Propagation of *Brachiaria subquadripara* (Trin.) Hitchc. for Establishment in National Parks of Sri Lanka

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***Brachiaria subquadripara* (Trin.) Hitchc. is a native, vigorously growing, semi erect annual grass that belongs to family Poaceae. Present study was conducted to determine propagation of *Brachiaria subquadripara* (Trin.) Hitchc. for establishment in National Parks of Sri Lanka to suppress the *Lantana camara* and other invasive plants. Two factors; cutting type and growing media were studied. One node, two node and three node cutting types were the levels of cutting type. Top soil and cow dung, top soil and leaf mold and top soil only were the levels of growing media. Highest number of survival plants was recorded in two node cutting type. Top soil and cow dung medium showed the highest number of tillers with referred to cutting types. Two node cutting type reported the highest number of tillers with referred to growing media. Three node cutting type and top soil and leaf mold medium showed higher number of panicles separately without any interaction. Therefore, two nodes cutting type and top soil and cow dung medium can be used when cow dung supplement is available. Three node cutting type can be used to plant in top soil when there is a difficulty to apply organic matter.**

KEYWORDS: *Brachiaria subquadripara* (Trin.) Hitchc., Cutting type, Growing media, *Lantana camara*, National Park

INTRODUCTION

Native plants naturally occur in the region in which they evolved. Compared to exotic plants, native plants have many additional advantages. Because native plants are adapted to local soils and climatic conditions, they generally require less watering and fertilizing than non-natives. Natives are often more resistant to insects and diseases as well, and so are less likely to need pesticides. Wildlife evolved with plants; therefore, they use native plant communities for food, cover and rearing young. Using native plants help to preserve the balance biodiversity, resist invasion by exotics and beauty of natural ecosystems (Slattery *et al.*, 2003).

Brachiaria miliiformis is a native, vigorously growing semi-erect annual grass that belongs to family Poaceae. The spikelet is more than 3 mm long, hairless or almost so and the lower lemma is without a membranous palea. Synonyms are *Brachiaria subquadripara* (Trin.) Hitchc., *Panicum distachyum* (L.). Common names are cori grass (Sri Lanka), green summer grass, two-spiked panic, two-finger grass (Australia) and thurston grass (Fiji). Distributed around Sri Lanka, tropical and subtropical Asia, Pacific Islands, now sparingly introduced throughout tropical and subtropical regions of the world (Skerman and Riveros, 1989). With the adaptation to a wide variety of fertility, humidity and light conditions (Toutain, 1986) and soil types, *Brachiaria subquadripara* (Trin.) Hitchc. can be found often in sandy soils and sandy alluvium but also recorded in heavier clay soils (Anon, 2008).

Propagation of *Brachiaria subquadripara* (Trin.) Hitchc. is done by seed and also vegetative spread from stolon (Whistler, 1995). Seed germination does not require light and is optimal at pH 5-6 and a temperature of 25 °C. Germination at 15 °C was <20%. Shoots emerge from soil depths of 0-7 cm, with maximum germination on the soil surface (Teuton *et al.*, 2004). No information found on dormancy or seed bank properties. Cultivated as a palatable forage grass in Australia and tropical Asia. Drought tolerant and adapted to poor soils (Wipff and Thompson, 2000).

Invasive exotic species pose an enormous threat to the world's biological diversity. Exotic plant invasions are often associated with alterations or declines in native plant species. Invasive plants compete so successfully against other plants that they can crowd out their competitors, thus producing a monoculture that discourages the growth of other plant species. These invasive species often produce prolific seeds that may disperse widely and remain viable in the soil for long periods of time (Drake *et al.*, 1989). *Lantana camara* is considered by IUCN as one of the world's 100 most invasive species, and among the ten worst weeds because of its invasiveness, potential for spread and economic and environmental impacts (Holm *et al.*, 1977).

In wildlife parks and in any other recreational areas, invasive plants like *L. camara* should be controlled only by methods that do not cause any hazard to the fauna and flora of the relevant area. Hence, studies on the possible biological and ecological means of controlling invasive plant populations are of paramount importance for the sustainable management of wildlife parks in Sri Lanka (Weerasinghe *et al.*, 2011).

As a plant with multiple methods of propagation, enormous capacity to survive in wide range of soils *Brachiaria subquadripara* (Trin.) Hitchc. is a highly potential plant that can be used as an ecological tool for management of invasive plants in National Parks (Krishan *et al.*, 2015).

Variation in growth pattern and performance, population density, vigor and aggressive behavior of invasive plants under different habitats were observed in several locations (Bansel, 1988; Pandey and Pandey, 2011). Similar observations were made in several wildlife parks of Sri Lanka too. However, details of such variations are yet to be further studied. Studies of this nature will be useful to develop the tools for the management of invasive plant populations (Weerasinghe *et al.*, 2011).

Invasive plant population density can be suppressed by increasing the richness of native plant species other than invaders. This should be done by establishing the populations of native plant species of the relevant National Park that are well adapted to the ecosystem and maintain the ecosystem in a way that they grow dominantly in the ecosystem suppressing invasive plant (Rathnayaka *et al.*, 2014).

According to the correlations between population characteristic of *Lantana camara* and *B. miliiformis* of disturbed ecosystems in Lunugamwehera National Park and Udawalawe National Park, *L. camara* can be suppressed by increasing the density of *B. miliiformis*. This should be practiced by establishing the population of *B. miliiformis* in relevant National Parks such that they maintain the ecosystem by growing dominantly (Krishan *et al.*, 2015).

Therefore, this research was carried out to study the propagation of *Brachiaria subquadripara* (Trin.) Hitchc. for establishment in National Parks in Sri Lanka as a potential tool for ecological management of invasive plant species that are causing a serious threat to the fauna and flora of National Parks.

MATERIALS AND METHODS

Experimental Site

The Experiment was carried out at the farm fields of Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila in Low Country Intermediate Zone (IL_{1a}), at an elevation of 30 m above mean sea level.

The Rainfall in Makandura during the experimental period was 1.02 mm while the relative humidity and average temperature were 80%, 32.7 °C respectively. The experiment was conducted from January to May 2016.

Experimental Design

Treatments were arranged in three replicates with Two Factor Factorial Design. Cutting type and growing media were the factors that tested. Each factor had three levels. Types of growing media were cow dung and top soil, leaf mold and top soil, only top soil. One node, two node, three node cuttings were the levels of cutting type (Table 1).

Table 1. Treatments and their attributes

Treatment	Cutting type	Media
T_1	One Node	Top soil + Cow dung
T_2	One Node	Top soil + Leaf mold
T_3	One Node	Top soil
T_4	Two Node	Top soil + Cow dung
T_5	Two Node	Top soil + Leaf mold
T_6	Two Node	Top soil
T_7	Three Node	Top soil + Cow dung
T_8	Three Node	Top soil + Leaf mold
T_9	Three Node	Top soil

Field Layout

Twenty seven raised beds (1 m×1 m) were prepared. Twenty five planting holes were marked in each bed, keeping 20 cm space between rows and within rows.

Field Establishment and Maintenance

Soil sterilization was done at the beginning after preparing the beds, using solarization method. Stem cuttings were planted in each prepared bed burrowing whole nodes in vertical orientation. Cultural practices were carried out such as weeding and watering. 214 g of cow dung and 400 g of leaf mold were added as basal dressing.

Data Recording

Number of surviving plants was counted up to fourth weeks after planting. Number of tillers, panicles and seeds produced by plants were counted 50 days after planting.

Statistical Analysis

The data were statistically analyzed using Statistical Analysis System (SAS Version 9.2).

RESULTS AND DISCUSSION

Number of Survival Plants

A significant difference was observed among treatments in cutting types in relation to the surviving plants. There was no significant difference among growing media and no interaction between cutting types and growing media.

Highest value was recorded in two node cutting type and lowest value was recorded in one node cutting type (Table 2). With the increase in number of nodes in a cutting, total bio mass, number of functioning cells, amount of stored food and moisture reserves and availability of plant growth regulators were increased (Hartmann *et al.*, 2007).

Table 2. Effect of Cutting type on survival

Cutting type	Number of surviving plants
One Node	29[b]
Two Node	81[a]
Three Node	77[a]

Frequencies in a column with the same letters are not significantly different at the 0.05 level (Maximum Likelihood Analysis of Variance)

Therefore, the potential for survival of cuttings can be also increased with the increase of the number of nodes. Lower number of survival plants in three node cutting type may be attributed to the higher requirement of food reserve for the maintenance of higher bio mass compared to the two node cuttings and possibility of having optimum ratio of bio mass to the stored food amount in two node cuttings.

Number of Tillers

Significant difference was observed in both cutting types and growing media. And also there was an interaction between cutting type and growing media.

One Node Cutting Type

No significant difference was observed. Highest tiller number was recorded in top soil and cow dung medium (Table 3).

Two Node Cutting Type

There was a significant difference among three media. Top soil and cow dung medium recorded highest tiller number and top soil recorded lowest tiller number (Table 3).

Table 3. Effect of cutting types on number of tillers with reference to media

Media	One node cutting type	Two node cutting type	Three node cutting type
Top soil + Cow dung	101[a]	345[a]	319[a]
Top soil + Leaf mold	85[a]	220[b]	189[c]
Top soil	85[a]	151[c]	244[b]

Frequencies in a column with the same letters are not significantly different at the 0.05 level (Maximum Likelihood Analysis of Variance)

Three Node Cutting Type

There was a significant difference among three media. Top soil and cow dung medium recorded highest tiller number and top soil recorded lowest tiller number (Table 3).

Among the media used in the experiment top soil and cow dung mixture may release more available nitrogen to the cutting quicker and high amount than top soil and leaf mold mixture. Tiller production by a plant is closely related with the production of a well-developed root system and the availability of nutrients required for vegetative growth in particular Nitrogen. In stolon cutting of grasses, preformed root primordia are concentrated near the nodes. Hence, the highest number of tillers produced by two and three node cuttings in the medium of top soil and cow dung.

Top Soil and Cow Dung

The Highest tiller number was observed in two node cutting type and lowest tiller number was observed in one node cutting type (Table 4).

Table 4. Effect of growing media on number of tillers with reference to cutting type

Cutting Type	Top soil + cow dung	Top soil + leaf mold	Top soil
One Node	101[b]	85[b]	85[c]
Two Node	345[a]	220[a]	151[b]
Three Node	319[a]	189[a]	244[a]

Frequencies in a column with the same letters are not significantly different at the 0.05 level (Maximum Likelihood Analysis of Variance)

Top Soil and Leaf Mold

Two node cutting type recorded highest tiller number and one node cutting type recorded lowest tiller number which were significantly different (Table 4).

Top Soil

There was a significant difference among cutting types. Highest tiller number was observed in three node cutting type and lowest tiller number was observed in one node cutting type (Table 4). Availability of food resources and moisture content are higher in two node and three node cuttings. In addition, ability to absorb nutrients is higher with the available higher number of preformed roots and root primordia.

Number of Panicle

Both cutting type and growing media were significantly different. But there was no interaction between them.

Highest panicle number was observed in three node cutting type and lowest panicle number was observed in one node cutting type

(Table 5). Number of panicles produced is usually proportionate to the number of tillers produced by the plants. Accordingly two node and three node cuttings have produced higher number of panicles.

Table 5. Effect of cutting type on number of panicle

Cutting Type	Number of panicle
One Node	3[b]
Two Node	19[a]
Three Node	28[a]

Frequencies in a column with the same letters are not significantly different at the 0.05 level (Maximum Likelihood Analysis of Variance)

There was no significant difference between top soil and cow dung medium and top soil and leaf mold medium. Highest panicle number was observed in top soil and leaf mold medium and lowest panicle number was observed in top soil (Table 6).

Table 6. Effect of growing media on number of panicle

Growing Media	Number of panicle
Top soil + Cow dung	18[a]
Top soil + Leaf mold	25[a]
Top soil	7[b]

Frequencies in a column with the same letters are not significantly different at the 0.05 level (Maximum Likelihood Analysis of Variance)

That may be attributed to the release of macro and micro nutrients required for the development of plant reproductive organs by leaf mold and cow dung. In addition, number of tillers, number of surviving plants, available nutrients and weather conditions would have had effect on the panicle production.

Number of Seeds

There was no significant difference between cutting type and growing media for the number of seeds produced.

Severe drought conditions prevailed during the experimental period may have acted as a limiting factor for number of surviving plants, tillers, panicles and seed production.

In most of the National Parks of Sri Lanka, populations of ruminant animals are available. Those animal dung can be collected from the places where they are gathering in herds for growing and water, for use as a supplement for *Brachiaria subquadripara* (Trin.) Hitchc. propagation medium. Use of cow dung from outside cannot be recommended due to the higher possibility of contamination by seeds of invasive plants that cause a serious threat to the biodiversity and general existence of the National Parks.

In addition, leaf mold is also a media supplement that can be found from National Parks without disturbing the ecosystem if care is taken, not to create exposure of soil surface to avoid soil erosion and threat to the fauna and flora. Generally top soil from National Parks can be used as a propagation medium for *Brachiaria subquadripara* (Trin.) Hitchc. even without and organic matter supplement due to the possibility of having higher fertility. Therefore, propagation of *Brachiaria subquadripara* (Trin.) Hitchc. can be done within the National Park itself, particularly where the invasive plants have created an alarming situation.

CONCLUSIONS

Highest vegetative and reproductive propagation performance of *Brachiaria subquadripara* (Trin.) Hitchc. can be observed in T_4 (Two node cutting+Top soil and cow dung) and T_7 (Three node cutting+Top soil and cow dung). Considering the number of cuttings that can be obtained from *Brachiaria subquadripara* (Trin.) Hitchc. plants from National park, two nodes cuttings can be recommended for propagation of *Brachiaria subquadripara* (Trin.) Hitchc. while medium of propagation can be selected depending on type of organic matter (Leaf mold and cow dung) available in the relevant National Park. Moreover, two nodes cuttings can be taken as planting materials when using cow dung as a supplement to the growing medium. During the critical period with lack of organic material in a National Park, even three nodes cutting can be recommended to be used in the propagation of *Brachiaria subquadripara* (Trin.) Hitchc. in normal top soil beds without addition of organic matter.

However, in order to have sustainable establishment of *Brachiaria subquadripara* (Trin.) Hitchc. in National Parks, further research work on propagation of *Brachiaria subquadripara* (Trin.) Hitchc. is recommended to be carried out in the conditions of relevant National Parks in order to find out the most suitable cutting type, propagation medium and possible method of seed collection in particular to the selected National Parks. That information will be of paramount importance for the sustainable establishment of *Brachiaria subquadripara* (Trin.) Hitchc. in National Park of Sri Lanka.

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