Poa annua and Phosphorus

By DR. WAYNE R. KUSSOW
Department of Soil Science
University of Wisconsin-Madison

For years, we have been told that generous supplies of phosphorus from soil or fertilizer enhance invasion of turf by *Poa annua* (PA). The reason, it seems, is that PA has a high phosphorus requirement. Satisfying this requirement gives PA a competitive growth advantage over other turfgrasses. How valid are these arguments?

The idea that PA has a high P requirement appears to have arisen from a number of field and greenhouse studies that date back as far at 1937. Let's examine some of these research findings, but without the usual citation of names, dates, places, research methodology, etc. Anyone wishing a list of the references drawn upon here can receive if for the asking.

To begin, let me list some observations that are often used to support the notion that PA is a P-loving plant:

1. Application of the equivalent of 5.9 lb plant available P-1000 ft^2 (hereafter cited as lb P) as bone meal or 3 lb P as 5-10-5 fertilizer each year for eight successive years increased PA populations in bentgrass 12 to 15% over the unfertilized control treatment.
2. Applying up to 90 lb P to "medium P" pots of soil then seeded to PA increased PA populations 22%, while application of P to a "very high P" soil had no effect on PA populations.
3. Application of P to a pH 4.5 loamy sand soil increased PA growth in pots, but not when the loamy sand was limited to pH 6.5 or when the P was applied to a silt loam soil adjusted to pH 4.5 or 6.5.
4. Application of 1.8 lb P along with 6, 10, or 10 lb N and 1.1 or 3.4 lb S for seven years on colonial bentgrass greens increased the area invaded by PA by an average of 20%.
5. Application of 4.5 to 18.0 lb P over three years on creeping bentgrass and then observing changesin PA over the three succeeding years revealed population increases of 3 to 7%.
6. Application of zero to 3.6 lb P and 3 lb N for two seasons on a golf fairway resulted in PA populations of 63 to 77% the first year and 75 to 83% the second year. Leaf P concentrations in the PA ranged from 0.42 to 0.60%. These contrast with reports that healthy Kentucky bluegrass contains 0.12 to 0.24% P.
7. The optimum P level in PA leaf tissue has been shown in greenhouse studies to be about 0.52%.

On the surface, these research observations constitute some pretty convincing evidence that P application imparts a growth advantage to PA. But let's examine these lines of evidence in more detail and cite some other sources of information. As a general observation, note that in three of the preceding instances we are getting excited about PA population increases averaging 1.5 to 2.8% each year. Recent detailed studies of PA population shifts in turf have revealed natural population changes in the range of 70% over a single season when PA populations are observed is very critical as far as the results of field research studies on PA are concerned.

In the first research study cited above, it has to be recognized that this work pre-dated soil testing. Hence, we have no way of knowing whether or not annual applications of 3 ot 5.9 lb P constituted what today would be considered reasonable rates of application. In any event, application of 117 lb bone meal or 70.2 lb 5-10-5 by no means constitutes a realistic fertilization program for bentgrass.

The next two studies cited were conducted with monostands of PA. Without the inclusion of other grass species for comparison purposes, ther is simply no basis for concluding that these studies support the contention that P application imparts a growth advantage to PA. In summarizing their work, the authors themselves concluded that "there is no suggestion that annual bluegrass differs from other bluegrasses in its responses to the major elements, N, P, or K."

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In the fourth study previously cited, whether or not P application truly enhanced PA in the bentgrass is difficult to judge. No statistically significant difference levels were reported. Hence, which treatment effects can reasonably be expected to be reproducible rather than the result of randomm events cannot be ascertained. Perhaps of even greater interest in this study is the fact that application of .1 lb S per season led to an average increase of 92% in the area infested by PA, while P application increased the PA-invaded area by only 20%.1

The fifth study actually involved variable rates of K as well as P. Increasing K rates had as great an influence on PA populations as did P. If one takes the time to read the discussion section of this report, it becomes evident that the authors recognized factors such as dollar spot infection as being a contributing factor in PA invasion of the bentgrass.

The sixth reference suggests major increases in PA populations over one year (63 to 77% PA the first year and 75 to 83% PA the second). Three interesting features of this study are: (1) the original PA population was estimated at 95%; (2) N scheduling had as great an impact on PA populations as did P application; and (3) when averaged across the different N schedules, P applications did not significantly influence PA populations recorded at the end of the study.

References 6 and 7 provide bentgrass tissue analyses that have been interpreted as evidence that PA has a high P requirement. In one such study, at fertilizer P rates where Kentucky bluegrass and bentgrass were still showing growth responses to the fertilizer P, leaf P contents ranged from 0.40% to 0.53%. Thus, the optimum tissue P concentrations for these two grasses appear to be as high or higher than the 0.52% optimum tissue P level reported for PA. If one studies existing literature carefully, it is not difficult to find reports of bentgrass tissue P levels ranging as high as 0.8% in plots where recommended P fertilization practices have been employed.

So what do these research data really tell us regarding the influences of soil or fertilizer P on PA encroachment into turf? My conclusion is that the effects of P have been badly overstated. The influences of P cannot be readily isolated from factors such as soil pH, N scheduling, and applications of other nutrients such as K and S. What appears to be of primary importance is the total fertilization package employed, not whether or not P application is a part of the that package.

This bringsj us to some recent observations on this subject. A study reported in 1986 suggests that:

1. Germination of PA in perennial rye-grass turf is determined by the numbers and sizes of invasion gaps that exist in the turf. This makes sense in that PA seed germination requires an abundance of light.
2. Survival of PA seedlings once germination has taken place is determined by their success in competing for nutrients in the root zone. Application of N overcomes the root zone competition while P and K applications have little or no effect.

A second recent study entailed meticulous recording of PA populations in a bentgrass fairway. The data presented support the authors' conclusion that "P did not exercise the dominant role that N does in determining species compostion in a bentgrass-annual bluegrass community." Thus, these two recent studies compliment one another and relegate to P a secondary influence on PA invasion of turf.

Finally, I am now in the process of finalizing my report on a three-year study of N source effects on PA invasion of creeping bentgrass turf. In plots where soil test P ranged from 65 to 225 lbacre, the soil P levels bore no relationship to PA populations in the turf. Rather, under the conditions of the study, indications were that PA invasion and spread were controlled by the combined effects of earthworm activity and the verdue of the bentgrass. Large numbers of earthworm casts and low verdure apparently created the invasion gaps required for PA encroachment in the bentgrass.

In summary, I firmly believe that the time has come to lay to rest the idea that ample supplies of P from soil or fertilizer inevitably result in higher PA populations in turf. A corollary statement is that starving turf for P is not an effectie PA control measure. Rather, anything that creates invasion gaps in turf favors invasion by PA. A radical statement? Hardly. Let me end with a quote from a pioneering and classical 1937 report on PA and its growth requirements:

"The abundance of this pest in golf greens is apparently due largely to the loss of vigor or actual death of the permanent grass in critical periods, which furnishes opportunity for new plants of (annual) bluegrass to invade or completely occupy the injured area."

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