Coleus hybrids Crossandra hybrids Curcuma roscoeana Cuphea hyssopifolia Evolvulus glomeratus Rhoeo spathacea Scaevola 'Blue Wonder' Setcreasea pallida Stachytarpheta spp. Torenia fournieri Turnera ulmifolia Zinnia angustifolia

## **MEDIUM HEIGHT**

Brunfelsia spp. Galphimia glauca Gingers - many Heliconia spp. False Heather Blue Daze Oyster Plant

Purple Queen Porterweed Wishbone Plant

Lady of the Night Thryallis Hibiscus hybrids Ixora hybrids Jatropha integerrima Mussaenda cvs. Pentas hybrids Plumbago capensis Poinciana pulcherrima Thunbergia erecta Tibouchina spp.

# TREES

Brugmansia spp. Bulnesia arborea Lagerstroemia speciosa Tecoma stans

## VINES

Solandra spp. Thunbergia grandiflora Dwarf Poinciana King's Mantle Princess Flower

### Angel's Trumpet

Queen's Crape Myrtle Yellow Elder

Golden Chalice Blue Sky Vine

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# **OVERSEED TRIALS ON FAIRWAY AND PUTTING GREEN BERMUDAGRASS**

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Abstract. Twenty-nine cool-season grasses were overseeded on a 'Tifway' bermudagrass fairway and a 'Tifdwarf' bermuda-grass putting green at Gainesville, FL. Studies were established in mid October 1994 and terminated in May 1995. On the fairway, entries with best seasonal turf quality scores, which averaged 5.8 on a 1 to 9 scale where 9 = best, were perennial ryegrass cultivars 'Divine', 'Palmer II', 'TMI-EXFLP94', and 'Top Hat'; perennial ryegrass blends 'Blend 1', 'Marvelgreen Supreme', 'Medalist 8', 'Pleasure+', and 'Sunrise Primo'; and a mixture of 'Brightstar' perennial ryegrass with 'Winterplay' rough bluegrass. Bermudagrass competition on the fairway seriously affected overseeded grass establishment and performance. On the putting green, entries with best seasonal turf quality scores, which averaged 7.0, were creeping bentgrass cultivars 'Penncross' and 'ProCup'; rough bluegrass cultivars 'Pro-Am', 'PT-GH-92', and 'Winterplay'; a mixture of 'Winterplay' rough bluegrass with 'Seaside' creeping bentgrass; and a mixture of 'Brightstar' perennial ryegrass with 'Winterplay' rough bluegrass.

Throughout the southern United States, fairways and putting greens are overseeded annually with cool-season turfgrasses during winter months. This practice provides live, green turf covers and improves playing surfaces when bermudagrass goes dormant (Turgeon, 1991). Turfgrass breeders and seed producers continue to develop new grasses, resulting in numerous cool-season grasses for overseeding. In addition to new cultivars, producers also formulate new grass mixtures and blends. Timely trials are needed to evaluate performance and to provide information to potential users of these grasses (Anderson and Dudeck, 1994; Dudeck and Anderson, 1991; Dudeck and Anderson, 1992). The purpose of these studies was to evaluate suitability of selected cool-season turfgrass species, cultivars, mixtures, and blends for overseeding purposes in north Florida.

### **Materials and Methods**

Two concurrent studies were conducted during the 1994-1995 winter period: one under fairway conditions, the other under putting green conditions. Twenty-nine entries of coolseason grasses listed in Table 1 were overseeded on a 'Tifway II' bermudagrass (*Cynodon* spp.) fairway on 14 Oct. 1994. The same grasses were overseeded on a 'Tifdwarf' bermudagrass (*Cynodon* spp.) putting green on 18 Oct. 1994. Bermudagrass control plots, which were not overseeded, were included in both studies. Studies were conducted at the University of Florida, Institute of Food and Agricultural Sciences, Turfgrass Field Laboratory, Gainesville, FL.

Prior to overseeding, the putting green site was topdressed with a fumigated Arredondo fine sand (loamy, silicious, hyperthermic Grossarenic Paleudult), identical to underlying soil. Topdressing rate was 7.4 ft<sup>3</sup> per 1,000 ft<sup>2</sup> (approximately one-eighth inch of soil). Instead of topdressing, the fairway site was scalped to 0.5 inch with a mower prior to overseeding.

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Table 1. Cool-season turfgrasses with their composition and seed source that were overseeded at Gainesville, FL, during the 1994-1995 winter period.

		Components				
Turfgrass	Mix/Blend	Cultivar	Species <sup>z</sup>	Source		
	%					
Alliance Blend	25	Brightstar	PR	Pure Seed Testing		
	25	Quickstart	PR			
	25	Saturn	PR			
	25	Navajo	PR			
Blend 1	33	Brightstar	PR	Pure Seed Testing		
	33	Charger	PR			
	33	246	PR			
Danish Common	100	Danish Common	RB	Pickseed		
Darkhorse	100	Darkhorse	RB	Pickseed		
Divine	100	Divine	PR	O. M. Scotts		
Double Eagle Blend	33	Advantage	PR	Lesco		
-	33	Assure	PR			
	33	Legacy	PR			
Froghair	100	Froghair	IR	Turf Merchants		
J100	100	J100	CB	Jacklin		
[1704	100	J1704	PR	Jacklin		
Laredo	100	Laredo	PR	Turf Merchants		
LPT-CT	100	LPT-CT	RB	Lofts		
Marvelgreen Supreme	25	Prelude II	PR	Lofts		
0 1	25	Repell II	PR			
	50	Palmer II	PR			
Med1707	100	Med1707	PR	Jacklin		
Medalist 8	50	APM	PR	Medalist America		
	50	Accent	PR			
Mix 1	80	Brightstar	PR	Pure Seed Testing		
	20	Winterplay	RB	5		
Mix 2	30	Seaside	CB	Pure Seed Testing		
	70	Winterplay	RB	0		
Mix 3	30	Southshore	CB	Lofts		
	70	Laser	RB			
Palmer II	100	Palmer II	PR	Lofts		
Penncross	100	Penncross	СВ	Ag Resources		
Pleasure+	33	Pleasure	PR	Ampac		
	33	Delaware Dwarf	PR	I III		
	33	Nobility	PR			
Pro-Am	100	Pro-Am	RB	Lesco		
ProCup	100	ProCup	СВ	O.M. Scotts		
PT-GH-92	100	PT-GH-92	RB	Pickseed		
Seaside	100	Seaside	СВ	Pure Seed Testing		
Sunrise Primo Blend	40	Pebble Beach	PR	Pennington Seed		
	40	Syn P	PR			
	20	Sunrise 246	PR			
TMI-94PT1	100	TMI-94PT1	RB	Turf Merchants		
TMI-EXFLP94	100	TMI-EXFLP94	PR	Turf Merchants		
Top Hat	100	Top Hat	PR	International Seed		
Winterplay	100	Winterplay	RB	Pure Seed Testing		
······································				r are been results		

CB=Creeping bentgrass, IR=Intermediate ryegrass, PR=Perennial ryegrass, RB=Rough bluegrass

A shaker bottle was used to hand seed all plots accurately and uniformly within a 4 by 6 foot seeder box. Small seeded grasses, such as bentgrass (Agrostis spp.) and bluegrass (Poa spp.), were diluted with a small amount of soil prior to hand seeding. Perennial ryegrass (Lolium perenne) and intermediate ryegrass (L. hybridum) were seeded at a rate of 15 PLS (pure live seed) per square inch on fairways and 50 PLS per square inch on putting greens (Table 2). Rough bluegrasses were seeded at a rate of 30 PLS per square inch on fairways and 100 PLS per square inch on putting greens. Creeping bentgrasses were seeded at a rate of 45 PLS per square inch on fairways and 150 PLS per square inch on putting greens. After seeding, both sites were topdressed at 7.4 ft<sup>3</sup> per 1,000 ft<sup>2</sup> with Arredondo fine sand to cover seed. Preventative fungicides and insecticides were applied throughout the study to minimize disease and insect problems. Light irrigation was applied twice daily for two weeks following overseeding; this was then reduced to once per day to replace losses from evapotranspiration.

The putting green site was mowed six times a week at a height of 0.19 inch. Clippings were removed only from the putting green. The fairway was mowed three times weekly at 0.75 inch. Both sites were fertilized once every two weeks with a water soluble 15-0-15 (N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) fertilizer at 0.5 pounds of N per 1,000 ft<sup>2</sup>. A total of 5.5 pounds of N per 1,000 ft<sup>2</sup> was applied over the course of the studies.

Data generated included rate of establishment, which was based on visual estimates of percent overseed cover by three or four independent observers. These ratings were taken every three or four days for the first three weeks following overseeding, then at twice monthly for the remainder of the study. Rate of ground cover was calculated after Maguire (1962), as the sum of average daily ground cover estimates for 21 days following overseeding. Cover<sub>50</sub> values, which indicate days to

			Se	ed	Seed Rate <sup>2</sup>		
Turfgrass	Purity	Germ	Bulk	PLS	Green	Fairway	
	%	%	#/	/lb	lbs/10	00 sq. ft.	
Alliance Blend	98.1	94.1	249,469	230,860	39.1	9.5	
Blend 1	98.8	95.9	247,581	234,727	30.4	9.1	
Danish Common	99.1	97.0	1,853,061	1,782,011	8.1	2.4	
Darkhorse	99.4	88.0	2,230,000	1,953,373	7.4	2.2	
Divine	97.4	91.0	254,000	225,223	32.0	9.6	
Double Eagle Blend	98.1	90.0	252,733	227,056	31.3	9.4	
Froghair	96.0	90.0	225,000	194,400	37.0	11.1	
1100	96.0	93.0	4.048.611	3.615.729	6.0	1.8	
<u>]</u> 1704	96.6	92.0	290,787	257,679	27.9	8.4	
Laredo	95.0	92.0	240,000	209,760	34.3	10.3	
LPT-CT	94.8	85.0	2.662.757	2.146.329	6.7	2.0	
Marvelgreen Supreme	98.8	96.5	237.533	227.056	31.7	9.5	
Med1707	88.0	86.0	293,284	221,932	32.4	9.7	
Medalist 8	98.3	97.0	237,326	226,339	31.8	9.6	
Mix 1	99.2	94.8	1.330.610	1.268.696	24.5	7.4	
Mix 2	99.0	92.0	4.037.500	3.616.236	5.5	1.6	
Mix 3	99.0	94.0	4.371.647	4.063.398	4.9	1.4	
Palmer II	98.3	97.0	237.326	226.339	4.9	9.5	
Penncross	98.1	91.8	5.307.037	4.774.744	4.5	1.4	
Pleasure+	98.4	96.0	250,000	237.042	30.9	9.0	
Pro-Am	98.5	90.0	2.270.000	2.012.151	7.2	2.1	
ProCup	98.1	92.0	5,424,000	4.896.266	4.4	1.3	
PT-GH-92	77.3	89.0	2.161.905	1.487.711	9.7	2.9	
Seaside	99.4	88.0	5.675.000	4.963.537	4.4	1.3	
Sunrise Primo Blend	98.2	89.0	267.170	233.501	30.8	9.3	
TMI-EXFLP94	97.0	94.0	230.000	209.714	34.3	10.3	
TMI-94PT1	98.0	96.0	2.350.000	2.210.880	6.5	2.0	
Top Hat	98.0	94.7	273.517	253.840	28.4	8.5	
Winterplay	99.7	96.0	2,400,000	2,295,936	6.3	1.9	

Table 2. Cool-season turfgrass seed quality, bulk and pure live seed (PLS) number per pound, and seeding rate for overseed trials at Gainesville, FL during the winter of 1994 to 1995.

'See text for PLS seeding rate.

50% overseed ground cover were calculated with a 95% probability. From Nov. through Feb., turf quality estimates were recorded once every two weeks by three or four different observers. These scores were summarized and presented in tabular form as monthly averages. A rating scale from 1 to 9 was used where 1 = poor and 9 = best turf quality. A rating scale from 1 to 5 was used to rate turf color where 1 = lightgreen and 5 = dark green. Dollar spot disease was rated five times during April. A rating scale from 1 to 9 was used where 1 = least and 9 = most disease damage or incidence.

Both studies were randomized complete block designs with four replications. All data were subjected to analysis of variance and means were separated using the Waller-Duncan k-ratio *t*-test at the 5% level of probability.

#### **Results and Discussion**

Seed number per pound varied widely among cultivars within species (Table 2). Seed number per bulk pound varied from 230,000 to 293,000 for 'TMI-EXFLP94' and 'Med1707' perennial ryegrass, respectively. Similarly, seed number per pound varied from 1.8 to 2.7 million for 'Danish Common' and 'LPT-CT' rough bluegrass, respectively. Therefore, pure live seed (PLS) content was used to equate seeding rates within grass species.

Although the 1994-1995 growing season averaged 2.5°F below the 29-year average (Table 3), above normal temperatures in Nov. increased bermudagrass competition, especially on the fairway trial. Frost occurrences in Dec., Jan., and Feb.

Table 3. Average, minimum, and maximum daily air temperature (°F) and departure from normal air temperatures during the 1994-1995 growing season at Gainesville, FL.<sup>4</sup>

		1994-1995		Departure from 29-year average			
Month	Max.	Min.	Mean	Max.	Min.	Mean	
Oct.	80.6	61.1	70.9	-2.1	0.6	-0.7	
Nov.	78.5	57.2	67.8	2.9	5.2	4.0	
Dec.	68.7	47.4	58.0	-1.3	1.3	0.0	
Ian.	65.5	39.5	52.5	-3.1	-4.0	-3.6	
Feb.	68.4	41.5	55.0	-2.1	-3.4	-2.8	
Mar.	77.2	53.0	65.1	0.5	2.0	1.3	
Apr.	80.8	54.7	67.8	-1.6	-1.0	-1.3	

'Recorded at Agronomy farm, University of Florida campus.

Table 4. Average weekly ground cover estimates,	days to 50% cover, and cover	rate of cool-season grasses	during the first three w	veeks after overseeding a
'Tifdwarf' bermudagrass putting green on 18	October 1994 at Gainesville, FI	-		

		% Cover @ day				
Turfgrass	7	14	21	Cover <sub>50</sub> <sup>2</sup>	Cover Rate <sup>v</sup>	
Froghair	74	97	70	4.9±0.1	51.3 a×	
Laredo	50	99	95	$5.5 \pm 0.1$	48.3 ab	
Divine	47	97	91	$5.8 \pm 1.0$	46.4 ab	
Alliance Blend	47	99	86	5.7±1.1	46.1 ab	
Marvelgreen Supreme	50	98	89	$5.7 \pm 1.0$	45.6 a-c	
Palmer II	50	97	87	$5.8 \pm 1.0$	45.3 a-c	
Blend 1	50	97	93	$5.8 \pm 1.0$	44.3 a-c	
Pleasure+	47	99	87	$5.9 \pm 1.0$	44.1 a-c	
Medalist 8	47	99	92	$5.9 \pm 1.0$	42.6 a-c	
Mix 1	46	99	99	$6.2\pm0.8$	41.7 a-c	
Double Eagle Blend	47	97	85	$6.1\pm0.8$	41.0 a-c	
Top Hat	46	99	91	$6.3 \pm 1.0$	41.0 a-c	
Sunrise Primo Blend	47	86	83	$6.2 \pm 1.0$	40.1 a-c	
TMI-EXFLP94	44	97	91	$6.4 \pm 1.2$	39.5 a-d	
[1704	43	77	91	$6.8 \pm 1.1$	37.4 b-e	
Danish Common	48	92	99	$6.7 \pm 1.0$	36.3 b-e	
Med1707	44	94	84	$6.6 \pm 0.5$	36.3 b-e	
J100	43	91	98	$6.9\pm0.9$	35.0 b-f	
Seaside	40	86	96	7.3±0.6	31.9 c-g	
Pro-Am	43	81	99	8.1±0.1	26.5 d-h	
Mix 2	30	87	99	$8.2\pm0.5$	24.7 e-h	
Winterplay	34	65	99	8.8±0.7	24.0 e-h	
Darkhorse	34	58	97	$9.5 \pm 1.1$	21.9 f-h	
PT-GH-92	36	60	99	$9.5 \pm 1.4$	21.9 f-h	
ProCup	30	65	96	$9.4\pm0.9$	21.6 f-h	
TMI-94PT	25	56	99	$9.6 \pm 0.8$	19.8 gh	
LPT-CT	24	51	99	$10.5 \pm 0.9$	18.8 gh	
Penncross	0	64	97	9.4±0.8	15.9 <b>h</b>	
Mix 3	13	59	99	$10.1\pm0.3$	15.5 h	
– – – – – – – – – MSD <sup>w</sup>		<u>32</u>			13.9	

'Cover<sub>50</sub> = Days to 50% overseeded cover.

<sup>v</sup>Cover rate= Sum of average percent ground cover estimates during the first 21 days after overseeding. Six estimates were averaged.

\*Means within columns with the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio +test.

\*MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio t-test.

Table 5. Monthly and season means for turf quality of overseeded grasses grown on a 'Tifdwarf' bermudagrass putting green from November 1994 to April 1995 at Gainesville, FL.

-		Dec.	Jan.	Feb.	Mar.		Season	
Turfgrass	Nov.					Apr.	Mean	CV <sup>z</sup>
				Rating				%
Penncross	5.9	6.9	7.0	7.6	8.2	7.9	7.25 a <sup>x</sup>	11.6
Pro-Am	7.1	7.4	7.7	8.1	7.6	5.2	7.18 a	16.4
Mix 1	6.7	7.4	7.2	7.9	7.6	5.8	7.09 ab	13.6
ProCup	5.7	6.4	6.4	7.1	8.1	8.4	7.00 a-c	14.6
PT-GH-92	6.9	7.7	7.6	7.8	7.3	4.6	7.00 a-c	21.0
Mix 2	6.4	6.6	6.8	7.5	7.5	6.3	6.86 a-d	11.1
Winterplay	6.9	7.2	7.2	7.6	7.5	4.8	6.86 a-d	19.4
LPT-CT	6.9	7.1	6.9	7.6	7.5	4.6	6.77 b-d	20.1
TMI-94PT1	7.1	7.2	6.5	7.4	7.1	4.9	6.70 b-d	16.8
Mix 3	6.3	6.2	6.5	7.2	7.2	6.5	6.64 cd	9.6
Seaside	5.1	5.9	5.9	6.9	8.0	8.1	6.63 cd	17.5
Darkhorse	6.8	7.0	6.8	7.0	7.3	4.6	6.60 d	18.8
J100	6.4	6.3	5.8	6.4	7.8	6.4	6.50 de	13.0
Danish Common	6.5	6.8	5.9	5.7	6.1	5.8	6.16 ef	11.6
Medalist 8	5.6	5.8	5.9	6.5	6.8	6.1	6.11 ef	12.6
Laredo	5.1	6.1	5.4	5.9	6.3	6.1	5.80 fg	12.6
Sunrise Primo Blend	4.8	5.7	5.0	5.5	5.9	5.7	5.41 gh	14.4

<sup>2</sup>CV = Coefficient of variation is a measure of relative variation around season mean expressed in percent. Forty-one ratings were averaged. <sup>3</sup>Quality rated from 1 to 9 where 9=best.

\*Season means followed by the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio t-test.

"MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio t-test.

Table 5. (	Continued) Monthly and	season means for tur	f quality of overseeded	l grasses grown on a	'Tifdwarf' l	bermudagrass putting gre	een from November
1994 to	April 1995 at Gainesville,	, FL.					

							Sea	son
Turfgrass	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Mean	CV′
				Rating				%
Blend 1	4.7	5.4	5.1	5.5	5.9	5.6	5.40 h	16.3
Divine	5.3	5.8	4.8	5.3	5.9	5.4	5.40 h	13.2
Pleasure+	4.5	5.6	4.9	5.4	5.9	5.6	5.31 h	13.6
TMI-EXFLP94	5.1	5.3	4.9	5.1	5.8	5.8	5.31 h	13.0
[1704	4.8	5.2	4.8	5.5	5.9	5.8	5.30 h	14.8
Top Hat	5.1	5.4	4.6	5.2	5.8	5.5	5.27 h	14.4
Med1707	4.8	5.3	4.8	5.6	5.8	5.4	5.26 h	15.3
Alliance Blend	4.3	5.6	4.8	5.4	5.8	5.5	5.24 h	14.3
Palmer II	4.9	5.1	4.7	5.3	5.8	5.5	5.23 hi	14.5
Marvelgreen Supreme	4.8	4.9	4.3	5.2	5.8	5.4	5.08 hi	15.4
Double Eagle Blend	3.9	4.8	4.4	4.9	5.8	5.2	4.84 i	17.6
Froghair	1.9	2.6	2.3	3.1	4.3	4.1	3.04 j	34.3
Bermudagrass check	1.0	1.0	1.0	1.0	1.2	1.6	1.01 k	43.7
	0.7			0.5	0.4	0.4	0.04	

'CV = Coefficient of variation is a measure of relative variation around season mean expressed in percent. Forty-one ratings were averaged. 'Quality rated from 1 to 9 where 9=best.

Season means followed by the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio 4-test.

\*MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio *t*-test.

Table 6. Turf color and Dollar spot disease ratings of overseeded grasses grown on a 'Tifdwarf' bermudagrass putting green at Gainesville, FL during the winter of 1994 to 1995.

		Co	olor		Disease	
Turfgrass	Jan.	Feb.	Mar.	Mean	Apr.	
			Rating			
Divine	5.0	4.9	4.8	4.84 a <sup>y</sup>	1.5 gh	
Laredo	4.8	4.8	4.8	4.81 a	1.6 gh	
Marvelgreen Supreme	4.8	4.8	4.8	4.81 a	1.4 gh	
Top Hat	4.8	4.8	4.9	4.81 a	1.4 gh	
Blend 1	4.8	4.9	4.7	4.80 ab	1.5 gh	
Palmer II	4.8	4.8	4.8	4.78 ab	1.4 gh	
Medalist 8	4.8	4.7	4.7	4.73 ab	1.3 gh	
Double Eagle Blend	5.0	4.6	4.8	4.71 ab	1.4 gh	
11704	4.9	4.7	4.7	4.71 ab	1.4 gh	
Sunrise Primo Blend	4.8	4.7	4.7	4.70 ab	1.4 gh	
Med1707	4.8	4.6	4.6	4.64 ab	1.4 gh	
Pleasure+	4.7	4.6	4.7	4.64 ab	1.4 gh	
Alliance Blend	4.5	4.6	4.6	4.61 ab	1.4 gh	
TMI-EXFLP94	4.6	4.4	4.8	4.56 b	1.4 gh	
1100	3.5	3.5	4.6	3.91 с	3.2 c	
Penneross	3.4	3.0	3.8	3.36 d	2.0 fg	
ProCup	3.2	3.0	3.8	3.36 d	1.0 h	
TMI-94PT1	3.8	3.5	2.9	3.36 d	6.6 bc	
Mix 3	3.1	3.6	3.2	3.33 d	2.6 ef	
Seaside	2.7	2.9	3.0	2.92 e	1.2 gh	
Darkhorse	2.9	3.0	2.8	2.91 e	5.8 c	
Mix 1	3.4	2.8	2.8	2.91 e	4.2 d	
Winterplay	3.3	2.8	2.8	2.91 e	6.2 bc	
Mix 9	2.9	2.6	2.8	2.73 ef	2.6 ef	
PT-GH-92	3.1	2.4	2.7	<b>2.64</b> f	7.8 a	
LPT-CT	3.0	2.2	2.8	2.56 fg	8.2 a	
Pro-Am	2.8	2.2	2.7	2.50 fg	6.8 b	
Froghair	2.8	2.5	2.0	2.38 g	1.9 f-h	
Danish Common	1.0	1.0	1.0	1.0 h	2.2 fg	
— — — — — — — — — — — — — — — — — — —		0.3		0.24	0.9	

Color rated from 1 to 5 where 1=yellow green and 5=dark green. Fifteen color ratings were averaged. Dollar spot disease rated from 1 to 9 where 1=least and 9=most disease incidence. Five ratings were averaged.

Means within columns followed by the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio 4-test.

\*MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio +test.

totalled 1, 7, and 9 days, respectively. Consecutive days of frost were recorded from 24 to 27 Jan. and from 2 to 10 Feb. No injury to overseeded grass was noted during this time period.

Putting green study. Rate of ground cover establishment on the putting green varied widely between overseeded grasses (Table 4). Overseeded grasses with best rate of ground cover, which averaged 44%, included 'Alliance Blend', 'Blend 1', 'Divine', 'Double Eagle Blend', 'Froghair', 'Laredo', 'Marvelgreen Supreme', 'Medalist 8', 'Mix 1', 'Palmer II', 'Pleasure+', 'Sunrise Primo Blend', 'TMI-EXFLP94', and 'Top Hat'. These grasses, which were predominately perennial ryegrass, produced 50% ground cover in 5.8±0.9 days after seeding. Rough bluegrass and bentgrass entries had significantly slower establishment rates compared to ryegrass.

Turf quality on the putting green differed between overseeded grasses throughout the winter growing period (Table 5). Grass entries with best turf quality scores, which averaged 7.0, included 'Mix 1', 'Mix 2', 'Penncross', 'Pro-Am', 'Pro-Cup', 'PT-GH-92', and 'Winterplay'. These grasses were predominately rough bluegrass or creeping bentgrass entries. 'Penncross' creeping bentgrass and a mixture of 'Laser' rough bluegrass with 'Southshore' creeping bentgrass had lowest CV values, which averaged 11.3%, indicating uniform performance throughout the entire 6-month study. All overseeded grass entries provided better turf quality throughout the season compared to that of the bermudagrass control plots, which were not overseeded. Turf color on the putting green differed between overseeded grasses throughout the study period (Table 6). Grasses with darkest green color, which had an average score of 4.7 out of 5.0, were perennial ryegrass entries. These included 'Alliance Blend', 'Blend 1', 'Divine', 'Double Eagle Blend', 'J1704', 'Laredo', 'Marvelgreen Supreme', 'Med1707', 'Medalist 8', 'Palmer II', 'Pleasure+', 'Sunrise Primo Blend', and 'Top Hat'.

A severe outbreak of dollar spot was noted predominately on the rough bluegrasses during the month of April (Table 6). 'LPT-CT' and 'PT-GH-92' rough bluegrasses had the greatest incidence of dollar spot, which averaged 8.0 out of a possible 9.0 for most disease severity. In contrast, 'Danish Common' rough bluegrass, which averaged 2.2, had least dollar spot infection during this same period.

*Fairway study.* Rate of ground cover establishment on the fairway varied widely among grasses (Table 7). Overseeded grasses with best ground cover rate, which averaged 36%, included 'Alliance blend', 'Blend 1', 'Divine', 'Froghair', 'Laredo', 'Marvelgreen Supreme', 'Med1707', 'Medalist 8', 'Palmer II', 'Pleasure+', 'Sunrise Primo Blend', and 'TMI-EXFLP94'. This group produced 50% ground cover in 8.5±0.4 days after seeding.

Turf quality on the fairway differed between grasses throughout the study period (Table 8). Grasses with best seasonal turf quality scores, which averaged 5.8 included 'Blend 1', 'Divine', 'Marvelgreen Supreme', 'Medalist 8', 'Mix 1',

Table 7. Average weekly ground cover estimates, days to 50% ground cover, and cover rate of cool-season grasses during the first three weeks after overseeding a 'Tifway' bermudagrass fairway on 14 October 1994 at Gainesville, FL.

		% Cover @ day			
Turfgrass	7	14	21	Cover <sub>50</sub> <sup>2</sup>	Cover Rate <sup>y</sup>
Laredo	48	94	99	8.1±0.3	37.1 a×
Medalist 8	48	95	99	8.2±0.4	36.9 a
Alliance Blend	45	94	99	8.3±0.4	36.4 ab
Froghair	46	94	99	8.3±0.6	36.4 ab
TMI-EXFLP94	46	95	99	8.3±0.4	36.3 a-c
Sunrise Primo Blend	45	95	97	8.3±0.3	36.2 a-c
Blend 1	43	95	99	8.4±0.6	36.0 a-c
Palmer II	43	95	99	8.5±0.3	35.7 a-c
Pleasure+	39	92	99	8.7±0.6	34.5 a-c
Divine	38	95	93	8.8±0.5	34.1 a-c
Med1707	36	95	99	8.9±0.3	33.9 a-c
Marvelgreen Supreme	36	94	99	8.9±0.4	33.6 a-c
Top Hat	31	95	97	$9.0\pm0.4$	32.6 b-d
11704	33	93	96	$9.0\pm0.4$	32.4 b-d
Double Eagle Blend	31	94	99	$9.2\pm0.4$	32.3 cd
Mix 1	24	93	97	$9.9\pm0.3$	29.2 d
Danish Common	5	66	97	$12.1 \pm 1.4$	19.0 e
Winterplay	0	27	63	22.7±3.7	7.4 f
TMI-94PT1	0	29	56	$25.4\pm5.8$	7.2 f
Darkhorse	0	22	85	$18.8 \pm 2.2$	6.9 f
Mix 2	0	25	59	$22.5\pm3.2$	6.5 f
PT-GH-92	0	22	53	$23.6 \pm 2.7$	6.2 f
LPT-CT	Õ	16	70	21.7±1.5	5.7 f
Mix 3	0	12	63	24.5±3.8	4.2 fg
Seaside	0	5	13		1.5 gh
Penncross	Ō	5	9	_	1.0 gh
ProCup	Ō	3	6	43.5±6.3	0.7 gh
J100	0	0	0		0.0 h
					4.1

<sup>2</sup>Cover<sub>50</sub>=Days to 50% overseeded cover.

<sup>v</sup>Cover Rate= Sum of average percent ground cover estimates for the first 21 days after overseeding. Six estimates were averaged.

\*Means within columns with the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio & test.

\*Minimum significant difference (P=0.05) using Waller-Duncan k-ratio +test.

							Seas	on
Turfgrass	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Mean	CV <sup><i>i</i></sup>
• • • • • • • • • • • • • • • • • • •				Rating				%
Mix 1	4.6	6.6	4.9	5.9	6.8	7.4	6.04 a <sup>x</sup>	17.4
Medalist 8	4.9	6.8	4.5	4.9	7.1	7.8	5.99 ab	22.2
Top Hat	5.1	6.5	4.5	5.2	6.8	7.4	5.91 a-c	18.1
Blend 1	4.8	6.5	4.8	5.0	6.7	7.6	5.89 a-c	18.9
TMI-EXFLP94	5.0	6.4	4.3	5.1	6.9	7.4	5.84 a-d	20.2
Marvelgreen Supreme	4.5	6.1	4.7	5.6	6.9	7.1	5.82 a-d	17.2
Palmer II	5.5	6.3	4.5	4.6	6.6	7.4	5.79 a-d	20.3
Sunrise Primo Blend	5.6	6.3	4.3	4.3	6.4	7.5	5.73 a-d	22.3
Divine	4.6	6.3	4.5	5.0	6.6	7.3	5.69 a-e	19.0
Pleasure+	5.0	5.9	4.2	4.6	6.8	7.3	5.63 a-e	22.3
Alliance Blend	4.6	6.1	4.3	4.6	6.8	7.1	5.57 b-e	21.8
Med1707	5.1	6.3	4.2	4.5	6.5	6.9	5.56 b-e	20.4
Laredo	5.3	6.1	4.0	4.5	6.4	6.9	5.54 c-e	20.8
Double Eagle Blend	4.6	5.1	3.9	4.4	6.8	7.6	5.44 d-f	25.8
11704	4.0	5.5	4.2	4.4	6.3	7.1	5.25 e-g	23.0
Winterplay	3.3	5.3	4.1	4.5	6.2	7.1	5.06 f-h	26.0
PT-GH-92	2.5	5.5	4.2	4.1	6.3	7.1	5.02 f-i	28.5
Mix 2	3.3	4.6	3.9	4.7	6.2	7.1	4.97 g-i	26.5
Danish Common	4.3	5.1	3.8	4.1	5.3	6.0	4.75 h-i	17.3
LPT-CT	3.1	3.9	3.7	4.0	6.0	7.4	4.69 h-j	31.7
TMI-94PT1	2.6	4.6	3.5	3.9	5.9	6.9	4.58 ij	31.3
Froghair	3.8	4.4	4.0	4.8	5.1	5.4	4.51 j	13.8
Mix 3	2.8	4.6	3.4	4.0	5.5	6.7	4.49 j	29.6
Darkhorse	2.4	4.3	3.5	4.1	5.8	6.8	4.44 j	32.0
ProCup	1.1	1.3	1.1	1.3	2.4	3.4	1.78 k	49.5
Seaside	1.1	1.5	1.1	1.1	2.2	3.5	1.76 k	52.9
Penncross	1.1	1.1	1.0	1.1	2.2	3.4	1.66 k	58.0
1100	1.1	1.0	1.0	1.0	1.9	3.2	1.54 k	53.5
Bermudagrass check	1.0	1.0	1.0	1.0	1.9	3.1	1.49 k	54.0
	0.9			0.8	0.5	0.6	0.44	

Table 8. Monthly season	means for turf quality of	overseeded grasses	grown on a	'Tifway'	bermudagrass fairv	way from Novem	ber 1994	to April	1995 at
Gainesville, FL.	• •	Ū	0	·	0			-	

·CV = Coefficient of variation is a measure of relative variation around season mean expressed in percent. Thirty-two ratings were averaged. Quality rated from 1 to 9 where 9=best.

Season means followed by the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio t-test.

\*MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio +test.

Table 9. Monthly and season means for turf color of overseeded grasses grown on a 'Tifway' bermudagrass fairway at Gainesville, FL during the winter of 1994-1995.

Turfgrass	Jan.	Feb.	Mar.	Mean
		Rat	ing <sup>z</sup>	
Divine	5.0	5.0	5.0	4.99 a <sup>y</sup>
Blend 1	5.0	5.0	4.8	4.93 ab
Palmer II	4.8	5.0	5.0	4.93 ab
Top Hat	4.9	4.9	4.9	4.90 ab
Alliance Blend	4.9	4.8	4.9	4.89 ab
Marvelgreen Supreme	4.9	4.8	4.9	4.89 ab
Sunrise Primo Blend	4.8	4.9	4.8	4.85 ab
Double Eagle Blend	5.0	4.6	4.9	4.83 ab
11704	4.9	4.6	5.0	4.83 ab
Medalist 8	4.8	4.9	4.8	4.83 ab
Pleasure+	4.9	4.8	4.8	4.82 ab
Laredo	4.8	4.8	4.8	4.79 b
TMI-EXFLP94	4.6	4.9	4.8	4.79 b
Med1707	4.8	4.7	4.8	4.76 b
Mix 1	3.6	3.9	3.3	3.57 c
TMI-94PT1	3.5	3.0	3.0	3.19 d
Winterplay	3.1	2.9	2.7	2.92 e
LPT-CT	2.9	2.5	2.8	2.75 ef

'Color rated from 1 to 5 where 1=yellow green and 5=dark green. Fifteen ratings were averaged.

<sup>2</sup>Means followed by the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio *t*-test. <sup>\*</sup>MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio *t*-test.

Table 9. (Continued) Monthly and season means for turf color of overseeded grasses grown on a 'Tifway' bermudagrass fairway at Gainesville, FL during the winter of 1994-1995.

Jan.	Feb.	Mar.	Mean
	Rat	ting <sup>z</sup>	
2.8	2.5	2.8	2.68 f
2.8	2.6	2.5	2.65 fg
2.6	2.6	2.8	2.64 fg
2.4	2.4	2.7	2.50 g
2.3	2.7	1.9	2.28 h
1.0	1.0	1.0	1.00 i
	0.3	0.2	0.18
	Jan. 2.8 2.8 2.6 2.4 2.3 1.0 0.3	Jan. Feb.   2.8 2.5   2.8 2.6   2.6 2.6   2.4 2.4   2.3 2.7   1.0 1.0   0.3 0.3	Jan. Feb. Mar.   Rating <sup>z</sup> Rating <sup>z</sup> 2.8 2.5 2.8   2.8 2.6 2.5   2.6 2.6 2.8   2.4 2.4 2.7   2.3 2.7 1.9   1.0 1.0 1.0   0.3 0.3 0.2

<sup>4</sup>Color rated from 1 to 5 where 1=yellow green and 5=dark green. Fifteen ratings were averaged.

Means followed by the same letter are not significantly different (P=0.05) using Waller-Duncan k-ratio t-test.

\*MSD = Minimum significant difference (P=0.05) using Waller-Duncan k-ratio t-test.

'Palmer II', 'Pleasure+', 'Sunrise Primo Blend', 'TMI-EXFLP94', and 'Top Hat'. Most were perennial ryegrasses. Although turf quality in this group was seriously affected by bermudagrass competition, plots were relatively uniform throughout the study period (CV=19.8%). None of the creeping bentgrasses produced turf quality which was better than that of the bermudagrass control plots which were not overseeded. Thus, use of the creeping bentgrass for overseeding fairways is a questionable practice.

Turf color on the fairway differed among grasses throughout the study period (Table 9). Grasses with darkest green color were perennial ryegrasses, which had an average score of 4.9 out of 5.0. These included 'Alliance Blend', 'Blend 1', 'Divine', 'Double Eagle Blend', 'J1704', 'Marvelgreen Supreme', 'Medalist 8', 'Palmer II', 'Pleasure+', 'Sunrise Primo Blend', and 'Top Hat'.

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# **CULTURE OF COMMON ARROWHEAD**

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Additional index words. Sagittaria latifolia, ornamental aquatic plants, aquatic gardens, aquascaping, fertilization practices.

*Abstract.* Common arrowhead (*Sagittaria latifolia* Willd.), a member of the Alismaceae or water-plantain family, is used as an aquatic ornamental and for aquatic habitat restoration. Indigenous to North America, this plant produces flowers with three white petals and dark green, three-lobed leaves that make an attractive addition to aquatic gardens. The plant may be propagated from seed or rhizomes. Little is known of the fertilization requirements for culture of common arrowhead al-

though the plant grows in a variety of aquatic habitats. In the current study, common arrowhead plants were planted in sand-filled plastic containers placed under an outdoor overhead sprinkler system. Sierra fertilizer (17 N - 6 P,O, - 10 K,O plus minors) formulated for an 8-9 month release rate was placed in amounts of 2, 4, 8, 16, 32, and 64 g per container as a layer 7 cm below the surface of the sand. Growth during four 16-week culture periods, as measured by number of plants, height of tallest leaf, width of tallest leaf, and plant dry weight, was low for plants in containers at the 2- and 4-g rate. Growth at the 32 and 64-g rate, equivalent to 360 and 720 g per m<sup>2</sup>, showed that an estimated 135 and 214 plants per m<sup>2</sup> averaging 12 and 10 g per plant, respectively, could be expected in a 16week period. Growth at the 8- and 16-g rate was intermediate between the low and high fertilizer rates. Correct fertilization levels in the rooting medium of common arrowhead is required to produce large plants with wide leaves.

Plants in the Alismaceae or water-plantain family are rhizomatous perennial herbs found primarily in fresh water in temperate and tropical regions of the Northern Hemisphere. Included in this family is the predominantly North America genus *Sagittaria* with about 20 species (Dahlgren, et al. 1985). Common arrowhead (*Sagittaria latifolia* Willd.), also known as

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