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Research Article
The Effect of Planting Material on Nutrient Quality and Production of *Brachiaria* spp. in Yogyakarta, Indonesia

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Abstract
Background and Objective: *Brachiaria* spp. is a potential grass that can be cultivated in Indonesia. Grass production and quality can be affected by the planting material. This study aimed to identify the nutrient quality and production of *Brachiaria* spp. with different planting materials in Yogyakarta, Indonesia. **Materials and Methods:** The planting materials used in this research were seeds (10 days after germination) and pols. This study used a split-plot design in which the main plot is the variety of *Brachiaria* (*B. brizantha* cv. MG5, *B. ruziziensis* cv. Kennedy and *B. decumbens* cv. Basilisk) and the subplot is planting material. Each treatment was replicated nine times. The parameters observed in this research were dry matter, organic matter, crude fiber and crude protein, fresh production, dry matter production, organic matter production, dry matter digestibility and organic matter digestibility. **Results:** The planting material significantly affected ($p<0.05$) the chemical composition. The use of pols increased the dry matter content (23.10%) but also increased the crude fiber content (30.15%). The planting material did not significantly affect ($p>0.05$) the production and digestibility of *Brachiaria* spp. Varieties of *Brachiaria* spp. showed significant ($p<0.05$) differences in chemical composition, production and digestibility. *B. decumbens* cv. Basilisk had the highest proportions of dry matter (24%) and organic matter (87%) and *B. ruziziensis* cv. Kennedy showed the best result for crude protein content (11.86%). *B. decumbens* cv. Basilisk showed the best result for production with 6.83 t ha^{-1} fresh production, 1.69 t ha^{-1} dry matter production and 1.48 t ha^{-1} organic matter production. *B. ruziziensis* cv. Kennedy had the greatest dry matter digestibility with 78.40% and *B. decumbens* cv. Basilisk had the greatest organic matter digestibility with 82.56%. **Conclusion:** The use of optimal planting material can increase the quality of chemical composition, production and digestibility of several varieties of *Brachiaria* spp.

Key words: *Brachiaria* spp., forage seed, pols, forage production, quality

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Brachiaria spp. is a superior grass that has the potential to be developed in Indonesia as a feed plant. *Brachiaria* has high productivity and nutritive value. Apart from being a "cut and carry" feed grass, research on *Brachiaria* in grazing areas also shows that *Brachiaria* has positive value as pasture grass[1]. Types of *Brachiaria* grass that are widely developed in Indonesia include *Brachiaria decumbens* cv. Basilisk, *Brachiaria ruziziensis* cv. Kennedy and *Brachiaria brizantha* cv. MG 5.

Brachiaria decumbens cv. Basilisk is a tropical grass species originating from northern Africa and has been broadly introduced in grazing regions due to its tolerance of dry conditions. *Brachiaria decumbens* cv. Basilisk is typically planted in South Africa in areas with low rainfall of 750 mm year^{-1}. This cultivar can tolerate dry and acidic soils and displays medium palatability, rapid growth and greater biomass in low-rainfall areas than in acidic soil conditions with rainfall of 1800 mm year^{-1} [2]. The *in vitro* dry matter digestibility of *Brachiaria decumbens* cv. Basilisk in the winter was approximately 49.7% at 12 weeks of regrowth after cut-off, whereas in the summer season, this digestibility was 44.8% at eight weeks after cut-off[3].

Brachiaria ruziziensis cv. Kennedy is the result of diploid sexual crosses that are widely cultivated in the tropics and subtropics as feed plants. *Brachiaria ruziziensis* has good nutrient content and seed production and requires good soil fertility and drainage[4]. *Brachiaria ruziziensis* cv. Kennedy contains 18-20% dry matter, 80-82% moisture content, 89-90% organic matter, 9-10% ash, 8-14% crude protein, 50-61% Neutral Detergent Fiber (NDF) and up to 40% Acid Detergent Fiber (ADF)[5].

Brachiaria brizantha originated in Africa. This grass has an upright growth pattern, the base of the stems is extensively branched, the height can reach approximately one meter and the base is covered with hairy leaves[1]. *Brachiaria brizantha* grass is drought-resistant, with production of 40 t ha^{-1} year^{-1} with a content of 13.5% crude protein, 3.4% fat, 64.2% NDF, 15.8% ash, 0.31% calcium and 0.37% phosphorus[6].

The use of different planting materials affects the growth and productivity of plants because plants have different growth rates[7]. The use of pols as planting material facilitates rapid growth and the risk of death in the field is smaller; the limitation of this planting material is the need to obtain healthy pols with many roots[8]. Seed planting material requires less time to plant and can be applied to a very large area because it can be spread but newly harvested grain seeds are difficult to germinate, so the seeds must be stored for approximately 6-8 months or soaked with sulfuric acid. Preparation of the planting material should be tailored to the surrounding environment and easy to manage[9].

The amount of material required for each hole also needs to be considered to avoid competition for nutrients in the soil that affect the quality of forage. Increasing populations of 10,000, 20,000 and 30,000 plants/hectare will have elevated levels of dry matter and a decrease in crude protein content. Strong light competition will result in plants growing more erect with fewer leaves and smaller stems, increasing the amount of dry matter stacked on the stem, such that the dry matter content is greater in plants grown at high population density[10].

Forage quality is evaluated based on the nutrient content, production and digestibility value. The chemical analyses performed for this evaluation are proximate and *in vitro* digestibility analysis. *In vitro* digestibility analysis has many advantages. *In vitro* methods are inexpensive, rapid and provide results close to *in vivo* results that are usually performed on ruminants that mimic the processes occurring within the rumen[11]. Digestibility can be measured by *in vitro* fermentation techniques according to the Tilley and Terry method[12]. This research aimed to identify the nutrient quality, production and digestibility of *Brachiaria* spp. grown from different planting material.

MATERIALS AND METHODS

This study was conducted for 4 months from April-August 2017 in the Greenhouse and Laboratory of Forage and Pastures, Faculty of Animal Science of Universitas Gadjah Mada, Yogyakarta, Indonesia. The soil was taken from the field of the Forage and Pasture Laboratory, Faculty of Animal Science, UGM. The soil (regosol) used in this study was the topsoil approximately 15 cm from the ground surface. Soil analysis was conducted to determine the nutrient content. The soil composition was C-organic (5.46%), N-Total (0.57%), N-NH_4 (257 ppm), P_2O_5 (180 ppm), K (600 ppm) and pH (6.87). The soil was first separated by hoeing and sieving. The sieved soil was then placed into a polybag (5 kg capacity). The treatments were arranged in a split-plot design in which the main plot was the variety of *Brachiaria* (*B. brizantha* cv. MG5, *B. ruziziensis* cv. Kennedy and *B. decumbens* cv. Basilisk) and the subplot was planting material. A total of 54 polybags were divided randomly into 6 treatments and 9 repetitions. All the polybags were placed in a greenhouse with a spacing of 50$\times$50 cm. Seedlings aged 10 days old and pols were planted into the polybags. The plants were fertilized once, 30 days after planting, using 3.75 g of NPK 25-5-7. The fertilizer was provided at four points around the plant. Harvesting was conducted on the 45th day after planting, with the plants cut at 10 cm from the soil. The plants from each polybag were weighed immediately to obtain a fresh weight of crown biomass. The whole sample was then chopped and weighed. Samples were inserted into a paper bag and dried in an oven at 55°C for approximately 5 days until a constant weight was achieved. The samples were milled using a Wiley mill with a screen diameter of 1 mm and then, the milled samples were analyzed considering the levels of dry matter, organic matter, crude fiber and crude protein following AOAC methods[13]. The dry matter content was obtained by drying the material at 105°C; the water in the feed evaporated completely and left behind the dry material. The organic matter content was obtained by burning the sample at 550°C, at which point all organic materials will oxidize to CO_2, H_2O and other gases, while those remaining were ash. The crude fiber content was obtained by boiling a fat-free sample with 1.25% H_2SO_4 and 1.25% NaOH and burning the remaining ingredients at 550°C. The material lost at the time is the crude fiber. The crude protein content was obtained by breaking the organic N bond using 20% H_2SO_4 and a catalyst into NH_4HSO_4, which in an alkaline atmosphere can release NH_2 which is then captured by borax acid and titrated with 0.1 N HCl.

Dry matter and organic matter digestibility were measured using the Tilley and Terry method[12]. The determination of *in vitro* digestibility according to Tilley and Terry consists of 2 stages. Stage 1 is a carbohydrate digestion by microbial rumen for 48 h. Stage 2 is a digestion with pepsin and HCl to remove protein from the bacteria and feed that remain after the 48 h of incubation.

All data were subjected to analysis of variance using SPSS 18®, according to the split-plot design. The differences among mean values were compared by Duncan's Multiple Range Test (DMRT) at the p = 0.05 probability level.

RESULTS AND DISCUSSION

Chemical composition: The chemical composition of *Brachiaria* spp. grown from different planting materials in Table 1. The planting material had a significant effect (p<0.05) on the dry matter content of three varieties of *Brachiaria*. The dry matter content of *Brachiaria* grown using pols was higher (23.10%) than that grown using seed (19.68%). The use of pols produces more dry matter because the nutrient absorption rate of pols is better than that of seeds. This difference occurs because the formation of grass tillers in plants grown using pols is less than that of seed (ten days after germination), so the level of competition for plants to absorb nutrients and sunlight is lower for plants grown from pols than from seeds. Pols have faster root development than seeds. This change causes the plant to absorb nutrients more quickly and result in increased nutrient value of the plant[14]. An excessive number of plants would decrease crop production due to competition for nutrients, water, sunlight and plant growing space[15].

Table 1: Chemical composition of *Brachiaria* spp. with different planting materials (%) in Yogyakarta, Indonesia

	Pols	Seed	Average
Dry matter			
Brachiaria decumbens	23.34±0.80	26.00±5.42	24.67±1.57^{x}
Brachiaria ruziziensis	21.74±0.07	16.56±0.57	19.15±0.57^{z}
Brachiaria brizantha	24.23±0.93	16.49±1.31	20.36±4.36^{y}
Average	23.10±1.25^{a}	19.68±4.79^{b}	
Organic matter			
Brachiaria decumbens	86.71±1.03	88.94±0.65	87.82±1.26^{x}
Brachiaria ruziziensis	89.03±0.63	85.65±1.26	87.34±2.05^{x}
Brachiaria brizantha	85.95±0.79	85.02±0.30	85.48±0.73^{y}
Average	87.23±1.57	86.54±1.96	
Crude fiber			
Brachiaria decumbens	28.63±1.54	29.82±1.50	29.23±1.51
Brachiaria ruziziensis	30.38±2.07	25.69±1.52	28.04±3.04
Brachiaria brizantha	30.15±0.24	27.61±1.48	29.52±2.29
Average	30.15±1.78^{a}	27.70±2.21^{b}	
Crude protein			
Brachiaria decumbens	10.92±0.51	10.80±0.55	10.86±0.48^{y}
Brachiaria ruziziensis	11.93±0.78	11.80±1.09	11.86±0.85^{z}
Brachiaria brizantha	9.97±0.54	9.97±0.51	9.97±0.47^{x}
Average	10.94±1.00	10.85±1.03	

^{a,b}different superscripts in the same row indicate significant differences (p<0.05) ^{x,y,z}different superscripts in the same column indicate significant differences (p<0.05)

Varieties of *Brachiaria* showed a significant difference (p<0.05) in dry matter content. *Brachiaria decumbens* cv. Basilisk produced the most dry matter (24.67%) compared to *Brachiaria ruziziensis* cv. Kennedy (19.15%) and *Brachiaria brizantha* cv. MG5 (20.36%). The amount of dry matter shows the efficiency of the plant in utilizing the available nutrients and converting them to dry matter.

Organic matter from grass grown using pols and seeds showed no significant difference (p>0.05), with organic matter contents of 87.23% for grass grown from pols and 86.54% for grass from seed. Varieties of *Brachiaria* showed a significant difference in organic matter content (p<0.05). *Brachiaria decumbens* cv. Basilisk produced the most organic matter (87.82%) compared to *Brachiaria ruziziensis* cv. Kennedy (87.34%) and *Brachiaria brizantha* cv. MG5 (85.48%). The content of organic matter is one of the main parameters determining the quality of the plant: feed with more organic materials has more components that can be utilized by livestock. Factors affecting grass nutrient values include plant maturity, plant species, plant spacing and nutrient content[16].

The use of different planting materials produced a significant difference (p<0.05) in the crude fiber content of the grass. The crude fiber content of grass with pols planting material was higher (30.15%) than that of the grass grown from seed (27.70%). *Brachiaria* varieties showed no significant differences (p>0.05) in grass fiber content. The three varieties of grass have similar morphology and were also cut at the same age, with no real difference to the crude fiber content.

The planting material had no significant effect (p>0.05) on the crude protein content. Grasses grown using pols contained a crude protein content of 10.94%, while those grown using seeds had a crude protein content of 10.85%. *Brachiaria* varieties showed a significant difference (p<0.05) in protein content. *Brachiaria ruziziensis* cv. Kennedy had the highest crude protein content (11.86%), Table 1, compared to *Brachiaria decumbens* cv. Basilisk (10.86%) and *Brachiaria brizantha* cv. MG5 (9.97%). Protein content is strongly influenced by the ability of plants to assimilate nitrogen from the planting medium to internal nitrogen networks. Plants that are more effective and efficient in utilizing nitrogen will have higher protein contents. The crude protein contents of *B. decumbens*, *B. ruziziensis* and *B. brizantha* that were harvested at six weeks were 10.6, 11.6 and 10.8%[9].

Production: Production metrics of *Brachiaria* spp. grown from different planting material in Table 2. The use of different planting materials did not have a significant effect (p> 0.05) on fresh biomass production. The grass grown using pols produced fresh biomass of 5.43 t ha^{-1}, while the grass grown from seed produced fresh biomass of 5.46 t ha^{-1}. The *Brachiaria* variety showed a significant relationship (p<0.05) with fresh production. *Brachiaria decumbens* cv. Basilisk produced the greatest fresh biomass production of 6.83 t ha^{-1} while *Brachiaria ruziziensis* cv. Kennedy produced 5.56 t ha^{-1} and *Brachiaria brizantha* cv. MG5 produced 3.94 t ha^{-1}. The number of shoots present in each clump will affect the production of the plant. The formation of buds is closely related to the formation of productive shoots, with more buds relating to more productive shoots[17].

The planting material did not show any significant correlation (p>0.05) with the dry matter production. The grass planted using pols produced 1.25 t ha^{-1} of dry matter while the grass planted using seed produced 1.12 t ha^{-1} of dry matter. The production of this dry matter is based on the production of fresh grass, which does not show any real difference between the grass grown using pols and using seeds. *Brachiaria* varieties showed a significant difference (p<0.05) in dry matter production. *Brachiaria decumbens* cv. Basilisk produced the greatest dry matter production of 1.69 t ha^{-1}, while *Brachiaria ruziziensis* cv. Kennedy produced 1.07 t ha^{-1} and *Brachiaria brizantha* cv. MG5 produced 0.79 t ha^{-1}. The shape and morphology of the plants are very influential on the production. The height of the grass plant *Brachiaria decumbens* influences the resulting dry weight of the plant[18].

The planting material did not show any significant relationship (p>0.05) with the production of grass organic material. The grasses grown using pols produced 1.03 t ha^{-1} of organic matter and the grasses grown from seed produced 1.03 t ha^{-1} dry matter. *Brachiaria* varieties significantly differed (p<0.05) in the production of organic matter. *Brachiaria decumbens* cv. Basilisk had the highest organic matter production of 1.48 t ha^{-1} while *Brachiaria ruziziensis* cv. Kennedy produced 0.94 t ha^{-1} and *Brachiaria brizantha* cv. MG5 produced 0.67 t ha^{-1}. The ability of a plant to absorb nutrients affects the organic matter content of a plant[19]. The results for *Brachiaria decumbens* cv. Basilisk indicated that this variety can optimize the use of nutrients available in the soil better than the other varieties of *Brachiaria*.

Table 2: Production of *Brachiaria* spp. with different planting materials (t ha^{-1})

	Pols	Seed	Average
Fresh			
Brachiaria decumbens	6.69±0.47	6.98±0.48	6.83±0.45^{x}
Brachiaria ruziziensis	5.97±0.41	5.16±0.05	5.56±0.51^{y}
Brachiaria brizantha	3.65±0.11	4.24±0.05	3.94±0.33^{z}
Average	5.43±1.41	5.46±1.23	
Dry matter			
Brachiaria decumbens	1.56±0.14	1.81±0.13	1.69±0.18^{x}
Brachiaria ruziziensis	1.29±0.08	0.85±0.03	1.07±0.24^{y}
Brachiaria brizantha	0.88±0.05	0.70±0.06	0.79±0.11^{z}
Average	1.25±0.30	1.12±0.52	
Organic matter			
Brachiaria decumbens	1.35±0.10	1.61±0.11	1.48±0.17^{x}
Brachiaria ruziziensis	1.15±0.08	0.73±0.03	0.94±0.23^{y}
Brachiaria brizantha	0.59±0.04	0.76±0.05	0.67±0.10^{z}
Average	1.03±0.34	1.03±0.43	

^{x,y,z}different superscripts in the same column indicate significant differences (p<0.05)

Digestibility: *In vitro* levels of dry matter and organic matter digestibility of *Brachiaria* spp. grown from different plant materials in Table 3. The different planting materials showed

Table 3: Digestibility of *Brachiaria* spp. with different planting materials (%)

	Pols	Seed	Average
Dry matter			
Brachiaria decumbens	77.91±1.99	78.59±0.96	78.25±1.45^{x}
Brachiaria ruziziensis	76.81±1.00	79.99±1.83	78.40±2.18^{x}
Brachiaria brizantha	63.72±8.10	66.27±9.33	64.99±7.96^{y}
Average	72.81±8.03	74.95±8.09	
Organic matter			
Brachiaria decumbens	81.70±1.62	83.42±1.39	82.56±1.65^{x}
Brachiaria ruziziensis	80.28±0.49	83.40±0.38	81.84±1.75^{x}
Brachiaria brizantha	66.35±7.22	69.65±9.80	68.00±7.91^{y}
Average	76.11±8.23	78.82±8.47	

^{x,y,z}different superscripts in the same column indicate significant differences (p<0.05) no significant effect ($p>0.05$) on the resulting dry matter digestibility. The dry matter digestibility with pols as planting material was 72.81%, while this digestibility for the grass grown from seed was 74.95%. The *Brachiaria* varieties significantly differed ($p<0.05$) in dry matter digestibility. *Brachiaria ruziziensis* cv. Kennedy showed the highest dry matter digestibility of 78.40% while *Brachiaria decumbens* cv. Basilisk had 78.25% and *Brachiaria brizantha* cv. MG5 had the lowest dry matter digestibility of 64.99%. In general, *Brachiaria* has a high dry matter digestibility and can improve average daily gain as well[9]. One of the factors that affect dry matter digestibility is the nutrient content of the feed. Higher nutrient content in feed ingredients will also increase digestibility[20].

Planting material did not show any significant relationship ($p>0.05$) with the digestibility of organic matter. The grasses planted with pols as the planting material showed 76.11% digestibility, while those planted from seeds showed 78.82% digestibility. The *Brachiaria* varieties showed significant differences ($p<0.05$) in the digestibility of organic matter. *Brachiaria decumbens* cv. Basilisk showed the highest dry matter digestibility (82.56%), followed by *Brachiaria ruziziensis* cv. Kennedy (81.84%) and *Brachiaria brizantha* cv. The MG5 had the lowest digestibility (68.00%). The digestibility of organic matter is related to dry matter digestibility; a higher level of dry matter indicates greater digestibility of organic matter. A high percentage of crude fiber in the diet will lower the digestion of food substances because crude fiber contains components that are difficult to digest, such as lignin and silica[21].

CONCLUSION

It can be concluded that the use of pols as planting material can increase the dry matter of plants but also increase the content of crude fiber. *Brachiaria decumbens* cv. Basilisk showed the best chemical composition. The use of different planting materials had no significant effect on grass production. *Brachiaria decumbens* cv. Basilisk showed the best production. The difference in planting material did not produce any significant difference in the dry matter and organic matter digestibility. *Brachiaria ruziziensis* cv. Kennedy showed the best dry matter digestibility and *Brachiaria decumbens* cv. Basilisk showed the best organic matter digestibility.

SIGNIFICANCE STATEMENT

This study found that the use of different planting materials can affect the nutrient content of the mature plant. Pols is the best planting material because it can increase the dry matter content of grass. The use of different planting materials did not affect the production or digestibility of *Brachiaria*. *Brachiaria ruziziensis* cv. Kennedy was the best variety based on nutrient content, production and digestibility. Direct field tests are needed to identify the real effects of the selection of planting material in *Brachiaria* spp.

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