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Optimizing Your Fertilizer Applications

Sean R. Jordan, *T.Ag., Technical Agrologist*

Efficiency ***noun*** \ ih-fish-uhn-see\: 1. the state or quality of being efficient; competency in performance. 2. accomplishment of, or ability to accomplish, a job with a minimum expenditure of time and effort.

This article is written based on the presentation "Optimizing Fertility" given at the Sports Turf Association Ontario Field Day in September and deals with improving the efficiency of applied fertilizer and amendment products.

Efficiency and Where Losses Occur

Being well into fall, we are transitioning out of the season of "go, go, go" turf management where many days we are happy if we are able to perform the basic tasks ahead of the sports, both organized and not, played on our fields. The months ahead will be filled with repairing, replacing, purchasing and just simply recharging our own batteries in between spurts of snow removal. The fall and winter are also when many purchases of the necessary inputs such as fertilizers and seed are made. Hours will be spent looking over soil test reports, considering user group scheduling and looking at budgets, to decide on the right products to apply. Despite the best planning and products, losses in efficiency can still occur. The following will look at where this happens and where management programs can be adjusted to make the most of the time and money spent planning fertilizer programs.

To best understand how to get the most of fertilizer and amendment applications, we must first look at where losses occur. The following points are presented in no particular order; they all directly contribute to less-than-expected results.

Timing. Apply fertilizers or amendments when they can be best utilized by the turf. Whether adding nutrients to the soil or directly into the plant by way of the foliage, you'll want to plan your application based on when the applied nutrients are of most use to the plant. Consult the accompanying technical materials or fertilizer supplier for more information on timing.

Imbalances. Liebig's Law of the Minimum states: "growth is controlled not by the total amount of resources available, but by

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Figure 1. Spreader alignment for pan test (photo courtesy of Ferti Technologies)

Figure 2. Evenly spaced pans to either side of path of travel (photo courtesy of Ferti Technologies)

the scarcest resource." This means that all of the 14 essential nutrients required for plant growth must be present in at least the minimal amount. Although some soils exist with natural imbalances that are nearly impossible to overcome solely through fertilizer and amendment applications (e.g. high calcium levels of southern Ontario), most issues can be dealt with once they are detected. Several methods exist to determine the nutritional state of the soil medium in which turf is grown including soil testing, plant tissue testing and simply looking at the plants for symptoms of deficiency or excess.

Soil testing can provide a good, basic picture of the soil chemistry and changes made over time by a nutrient management plan. While there is very limited research-based data on the exact nutritional needs of turfgrass, there exists a wealth of knowledge, based on years of management of turf in soils. This knowledge allows for fairly accurate fertility programs to be written based on soil analysis, combined with turf type and use requirements. Plant tissue testing provides confirmation of the ability of turf to take in and utilize the applied nutrients, and can also be used for pinpointing more specific issues not easily determined through soil testing. Looking at turfgrass stands for common symptoms of deficiencies such as discolouration of leaf blades and abnormal growth, can also provide clues that an adjustment in soil nutrient levels is necessary. These symptoms may also suggest that certain nutrients are not being taken up due to some existing conditions such as water-logging or cold soil temperatures.

Rate. The rate at which a fertilizer is applied is a very important factor in the efficiency of a fertilizer or amendment application. This will be expanded upon more in the discussion of calibration, further along in this article.

Slow Release Technologies. While the turfgrass industry is quite large, it still is only a small portion of the agriculture/horticulture industry as whole. As such, most of the products we enjoy using in turfgrass management were developed for use in agricultural and/or greenhouse production. We enjoy fruits of the labour spent developing fertilizer and pesticide products for those industries, along with a preview of how they can be best utilized for turfgrass. Among these are slow release nutrient technologies.

Most slow release research deals with the nutrient required in the greatest quantity by the plant: nitrogen. This is partly due to the issues surrounding the instability of nitrogen in the soil. Most nitrogen sources are urea-based as it is the most economical source, due to the relatively low cost of production combined with the high-percentage of nitrogen it provides at 46%. Straight urea, is unfortunately easily converted in the soil to forms that are lost to the environment through leaching and volatilizing as well as being tied up by certain soil microorganisms. Urea is frequently coated, reacted or made less prone to these changes through the addition of inhibitors to microbial degradation.

Additionally, many other nutrients are made slowly available for the purpose of reducing losses and improving plant uptake. Every slow release source has a specific mechanism of release. Many reacted and organic sources require time and soil conditions conducive to microbial breakdown. Some more advanced physical coatings require combinations of soil temperature and the presence of water to allow release in tune with the needs of the turf throughout the growing season.

When these sources are applied with expectations to feed during a time when soil conditions are not ideal for release, there is a large loss of efficiency.

Application. All of the resources spent developing the many products that we have available and creating programs best suited to the specific needs of the sites we manage is wasted if the final step, application, is performed incorrectly. There are many stages in the application process where efficiency can be less-than-ideal,

leading to significant losses in efficacy of our products. The next part of this article involves reducing these losses through good planning and education.

Fine Tuning Your Turf Management Program

A fertilizer or amendment product is only as good as the application.

While every aspect of a procedure is subject to improvement over time based on experience and new information, there are a few points relative to fertilizer applications that are often overlooked and can yield great returns if identified and addressed. These are: planning, proper application preparation and equipment calibration.

When I give a talk on calibration I often ask people in the audience: "When do you calibrate your spreaders?" Many times the reply is that it is done just before the application, if at all. A calibration performed under the pressure of time to get out ahead of play or field use is subject to error.

It is common for turf operations to have fertilizers in stock well in advance of application as well as spreaders and the operators to use them. Periods of time when the crew cannot be on the turf due to play, an event or even rainy weather, are built-in opportunities throughout the season for calibration. Most facilities have an equipment storage area that is well suited to use for a calibration of walking spreaders and even some driven ones, which makes this process fairly simple and efficient. By following the steps below, the cost of getting into a routine of calibration in advance and utilizing "down time" will be more than justified in product savings and results.

Many fertilizer and amendment products from companies that supply the turf industry, are formulated using years of experience, customer feedback and testing, to ensure the best results. All of the science and experience in creating products cannot offset the detrimental effect of misapplication. Quite simply, if a product is applied at an improper rate, at the wrong time or with a piece of equipment that has not been properly calibrated, it will not perform as expected.

Calibration: Point-by-Point

Calibration simply defined is "to adjust a feature for accuracy". We calibrate to ensure that the amount of product applied will do the job intended. If too much is applied, you could see negative effects such as excessive growth, increased susceptibility to pests, losses of nutrients into the environment and possibly turf loss. Applications at less than the desired rate will result in poor performance, less tolerance to stressors and a shorter interval before the next application is required.

The equipment used for granular and liquid applications is calibrated in similar ways, but has one distinct difference when it comes to every day applications; granular spreaders should be calibrated for every material as each product will spread differently based on particle sizing, particle shape(s), density and uniformity index. Additionally, every spreader applying a material should be calibrated as age, condition and set-up will vary from unit to unit.

There are three basic pieces of information necessary to calibrate application equipment: application rate, width and speed. Each is discussed individually below.

Rate. The application rate needed to calibrate a granular spreader is based on how much of the product needs to be applied to achieve the prescribed amount of nutrient, or active ingredient in the case of granular pesticide, to a given area. Most times, this information is provided in the technical literature that accompanies the product, or can be derived with some simple math.

The fluid application rate for a sprayer is based on the target area of the spray solution: the leaf blade, crown area or in the soil. These rates will vary from around 6 litres/100 m^2 (1.5 U.G. Gallons/1,000 ft^2) to possibly more than 20 litres/100 m^2 (5 U.G. Gallons/1,000 ft^2). More often than not, managers will calibrate their sprayers with multiple nozzles or at differing speeds/pressures to allow for a range of liquid application rates. Once the sprayer is properly calibrated and double-checked, it is simply a matter of making sure that the volume/weight of product added to the tank matches the amount of area to be sprayed.

Width. The distance from the spreader at which the amount of applied product is approximately one-half of what is applied directly in the path of the spreader is called the effective width. Spread patterns can be different, as there are several types of spreaders including broadcast (with single and double impellers) and pendulum-action, such as Vicons. Some have a triangular shape where the applied amount is gradually reduced as the distance from the spreader increases. Others have a flat pattern where the applied amount remains consistent to a certain point, and then drops off suddenly.

The most common method of determining the effective width of a material applied with a granular spreader is called a pan test and involves placing a series of shallow pans perpendicular to the spreader's path of travel to catch material. The pans can be something as simple as aluminum baking pans lined with cloth or paper, which prevents granular material from bouncing out (Figures 1 & 2). There will be an odd number of pans, with one in the centre and the rest at equal distances out from the centre on each side with one just shy of and one just beyond the estimated width of throw. It is necessary to spread over the pans in the same direction several times to collect enough material to determine the effective width. Always traveling the same direction will also help detect biases in the pattern that can be corrected by adjusting hopper openings or other components of the spreader. The width necessary to calibrate sprayers is the distance between nozzles as there is a simple formula that will provide a distance over which the sprayer should be timed for use later in the procedure.

Speed. The type of spreader being used determines the operating speed. Walking spreaders should be calibrated for each operator as ground speed directly affects effective width. Operators should calibrate at a speed that they can maintain throughout the entire spreading job. If an operator were to calibrate at a fast pace, and then slow down during some point of the spreading job, the applied rate would increase due to a decrease in effective width. To keep this organized, each operator would be assigned a spreader if there are to be multiple applicators for the same product. Differentiating like spreaders with a number or letter will

Figure 3. An example of a gate calibration device (photo: Sean Jordan)

Figure 4. A common calibration catch used for pedestrian broadcast spreaders (photo courtesy of White Castle)

reduce variables at the time of application.

The speed for a vehicle or tractor-mounted spreader should be safe yet productive. When determining a safe speed, the area of turf that poses the greatest danger due to slope or proximity of hazards should be the greatest limiting factor. Also, many times a tractor will be limited in choices of speed due to the fact that a certain engine speed must be maintained for PTO-driven spreaders and sprayers.

Once these three pieces of information are collected or determined, the process becomes one of trial and error to determine the correct spreader setting for each material (and operator, in the case of walking spreaders). Spreader settings that are given on the bag or in the technical literature are provided as starting points for calibration. It is not possible to provide universal settings that will be right for every spreader and every operator as the variations mentioned earlier will cause differences in applied rates between spreaders.

Additionally, there are tools that are specifically developed to aid in calibrating granular spreaders. These include guides to measure the opening of hopper gates at specific settings and devices that catch material as the spreader runs to reduce the mess usually associated with calibrating spreaders (Figures 3 & 4).

Regular cleaning and adjustment is crucial to maintaining application equipment that performs consistently. Follow manufacturers' guidelines found in each piece of equipment's owner's manuals for set up and maintenance. Included in this is information on gate settings, tire pressure and lubrication points, all of which should be checked before each application. As well the spreader should be thoroughly cleaned and dried after each use.

Putting It All Together

Taking the time to formulate a solid fertilizer and amendment program created with good science and experience will pay off. A plan built on a foundation of quality products that are used at the right rate and applied through properly calibrated application equipment will provide the best possible results. As much as the time and effort to develop a good plan may sound like it will cost more, the savings in labour and improved turf stands will more than pay for the plan. •