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RATE, METHOD, AND TIME OF OVERSEEDING WHITE CLOVER ON BERMUDAGRASS DURING THE WINTER[1]

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Abstract. **When grown in association with grasses, legumes fix significant amounts of atmospheric nitrogen for plant use. Warm season turfgrasses which go dormant during the winter months are normally overseeded with cool season grasses for ground cover. The purpose of this experiment was to study establishment and performance of 'La. S-1' White clover (Trifolium repens L.) overseeded into a 'Tifway' bermudagrass (Cynodon spp.) turf. At monthly intervals from 23 September 1981 through 8 March 1982 inoculated White clover was hand seeded at planting rates of 500, 1000, or 1500 pure live seed (PLS)/m². Plots were verticut (blades spaced 2.5 cm apart) or not verticut prior to seeding. After establishment, plots were irrigated and mowed at 7.5 cm with a mulching mower as needed. Best plant stands were obtained at 1500 PLS/m². Verticutting prior to seeding had a greater affect on rate of legume ground cover establishment than legume seedling stands. Plant stands from October planting were 1.8 times greater in verticut plots, whereas no verticut plots had better seedling stands in January planting. Rates of legume ground cover were superior in verticut plots throughout the season. Best rates of ground cover were produced at 1500 PLS/m², although interactions of planting rate X month were found. Legumes planted in September 1981 produced the highest bermudagrass clipping weights during the 1982 summer. The amount of N fixed by White clover in the best treatments was insignificant and produced inferior bermudagrass turf quality the following summer compared to standard N fertilization. The practice of winter overseeding bermudagrass with legumes may have merit only on golf course roughs or other low maintenance turfgrass areas. Value of this practice for overseeding golf course fairways should be reevaluated if fertilizer availability and cost become problems. If desired, verticut in one direction prior to overseeding 1000 PLS/m² of White clover in late September.**

Legumes fix significant amounts of atmospheric N_2 for grass use (5) when grown in mixtures. Warm-season turfgrasses which go dormant during winter months are normally overseeded with cool-season grasses for green ground cover (4). White clover, *Trifolium repens* L., when overseeded on 'Argentine' bahiagrass, *Paspalum notatum* Flugge., fixed enough N during the winter period to significantly increase turf quality and clipping yields of bahiagrass during the following warm-season growth periods without need for supplemental N fertilization (3). The purpose of this experiment was to study establishment and performance of 'La. S-1' White clover overseeded into a turf of 'Tifway' bermudagrass, *Cynodon* spp.

Materials and Methods

Plots 1 x 3 m of 'Tifway' bermudagrass were vertically moved in one direction or not vertically mowed prior to 7 monthly seedings from 23 September 1981 to 10 March 1982. Blades spaced 2.5 cm apart penetrated 0.6 cm into the soil. Inoculated White clover was hand-seeded into 1 x 1 m sub-plots at rates of 500, 1000, or 1500 pure live seed (PLS)/m². No companion grasses were used. Light, frequent irrigation was applied as needed until seedlings were established. All seedlings within a diagonally oriented 1 x 10 dm quadrat were counted 1 month after seeding to quantify seedling establishment. Visual cover estimates were made bi-weekly throughout the experiment. Plots were mowed weekly with a mulching mower at 7.5 cm until 3 March 1982 when mowing height was lowered to 2.5 cm. This negated shading from the clover canopy on bermudagrass which was resuming spring growth at that time. Daily maximum-minimum soil temperatures were measured at a depth of 1 cm under an adjacent 'Floratam' St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze, sod to measure the relationship of clover establishment with soil temperature.

The experimental design was a split split-plot with 4 replications where planting months were main plots, vertical mowing treatments were sub plots, and seeding rates were sub, sub plots. Analysis of variance was performed on all data. Percent cover estimates were first transformed using angular transformation (6). Cover rates which are the sum of average weekly ground cover were computed using Maguire's formula (7). Significant interactions were measured using a weighted error mean square and weighted degrees of freedom (6). Treatment means were separated using Waller-Duncan k-ratio t-test if appropriate, otherwise Duncan's Multiple Range test (2) was used.

Plots were sprayed with a broadleaf herbicide on 6 May 1982 to remove White clover which was still actively growing. Bermudagrass growth rates as affected by residual N fixed by White clover during the winter were measured in clipping dry weights at monthly intervals from June to August 1982. Growth rates were compared to standard

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bermudagrass growth curves effected by 0, 1.25, 2.50, 3.75, and 5.00 g/m² of N from ammonium nitrate applied 2 wk prior to the June to August harvests. Plots for the standard curve were 1 x 3 m and were replicated 3 times in a randomized block design on bermudagrass which had no legume cover during the winter.

Results and Discussion

White Clover seedling stands were influenced by seeding rates. This was consistent over planting month as well as vertical mowing treatment as no interaction was found. Seedling stands averaged 7.4, 4.8, and 2.9/dm² when seeded at 1500, 1000, and 500 PLS/m², respectively. However, there was a significant interaction between vertical mowing treatments and planting months (Table 1). Seedbed preparation by vertical mowing had no affect on seedling stands when done immediately prior to sowing in September, November, December, February, or March. However, vertical mowing increased seedling stands when White clover was sown in October. Conversely, better seedling stands were found in plots that were sown in January without vertical mowing. The lowest average soil temperatures of 14.2°C in December resulted in the poorest establishment of White clover which averaged only 3.2 seedlings/dm². Possibly better thermal insulation in the undisturbed seedbed at the January planting caused better seedling stands in plots which were not vertically mowed.

Table 1. Effects of vertical mowing treatments and month of sowing on seedling stands of 'La. S-1' White clover 1 month after overseeding Tifway bermudagrass.

Planting month	Vertically mowed	
	Yes	No
	....Seedlings/dm²....	
October	6.6 a[z]	3.7 cd
February	6.0 a	4.7 bc
September	5.8 a	5.5 ab
November	5.1 ab	6.4 ab
January	5.0 ab	6.8 a
March	4.0 b	3.0 d
December	3.8 b	2.6 d

[z]Mean separation within columns by the Waller-Duncan k-ratio t-test, 5% level. Means between columns joined by a common line are not significantly different using Duncan's multiple range test, 5% level.

Although soil temperatures in September, October, and March averaged 21.6°C which were comparable to optimum White Clover germination of 20°C (1) compared to the suboptimum soil temperatures of 15.5°C recorded for planting months of November, December, January, and February, no correlation was found between monthly maximum, minimum, or average soil temperatures and seedling stands. This may be because soil temperatures were measured below the seed-soil interface, they were not measured directly in each plot, and/or they were measured in a different grass species.

Vertical mowing treatments and rate of seeding had an interacting affect on rate of ground cover establishment of overseeded 'La. S-1' White clover (Table 2). The seeding rate of 1500 PLS/m² produced the highest rate of ground cover of 48% if plots were vertically mowed prior to seeding. Second best ground cover rates of 40% were in vertically mowed plots seeded at 1000 PLS/m². Poorest ground cover rates of 27% were in plots seeded at 500 PLS/m² and were unaffected by vertical mowing treatments.

Table 2. Effects of vertical mowing treatments and seeding rate on rate of ground cover establishment of 'La. S-1' White clover overseeded on Tifway bermudagrass.

Seeding rate (pure live seed/m²)	Vertically mowed	
	Yes	No
	.... Cover rate[z]	
1500	48 a[y]	35 a
1000	40 b	31 b
500	30 c	25 c

[z]Cover rate = sum of the average weekly ground cover estimates (%).
[y]Mean separation within columns by the Waller-Duncan k-ratio t-test, 5% level. Means between columns joined by a common line are not significantly different using Duncan's multiple range test, 5% level.

Seeding rates varied over planting months (Table 3). Ground cover rates averaged 42% from seeding rates of 1000 PLS/m² when 'La. S-1' White clover was overseeded in September, October, November, or December and were equal to ground cover rates obtained at 1500 PLS/m² rate of seeding. During the coolest months of January and February, best rates of ground cover were obtained only at 1500 PLS/m² rate of seeding. The March planting date was too late to seed White clover because bermudagrass breaks dormancy in North Florida at this time.

Table 3. Effects of seedling rate and month of sowing on ground cover establishment of 'La. S-1' White clover overseeded on Tifway bermudagrass.

Planting month	Pure live seed/m²		
	1500	1000	500
	..... Cover rate[z]		
September	53 a[y]	48 a	41 a
January	53 a	42 a	32 ab
October	48 ab	43 a	33 ab
February	48 ab	35 a	20 b
November	46 ab	41 a	36 a
December	38 b	37 a	29 ab
March	7 c	3 b	2 c

[z]Cover rate = sum of the average weekly ground cover estimates (%).
[y]Mean separation within columns by the Waller-Duncan k-ratio t-test, 5% level. Means between columns joined by a common line are not significantly different using Duncan's multiple range test, 5% level.

Perhaps the most practical appraisal of the value of winter overseeding bermudagrasses with legumes is actual legume ground cover at the end of the winter period regardless of seedling stands and/or rates of ground cover (Table 4). The best 'La. S-1' White clover cover of 78% in April was obtained by seeding at 500 PLS/m² in September, although the November seeding was equal. Plots that were vertically mowed prior to seeding averaged 67% legume cover in April and were better than no vertical mowing which averaged 52%. Vertical mowing treatments were consistent across planting months and seeding rates as no interactions were found.

Best bermudagrass growth during the following summer was produced on plots seeded with 'La. S-1' White clover in September (Table 5). Highest growth rates were found in July. Evidently 2 months were required for microbial release of N fixed during winter months. Unfortunately, the bermudagrass average growth rate of 20.5 kg/ha/day produced by the September planting of White clover was equal to only 0.13 g N/m²/month based on bermudagrass standard growth curves. Turf quality in these plots was unacceptable

Table 4. Effects of seeding rate and month of overseeding on 'La. S-1' White clover ground cover in April, 1982.

Planting month	Pure live seed/m² 1500	1000	500
	..... Cover (%)[z]		
September	78 a	84 a	78 a
January	77 a	57 b	37 c
November	76 a	73 ab	64 ab
October	70 a	68 ab	56 bc
December	63 ab	63 b	45 bc
February	44 b	27 c	12 d

[z]Retransformed means within columns separated by the Waller-Duncan k-ratio t-test, 5% level. Means between columns joined by a common line are not significantly different using Duncans multiple range test, 5% level.

in density and color when compared to that from normal fertilization rates of 2.5 to 5 g N/m²/month.

The practice of overseeding winter legumes into bermudagrass fairways is impractical if high quality bermudagrass is desired the following summer. If, however, fertilizer costs become prohibitive, this practice should be reevaluated, especially for use on golf course roughs and other bermudagrass areas receiving low maintenance.

Table 5. Tifway bermudagrass growth rates as affected by residual N fixed by 'La. S-1' White clover seeded during the previous winter months.

Planting month	Bermudagrass clipping yields June	July	Aug.	Mean
	..... kg/ha/day			
September	17.1 a[z]	29.2 a	15.3 ab	20.5 a
October	9.5 f	27.3 b	15.5 ab	17.4 b
February	11.7 c	21.3 d	17.6 a	16.9 bc
January	12.3 b	22.6 c	12.1 bc	15.7 cd
November	10.5 d	18.7 e	16.3 ab	15.2 d
December	9.8 e	18.1 f	10.0 c	12.7 e
March	6.4 g	15.4 g	8.0 c	9.9 f

[z]Mean separation within columns by the Waller-Duncan k-ratio t-test, 5% level.

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ARALIAS IN FLORIDA HORTICULTURE[1]

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Abstract. **The common name "Aralia" has been used in Florida and in the nursery industry for a variety of plants, most of which are now placed in the genus** Polyscias. **The common names used for many cultivars are appropriate in describing leaf form but there is confusion over the species within the genus to which each belongs. A collection assembled at AREC Fort Lauderdale has given some insight into these relationships and will form the basis for a more detailed study. Major cultivars are described.**

There are two sides to the story of Aralias in Florida horticulture: one, the use of a plant for hedges so common and reliable that its good qualities hardly register; the other, the recognition by interiorscapers of the value of relatives of this ugly duckling for dark, hot locations which few other plants will tolerate.

The plant used for hedges, *Polyscias guilfoylei* (Bull.) L. H. Bailey, is a common sight in the New World tropics and through much of the Pacific as a screen or a boundary marker (1). In south Florida it can form a narrow dense, leafy hedge up to 10 ft in height and only a few feet wide. The main trunks may be 6 to 8 inches in diameter but can continue to form branches at any point along their length and maintain a fastigiate growth habit unless the leafy tops become too lush to be held upright. Plain green and green and white-variegated cultivars are common and either may sport to the other form. Not many nurseries find it a worthwhile plant to grow since branches of any size root easily, and most hedges are planted with prunings from neighbors' plants.

Fancy-leaved cultivars of this species and several others, however, are important nursery plants. They are marketed in any size from a small plant in a 6-inch pot to massive specimen plants, and are a major crop for a number of Florida growers. They come in a wide range of leaf forms and variegations, and the trunks and branches can take on picturesque shape making them popular as specimen plants or focal points for a planting.

All commercially grown species are intolerant of waterlogged, poorly aerated soil, but if grown under a carefully controlled watering regime will maintain their exotic appeal and stay healthy for long periods under poor light and with severe heat build-up (W. West, personal communication).

Providing good soil aeration and maintaining tempera-

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