Foliar, Liquid, or Granular?

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Combine today's putting green mowing heights with the new, high density bentgrasses and you have a problem — mower pickup of granular fertilizer. Industry has responded with smaller, higher density fertilizers. Yet, as reported in the July 2001 issue of Golf Course Management magazine, cumulative 9-day mowing losses of greens grade fertilizers can range as high as 75%. Low-density natural organic products can equally be a problem. We removed 14 to 62% of fine natural organic fertilizers in a single mowing at 0.150 inch after brushing the fertilizer in and irrigating the day before.

Are foliar or liquid fertilizers the answer to the problem of mower pickup? Before addressing this question, we need to understand the distinctions between these two types of fertilizers.

As the name implies, foliar fertilizers rely upon absorption through plant foliage rather than the roots. This places restrictions on the composition of foliar fertilizers. All of the nutrients have to be in the form of ions or simple molecules and the potential for foliar burn becomes a concern. To avoid burn, concentrations of compounds that break into ions in water have to be 1% or less. Urea, which breaks into simple molecules, can have concentrations of up to 10% and is typically a major component of foliar fertilizers.

The term "foliar" further implies that the intent of these fertilizers is to wet plant foliage and not the soil. Thus, spray volumes have to be kept low — on the order of 1 gallon/M or less. The combination of low nutrient concentration and low spray volume adds up to low rates of nutrient application. A simple example illustrates this point. If we have a hypothetical 15-3-4 foliar fertilizer that weighs 10.5 lb/gal and it is applied at the recommended rate of 5 oz/M, the rate of N per application is 0.06 lb/M.

Today's liquid fertilizers typically contain water soluble slow-release N carriers such as methylene ureas or triazone. These have low burn potential that permits application at relatively high rates and spray volumes. Rates of N per application can range as high as 1.0 lb/M, especially if application is followed by irrigation. Some foliar uptake of N may occur, but the primary mode of plant entry is via roots.

In summary then, the main contrasts between foliar and liquid fertilizers are the nutrient application rates possible, all water soluble, fast-release N versus slow-release N, and the mode of plant entry of the nutrients. Rate of nutrient application is an important distinction from a turf management perspective.

In a typical year, a bentgrass putting green in southern Wisconsin produces about 95 lb/M of dry clippings averaging 4.0% N. That signifies removal of 3.8 lb N/M that needs to come from somewhere. For the sake of illustration, let's assume that 25% of this N is derived from fertilizer applied late last season and the decomposition of organic matter. That leaves 2.8 lb N/M that must be supplied during the current season.

A claim is being made that there is 100% plant absorption of foliar fertilizer. For the moment, let's accept this claim and use the hypothetical foliar fertilizer mentioned earlier. That product, applied at label rate, provides 0.06 lb N/M/application. With 100% absorption, it would still take 46 or 47 applications to satisfy the 2.8 lb N/M requirement for the season.

But is 100% absorption a reasonable claim? Absolutely not. For foliar absorption to occur, the fertilizer, in its liquid state, must overcome the hydrophilic (non-wetting) property of the plant leaf waxy surface coating and come in contact with channels that extend through the cuticle layer of the

leaf. Logic tells us that it is impossible for all of the foliar fertilizer to come in contact with these channels that are scattered across the leaf surfaces. Second, absorption ceases once the fertilizer has dried on the leaves and stems. Given these two requirements for absorption, it should not be surprising that researchers have measured foliar fertilizer absorption rates of 31 to 61% and have found that 40% is a good average value across different grass species, different fertilizer drying rates and different fertilizer compositions. Foliar fertilizers, because of the urea in them, are also subject to volatilization loss of N during the course of drying. One study conducted with foliarly applied urea reported a 17% volatilization loss of the N applied.

What happens to the 60% or so of the foliar fertilizer that is not absorbed by the turfgrass? This has been fairly well documented. About 40% of the amount applied is mowed off and the remaining 20% is washed into the soil via rainfall or irrigation water where its fate is that of any other fertilizer. So, if instead of 100% absorption of the foliar fertilizer the actual value is around 40%, the amount absorbed from the 0.06 lb N/M/application of our hypothetical fertilizer is 0.0024 lb N/M. Thus, to supply the turfgrass with our estimated seasonal requirement of 2.8 lb N/M, you would have to make about 117 applications.

Now we have to consider liquid fertilizers. Are they a viable alternative to granular products when the mower pickup rate is high (>10%)? They too are subject to mowing loss of material dried on leaf surfaces. The study reported in the July 2001 issue of Golf Course Management tested a liquid product and, with the methods employed, came up with a mowing removal rate of only 2 to 3%. Studies conducted with more sophisticated methods place the mowing removal rate at about 50% if none of the dried fertilizer is washed off the leaves. Since this is highly unlikely, the actual mowing removal rate is probably considerably lower, but we do not really know what that figure might be. My guess is that the mower pickup is somewhere in the range of 2 to 10% of the total quantity of nutrients applied. The controlling factor is how much dried fertilizer remains on the leaf surfaces that are removed by mowing.

So what can we conclude from this discourse on foliar, liquid, and granular fertilizers? First, I think it is fairly obvious that foliar fertilizers are not stand alone fertilizers. By this I mean that it is not practical to rely upon them as your sole nutrient source. Rather, they are supplements to a fertility program that involves and relies upon other forms of fertilizer. Foliar fertilizers are great for a quick green-up. Researchers have reported noticeable improvements in turfgrass color within 6 hours after application.

Liquids permit higher nutrient rates and less frequent applications while providing N with some slow-release properties. But foliar and liquid fertilizers often have a common limitation. To minimize foliar burn potential, their N:K ratio is high, often in the range of 2 to 5:1. On sand putting greens, I advise an N:K ratio of 1:1 over the course of a season made up of three to four potassium applications during the season to compensate for leaching loss of K. This is hard to achieve with many of the foliar and liquid fertilizers but easily accomplished with granular products.

It makes the most sense to me to use granular fertilizers with demonstrated low mower pickup rates as the core of your fertility program. If it fits into your program and you have the means to do so, intersperse liquid fertilizer applications with granular applications. Liquids are great for spoon feeding because it is so easy to achieve uniform applications of very low nutrient rates. Foliar fertilizers come into the picture as supplements when, for whatever reason, you want a quick, short-term response.