



Evaluation of Alternative Plant Species for Low Input Turfgrass

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Introduction

Golf courses are often accused of luxury consumption of management inputs. Investigation into the use of alternative, low input plant species for use as rough or out-of-play areas could help reduce the environmental impact of this industry. Mowing is needed to maintain aesthetics and function for these areas. Thus, plant response to mowing and the resulting effect on golf ball lie are important for plant consideration. However, management tolerance and performance of many low input plant species are unknown.

Objective

To compare the growth and performance of alternative plant species with common bermudagrass.

Materials and Methods

- The trial was conducted at the Athens Turfgrass Research and Education Center greenhouse complex in Athens, GA during the fall and winter of 2020/2021.
- Blue grama [*Bouteloua gracilis* (HBK) Lag. Ex Griffiths], common bermudagrass [*Cynodon dactylon* (L.) Pers.], black medic (*Medicago lupulina* L.), white clover (*Trifolium repens* L.), and common yarrow (*Achillea millefolium* L.) were seeded at 147, 98, 10, 5, and 5 kg ha⁻¹, respectively, into 15.2 cm circular pots filled with a soilless potting media on 15 Oct. 2020.
- Fertilizer (18N – 4P – 15K) was applied at time of seeding at a rate of 24.4 kg ha⁻¹ N.
- Greenhouse temperatures were maintained at day/night temperatures of 32/26 °C.
- Natural light was supplemented with artificial light at 500 µmol m⁻² s⁻¹ photosynthetic photon flux in a 12-h day to approximate summer light intensity and photoperiod.
- Irrigation was supplied through an overhead irrigation system calibrated to deliver approximately 3.8 cm of water wk⁻¹.
- Plants were maintained at a 5.1-cm mowing height and allowed to mature in the greenhouse over an 8-wk period.
- Treatments were arranged in a 5 x 3 factorial (five plant species x three mowing heights) within a randomized complete block design with 5 replications.
- Starting on 10 Dec. 2020, three mowing heights (2.5 cm, 5.1 cm, and non-mowed) were evaluated for each species. Plants mowed at 2.5 cm were gradually reduced over a 2-wk period until the start of the trial on 24 Dec. 2020 (**Fig. 1A and 1B**).
- Plants were mowed weekly with hand-held grass shearers over an 8-wk trial period.
- At the conclusion of the study (18 Feb. 2021), plant health [normalized difference vegetation index (NDVI)], shoot density (shoots cm⁻²), root biomass (g), and golf ball lie (% exposed ball) data were obtained.

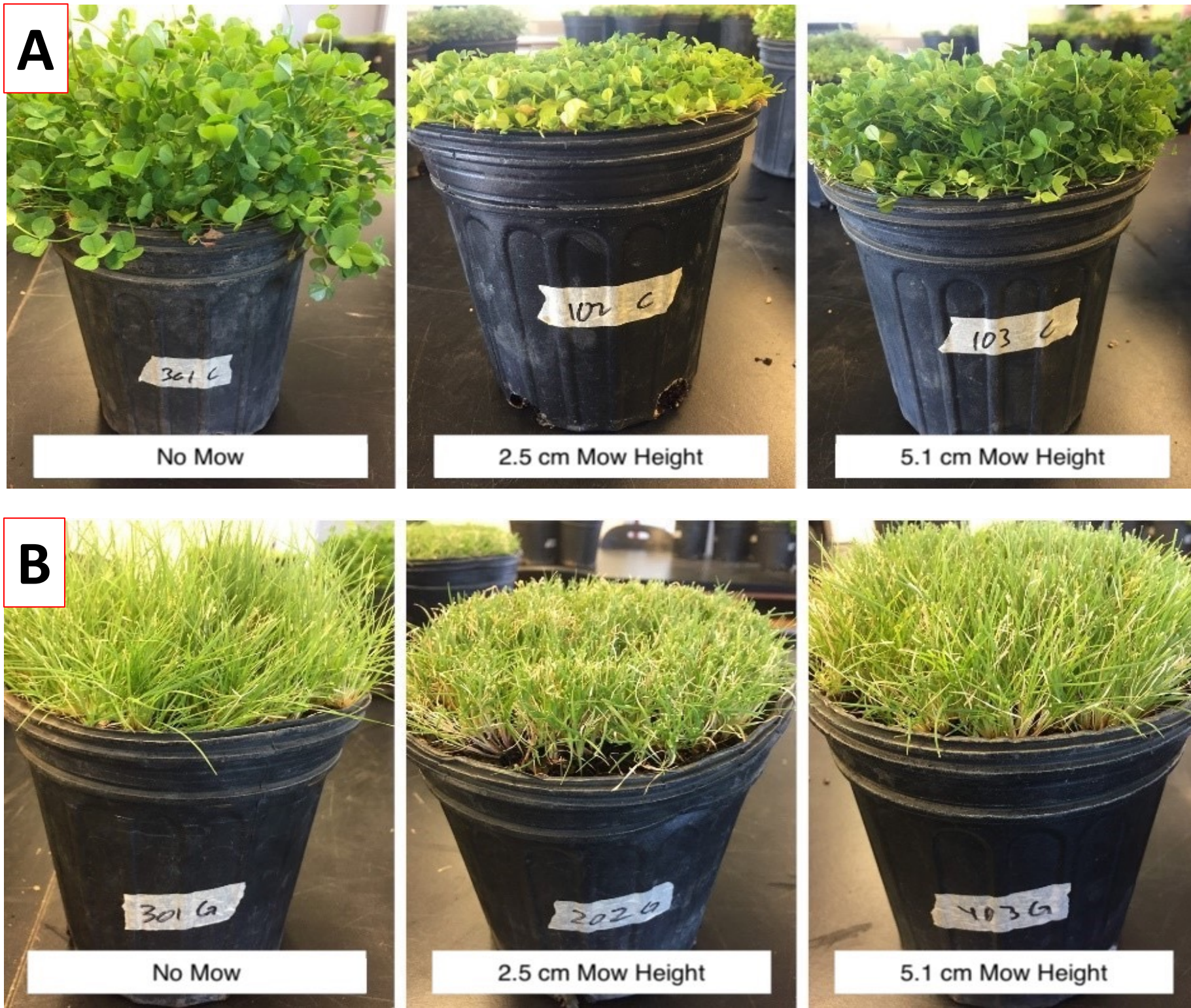


Figure 1. A) White clover and B) Blue grama maintained at the three mowing heights evaluated.

Materials and Methods

- Plant health was determined by averaging three values obtained with a hand-held NDVI meter aimed at the plant canopy.
- Shoot density (shoots cm⁻²) was obtained by removing a 3 cm² core using a PVC pipe and counting the number of shoots present (**Fig. 2**).
- Pots were destructively harvested, roots were washed of soil, separated from shoots, dried in an oven at 50 C for 7d, and weighed to determine biomass (g).
- A fixed apparatus was placed next to each pot in order to drop a golf ball (4.3 cm diameter) from knee high (61 cm). The average of three drops was used to determine the amount of ball exposed above the plant canopy. This number was converted to percent exposed ball.
- Data were subjected to analysis of variance (ANOVA) in SAS using error partitioning appropriate to a factorial design in the general linear models procedure.
- Treatment means were separated using Fisher's protected least significant difference (LSD) test at $\alpha = 0.05$.



Figure 2. Cores were removed from each plant pot in order to measure shoot density.

Results

Table 1. Effect of mowing height on plant health.

	NDVI ^a				
mowing height	common bermudagrass	white clover	blue grama	black medic	common yarrow
no mow	0.83 a	0.86 a	0.87 a	0.83 a	0.84 a
2.5 cm	0.73 b	0.84 a	0.81 b	0.82 a	0.83 a
5.1 cm	0.80 a	0.85 a	0.83 b	0.85 a	0.85 a
LSD _(0.05)	0.06	0.05	0.03	0.04	0.03

^a Abbreviation: NDVI, normalized difference vegetative index. Means within the same column followed by the same lowercase letter are not significantly different according to Fisher's LSD test at $\alpha = 0.05$.

Table 2. Effect of mowing height on plant shoot density.

	Shoot Density (shoots cm ⁻²) ^a				
mowing height	common bermudagrass	white clover	blue grama	black medic	common yarrow
no mow	8.6 a	4.6 a	11.2 b	8.6 ab	4.0 b
2.5 cm	8.0 a	5.0 a	19.6 a	3.6 b	5.8 a
5.1 cm	8.6 a	4.0 a	11.0 b	9.4 a	3.4 b
LSD _(0.05)	4.1	4.3	4.7	5.3	1.7

^a Means within the same column followed by the same lowercase letter are not significantly different according to Fisher's LSD test at $\alpha = 0.05$.

Results

Table 3. Effect of mowing height on plant root mass.

	Root Biomass (g) ^a				
mowing height	common bermudagrass	white clover	blue grama	black medic	common yarrow
no mow	7.8 ab	11.3 a	6.4 a	11.7 a	19.1 a
2.5 cm	7.1 b	6.6 b	5.4 a	7.7 b	17.0 a
5.1 cm	9.8 a	8.5 b	6.0 a	8.2 b	21.1 a
LSD _(0.05)	2.5	2.7	1.1	2.2	4.3

^a Means within the same column followed by the same lowercase letter are not significantly different according to Fisher's LSD test at $\alpha = 0.05$.

Table 4. Effect of mowing height on golf ball lie.

	Golf Ball Lie (% exposed ball) ^a				
mowing height	common bermudagrass	white clover	blue grama	black medic	common yarrow
no mow	0 b	14 b	2 b	74 a	50 a
2.5 cm	33 a	54 a	29 a	81 a	69 a
5.1 cm	0 b	24 b	6 b	81 a	55 a
LSD _(0.05)	9	29	16	32	19

^a Means within the same column followed by the same lowercase letter are not significantly different according to Fisher's LSD test at $\alpha = 0.05$.

Discussion

- Common yarrow and white clover (**Fig. 1A**) were able to tolerate 2.5 and 5.1 cm mowing heights by maintaining shoot density and root biomass (**Table 2 and 3**). Neither of these species negatively affected golf ball lie (**Table 4**).
- Although black medic exhibited similar plant health (**Table 1**) and shoot density (**Table 2**) when mowed, excessive root loss at the 2.5 cm mowing height may result in future stand reductions (**Table 3**).
- Blue grama responded well to mowing at both heights (**Fig. 1B**), but high concealment of the golf ball by the plant canopy could hinder sport performance (**Table 4**).
- Yarrow and white clover may be possible alternative species for use on golf courses; however, further research examining their response to traffic could reveal pertinent information on longevity potential.

Acknowledgements

- The authors would like to thank Joshua Goeden for his participation in this research project. Additional appreciation is extended to Kevin Tucker, Connor Bolton, Katie Dowler, and A.J. Brown for their assistance with trial maintenance and data collection.

