FALL FERTILIZATION OF TURFGRASS
Part II. The Practice

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Maintenance of top quality turf depends as much on what transpires in the fall of the year as what we do to bring the turf through the stresses of summer. As reviewed in the July/August issue of THE GRASS ROOTS, the heat of summer dramatically reduces turfgrass vigor and its capacity to rapidly recover from any type of injury. It is only with the onset of declining fall temperatures that turfgrass has the opportunity to regain lost vigor, to prepare for the ravages of winter and to build capacity for regrowth the following season.

The purpose of fall fertilization is to ensure that nutrition does not limit the biochemical and growth responses of turfgrass to the more favorable temperatures of autumn. Timing of fall fertilization is one of the keys to its effectiveness. The turf must be photosynthetically active when the fertilizer is applied but stimulation of shoot growth should not occur.

Time of Application

The figures in Part I of this article readily define the time for fall fertilization. When mean air temperatures* drop to 50°F, turfgrass photosynthesis is still 80 to 90 percent of maximum but respiration rates are only about 20 percent of their optimum levels. Consequently, net photosynthate production is high. Coupled with these biochemical responses to low mean air temperature is a sharp reduction in shoot growth rate. Because photosynthate production is high and shoot growth slow, the remainder of the plant is well supplied with carbohydrates for below-ground growth, winter hardening and storage purposes.

At this point it should be apparent that fall fertilization does not refer to fertilizer applied after September 21, start of the calendar fall, nor is it dormant fertilization. Rather, it is fertilization that occurs after the mean air temperature has declined to 50°F or less and well before the first killing frost (defined as a temperature of 28°F for two or more consecutive hours).

A single day with a mean air temperature of 50°F does not signal the start of the fall fertilization period. One such day can readily be followed by a couple of weeks of unseasonably warm weather. Thus, 3 to 5 days with mean air temperatures of 50°F or less can constitute a realistic definition of the start of the fall fertilization period.

Choice of N fertilizer has an effect on when fall fertilizer is applied. Ideally, the N should become available to the turfgrass as soon as the fall fertilization period begins. When soluble N fertilizers such as ammonium sulfate or urea solution are used, application should be at the start of the fall fertilization period. Turfgrass responses to urea prills does not occur until 5 to 7 days after application because of the time required for the urea to be converted to ammonium. With slow release N fertilizer such as urea formaldehyde or Milorganite, the delay in turfgrass response time is more on the order of 10 to 15 days after application.

Depending on location in Wisconsin and weather, the fall fertilization period may be no more than two weeks or so in duration. Therefore, application of N sources not immediately available to the turfgrass should precede the actual start of the fall fertilization period by the number of days required for response to the N fertilizer. In order to do this, we need to be able to predict the start of the fall fertilization period. Long-term weather records are the only basis for predicting when mean air temperatures in the fall are likely to decline to and thereafter remain at or below 50°F. Examination of these records reveals that the state can be conveniently divided into thirds and each one-third assigned a date for the start of the fall fertilization period. These dates, shown in Figure 1, have a 70 percent probability. In other words, in the long run, these dates will be reasonably accurate 7 years out of 10. We do however, have to keep in mind that in any given year and in an average of 3 years out of 10, the actual time when the fall fertilization period begins can vary by so much as 15 days from the dates shown. Regardless, these dates are the best basis available for deciding when to commence fall application of urea prills or slow release N sources.

Nitrogen Rates

Three variables influence fall N rates: (1) the expected duration of the response period; (2) the N source; and (3) whether or not fall fertilization is used in combination with dormant N fertilization. Weather records reveal that on the average, Wisconsin has two distinctly different fall fertilizer response periods. In the northern one-third of the state, the average duration is only about 10 days, while the southern two-thirds of the state has an average response period on the order of 20 to 22 days. It seems reasonable, therefore, to suggest lower fall N rates for the northern one-third of the state (Table 1).

Slow-release N sources are typically applied at somewhat higher rates than soluable materials. This, too, is incorporated into Table 1. Finally, ranges in N rates are shown for each combination of state region and type of N fertilizer. These ranges reflect my judgement on what the N rates should be when only fall N is applied and when fall N is followed by dormant N. The lower rates shown are those suggested for use in conjunction with dormant N.

Phosphorus and Potassium

Researchers have demonstrated that fall-applied P promotes turfgrass growth and K, through its influences on carbohydrate production, can reduce winter injury. But don't expect these responses unless your soil tests indicate a need for P and K fertilizer. When turfgrass is already adequately supplied with these nutrients, the effects of additional P and K on the grass are significant.

If soil testing is not being done on a regular basis or there are reasons to suspect a need for P and K, fall is definitely an excellent time to apply them. In these instances, a convenient way to judge P and K needs is according to the likely removal rates by the turfgrass during the season. The ratios of $N:P_2O_5:K_2O$ in bentgrass average about 5:1:3.5 and in Kentucky bluegrass about 5:1:4. Thus, for example, if the season's N rate on bentgrass is 2.5 lb/m, at least 0.5 lb P_2O_5/m (2.5 lb N/5 x 1) and 1.8 lb K_2O/m (2.5 lb N/5 x 3.5) need be to applied each year just to maintain soil tests near pre-existing levels.

The above approach for estimating K needs does not apply to sand-based or USGA greens. Potassium leaches easily from these greens and needs to be replenished. Research suggests a replenishment rate of 4 lb or more of K_2O/M/season. This is preferably applied via several applications spread throughout the season. If not, fall is clearly the optimum time for a single annual K application.

Benefits and Concerns

Research has demonstrated numerous benefits from fall fertilization. Some have already been discussed, but are being repeated here to make the list complete. Fall fertilization has the potential of:

1. Enhancing root, stolon and rhizome growth.
2. Increasing stored carabohydrate levels.
3. Improving fall color.
4. Reducing weed populations the following year through more vigorous turfgrass growth.
5. Reducing disease incidence.
6. Increasing rates of recovery from winter injuries.
7. Delaying the need for spring-applied N.
8. Reducing spring clipping weights.
9. Eliminating fertilizer burn.

Concerns commonly expressed about fall fertilization and N application in particular are: (1) reduced winter hardiness; (2) greater snow mold injury; and (3) enhancement of *Poa annua*. Older turfgrass literature repetitively cautions against late season N applications, the main reason given being that of reduced winter hardiness. What is important to recognize is that this precaution is based on research conducted at a time when annual N rates commonly ranged between 10 and 20 lb/M. More recent research has shown that at today's N rates, application of as much as 5 lb/N/M in October or November does not significantly influence winter injury in turfgrass. On the contrary, fall N rates in the range of 1.0 to 2.0 lb/m generally increase fall and spring carbohydrate levels in turfgrass and result in less winter injury.

To date, there is no evidence that fall N applied at the rates given in Table 1 increases the incidence of snow mold. What has been observed is that fall N speeds spring recovery from the disease when it occurs.

The question of the effects of time of N application on *Poa annua* has been well researched. In bentgrass sod, the best approach for maintaining high Poa density is a spoon-fed program wherein 0.25 lb N is applied bi-weekly throughout the season or 0.5 lb N applied monthly. Shifting to less frequent N application reduces Poa density. The greatest reductions in Poa density in bentgrass greens have been achieved with three N applications per season wherein the last application is delayed until after August. Similar results have been achieved with Kentucky bluegrass, particularly when the first N application has been delayed until mid- or late May and the last application until late October. Nitrogen fertilization of bentgrass sod or Kentucky bluegrass sod in April and/or August has been found to invariably favor *Poa annua*.

Summary

Fall fertilization is a management practive based on the physiological responses of cool season turfgrasses to the declining air and soil temperatures of fall. The potential benefits are many and have been confirmed by researchers in various locations throughout the region of cool season grasses. The practice is, however, not conducive to maintaining high *Poa annua* densities in turf.

To realize the full benefits of fall fertilization, guidelines for the practice need to be carefully observed. The key guidelines are:

1. The fertilizer is applied at a time such that the N is not readily available to the turfgrass until mean daily air temperatures have declined to 50°F or less.
2. The rate of N application is in the range of 1.0 to 1.5 lb/M (45 to 65 lb/A). This rate should include any N applied once the grass is dormant.
3. Spring N application is delayed as long as possible and preferably until mid-May or later.
4. Application of P and K with the fall N is advisable unless soil tests indicate no need for these nutrients.

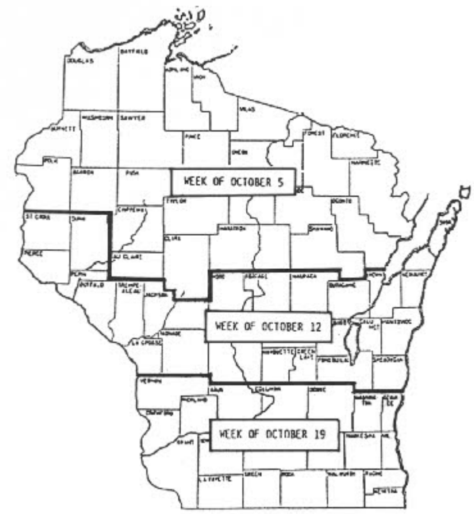

Fig. 1. Approximate dates when mean air temperatures decline to 50°F.

*Mean air temperature = $\frac{\text{daily high temperature + daily low temperature}}{2}$

Table 1. Recommended rates of nitrogen for fall application.

Portion of Wisconsin	Type of Nitrogen Soluble	Slow Release
	lb N/M	
Northern 1/3	0.50 to 0.75	0.75 to 1.0
Southern 2/3	0.75 to 1.0	1.0 to 1.5