Converting Bentgrass Putting Greens to Hybrid Bermudagrass by Transplant of Single Potted Plants.

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Introduction

Ongoing climate changes, irrigation water shortages and future pesticide use restrictions are factors that could dictate in the near future a progressively widespread adoption of bermudagrass in Mediterranean golf courses (Croce et al., 2001). This species could form the basis of new courses, but could also be used, with differing establishment techniques for fairways and putting greens (Ruemmele et al., 1993), for the conversion of existing courses. Traditional turfgrass substitution of a putting green usually entails the complete removal of the existing cover and often expensive operations to recuperate the playability of the surface. In order to minimize play suspension and conversion expenses, simplified establishment techniques are employed that make use of the chemical devitalisation of the existing cover, but not its removal, while a following thinning of the cover is carried out to facilitate sprigging of the new species (Hartwiger, 2007). An innovative warm season turfgrass species' establishment technique consists in transplanting single potted plants grown in peat (Volterrani et al., 2008). This technique is particularly useful for non-invasive putting green conversion, since the use of plants with full root systems and actively growing canopy enhances their colonisation potential and minimizes the effects of no-tillage conversion (Volterrani and Magni, 2006). One aspect that deserves further study is the transplant density that enables turf managers to obtain full green cover and adequate playing characteristics in the least time.

Materials and methods

With the aim of quantifying the effect of transplant density on the establishment rate and on putting green turf characteristics, a field trial was conducted at "Le Querce" Golf Club in Sutri (VT-Italy, 42°14′52″N 12°12′57″E, 291 m a.s.l.). On June 01 2009 an *Agrostis stolonifera* 'Penncross' putting green was treated with 3 l ha^{-1} a.i. of glyphosate, and the devitalized turf cover was then thinned by repeated scalping and verticutting. On June 30 2009 coring was carried out with 22 mm diameter hollow tines at 5 cm depth, with a density of 100 holes m^{-2}. Plants of *Cynodon dactylon* x *C. transvaalensis* 'Champion' obtained from single node sprigs and raised in seed trays filled with peat, were transplanted at a density of 25, 50 and 75 plants m^{-2} in the holes resulting from coring. Experimental plots were 2.5 x 2.5 m and were arranged in a randomized block experimental design, with three replications. In the two weeks following transplant irrigation was carried out twice daily to facilitate establishment, while only one daily irrigation was carried out henceforth until full establishment. Mowing started two weeks after transplant at 10 mm until full cover, and mowing height was then gradually reduced to 5 mm. From July to September 189 kg ha^{-1} of N and 100 kg ha^{-1} of K2O were distributed from soluble fertilizers. In order to obtain the required surface smoothness, the following operations were carried out: 6 rollings, 3 topdressings (for a total of 6 mm layer of sand) and 1 verticut (September 30 2009). Starting from 7 days after transplant (DAT) turfgrass cover was assessed weekly by digital image analysis. On October 6 2009 a 27 cm^2 plug was collected from all plots on which the following hybrid bermudagrass characteristics were measured: shoot density, leaf density, horizontal stem density (HSD), internode length, internode diameter and horizontal stem node density (HSND). Data were subject to ANOVA and Least Significant Difference test at $P \leq 0.05$ was used to detect differences between means.

Results

The lowest transplant density determined a lower green cover in all dates, but all treatments achieved full cover after 6 weeks from transplant (Table 1). Despite similar establishment speeds, at the end of the growing season different transplant densities determined different turfgrass characteristics. In particular, while no differences were recorded in vertical and horizontal stem per unit area (shoot density and horizontal stem density respectively) or on internode diameter, the lowest transplant density determined the lowest leaf density, while highest transplant density generated horizontal stems with longest internodes, and hence a lower node density (Table 2).

Table 1. Percent green cover for the different transplant densities during establishment. Values with same letters do not differ significantly at the P≤0.05 probability level. DAT = days after transplant.

Transplant density (plants m^{-2})	Green cover (%) 2009					
	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT
25	9.3 a	16.7 a	26.7 a	33.3 a	73.3 a	100.0
50	15.7 b	40.0 b	50.3 b	63.3 ab	91.7 b	100.0
75	20.3 c	43.3 b	55.0 b	80.0 b	98.7 b	100.0

Table 2. Bermudagrass turfgrass characteristics (October 6 2009). HSD = Horizontal Stem Density; HSND = Horizontal Stem Node Density. Values with same letters do not differ significantly at the P≤0.05 probability level. n.s. = not significant.

Transplant density (plants m^{-2})	Shoots and leaves		Horizontal stems			
	Leaf density (n° cm^{-2})	Shoot density (n° cm^{-2})	HSD (cm cm^{-2})	Internode length (cm)	Internode diameter (mm)	HSND (nodes cm^{-2})
25	13.2 a	4.6	4.7	1.8 a	1.0	2.8 b
50	14.5 ab	5.5	5.6	1.8 a	1.1	3.1 b
75	15.7 b	5.2	4.1	2.4 b	1.1	1.8 a

Conclusions

The use of single potted plants allowed the establishment of a warm season turf in putting green condition in 6 weeks. While the time needed to achieve full turfgrass cover would not justify a transplant density higher than 25 plants m^{-2}, plant architecture of the resulting turf suggests the adoption of higher densities. In particular, when 75 plants m^{-2} are used, a significantly higher leaf density is reached at the end of the establishment with a turf superior bearing capacity and resilience being expected. The lower node density recorded for this transplant density could determine a lower recuperative potential for turf but the beneficial effects for the playing characteristics of a putting green should be taken into account first when a quick restoration of playability is the main target.

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