Nitrogen Influences on Bentgrass Root Growth

By Michael Lyons

Research has shown that when mean daily air temperatures decline to 50°F or less in the fall of the year, bentgrass shoot growth virtually ceases even when supplied with additional nitrogen. This observation is the basis for the idea that when N is applied under these conditions, turfgrass color is improved, photosynthesis increases and the additional carbohydrate produced is available for stolon and root growth. This nitrogen-induced stimulation of late season root growth may be an important cultural practice, especially after high heat stress seasons such as 1988.

The purpose of this special project was to quantify creeping bentgrass root responses to different annual N rates, application schedules and the timing of fall N application.

The site from which the root samples were removed is a field experiment being conducted at the Cherokee Country Club. Treatments sampled include those where 2.3, 3.4 and 4.6 lb. N/M/season were applied according to these different schedules. They are:

	Percent annual N applied on:						
Schedule	5/15	6/15	7/15	8/15	9/15	10/15	11/15
Normal	40	—	20	—	40	—	—
Late fall	—	40	—	20	—	40	—
Dormant	—	40	—	20	—	—	40

The fertilizer used varied with time of season. Greens grade SCU was used May through September, Urea was applied in late fall and Milorganite served as the dormant fertilizer.

The root samples were collected on October 31 and again on November 29 by removing 1.4 inch diameter soil cores to a depth of six inches. Roots in the cores were washed free of soil, dried at 110°C and then ashed at 600°C. Weight loss upon ignition is what is being reported here as root dry weight. The November 29 soil cores were cut into 1.5 inch segments before root removal. This was done so that N treatment effects on root distribution in soil could be examined.

OBSERVATIONS

The root weights were examined from three perspectives:

1. The general effects of N rates and schedules on total root weights observed on November 29;
2. The percentages of roots found at the various soil depths on November 29; and
3. Fall N influences on root growth that occurred between October 31 and November 29.

Averaging the November 29 root weights for the three N schedules revealed the general influences of annual N rate on bentgrass root development. As shown in Figure 1, root weights were considerably greater when 3.4 or 4.6 lb. N/M rather than 2.3 lb. N were applied annually. Thus, the common assumption that turfgrass root weights progressively decline as N rates are increased was not borne out by this study. This observation has been reported by other researchers and seems to be most noticeable during the first year or two after turf establishment. The obvious implication is that from a root growth perspective, higher N rates are warranted the first year or so after bentgrass establishment.

Root weights averaged over the three N rates revealed a substantial influence of N scheduling on bentgrass root growth (Fig. 1). Delaying fall N application from mid-September to October (when topgrowth ceases) clearly enhanced root growth. Further delaying of the fall N application until November was detrimental to root development.

The N treatments had no consistent influence on root distributions within the six-inch sampling depth. There was, however, a general tendency for the percentage of roots in the 0 to 1.5 inch soil depth to increase as total root weight increased. This is illustrated in Figure 2. It needs to be emphasized, however, that root weight per se did

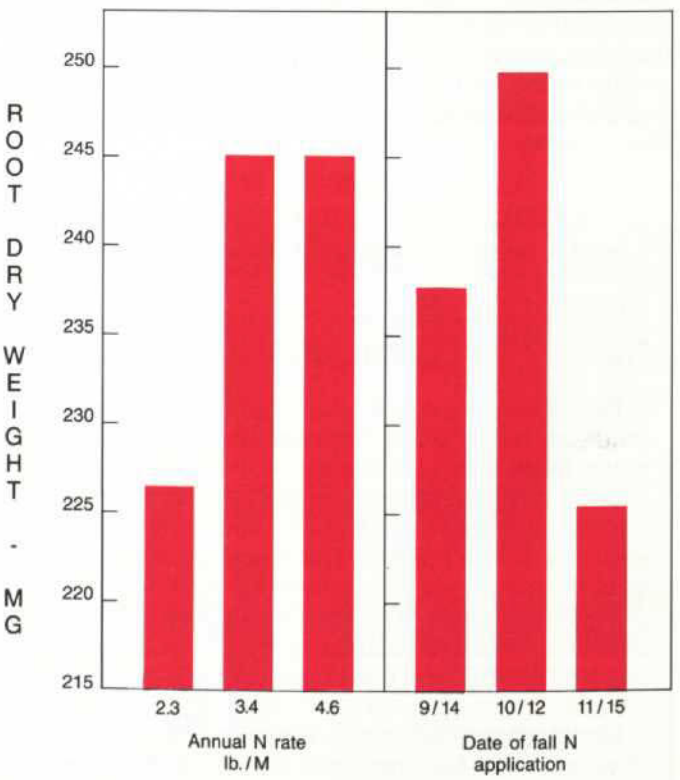

Figure 1. Average influences of annual N rate and date of Fall N application on bentgrass root weights on November 29, 1988.

not vary significantly at lower soil depths among any of the treatments.

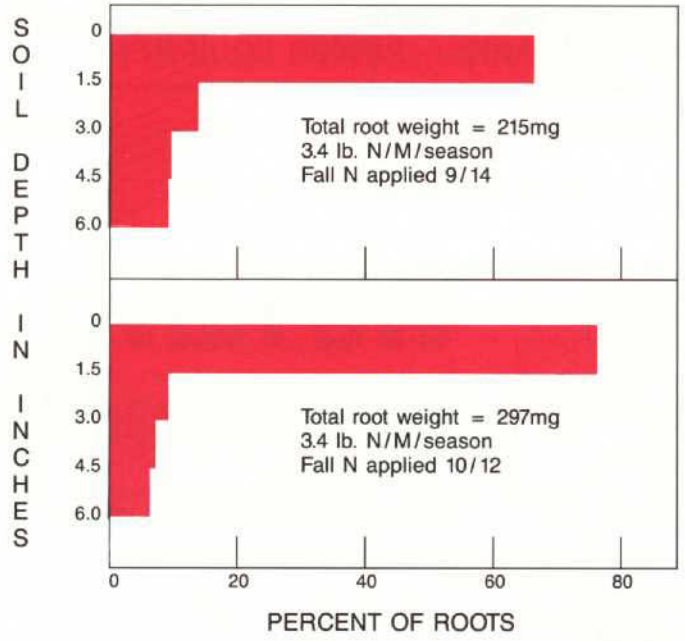

Figure 2. Bentgrass root profiles on November 29, 1988, for two different fall N treatments.

Root growth that occurred between October 31 and November 29 was markedly influenced by N rates and schedules. The bentgrass root systems actually appeared to decline during this time period when the annual N rate was 2.3 or 3.4 lb/M and fall N was applied September 14 (Table 1). At all three annual N rates, delaying fall N application, first to October 12 and then to November 15, progressively enhanced late season root growth and the effect increased with the annual rate of N application.

The data in Table 1 suggest that the best N treatment from the perspective of late season root growth was 4.6 lb. N/M/season in which 40 percent of this was dormant (November 15 application). This observation has to be interpreted cautiously because, as shown in Figure 1, total root weights on November 29 averaged 24 milligrams less for the dormant N schedule than for the late fall N schedule. It is possible that by the time bentgrass root growth ceased in January or February root weights were essentially the same for the late fall and dormant N treatments.

Table 1. Fall fertilizer N influences on bentgrass root weight changes between October 30 and November 29, 1988.

ANNUAL N RATE	FALL NITROGEN APPLIED		CHANGE IN ROOT WEIGHT+	
	RATE	DATE		
lb./M	lb./M	Mo./Day	mg	%
2.3	0.9	9/14	-120	-32.2
		10/12	-16	-6.5
		11/15	8	+4.6
3.4	1.3	9/14	-56	-20.7
		10/12	34	12.9
		11/15	21	10.2
4.6	1.7	9/14	20	8.9
		10/12	50	+28.7
		11/15	71	36.0

+ In a 1.4 inch diameter soil core taken to a six inch depth.

The N treatment effects on root growth rates between October 31 and November 29 support some of the theory and recommendations regarding late fall N fertilization. Reductions in root weights that occurred when fall N was applied on September 14 likely reflect the deleterious effects of the surge in top growth brought about by this N application. It is somewhat surprising that this competitive effect of shoot growth on root growth persisted into November.

The October 12 N application had no significant effect on bentgrass topgrowth at any of the annual N rates (Pers. Comm. Dr. Wayne Kussow). This leads to the expectation that root growth would be enhanced at all three annual N rates. The fact is that late season root growth was not enhanced by late fall N when the annual N rate was only 2.3 lb/M. This is believed to relate to reports from other researchers that application of some N in September seems to increase responses to late fall N, particularly at low annual N rates. The present study suggests that this preconditioning of turfgrass for response to fall N can be achieved just as well by increasing the annual rate of N application.

SUMMARY

From the standpoint of bentgrass root development and late season growth, annual N rate and time of application are of equal importance. In this study, root weights were low whenever the N program resulted in surges in topgrowth in June and September and/or season average turfgrass color ratings were slightly below or at the minimally acceptable level of 7.0. These conditions prevailed at the 2.3 lb/M annual N rate in the so-called "normal" and "dormant" fertilization schedules. Applying N at times such that early summer and fall surges in topgrowth were avoided and at annual rates where color ratings averaged 7.3 to 7.5 favored bentgrass root development.

Delaying fall N application from September to October stimulated late season root growth providing turfgrass color ratings preceding N application were 7.5 or greater. This precondition was achieved by increasing the annual N rate from 2.3 to 3.4 or more lb. N/M.

Editor's Note: Mike is a May, 1989, graduate of UW Turf and Grounds Management Program. While in school he was employed for two years at the Cherokee Country Club. He is currently working for Rod Johnson at the Sheboygan Country Club.