SEEDED AND VEGETATIVELY PROPAGATED CULTIVAR COMPARISONS WITHIN BOTH *CYNODON* AND *ZOYSIA* SPECIES

by

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Abstract

Limited water availability is a major concern in many regions of Mediterranean Europe. Mostly part C_3 cool-season turfgrasses have been used which unfortunately have a higher water use rate than for the C_4, warm-season species. The objective of this investigation was to evaluate the adaptation of vegetatively propagated versus seeded cultivars of both *Cynodon* and *Zoysia* species for the Mediterranean region. There were 11 seeded and 5 vegetatively propagated cultivars of *Cynodon* compared, along with 4 seeded and 5 vegetatively cultivars of *Zoysia*. All were maintained under cultural conditions representative of fairways and sports fields, including a 13 mm cutting height, mowed 2 to 3 times per week. After 4 years of assessments at the experimental site near Rome, Italy, the results reveal that the vegetative propagated cultivars have performed superior to the seeded cultivars in terms of turfgrass quality, shoot density, and leaf blade width. The green-live canopy biomass and root biomass assessments revealed no specific differentials between the two groups of cultivars for either species.

Keywords: canopy biomass, fairway, leaf blade width, root biomass, shoot density, sport fields, and turf quality.

Introduction

The higher quality, C_4, warm-season *Cynodon* and *Zoysia* cultivars used on golf courses and sport fields typically have been vegetatively propagated. The principle seeded bermudagrass used has been termed “common” (*C. dactylon*) as grown in the Yuma, Arizona area. Most seed of zoysiagrass (*Z. japonica*) has been used in the Asian region, and for the most part is harvested from naturalized stands in Asia. The characteristics of the seeded sources have typically been of a low density, open growth habit, particularly when compared to the vegetatively propagated, hybrid *C. dactylon* x *C. transvaalensis* and *Z. japonica* x *Z. tenuifolia* (1).

In the Mediterranean regions of Europe there has been a hesitancy to use the improved vegetatively propagated, hybrid cultivars. The preference has been to use seeded grasses, with one of the contributing factors being the lack of readily available vegetative production sources. Allied with the preference for seeded types has been the use of C_3, cool-season turfgrasses, which has been unfortunate, especially in low rainfall areas where there is limited water available. This is because the warm-season *Cynodon* species are far superior in drought resistance and a low water use rate. As a group the *Cynodon* species have superior drought resistance, dehydration avoidance, deep rooting,

heat stress resistance, and wear stress tolerance, but have poor shade adaptation and chill stress tolerance (1, 3). The *Zoysia* species have superior heat stress resistance and wear stress tolerance, plus intermediate shade adaptation, but poor drought resistance, hydration avoidance, and rooting.

A relatively recent development has been the release of seeded cultivars of both *Cynodon* and *Zoysia* species, principally by seed companies in the United States. The first breakthrough was the release of NuMex Sahara turf-type bermudagrass (*C. dactylon*) by New Mexico State University in 1987. This paper represents the initial assessments of seeded versus vegetatively propagated cultivars of both *Cynodon* and *Zoysia* species under Mediterranean climatic conditions.

Method and Materials

Establishment. The site of the research plots was just west of Rome near Casalpalocco, Italy at 41°40'N and 10°15'E. The native root zone was composed of 83.5% sand with 95% above 0.25 mm in diameter, 10.8% silt, and 5.7% clay. The infiltration rate was 89 mm h^{-1}, and the organic matter content was 4.7%. The plot size was 3 by 2 meters in a randomized block design with 4 replications. There was a 0.5 meter bare-soil alleyway between each plot. The *Cynodon* cultivar entries included 11 seeded and 5 vegetative cultivars, while the *Zoysia* cultivar entries included 4 seeded and 5 vegetative cultivars (Tables 1 and 2).

The site was tilled, and phosphorus and potassium were incorporated into the seedbed at rates based on a chemical soil test. The soil pH was 7.1. The site was fumigated with methyl bromide on July 14, 1995. The planting date for the seeded cultivars was July 21, 1995, and for the vegetatively planted materials it was August 17, 1995, with the exception of a few entries which were planted on August 5, 1996. These included the seeded W 3-2 and the vegetatively planted Santa Ana *Cynodon*. The vegetative plantings were sprig planted in rows, followed by rolling to firm the soil around the lateral stems. The seeding ratewas at 0.5 kg/100 m^2 for the *Cynodon*, and 1 kg/100 m^2 for the *Zoysia* cultivars. The seed was lightly raked into the surface, and then rolled to firm the soil around the seed.

Cultural Practices. During the initial establishment year the plots were mowed twice per week at a cutting height of 50 mm using a triplex reel mower. For subsequent growing seasons, the cutting height was lowered to 13 mm, and mowed at a frequency of 2 to 3 times per week, depending on the vertical shoot growth rate. A total of 2.41 kg/100 m^2 of nitrogen was applied during the 1996 growing season, divided into 4 applications. In 1997 the annual nitrogen fertilization rate was 1.53 kg/100 m^2, divided into 5 equal applications, and in 1998 it was 2.25 kg/100 m^2, divided into 5 applications. Phosphorus and potassium were applied at least twice annually as needed based on a chemical soil test. Supplemental irrigations were applied as needed to prevent visual wilt. No turf cultivation or vertical cutting was practiced on the experimental area in order to avoid interplot contamination. Invading weeds were hand removed during the establishment period, but after the turfs were fully established the weeds were allowed to invade. Some occasional, sporadic disease injury were evident in the turfed plots, but none was significant enough to cause any major damage to the turfgrass cultivars.

Assessments. Both turfgrass quality and morphological assessments were made during the 1996, 1997, and 1998 seasons. Visual turfgrass quality estimates were made at 15-day intervals throughout the growing season. These ratings were based primarily on a composite of two components: uniformity of appearance and shoot density. The rating scale used was 9=best and 1=poorest. A rating of 6.5 or higher represented an acceptable quality turf surface for fairways and sports fields.

The morphological assessments were made in September following the summer stress period. They included (a) actual leaf blade width measurements involving the midpoint of the second-youngest, fully expanded leaf, (b) shoot density counts (c) root biomass, and (d) green-live canopy biomass, with the latter three assessed on a 70 mm diameter turf plug. The data were processed and statistically analyzed using an analysis of variance.

Results

The establishment rates for the *Cynodon* cultivars were much more rapid than for the *Zoysia* cultivars. The turfgrass quality and morphological characteristics of both the *Cynodon* and *Zoysia* species are summarized in Tables 1 and 2, respectively. There was a general increase in the turfgrass quality, shoot density, and leaf blade width between 1997 and 1998 which probably is a reflection of an increased nitrogen fertilization rate from 1.53 to 2.25 kg/100 m^2.

Cynodon Cultivars

Tifway has been the standard *Cynodon* cultivar most widely used on fairways and sports fields in the warmer climatic regions around the world. These data indicate that Tifway continues to perform at a high level

Turfgrass Quality. The seasonal turfgrass quality data indicate the vegetatively propagated hybrid *Cynodon* cultivars were performed at a higher level than the seeded *C. dactylon* cultivars, when maintained at a 13 mm cutting height. Except for Princess, the seeded cultivars tended to rank lower in turfgrass quality primarily because of a lower shoot density and wider leaf width. The highest ranking seeded *C. dactylon* cultivars were Princess, Sultan and NuMex Sahara. A minimum of 4 years is required to obtain a reasonable overall assessment of turfgrass cultivar performance under field conditions.

Shoot Density. The vegetatively propagated, hybrid *Cynodon* cultivars were substantially higher in shoot density than the seeded *C. dactylon* cultivars with one exception, Princess. The shoot density is a key component in turfgrass quality, and also is a strong factor influencing the relative competitive availability of the cultivar to weed invasion. The lower the shoot density the turf the more likely radiant energy will penetrate the soil surface, thereby enhancing weed seed germination and growth.

Green-live Canopy Biomass. A high canopy biomass is an important dimension contributing to enhanced intraspecies wear stress tolerance. The data do not indicate any major differential in comparative canopy biomass between the vegetative propagated and the seeded *Cynodon* cultivars. Ranking highest in canopy biomass were Tifway II,

Primavera, Pyramid, Tifdwarf, Princess, and Sultan.

Leaf Blade Width. The vegetatively propagated, hybrid *Cynodon* cultivars were characterized by a distinctly finer leaf texture, than for the seeded *C. dactylon* cultivars. These same grasses tended to have the highest shoot density. Generally, the higher the shoot density the finer the leaf texture. Thus, it is hard to distinguish just how much of this leaf blade width effect is related to inherited characteristics versus the influence of the higher shoot density.

Root Biomass. A larger root biomass is associated with a greater capability to take up water and plant nutrients, with the former resulting in enhanced dehydration avoidance and resultant drought resistance. There was no general trend indicating superiority between the vegetatively propagated and the seeded *Cynodon* cultivars in terms of total root biomass. Those cultivars ranking highest in root biomass included Tifgreen, Primavera, Guymon, Tifdwarf, and Tifway II.

Zoysia Cultivars

Meyer is the cultivar of *Zoysia* species that has been most widely used for fairways and sports fields, especially in the warmer climates of North America. As a group the *Zoysia* cultivars were substantially lower in root biomass than the *Cynodon* cultivars, which confirms previous research (4, 5), which is the basis for an inferior dehydration avoidance (3).

Turfgrass Quality. As a group the vegetatively propagated *Zoysia* cultivars ranked substantially higher in turfgrass quality than the seeded *Zoysia* cultivar. Ranking highest was Emerald a hybrid of *Z. japonica* and *Z. tenufolia*, whereas the seeded cultivars were *Z. japonica*.

Morphological Characteristics. The comparative shoot density among the vegetatively propagated and seeded cultivars were related more to whether they were *Z. japonica* or *Zoysia* hybrids. The leaf blade width characteristics tended to correlate inversely with the shoot density. Finally, there were no definitive differentials between the vegetatively propagated and seeded *Zoysia* cultivars in terms of green-live canopy biomass and the root biomass. Ranking highest in canopy biomass was Meyer, and ranking highest in root biomass was Victoria.

Discussion

These data indicate that as a group the vegetatively propagated cultivars of both *Cynodon* and *Zoysia* species performed better than the seeded cultivars, when mowed at a 13 mm cutting height for use on sports fields and golf course fairways. It should be noted that some of the seeded *C. dactylon* cultivars may perform better if mowed at a height of 25 mm or higher, as for golf course roughs and minimal use areas. The selection and development of the vegetative propagated cultivars of both the *Cynodon* and *Zoysia* species have been underway for a much longer period of time, than the relatively recent emphasis on the development of seeded cultivars of each species. Further improvements

are likely if continued effort is devoted to the breeding and selection of seeded cultivars. The recent development of Princess indicates that additional improvements are possible, especially in shoot density. When utilizing vegetatively propagated cultivars, they should be obtained from a reputable grower with fields that are free from off-type contamination and have the genetic integrity of the cultivar being acquired.

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Table 1. Comparative Turfgrass Characteristics Among 5 Vegetatively Propagated Cultivars and 11 Seeded Cultivars

in *Cynodon* in the Third and Fourth Years at Casalpalocco, Italy, when mowed at 13 mm.

Cynodon Cultivar	Root Biomass (mg cm^{-3})	Leaf Blade Width (mm)	Verdure (mg cm^{-2})	Shoot Density (cm^{-2})		Turf Quality (9=best & 1=poorest)	
	1996	1998	1997	1997	1998	1997	1998
Tifway II*	2.65	1.2	171	14.5	10.8	7.20	7.90
Tifdwarf	2.70	1.2	140	9.1	9.0	7.20	7.76
Tifway	1.79	1.2	128	11.0	11.7	7.32	7.74
Tifgreen	4.47	1.2	116	5.3	8.6	7.18	7.21
Santa Ana		1.1		7.8	11.2	6.02	7.07
Princess	1.81	1.4	139	8.4	8.7	6.72	6.81
NuMex Sahara	2.01	1.8	123	4.6	5.2	5.99	6.08
Sultan	2.22	1.8	136	3.5	4.8	6.23	6.04
Sonesta	1.38	1.8	118	3.3	4.3	6.12	5.82
Jackpot	2.52	1.6	134	2.9	5.3	5.95	5.81
Pyramid	2.23	1.8	143	4.2	5.3	6.29	5.78
Mirage	1.42	1.9	126	3.0	4.5	6.13	5.76
Primavera	3.82	1.9	147	2.7	4.6	5.98	5.75
Guymon	2.95	1.9	112	2.8	4.0	6.02	5.67
common	2.30	1.9	107	2.5	4.8	5.84	5.65
Cheyenne	1.83	1.7	127	2.7	3.6	5.84	5.55
5% Lsd	1.23	0.3	33	2.7	2.2	0.37	0.83

*Cultivar (*Cynodon dactylon* x *C. transvaalensis*) is a vegetatively propagated hybrid bermudagrass, while all others are seeded dactylon bermudagrasses (*C. dactylon*).

Table 2. Comparative Turfgrass Characteristics Among 5 Vegetatively Propagated Cultivars and 4 Seeded Cultivars of *Zoysia* in the Third and Fourth Years at Casalpalocco, Italy, when mowed at 13 mm.

Zoysia Cultivar	Root Biomass (mg cm^{-3})	Leaf Blade Width (mm)	Verdure (mg cm^{-2})	Shoot Density (cm^{-2})		Turf Quality (9=best & 1=poorest)	
	1996	1998	1997	1997	1998	1997	1998
Emerald‡ *	0.72	1.4	97	7.2	9.9	6.38	8.29
Victoria**	1.92	1.9	125	5.0	6.6	6.97	7.40
De Anza**	0.72	2.2	115	4.1	4.8	6.93	7.13
Meyer†	0.82	2.2	143	4.3	5.0	6.72	6.97
El Toro†	1.34	2.6	121	4.3	4.4	7.03	6.93
T-1 Meyer†	0.93	2.0	122	4.7	5.4	6.13	6.54
China common (Sunrise)†	1.56	2.8	110	2.4	2.5	6.24	6.10
W 3-2†		2.4			4.1		5.24
J-36†		2.6			3.3		4.74
5% Lsd	0.60	0.3	43	0.9	2.1	0.77	0.84

*Vegetatively propagated cultivars in bold face, with all others seeded.
**Cultivar is a hybrid of *Zoysia japonica* x *Zoysia* species.
†Cultivar is *Zoysia japonica.*
‡Cultivar is a hybrid of *Zoysia japonica* x *Z. tenuifolia.*