Phosphorus Requirement for Bentgrass Establishment in a Root Zone Mix

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INTRODUCTION

Insufficient levels of soil phosphorus slow turfgrass establishment and retard root development (2). Turf managers are therefore advised to apply starter fertilizer P, but in accord with soil tests (1, 5). In Wisconsin, there is no information on the optimum soil P levels for bentgrass establishment in sand-based putting greens.

The purpose of this project was to identify the optimum soil test P level for bentgrass in a sand root zone mix. While this may seem like an easily researched topic, there may be a complicating factor. Applying N to turfgrass stimulates shoot growth that creates nutrient demand and stimulates P uptake. Hence, it is possible that the optimum soil test P level for turfgrass establishment varies with the rate of N application.

METHODS

The root zone mix used in this study was an 80/20 blend purchased from Wolosek Landscaping. The sand in the mix meets USGA requirements. The mix has a pH of 6.4, contains 2.1% organic matter in the form of peat humus, and has 6 ppm P as determined by the Bray-1 method.

Bulk samples of the mix were equilibrated for 2 weeks with 0, 10, or 30 ppm P applied as monopotassium phosphate. A fixed weight of each mix was weighed into each of nine pots. All pots had 1.0 lb N/M in the form of Scotts 29-3-4, shallowly incorporated before seeding to Penncross' creeping bentgrass. Emergence of the grass began 7 days after seeding. One week later, the pots were divided into three groups for weekly application of 0.2, 0.4, or 0.8 lb N/M in the form of a urea solution.

The bentgrass was clipped at 0.5 inch 1 month after seeding and three more times at 7-day intervals. All clippings were oven-dried and weighed. There was not enough time in some treatments for P analysis. Therefore, all four clippings were combined, ground, and analyzed for P.

OBSERVATIONS

By the time the bentgrass seedlings were ready to clip, P deficiency symptoms were evident where no P was added to the root zone mix. These symptoms were in the form of bluish-green coloration and narrowed leaves. Clipping weights of the P deficient bentgrass were one-seventh the weights of non-P deficient treatments. Over time, the tips of the P deficient bentgrass became discolored, taking on a reddish-orange color. According to Love (4), these are symptoms of severe P deficiency.

The data gathered in this study are summarized in Table 1. The clipping weights clearly show that P levels controlled bentgrass growth. At each root zone mix P level, there was no response to increasing N rates. However, N did influence clipping P concentrations. Increasing the N rate significantly decreased clipping P concentrations.

A fundamental assumption in this study is that bentgrass clipping weights were an index of bentgrass establishment. Thus, the first approach taken to identify the optimum soil P level was to examine the relationship of clipping weight to soil P level. This relationship (Fig. 1) suggests that when averaged over all N rates, the optimum P rate was around 25 ppm.

To examine whether or not N rate affected the optimum soil P level, clipping weight was simultaneously related to N rate and soil P by way of multiple linear regression. The resulting equation was used to calculate at each N rate the soil P required to produce 440 mg/pot of clippings. These calculations revealed optimum soil P levels of 25.7 ppm P at 0.2 lb N/week, 28.9 ppm P at 0.4 lb N/week, and 29.0 ppm P at 0.8 lb N/week.

By observing how much 10 and 30 ppm fertilizer P increased soil test P levels in the root zone mix, it was possible to estimate the amount of fertilizer P_2O_5 that is equivalent to 1.0 ppm soil test P. Depending on the amount of fertilizer applied, the ratio of P_2O_5 ppm/ppm soil test P

Table 1. Fertilizer N rate and soil P level effects on creeping bentgrass clipping weights and clipping P concentration.

N rate	Soil P	Clipping weight	Clipping P
lb/M/week	ppm	mg/pot	%
0.2	6	79	0.21
	12	301	0.50
	27	439	0.70
0.4	7	78	0.20
	12	286	0.36
	29	424	0.52
0.8	7	72	0.15
	13	285	0.24
	29	420	0.34
LSD (p = 0.05)		72	0.08

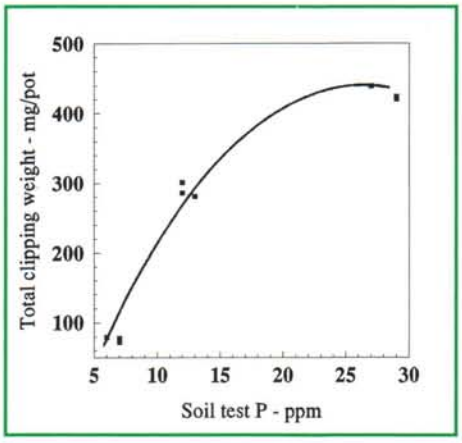

Figure 1. Relationship between bentgrass clipping weight and soil test P (Bray-1).

ranged from 3.2 to 4.1 and averaged 3.6. This ratio becomes useful only when expressed as lb/m P2O5/ppm soil test P. By assuming 1 inch to be the optimum depth of fertilizer

incorporation as found by King and Skogley (3) and the laboratory measured mix bulk density of 98 lb/ft2, the ratio of the weight of fertilizer P2O5 to soil test P was found to be 0.028 lb P2O5/ppm P.

CONCLUSIONS

For the acid (pH 6.4) root zone mix used in this study, indications were that a soil test level of at least 25 ppm P was required for rapid bentgrass establishment. This optimum soil test P increases as the rate of N application increases. Increasing the N rate from 0.2 lb/M/week (4.8 lb in a 24-week grow-in year) to 0.8 lb N/M/week (19.2 lb N for grow-in) increased the soil P requirement by about 4 ppm.

To calculate the P2O5 requirement of a root zone mix similar to the one used in this study, three pieces of information are needed: (1) the present soil test P level of the mix, (2) the desired (optimum) soil test P level, and (3) the conversion factor of 0.028 lb/M P2O5/ppm soil test P. In the present case, the initial soil test P was 6 ppm and the optimum was 30 ppm. Therefore, the appropriate rate of starter fertilizer P would be (30 ppm - 6 ppm) (0.028 lb/M P2O5/ppm soil test) = (24) (0.028) = 0.67 lb P2O5/M.

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