic math skills, an understanding of proper irrigation frequency and a reasonable estimate of the irrigated area.

For example, you can apply 1 pound of N per 1,000 square feet per month by fertigating 16 times (about every other day) at a rate of 0.06 pound of N per 1,000 square feet each cycle. Using an estimation of the area being irrigated and the analysis of the fertilizer, you can determine the amount of N to apply by measuring the decrease of fertilizer in the tank.

For example, let's say the area you're irrigating is about 10 acres. To apply 1 pound of N per 1,000 square feet requires roughly 435 pounds of N. If your fertilizer is 11 percent N, it takes 3,960 pounds of fertilizer. You want 0.06 pound of N each time you irrigate, so divide 3,960 by 16. The result: you'll use about 250 pounds of 11 percent fertilizer during each irrigation.

The weight of 11 percent N fertilizer is about 10 pounds per gallon, so 25 gallons (250 pounds) is equal to 0.06 pound of N per 1,000 square feet for 10 acres.

With this information, you can set the Fertigation system's injection system for the necessary flow rate. Double-check the system by visually monitoring the amount of material pumped out of the tank during an irrigation cycle. Through experience, you can adjust the system until you reach the desired application rate.

Several scenarios could take place that might require you to re-calibrate your system. These include a change in the concentration of the fertilizer added to the tank, altering irrigation frequency or irrigation-system design changes. As the nutrient content of the fertilizer increases, you need less fertilizer. To achieve the same fertilizer application rate when you increase the irrigation frequency, you should inject a correspondingly lower rate of fertilizer into the irrigation system. The calibration procedure is the same for any size area from golf courses to home lawns. The control over nutrient application is as easy as a few simple calculations and turning a dial.

Although some can use Fertigation as the primary source of fertility, many use it to supplement a dry fertilizer program. One popular use of Fertigation is to give the entire turf area a quick green-up just before a tournament or special event. This is particularly true when preparation for a large event or special day eliminates any manpower to apply dry fertilizer over the entire turf area.

The Fertigation system allows you to best use your resources as well as provide optimum conditions. Only after you become familiar with your system will you realize the full benefits of Fertigation.

Some Voiced Concerns

Some concerns regarding the potential for "**Green Circles**" have been expressed by owners of older irrigation systems, or less than ideal sprinkler spacing. While this may be valid at high rates associated with infrequent injection, when mini-dosing is practiced on a more frequent basis the coverage is very even. Even coverage is achieved because the sprinkler impact area will move around slightly with changes in the wind and fill in spacing gaps. Also, the spray mist will carry the nutrients to other areas. This light foliar application will produce a very even coverage and color response.

Worries about "**Burning Turf**" in the event of a sticky sprinkler head ofr major leaks are also minimized by mini-dosing. The mini-dose injection rate of the system is designed to prevent this from ever happening. The typical injection rate is 20 to 500 parts per million. Accordingly, if one irrigates using one million gallons of water, the application of up to 500 gallons of fertilizer. In the event of a major leak, during which the irrigation pump delivers 20,000 gallons of water to the affected area, there will be ten gallons of highly diluted fertilizer or less in that water. In this occurrence, we'd expect a greening but no damage to the turf.

The production of a **proper root structure** is tied to the foliar uptake. Since there is a foliar uptake maximum of roughly 25%, nutrient efficiency is enhanced and top growth is managed. The plant energy is directed to root growth.

The **uniform delivery** of fertilizer has been successfully carried out routinely. The practice of light, frequent injection assures that all areas receive the same rate. The fertilized water delivered farthest from the pump station will have the same nutrient rate as an area in close proximity to the pump station. The same amount of nutrient will be delivered as long as the same amount of water is delivered. Uniformity is assured because the entire system is charged with the same amount of nutrients.

Fertigation **will not replace dry** fertilizers. While the practice will allow you to apply at a high percentage of the nutrient requirements percent of your nutrient needs via the irrigation system, certain areas will need a dry fertilizer supplement. These ideas can be identified by visual determination, mowing practices and formalized diagnostic testing.

The **need to apply different types of fertilizers** is no different with Fertigation that with dry applications. The high water requirements attached to tees, greens and fairways typically match up with the nutrient rate requirements for these same areas. Under normal irrigation practices the ratio of most nutrients will be close.

Damage to the irrigation system is not a concern due to the low rate (ppm) of application.