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Growth, Production and Seed Quality of *Brachiaria brizantha* cv. Mg 5 Under Different Planting Space

Nafiatul Umami*, Asrie Hardianing Indra Kusuma, and Cuk Tri Noviandi

Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia

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* Corresponding author:
Telp. +62 87839375048
E-mail: nafiatul.umami@ugm.ac.id

ABSTRACT

The research aimed to investigate the effect of different planting space on the seed production of *Brachiaria brizantha* cv. MG 5.This study used three dimensions of spacing: 75 x 75 cm, 100 x 100 cm, and 150 x 150 cm. The seed was germinated before planted on the 3 x 3 m plot with three replications. Fertilization was performed twice at the age of 30 and 90 days with NPK fertilizer 400 kg ha^{-1} and given the same amount of water. The variables observed were the plants' height, length, number of tiller, inflorescence, raceme, spikelet, the seed purity, the seed production (kg ha^{-1}), and viability. The data obtained were analyzed statistically by using the Completely Randomized Design (CRD), and if any difference existed, it was continued with Duncan's new multiple range test. The results showed that the different planting space was significant ($P<0.05$) to the seed production of *Brachiaria brizantha* cv. MG5., which was the seed production at 75 x 75 cm spacing was 206.43 kg ha^{-1}, 100 x 100 cm was 354.43 kg ha^{-1}, and 150 x 150 cm was 128.87 kg ha^{-1}. The highest seed production was resulted in planting space of 100 x 100 cm that was 354.43 kg ha^{-1}.

Keywords: *Brachiaria brizantha* cv., Growth, Planting space, Quality, Seed production

Introduction

Brachiaria brizantha is one of the superior introducing grasses that has been adapted and known by farmers in Indonesia. These grasses can grow in most parts of Indonesia, because they are compatible with the tropical climate in Indonesia and are tolerant of various types of soil, including acidic soils. *Brachiaria brizantha* contains a good nutritional value, characterized by good palatability and high protein. Besides used as animal feed, this grass can also be used as cover crops on plantations or for reclamation and conservation on marginal land (Fanindi and Prawiradiputra, 2005).

B. brizantha grass comes from Africa (Uganda, Kenya, and Tanzania) and spread to various regions including Asia and the Pacific. This grass began to be introduced to Indonesia in 1958, along with breeding research and the discovery of new *Brachiaria* grass cultivars. The discovery of this new type, causing an increase in species including *Brachiaria brizantha* cv. MG5. Amorim (2014) describes that plant of *B. brizantha* cv. Xaraes or also known as cv. MG 5 or cv. Victoria comes from Africa. This plant can grow up to a height of 1.50 m, and the diameter of the stem reaches 6.0 mm. Alencar (2007) cit. Cunha *et al.* (2012) added that grass of *B. brizantha* cv. Xaraes has the highest productivity compared to other forages grown in Brazil.

B. brizantha seed propagation is an important factor in its cultivating. Seed propagation can be performed vegetatively and generatively. Vegetative propagation is by using pols and stolons while generative using seeds. Seed propagation using pols (tillers) has the advantage of the fast growing and the low risk of death in fields, while using seeds is better because it is easy to spread, the little amount needed, and easy to apply in the field (Hidayat *et al.*, 2008). The country in Southeast Asia, where the seeds are produced for forage today, is Thailand. Nakamanee and Phaikaew (2000) explain that research in Thailand has developed improvement of forage crops and appropriate management guidelines in seed production. Research conducted in grass seed production of forage is mostly carried out in the United States, Australia and some in Thailand, there is still limited information about the production of forage conduct in Indonesia.

The key to success in increasing the production of forage is dependent on several factors, including the type of forage, climatic conditions, water, soil fertility, and planting space. Planting space is a pattern of inter-cropping arrangements in farming. Planting space will affect the production of plants because it is related to the availability of nutrients, sunlight, and space for plants (Reksohadiprodjo, 1985a). Planting space influences the number of a plant stem that will affect the production of grass seed. Planting management with optimal Planting space will obtain maximum seed production, so with the good potential of *B. brizantha* cv. MG 5 then it is required proper planting space in order to produce better seed production.

Planting space greatly affects the productivity of forage seeds, each region has a different growth ability, in *Paspalum dilatatum* which is planted in Indonesia, when used planting space of 100 x 100 cm can produce the most optimal seed production of 139 kg ha-^{1} and 185 kg ha-^{1}, *B. brizantha* planted with planting space of 90 x 90 cm in Brazil produces 500 - 800 kg ha-^{1}. There needs data related to growth and production of *B. brizantha cv*. MG 5 seeds in Indonesia, so that it is necessary to find the ideal planting space for this grass, in this study was used three dimensions of spacing: 75 x 75 cm, 100 x 100 cm, and 150 x 150 cm to obtain the best growth, production, and quality of brachiaria seeds.

Materials and Methods

Material

This research was carried out in the field and Laboratory of Forage and Pasture, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta. The research was conducted for 9 months starting from June 2014 to January 2015. The tools used in this study were portray, tractors, hoes, measuring instruments/ruler, measuring tape with a size of 100 cm, nylon bags, ropes, digital scales with a capacity of 5 kg and sensitivity 1 g, sickle, and analytical scales with a sensitivity of 0.0001 g. The materials used were the soil of regosol from the garden of forage and pasture, NPK fertilizer 400 kg ha^{-1}, *B. brizantha* cv. MG 5 seed from Miyazaki University Japan.

Implementation of research

The research implementation consisted of several stages that were: germination, land preparation, planting, replanting seed, watering, fertilizing, weeding, seed wrapping, and harvesting. The seed was first germinated or grown using portray which had a size of 30 x 50 cm with 145 holes, which then filled with soil performed for 14 days with plant height ± 10 cm. Land preparation by plowing and making a plot with a size of 3 x 3 m. Planting was carried out by moving the germination results to the field with a depth of 5 cm from the soil surface. Watering was done every morning and afternoon in the first month with 500 ml of water in each plant, after entering the next second-month spraying water with a pipe with a watering time about 1,500 ml once a day. Replanting seed was carried out by replanting on the hole of dead plant performed 2 weeks after planting. Fertilization was performed with N:P:K fertilizer (15:15:15) as much as 400 kg ha^{-1}, at the age of 30 and 90 days after planting. Fertilizer was given around the plant by side dressing with a distance of 10 cm from the plant and covered with soil. Seed wrapping was done when the plant had begun to flower, and inflorescence had seeded. Wrapping used a nylon fabric which had been sewn in a bag shape with a size of 25 x 35 cm which was then tied using rope. Harvesting was performed when the seeds were ripe or old, which were marked by changes in color from green to brownish yellow, and there were some seeds that start to fall collected in a bag of nylon fabric. Harvesting was carried out by cutting the flower stalk.

Method

This experiment was conducted experimentally using Completely Randomized Design (CRD) with three treatments: J1= 75 x 75 cm, J2 = 100 x 100 cm, and 150 x 150 cm. The parameters observed were vegetative growth (plant height, plant length, and number of tiller or stem) and generative growth, i.e., number of inflorescence, number of racemes, number of spikelets, seed weight, the percentage of seed purity, and seed production

Statistical analysis

Data were analyzed using analysis of variance to determine the effect on the variables observed, if the results of data analyzed affected then continued with Duncan's Multiple Range Test (DMRT) to determine differences between treatments.

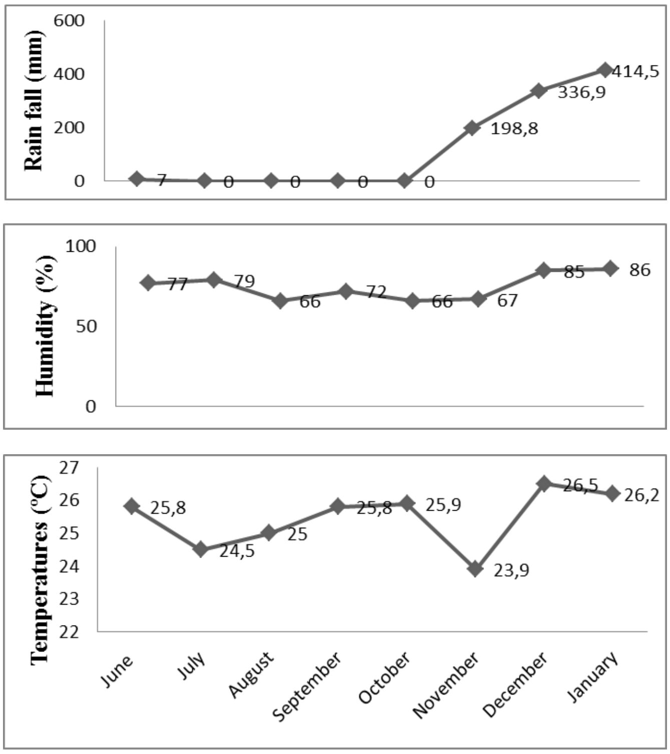
Result and Discussion

The condition of the research site

Land of Forage and Pasture Laboratory, Faculty of Animal Science, Universitas Gadjah Mada, Sleman, Yogyakarta has a land slope of 0 - 2% and is located at an altitude of 165 mdpl (latitude and longitude application). Implementation of research for 9 months started from June 2014 until January 2015. Type of soil used for research was regosol soil with texture dominated by loam sand fraction. The chemical composition of soil which was used was pH 7.12, C 1.87%, OM 3.23%, N 0.20%, P 0.22, K 0.10, and C/N ratio 9.35. Data obtained from Meteorological, Climatological, and Geophysical Agency from June 2014 to January 2015 (Picture 1) at the study sites were: temperature 25.8-26.2^{o}C, humidity 66-86%. Bouathong *et al.* (2009) stated that optimum temperature and humidity for *Brachiaria* grass were 25^{o}C - 35^{o}C and 60 - 70%. Wind speed 18 km/h, and with wind direction from Southeast. The average rainfall in the Sleman Yogyakarta area was 2,070 mm year^{-1} with 99 rainy days. Rainfall of 2,070 mm year^{-1} in Indonesia was classified as moderate rainfall, Basuki (2011) wrote that average of moderate rainfall was rainfall that had 2.000-3.000 mm per year, while the lowest was below 1,000 mm year^{-1} and the highest was more than 3,000 mm per year. Bouathong *et al.* (2009) stated that *Brachiaria* grass required 83-125 mm of monthly rainfall for its growth cycle. During the harvest period, there was rainfall of 198.8 - 414.5 mm in mid-October to January. Bouathong *et al.* (2009) stated that the Brachiaria grass was well harvested in a period of rainfall has stopped, so the quality of the seeds was superior at harvest time.

Vegetative growth

In this study, observations of vegetative growth that was carried out including height (cm), length (cm), and a number of tillers could be seen in Table 1. The treatment of planting space from several different planting spaces of 75 x 75 cm, 100 x 100 cm and 150 x 150 cm did not show a significant effect on plant height at the age of 5 weeks and 10 weeks. The treatment of different planting space showed significant differences at the age of 15 weeks (P<0.05) with planting space of 75 x 75 cm and 100 x 100 cm higher than the planting space of 150 x 150 cm. Hidayat *et al.* (2008) explained that at low densities, plants were less competitive with other plants so that the individual performance of plants was better. Conversely, at high density, the level of competition between plants to light, water, and nutrients were increasingly stringent so that the growth of plants could be hampered. Reksohadiprodjo (1985b) described that *B. brizantha* plant had semi-erect growth. At the distance of 75 x 75 cm and 100 x 100 cm, the density was higher when compared to the distance of 150 x 150 cm so that the plants coincide with each other and push each other



Picture 1. Data of meteorology, climatology, and geophysics.

Table 1. The effect of different planting space to plant height, length, and a number of tillers of *Brachiaria brizantha* cv. MG 5

Variable	Planting space (cm)			Average
	75 x 75	100 x 100	150 x 150	
Height (cm)				
5 weeks	51.25±2.41	47.13±3.81	49.42±8.03	49.26±4.94
10 weeks	79.50±2.61	68.13±7.14	64.42±11.90	70.68±9.81
15 weeks	145.08±31.90^{c}	124.17±20.02^{b}	112.08±15.40^{a}	127.11±24.96
Length (cm)				
5 weeks	73.00±5,89	73.12±5.63	63.12±13.82	69.75±9.43
10 weeks	117.75±5.95	111.17±9.36	109.92±4.25	112.94±6.97
15 weeks	155.33±29.71	145.5±15.15	147.50±16.76	149.44±13.71
Tiller				
5 weeks	68.92±25.61	48.08±8.43	57.08±5.54	58.03±16.47
10 weeks	88.58±9.82	88.67±10.97	92.67±11.13	89.97±9.45
15 weeks	105.92±16.23^{b}	94.92±11.66^{a}	112.33±12.74^{b}	104.39±14.09

^{a,b,c} Different superscript on the same column showed a significant difference (P<0.05).

stems or branches of the previously semi-erect grass became more erect. Azwir (2008) stated that without a distance the branches would collide. The height of the plant was measured starting from the ground surface until the highest leaf. Planting space of 75 x 75 cm and 100 x 100 cm was higher than the planting space of 150 x 150 cm because at the planting space of 150 x 150 cm the plant had enough space to lay down the stems and leaves. *B. brizanta* cv. MG 5 had an average plant height of 127.11 cm at the age of 15 weeks. Plant height of *B. Brizanta cv* MG5 was still low when compared to research conducted by Bouathong *et al.* (2009) which was 131.0 cm planted in Thailand with latosol soil.

The treatment of planting space from several different planting spaces of 75 x 75 cm, 100 x 100 cm and 150 x 150 cm did not show a significant effect on plant length at the age of 5, 10 and 15 weeks, as well as on plant height on plant length. Hidayat *et al.* (2008) explained that at low densities, plants were less competitive with other plants so that the individual performance of plants was better. Conversely, at high density, the level of competition between plants to light, water, and nutrients were increasingly stringent so that the growth of plants could be hampered. *Brachiaria* BR02/1794 which was planted in Thailand with planting space of 50 x 80 cm had an average height of 131.0 cm while in this study with *B. brizantha* cv MG5 had an average height of 149.44 cm.

The results showed that the treatment of different planting space on the number of tillers in the three *Brachiaria* varieties at the age of 5 weeks and 10 weeks was not significantly different, while at the age of 15 weeks at planting space of 75 x 75 and 150 x 150 cm had almost the same amount of 105.92 and 112.33. Planting Space of 100 cm had the lowest number of tillers than planting space of 75 x 75 and 150 x 150 cm. The average number of tillers in *B. Brizanta* cv. MG 5 was 105.92. The number of tillers in this study was almost the same when compared to the research conducted by Bouathong *et al.* (2009) that the *Brachiaria* plant BB02/1794 planted in Thailand with planting space of 50 x 80 cm had the average tiller amount of 102.3. The differences in the number of tillers occurred due to competition among the absorption of nutrients, water, and sunlight for photosynthesis. Plants also needed space or distance for their survival so that they did not overlap (Azwir, 2008). Hatta (2011) stated that the right planting space of grass could obtain an optimal number of stems or tiller, and was influenced by different grass varieties.

Generative growth

Observations of generative growth carried out in this study including the amount of inflorescence, raceme, spikelet, seed purity, seed production (kg ha^{-1}) and seed viability test (%) could be seen in Table 2. *B. brizanta* cv. MG 5 began to flower on November 5, 2014, and seeds of *B. brizanta* cv. MG 5 was harvested on December 15, 2014.

The results of this study showed that the treatment of planting space was significantly different (P<0.05) on the number of flowers or the inflorescence of each plant. The inflorescence at planting space of 75 x 75, 100 x 100, and 150 x 150 cm were 8.33, 17.33, and 9.00. The planting space at 100 x 100 cm has the highest inflorescence of each plant. Reksohadiprodjo (1985b) the amount of inflorescence was influenced by the number of plant shoots that grown per unit of land area. The highest number of inflorescence was 17.33 obtained from planting space 100 x 100 cm that was with a number of the tiller of 94.92. The number of raceme, spikelet, and the percentage of seed purity did not show significant differences. Puspitasari (2013) stated that treatment of different planting space did not get significant differences to the number of raceme, spikelet, and percentage of seed purity in sweet sorghum (*Sorghum bicolor* L.) that influenced was the amount of inflorescence or the amount of flower on any plants caused by nutrient competition in the ground.

The results of this research showed that the treatment of planting space was significantly different (P<0.05) on the seed production of *B. brizanta cv.* MG 5. The planting space of 75 x 75 cm was obtained seed production of 206.43 kg ha^{-1}, while planting space of 100 x 100 cm was obtained the highest production of 354.43 kg ha^{-1}, and planting space of 150 x 150 cm was obtained the lowest seed production of 128.87 kg ha^{-1}, it was quite low when compared to research conducted by Andrade (2001) in Brazil, *B. brizantha* cv. Marandu which was planted at optimal planting space of 70 to 90 cm could produce 500 to 800 kg ha^{-1} of seed. The results of research conducted by Nakamanee and Phaikaew (2000) in Thailand showed that with planting space of 40 cm *B. brizantha* CIAT 16835

Table 2. The effect of different planting space on the number of inflorescence, raceme, spikelet, seed purity (%), and the seed production (kg ha^{-1})

Variable	Planting space (cm)			Average
	75 x 75	100 x 100	150 x 150	
Inflorescences/ plant	8.33^{a}±2.08	17.33^{b}±2.52	9.00^{a}±2.00	11.56±4.74
Racemes/ Inflorescence	6.33±0.58	6.33±1.15	7.00±1.00	6.56±0.88
Spikelets/ raceme	50.00±12.12	53.33±8.33	50.67±8.62	51.33±8.66
Seed purity (%)	80.33±2.51	80.33±1.53	80.67±5.13	80.44±2.96
Seed production (kg ha^{-1})	206.43^{b}±24.57	354.43^{c}±101.10	128.87^{a}±34.92	229.91±113.41

^{a,b,c,} Different superscripts in the same column showed significant differences (P<0.05).

produced 601 kg ha^{-1} of seed. Reksohadiprodjo (1985b) explained that the seed production depended on the genetic nature of the plant and environmental factors or ways of farming. The number of flower stalks from each inflorescence, the number of flowers in each stem of inflorescence, and the number of seeds created in each flower determined the number of flowers each inflorescence. The number of flowers per inflorescence multiplied with inflorescence density obtained the potential of plant seeds. The planting space of 100 x 100 cm obtained the highest seed production of 354.43 kg ha^{-1}. Maximum seed production was achieved at optimal plant stem density, less than or more than optimal plant density caused seed production decrease. The highest seed production obtained at 94.92 stems per plant was at planting space of 100 x 100 cm.

The results from the seed viability test of several varieties of *Brachiaria* at different planting space had an average of 81-89%. This research was good enough because according to Reksohadiprodjo (1985b), the seed which was grown from seed planted had a viability of 80%. This was determined in order to avoid the use of many seeds that could increase production costs. Seed viability was defined as the ability of seeds to grow into sprouts. Another term for seed viability was the power of seed sprouts, the percentage of seed sprouts or growing power of seeds.

Conclusions

The conclusion that could be taken was the treatment with planting space of 100 × 100 cm obtained the best seed production among planting space of 75 x 75 cm and 150 x 150 cm.

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