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***Short Communication***

# Studies with *Urochloa brizantha* cv. MG5 Vitória in Okinawa, Japan: Vegetative propagation and a tractor tyre stress test

## *Estudios con* Urochloa brizantha *cv. MG5 Vitória en Okinawa, Japón: Propagación vegetativa y una prueba de estrés por presión de llantas de tractor*

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**Abstract**

Feeding of high quality grass is critical to ensure breeding cows remain healthy with high reproductive rates and growing and fattening cattle achieve good growth rates. The Brazilian grass cultivar, *Urochloa brizantha* cv. MG5 Vitória, is highly nutritious and is known for its drought tolerance. In view of its low seed production potential in subtropical Japan and of phytosanitary problems (contamination with soil particles) of imported seed, a study was conducted in Okinawa to assess 2 methods of propagating this cultivar vegetatively. Cutting stems (culms) at about 10 cm from ground level and inserting them 3 cm into a 50:50 compost:soil mixture produced a 77% success rate in terms of rooted plantlets in a glasshouse compared with 67% for cutting the culm at 3 nodes from the base, subsequently allowing 2 weeks for adventitious roots to form on the lowest node, then cutting below the node where roots emerged and planting the rooted propagule in the same mixture. It seems that the simple process of cutting stems at about 10 cm from ground level and inserting them into a suitable mixture of soil and compost should result in an acceptable yield of plantlets for establishment of an MG5 forage crop. However, locating a source of high-quality seed free of phytosanitary problems seed would seem to be a better solution to increase the areas in Okinawa planted to MG5.

In the tractor tyre stress trial conducted over 2 years, an MG5 forage crop established from seed showed depressed yields on the treatment subjected to tractor tyre pressure but performed as well as *Chloris gayana*, a much-used forage grass in Okinawa.

**Keywords:** *Urochloa brizantha*, dry matter yield, pasture establishment, plantlet production, tropical pasture.

**Resumen**

La alimentación con pasto de alta calidad es fundamental para garantizar que las vacas reproductoras se mantengan sanas con altas tasas de reproducción y que el ganado en crecimiento y engorde alcance buenas tasas de crecimiento. El cultivar de pasto brasileño, *Urochloa brizantha cv*. MG5 Vitória, es muy nutritivo y es conocido por su tolerancia a la sequía. En vista de su bajo potencial de producción de semillas en el Japón subtropical y de los problemas fitosanitarios (contaminación con partículas del suelo) de las semillas importadas, se realizó un estudio en Okinawa para evaluar 2 métodos de propagación vegetativa de este cultivar. Cortar tallos (culmos) a unos 10 cm del nivel del suelo e insertarlos 3 cm en una mezcla 50:50 de compost y suelo produjo una tasa de éxito del 77% en términos de plántulas enraizadas en un invernadero en comparación con el 67% al cortar el culmo a 3 nudos de la base, luego dejando 2 semanas para que se formen raíces adventicias en el nudo más bajo, luego cortando debajo del nudo donde emergieron las raíces y plantando el propágulo enraizado en la misma mezcla. Parece que el simple proceso de cortar los tallos a unos 10 cm del nivel del suelo e insertarlos en una mezcla adecuada de tierra y compost debería dar como resultado un rendimiento aceptable de plántulas para el establecimiento de un cultivo forrajero MG5. Sin embargo, localizar una fuente de semilla

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de alta calidad libre de problemas fitosanitarios parece ser una mejor solución para aumentar las áreas en Okinawa sembradas con MG5.

En la prueba de estrés de los neumáticos del tractor realizada durante 2 años, un cultivo forrajero MG5 establecido a partir de semillas mostró rendimientos reducidos en el tratamiento sometido a la presión de los neumáticos del tractor, pero tuvo un rendimiento tan bueno como *Chloris gayana*, una pastura forrajera muy utilizada en Okinawa.

**Palabras clave**: *Urochloa brizantha*, establecimiento de pastos, producción de plántulas, pastos tropicales, rendimiento de materia seca.

## Introduction

In Okinawa, the southernmost part of Japan, rate of increase in gross agricultural production between 2011 and 2016 was the highest in Japan. In particular, the beef industry accounted for 22.3% of gross agricultural production in 2017 and sales of calves during the past 10 years ranked fourth throughout Japan. In addition, more than 3 million foreign tourists, mainly from Taiwan, Hong Kong, South Korea and China, visited Okinawa in 2018, which was the highest number recorded in any year. In view of the resulting increased demand for livestock products, there is an urgent need to boost the production of Okinawa's famous unique beef brands such as 'Ishigaki Gyu', 'Yamashiro Gyu' and 'Miyako Gyu'. Feeding high quality grass is necessary for breeding cows to be healthy with high reproductive rates and for growing and fattening animals to achieve high levels of production. Okinawa has a subtropical climate and warm season perennial grasses can be grown successfully. The many small islands comprising the Prefecture of Okinawa where cattle are raised often suffer from drought, so introduced forage species should be drought-tolerant.

Some species of the genus *Brachiaria*, which are now recognized as species of the genus *Urochloa*, introduced from Africa, are of considerable economic importance in the tropics due to their adaptation to low-fertility soils (Rao et al. 1996), their drought-tolerance (Gayalin et al. 1994; Guenni et al. 2002) and good nutritive value (Lascano et al. 1996). In Brazil, *Urochloa* pastures extend over almost 100 million hectares (Jank et al. 2014).

A cultivar of one species, *Urochloa brizantha* (syn. *Brachiaria brizantha*) cv. MG5 Vitória (referred to subsequently as MG5), in tropical America also known under the cultivar names 'Toledo' and 'Xaraés' (Cook et al. 2020), has been shown to have high nutritive value in studies with growing cattle in Okinawa and has performed comparably with *Chloris gayana* cv. Katambora and *Digitaria eriantha* cv. Transvala (Nakanishi et al. 2006, 2008). This cultivar also proved to be more tolerant of drought than all other *Urochloa* species and cultivars tested (Kudaka et al. 2010). Based on these and other regional research results, MG5 was recommended for use in Okinawa Prefecture in 2016.

However, seed production and seed viability of this species in Okinawa are low (Kouki et al. 2007; 2009) and due to phytosanitary considerations (contamination of commercial seed lots with soil particles), it is difficult to import seeds of MG5 from other countries such as Brazil (Kouki and Ebina 2009). As a result, MG5 is still uncommon in Okinawa and mechanisms and strategies for increased usage should be developed.

While cattle are grazed in some areas of the Prefecture, forage is usually used for hay production which involves mowing, aerating and baling using heavy tractors, 5 or 6 times per year. Consequently, a forage cultivar such as MG5 must be resistant to tractor tyre stress and produce acceptable growth under this regime.

To address these issues we investigated methods of vegetative propagation of MG5 and production of MG5 for 2 years, while being harvested by tractors. Some of the data reported here have also been reported in Japanese language in the Okinawa Livestock Research Center´s bulletin series.

## Materials and Methods

The research was conducted at Okinawa Livestock Research Center (Nakijin, Okinawa, Japan) (26º41' N, 127º56' E; 90 masl).

### *Study 1: Vegetative propagation*

*Raising plantlets*. A tray comprising 55 cells, each 4.5 × 4.5 × 4.5 cm, was filled with a 50:50 mixture of potting compost (TAKII & Co. Ltd, Kyoto, Japan) and red ball earth[1] (TAKII & Co. Ltd). For raising plantlets, soil in the trays was kept moist by sprinkling with 3.7 mm water per day in a glass-house.

Cuttings were taken from a mature pasture stand of MG5 of 70–90 cm height. Two methods were compared to obtain material for planting. For the first method (Method 1: higher cutting and root formation), grass stems (culms) were cut above the third joint (node) from

[1]Granular clay-like mineral of volcanic origin.

the base. While the cut plant portion was removed and discarded, the uncut stem portion stayed in the field for two weeks (Figure 1). During this time adventitious roots start to develop from the lowest node. The stem was then cut to retain 2 nodes above the rooting node and was inserted to a depth of 3 cm into soil in the trays. For the second method (Method 2: lower cutting and direct planting), MG5 stems were cut at about 10 cm from ground level (Figure 1) and the lowest joint was inserted immediately into the soil in the trays to a depth of 3 cm.

Acceptably formed plantlets were identified about 2 months later by counting those rooted cuttings where, if lifted by the stem, soil did not fall away from the stem as roots were completely attached to the soil.

*Transplanting plantlets into the ground.* Plantlets obtained by vegetative propagation and about 21 weeks of age, were transplanted into the field of Kunigami merge[2]. Two transplanting methods were compared in terms of time necessary for planting a given area: using a vegetable transplanter machine (Yanmer, Osaka, Japan); and by means of a manual planting tool with 2 handles (Figure 2). In the former, plantlets were fed into a hopper on the machine and were drawn down into the ground while in the latter, a plantlet was placed in the bottom of the tool, the jaws at the bottom were inserted into the soil, and the soil was opened by forcing the levers at the top apart. While press wheels compacted the soil around the plantlet for the vegetable planter, soil was pressed down with the foot for the planting tool method. Both methods involved 3 people and their working time was recorded. For each method, 110 plantlets were planted 18 cm apart in 8 furrows 36 cm apart, giving an area of about 50 $m^2$ for each method.

**Figure 2.** Machine planting and manual planting of *Urochloa brizantha* plantlets.

*Test for tractor tyre stress*

Seeds of *Chloris gayana* cv. Katambora and MG5 were each sown at 30 kg/ha on 27 September 2005. For each grass, an area of 47.6 $m^2$ (14 × 3.4 m) replicated 4 times

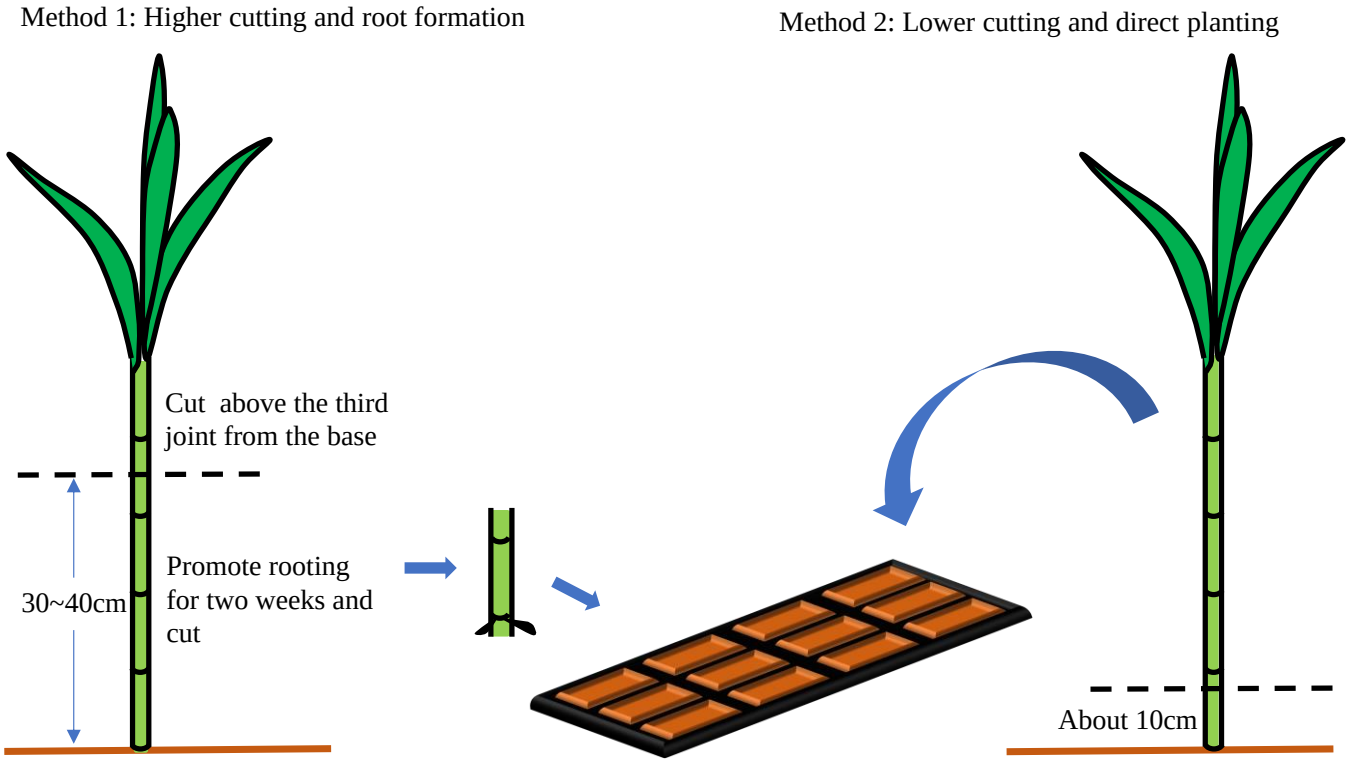


**Figure 1**. Method 1 – Higher cutting and root formation; and Method 2 – Lower cutting and direct planting.

[2]A fine-grained red soil sometimes containing gravel but with low organic matter concentration.

was used to assess the impacts of tractor tyre stress or no tractor stress (Control) on plant growth. Both grasses were mown by hand 3 times, the last one on 27 June 2006, before the investigation commenced. To impose tractor tyre stress on appropriate plots, a tractor (98 PS, about 3 tonnes weight, gear M-2, Iseki Co. Ltd, Ehime, Japan) was driven over the whole of each plot 3 times evenly every harvest: 16 August, 05 October and 19 December in 2006, and 21 May, 15 August and 29 October in 2007, to simulate mowing, aerating for drying and collecting in round bales as for a conventional harvest. To determine dry matter yield, 3 different fixed areas (1 × 1 m) in each plot were cut by hand for each treatment and the harvested material was dried for 48 h at 72 ºC.

*Statistical analysis*

Statistical treatment of the tyre stress test was by two-way analysis of variance (ANOVA) with a Fisher's least significant difference test for the 2 factors, grass species and tractor tyre stress, regarding dry matter yield for each date and total yield.

## Results and Discussion

*Raising and transplanting plantlets*

The standard method for vegetative propagation of grasses in Okinawa is to cut stems (culms) to retain 2 joints (nodes), the cuttings then being inserted into a mixture of soil and potting mix (Mochizuki et al. 2005). With MG5 this method normally results in a success rate of about 10% of plantlets being produced (T. Hanagasaki unpublished data). Results have been similar when a commercial rooting accelerator (TGG010S or TGG020S, both from the auxin group; Tokai Global Greening Co. Ltd, Gifu, Japan) was used, indicating that treatment with that plant hormone had no effect on rooting of MG5 cuttings. In a comparison trial, success rate for MG5 (18%) has been lower than those for other *Urochloa* species and cultivars (*U. brizantha* cv. Marandu at 31%, *U. decumbens* at 28%, *U. ruziziensis* at 52% and *U. humidicola* at 56%) (T. Hanagasaki unpublished data).

However, in the current study both methods to produce rooted cuttings resulted in a satisfactory percentage of plantlets (Table 1). With about 77% of plantlets produced, the lower cutting of stems followed by direct insertion into soil is a successful and practical method for vegetative propagation of MG5.

In a complementary study, time involved in transplanting plantlets showed that machine planting took 107 seconds per 20 m and 39 seconds for a change of direction. In contrast, manual planting took 287 seconds per 20 m. Thus, manual planting of 1,000 $m^2$ took twice as much time as machine planting (Table 1). MG5 generally grew rapidly with both methods of transplanting.

*Tractor tyre stress test*

There was no major difference between the 2 grasses regarding Grand total DMY over 2 years (Table 2). However, tyre stress depressed ($P<0.05$) Total DMY in 2007 and Grand total DMY over 2 years in MG5, while Katambora was generally unaffected by tyre stress. Considering that MG 5 is a fairly erect-growing tussock grass with short rhizomes and Katambora is stoloniferous (although it can attain an erect growth habit in a dense pasture), this finding is in general agreement with the observations of Honda and Yamanobe (1958), who reported that tractor tyre stress generally markedly suppressed growth of erect grasses but could have favorable impact on sod-forming grasses, if subjected to stress on only few occasions separated by reasonable intervals. Hosono et al. (1965) reported that forage yield of Italian ryegrass decreased as the number of transits increased (0, 1, 3 and 5 times).

**Table 1.** Vegetative propagation and transplanting of *Urochloa brizantha* cv. MG5: **A**) Percentage of rooted cuttings (plantlets) produced with 2 methods of selecting and planting of cuttings. **B**) Time for transplanting rooted cuttings in a 1,000 $m^2$ plot by 2 methods.

| Method | A) Percentage of rooted plantlets after 2 months | B) Time for transplanting |
|---|---|---|
| Higher cut to promote rooting | 66.7% (1,155)[1] | Not applicable |
| Lower cut with direct insertion | 76.7% (648) | Not applicable |
| Machine planting | Not applicable | 6.3 hours |
| Manual planting | Not applicable | 12.9 hours |

[1]Numbers in parenthesis represent the number of stems inserted in a compost-soil mixture.

**Table 2.** Effects of tractor tyre stress on dry matter yield of 2 tropical grasses during 2 years (kg/10a).

| Date | | *Urochloa brizantha* cv. Vitória MG5 | | *Chloris gayana* cv. Katambora | |
|---|---|---|---|---|---|
| | | Control | Tyre stress | Control | Tyre stress |
| 2006 | 16 Aug | 750ab | 660bc | 792a | 643c |
| | 05 Oct | 484a | 483a | 503a | 476a |
| | 19 Dec | 330a | 312b | 423a | 405a |
| Total 2006 | | 1,564ab | 1,455b | 1,718a | 1,524ab |
| 2007 | 21 May | 735a | 420b | 893a | 828a |
| | 15 Aug | 1,255a | 871b | 812b | 796b |
| | 29 Oct | 723a | 436b | 556b | 491b |
| Total 2007 | | 2,683a | 1,727 | 2,261b | 2,115bc |
| Grand total | | 4,247a | 3,182c | 3,979ab | 3,639bc |

Means followed by different letters within each row differ significantly according to Fisher's least significant difference test (P<0.05).

## Conclusion

In conclusion, it appears that under the conditions of Okinawa, cutting stems of MG5 low to the ground and inserting them immediately into a soil-compost mixture in a glass-house will result in successful production of plantlets. While this methodology is acceptable for small areas, for planting large areas there is a need to locate a source of commercial seed free of contamination by soil particles and thus can be safely imported.

While tractor tyre stress did not influence DM yields of Katambora severely, impact of tractor tyres markedly lowered yields of MG5, especially in the second year. However, total DM yield of MG5 under tractor tyre stress for the 2 years was not significantly different from that of Katambora, which indicates the production capacity of MG5. Tractor tyre stress could be a concern where material is harvested as hay using heavy tractors and balers but it would not be a significant issue under cut-and-carry or grazing systems. Furthermore, in a practical situation the impact would probably be reduced as the total area of pasture is not normally affected by each operation in the haymaking process. However, soil compaction, which was not considered in this study, should also be taken into account.

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