

EFFECTS OF CULTIVATION ON TURFGRASS ROOTING AND SHOOT GROWTH

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Golf course putting greens are typically subjected to large amounts of traffic. Extensive traffic can lead to problems associated with soil surface compaction. Soil cultivation is utilized to alleviate poor soil conditions on golf course putting greens. Even newly constructed greens with modified soil designed to alleviate stresses associated with compaction frequently show positive responses to core cultivation.

This study was designed to evaluate hollow tine cultivation (HTC) as a method to improve turf shoot and root growth. The study was performed on a 5 year old "Penncross" creeping bentgrass green grown on a modified loamy sand soil and maintained at a 0.6 cm cutting height. Compaction was initiated on 16 June, 1986 with a water-filled drum (approximately 50 kPa static pressure). The entire plot area received 70 passes of compaction in 1986, 54 passes in 1987, 120 passes in 1988. Three minirhizotron tubes were installed in each plot at a 30 degree angle to the soil surface in order to view the development of roots in the soil profile.

Cultivation treatments were initiated on 9 July, 1988 and consisted of a check (no cultivation) and hollow tine cultivation (HTC). HTC was performed with a TORO aerator equipped with 1/2 inch hollow tines. Additional cultivation treatments were applied on 19 Aug and 3 Oct, 1988 and Aug 13, 1989. Soil brought to the surface with cultivation was removed. Clippings were collected and weighed for the growth periods of 15-19 Aug, 23 to 26 Aug, 26 to 31 Aug, and 26 Sept to 1 Oct, 1988. Root and thatch sampling was performed in late October.

Clipping yield data (Table 5) showed that HTC did not result in a significant increase in shoot growth compared to the check until 12 days after treatment. This delay in growth response to HTC was most likely due to removal and injury of crown tissue associated with HTC. Shoot growth enhancement with HTC declined with time and became equivalent to the check plots prior to the 3 October treatment date. It appeared that shoot growth enhancement with HTC was a short term response (less than one growing season).

TABLE 5. The influence of hollow tine cultivation (HTC) on clipping yield of a compacted "Penncross" creeping bentgrass green mowed at 0.6 cm in 1988; cultivated 9 July, 19 Aug, and 5 Oct, 1988.

TREATMENT	Fresh Clipping Yield				Thatch	Total Root Weight
	8/19	8/26	8/31	10/31		
	-----g m ⁻² day ⁻¹ -----				-----kg m ⁻² -----	
Check	8.3	6.4	6.2	4.8	1.41	0.534
HTC	8.0	6.9	6.8	5.0	1.17	0.466
L.S.D.	NS	NS	0.58	NS	0.20	0.065

L.S.D., Least significant difference at 5% probability level NS, denotes not significantly different.

Table 6 shows the amount of thatch and root mass measured in November, 1988. Thatch data supported the idea of crown tissue removal and injury. HTC resulted in lowering the amount of thatch compared to noncultivated plots. Total root weight was reduced with HTC compared to the check. Reduction in root weight occurred primarily in the zone of cultivation (0-5 cm) with HTC (data not shown). No weight differences were found at other depth zones. Root videotape data from the minirhizotron tubes indicated the number of roots below 7 cm (approximately 3 inches) were reduced also (Table 6). These data suggest HTC can result in injury and loss of root mass and numbers.

TABLE 6. The influence of hollow tine cultivation (HTC) on root numbers along minirhizotron tubes on a creeping bentgrass green; cultivated 9 July, 19 Aug, and 5 Oct, 1988.

DEPTH ZONE	9/10/88		9/30/88		11/14/88			
	CHECK	HTC	CHECK	HTC	CHECK	HTC		
inch	-----		Root Observations cm ²				-----	
3-4	17	9	20	15	21	14		
4-6	8	4	8	6	8	4		
6-8	3	1	3	1	3	1		
8-10	1	0	2	1	1	0		
10-12	1	0	0	1	0	0		
TOTAL	30	14	33	24	33	19		

Root data did not indicate a significant increase in fall root development following summer and fall cultivation. Increases in root mass due to cultivation treatment may occur primarily in the spring when the initiation rate of new roots from plant crown tissue (growing points) is greatest. However, the fact that fall root mass has not increased does not indicate whether there was a change in root activity. The aspect of root functioning in relation to cultivation is still being assessed in our research. It is possible that root functioning of uninjured roots may be improved following cultivation.

SUMMARY

Mechanical injury and loss of crown tissue following HTC places an additional stress on the turf and thus, may slow the response of the turf to improved soil conditions. HTC can reduce thatch weight if the practice is performed on a frequent basis (2 to 3 times per growing season). HTC reduced total root mass compared to the check plots. Root damage and removal during cultivation was the reason for this response to HTC. The reduction of root weight does not necessarily mean that root activity or functioning has not been improved. This effect of cultivation is still being investigated in our research.