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Turf Characteristics of Native Grasses *Digitaria longiflora* & *Ischaemum ciliare*

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Introduction

There are over 90 grass species documented in Singapore. Of these, about 60 species are native to tropical Asia, including Singapore (Duistermaat, 2005). With urbanization, most native grasses in Singapore are presently found in open habitats of turf, roadsides and undeveloped lands. Such man-made open habitats pose threats to these grasses as they were removed as weeds. Hence, there is a need for higher awareness to the utility of native grasses for our landscapes before they disappeared.

The most common turfgrass in Singapore is *Axonopus compressus* (cowgrass). It was first introduced from early 1895 and 1900 by traders from America (Jagoe, 1940; Duistermaat, 2005) to be used as grass edges around flower beds during colonial Singapore (Ridley, 1903). Today, it is widely used as turf for slopes, roadsides, lawn, sports fields and golf courses. A significant vegetative characteristic of turfgrasses is their ability to form a continuous surface/coverage either through aboveground horizontal stems (stolons) or underground horizontal stems (rhizomes). Such surface continuity formed by turfgrasses is thus defined as turf. A quality turf comprises a dense surface with high shoot density. A dense turf will be able to shade-out weeds and also provide a strong surface to prevent surface erosion and for temperature-control.

There are up to 16 species of native grasses with the ability to spread horizontally. Majority of these forms stolons (Duistermaat, 2005). Several native grasses in Singapore have been proposed to be useful as turf in early literature (Ridley, 1903; Gilliand, 1971). However, none of these grasses, today, are used as turf commercially. Of these proposed grasses, two species are selected and examined in this study to evaluate their vegetative turf characteristics. These grasses are selected based on field observations of their vegetative characteristics (stoloniferous habit, shoot density) for turf (**Fig. 1A &B**).

A short account of these two grasses is as follows:

1. *Digitaria longiflora* (Retz.) Pers. (lesser crab grass) – first record for Singapore in 1894; It was noted to be used as a lawn turf in some parts of Malaya as it produces many long runners when closely mown and it has a blue-green colour (Gilliland, 1971)
2. *Ischaemum ciliare* Retz. (smut grass) – first record for Singapore in 1890; It was remarked as a good running grass that creeps fast and potentially forms a good turf mat (Ridley, 1903)

Fig. 1A A cultivated plot of *Digitaria longiflora* displays strong coverage and density

Fig. 1B *Ischaemum ciliare*, as observed in the wild, forms a loose turf surface

This Research Technical Note (RTN) reports the vegetative characteristics for two stoloniferous native grasses in Singapore. The aim of this study is to evaluate the vegetative growth biometrics of the two grasses so as to better describe their qualitative characters in order to evaluate their potential utility as turfgrass for Singapore.

Evaluation of Vegetative Growth Characteristics

The two grass species were established in a mixture of sand & compost (60:40). The determinants of vegetative growth (stolon morphometrics, leaf blade morphometrics and green coverage) for the two species were monitored over four weeks from December, 2014 to January, 2015. All measurements reported in this study were means of triplicates and paired-t test was applied to determine the statistical significance of each parameter.

Stolon morphometrics:

The growth of selected stolon was monitored weekly over four weeks. The stolon morphometric determinants (**Fig. 1**) include – (1) length of stolon measured from base origin of stolon to the upper surface of first leaf sheath; (2) growth rate of stolon derived from the length of stolon over 7 days; (3) length of internode as the length between two nodes; (4) length of leaf sheath as the length of the second expanded leaf sheath position from the top of stolon; (5) stolon leafy index is a function of sheath length to internode length. As each node bears a single leaf, stolon leafy index denotes how tightly or loosely the leaves are distributed along a stolon length.

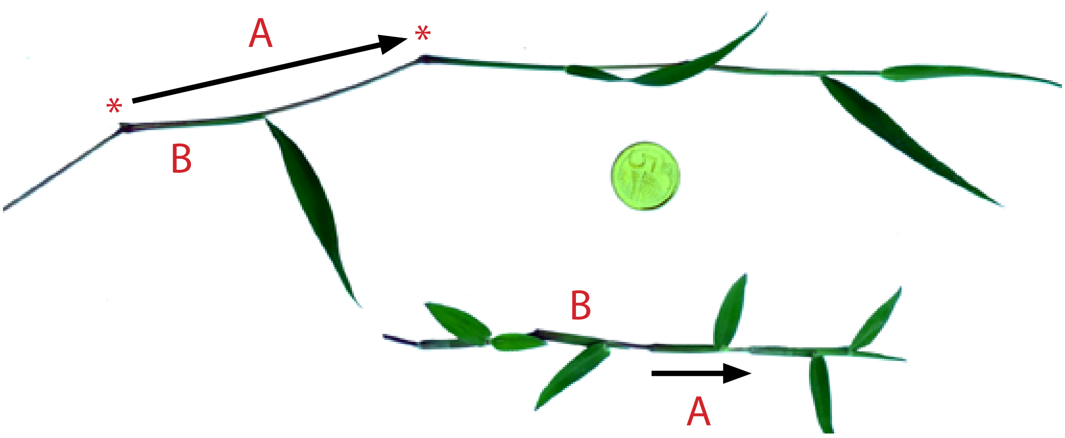


Fig. 2 Morphometric descriptions of stolon in *Ischaemum ciliare* (top) and *Digitaria longiflora* (below) – (A) internode length, (B) leaf sheath length

Table 1 Morphometric measurements of stolon (stolon length, stolon growth rate, internode length, leaf sheath length and stolon leafy index).

Species	Stolon length (cm)	Stolon growth rate (cm/day)	Internode length (cm)	Leaf sheath length (cm)	Stolon leafy index (%)
Ischaemum ciliare	49.71 ± 3.10 **	3.09 ± 0.10 **	7.68 ± 0.50 **	3.25 ± 0.080 **	43 ± 0.050
Digitaria longiflora	30.65 ± 2.50	1.05 ± 0.20	2.58 ± 0.10	1.61 ± 0.040	63 ± 0.080 **

** denotes statistical significance at P< 0.05

Leaf blade morphometrics:

The characteristics of leaf blade were determined from the second expanded leaf blade along a selected stolon (Fig. 2). The determinants were as follows – (1) leaf length as length of single leaf; (2) width of leaf measured from the widest part of the leaf; (3) leaf: width ratio as a function of leaf length to leaf width and (4) area of the leaf is determined with digital image analysis.

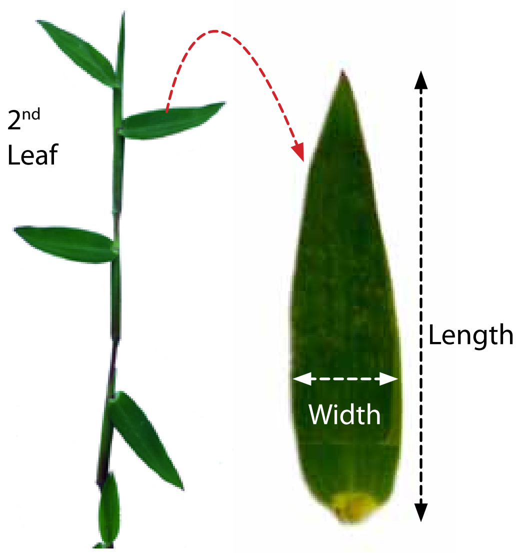


Fig. 3 Morphometric description of second leaf and single leaf blade

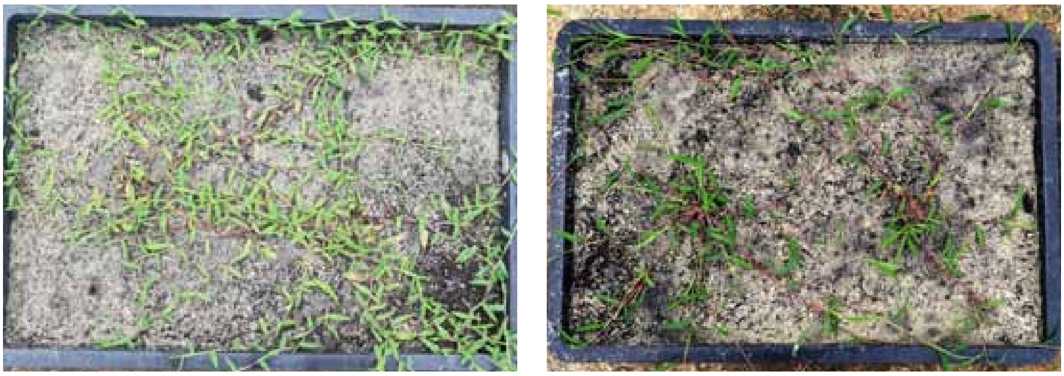
Table 2 Morphometric measurements of leaf blade (leaf length, width, length: width ratio and leaf area).

Species	Leaf length (cm)	Leaf width (cm)	Length: Width ratio	Leaf area (cm^2)
Ischaemum ciliare	2.84 ± 0.04 **	0.7 ± 0.0 **	4.05 ± 0.05 NS	1.43 ± 0.03 **
Digitaria longiflora	2.35 ± 0.1	0.6 ± 0.0	3.91 ± 0.10	1.13 ± 0.04

** denotes statistical significance at P< 0.05, NS non- significant

Green Coverage:

The green coverage parameter describes the coverage by shoots over four weeks. It was determined based on – (1) total number of leaves within the tray area (1899 cm^2); (2) total area of green coverage as determined by the total area of leaves within tray area derived from digital images; (3) rate of green coverage per day was calculated from total green coverage over 7 days; (4) shoot density measures the density of leaves within the tray area (1899 cm^2) and is calculated as a function of total number of leaves to the tray area.



Digitaria longiflora *Ischaemum ciliare*

Fig. 4 Green coverage of *Digitaria longiflora* and *Ischaemum ciliare* at 30 DAP (days after planting)

Table 3 Green coverage measurements (total number of leaves, shoot density, total green coverage and rate of green coverage).

Species	Number of leaves	Shoot density (%)	Total area of green coverage (cm^2)	Rate of green coverage (cm^2 / day)
Ischaemum ciliare	133.66 ± 26.3	7.03 ± 1.3	184.84 ± 42.3	7.40 ± 2.9
Digitaria longiflora	206.33 ± 21.6 **	10.86 ± 1.1 **	269.36 ± 59.1 NS	10.70 ± 2.1 NS

** denotes statistical significance at $P< 0.05$, NS non-significant

Results & Discussion

Both *Ischaemum ciliare* and *D. longiflora* can be classified as coarse textured grasses (similar to *A. compressus*) based on their broad leaf width (**Fig. 5**, **Table 2**). The stolon length as well as stolon growth rate is significantly higher in *I. ciliare* than *D. longiflora* (**Table 1**). This supports earlier observations that *I. ciliare* is a fast creeping grass with long runners (Ridley, 1903). However, the stolon leafy index (characterizing how tightly or loosely the leaves are distributed along a stolon) is higher in *D. longiflora* (**Table 1**). The higher stolon leafy index value implies that leaf arrangement in *D. longiflora* is more tightly distributed along a stolon length (**Fig. 2**). A more compact arrangement of leaves is a desirable turfgrass trait as it potentially contributes to a denser turf.

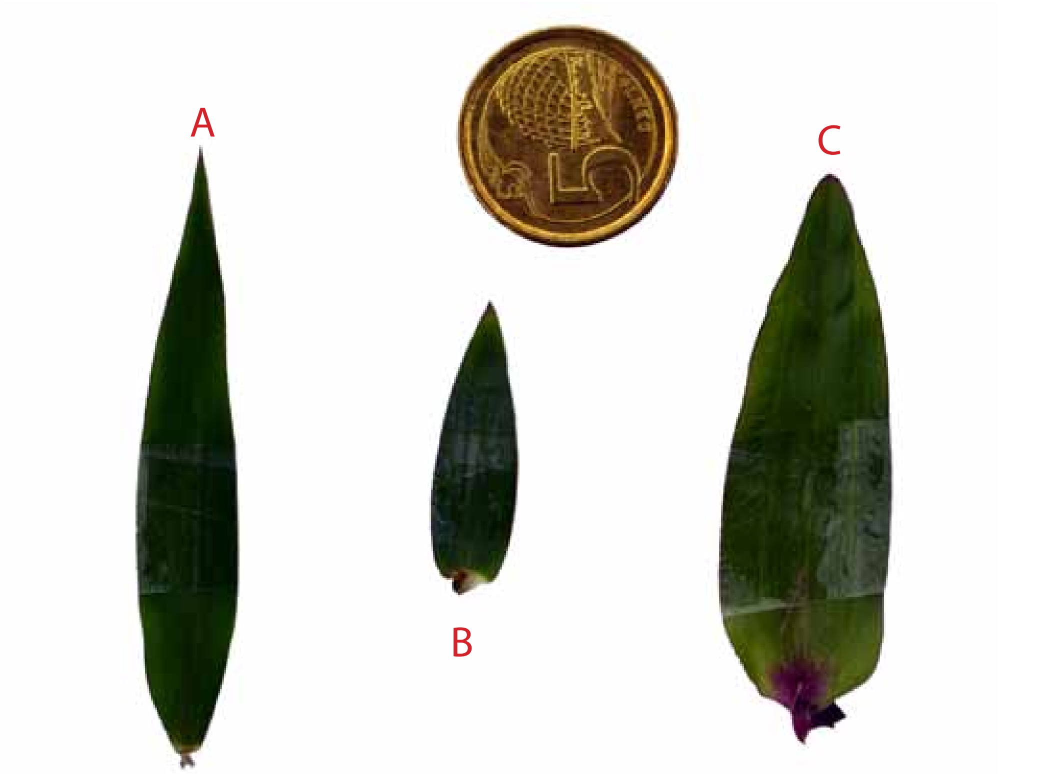
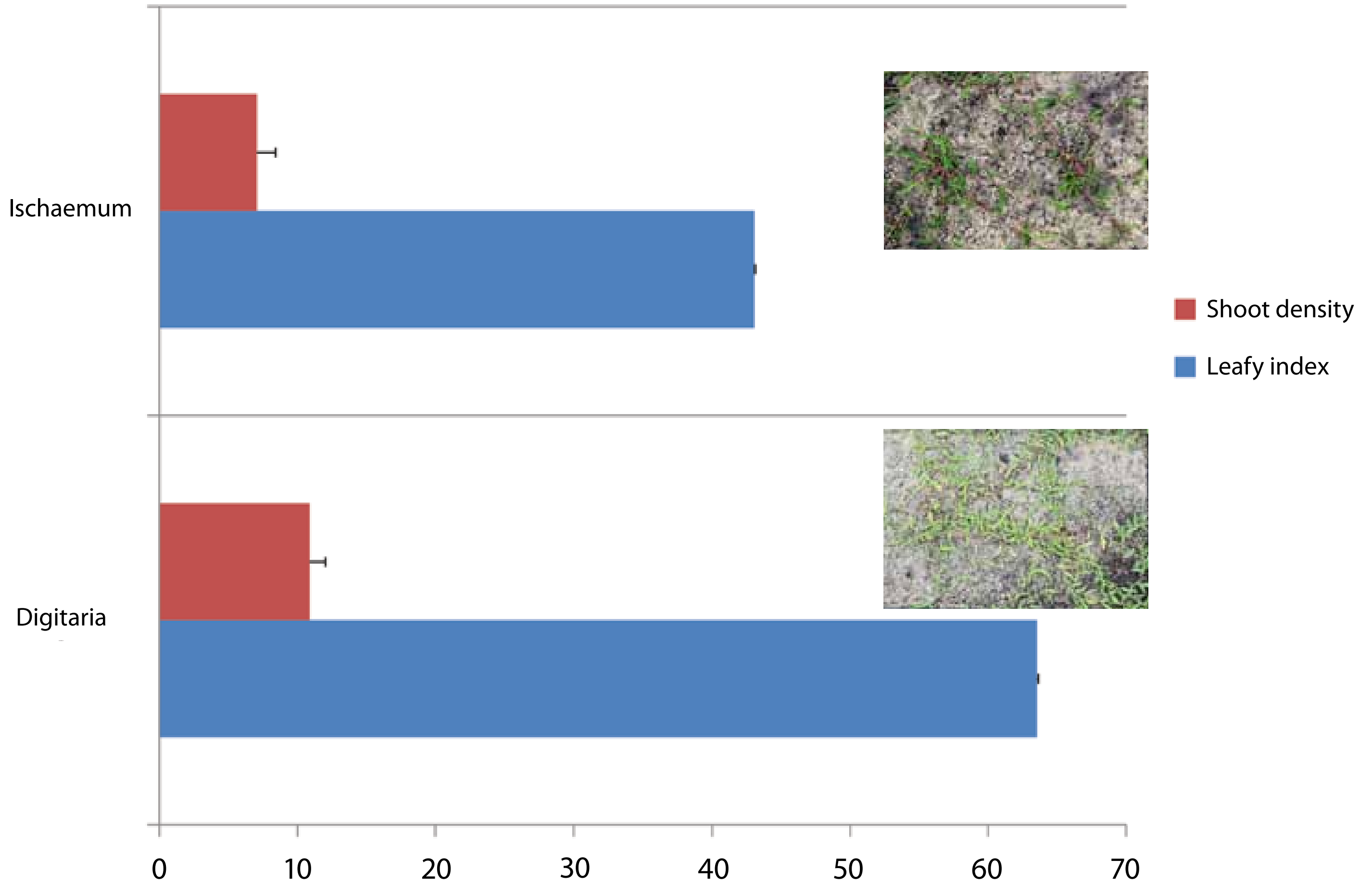


Fig. 5 Leaf texture comparison between *Ischaemum ciliare* (A), *Digitaria longiflora* (B) and *Axonopus compressus* (C)

The mean values for all green coverage parameters (number of leaves, shoot density index, total area of green coverage and rate of coverage) were higher in *D. longiflora* than *I. ciliare* (**Table 3**). However, total green coverage and rate of coverage were not statistically significant. As individual species growth rate can be differentially influenced by its genetic background and its interactions with the environment, further studies will need to be conducted with a larger number of samples as well as sampling from a more uniform genetic background to ensure growth comparison to be more robust and reliable. Nonetheless, shoot density of *D. longiflora* was visually observed to be higher than *I. ciliare* (**Fig. 1A &B**). This observation was also corroborated by the results in this study. Shoot density is a significant trait for turf as this contributes to the total density of turf coverage by leaves. Higher shoot density certainly confers a denser turf than a lower shoot density species.

In conclusion, the native grass *D. longiflora* carries several desirable vegetative traits (shoot density and stolon leafy index, **Fig. 6**) that could potentially make it a better lawn turf relative to *I. ciliare*. Further studies are in progress to evaluate the drought, shade and wear performance of *D. longiflora* relative to the common *A. compressus* (cowgrass).

Fig. 6 Summary of two desirable turf characteristics (shoot density & stolon leafy index) in *Digitaria longiflora* and *Ischaemum ciliare*. Measurements expressed as percentage for easy illustration and error bars indicate standard error of means



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