Physical quality of some types of grass on mixed planting with Arachis pintoi and organic fertilizing

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Abstract. Increased livestock productivity is largely determined by the availability of sufficient forage. Good forage is determined by digestibility, which is related to physical quality. This study aims to determine the physical quality of several types of grass planted with Arachis legumes and the provision of organic fertilizer. This study used a Randomized Block Design with a factorial pattern consisting of 3 types of grass planted with Arachis legumes (factor A) and fertilizing 2 types of solid and liquid organic fertilizer (factor B) with 3 replications. The treatment combinations are: R1C (Paspalum notatum with Arachis pintoi + Compost), R1B (Paspalum notatum with Arachis pintoi + Biourine), R2C (Paspalum conyugatum with Arachis pintoi + Compost), R2B (Paspalum conyugatum with Arachis pintoi + Biourine), R3C (Axonopus compressus with Arachis pintoi + Compost), R3B (Axonopus compressus with Arachis pintoi + Biourine). The results showed no significant difference (P>0.05) both in the mixture of some grass plants with Arachis pintoi and the provision of organic fertilizer on the physical quality of forage. In planting a mixture of Axonopus comprsus grass with Arachis pintoi showed average dry matter (DM), water regain capacity (WRC), and water solubility (WS). Where compost gets higher average values than biourine for dry matter, WRC and WS. The combination of mixed planting and fertilizing, compost showed the highest average, especially water solubility (WS). From this research it can be concluded planting a mixture of grass and legumes fed with compost on average is better for the physical quality of the grass, but not significantly different (P>0.05) from all treatments.

1. Introduction
Provision of forage is very important in maintaining ruminants, both in the form of grazing on grasslands and cutting forage. More than 90% of the pasture that is cultivated to produce animal feed in Indonesia is dominated by natural grass, while the legume component is very small [1]. Meadows are good and economical if it consists of a mixture of grass with legume [2]. The diversity of forages given to livestock is influenced by the season, where the dry season is given more natural grass while the legumes are very small [3]. Judging from the physical, chemical and biological qualities of natural grass is lower than superior grass and some types of bushes and tree legumes [4].

Various types of superior grasses that have long been introduced in Indonesia include Paspalum notatum, Paspalum conjugatum, Axonopus compressus, and each type of grass has different qualities. Some types of grass are very suitable as shepherd grass because they grow short and spread with stolons, hold the stampede because of strong and deep roots, and are resistant to drought. Paspalum notatum or called Australian grass besides having many advantages, also has a weakness that is still low productivity [5]. Paspalum conjugatum grass originating from the American tropics makes it suitable
for planting in tropical and humid regions as well as various acid soil conditions, growing with stolons with roots, plant height can reach 40-60 cm. While *Axonopus compressus* grass has many branches spread strongly on the ground so it is resistant to tread and its production is quite high [6].

To improve the productivity and quality of grass in developed countries, many associations are applied to grow grass and legumes, especially in grasslands with the aim of leguminous plants that can be symbiotic with *Rhizobium* bacteria that can bind N from the air, can increase protein content, and maintain production in the dry season [7]. *Arachis pintoi* is a type of legume which has characteristics suitable for life related to grass, is resistant to being trampled, and is very preferred by livestock because it has palatable properties [8]. In addition to associating grass plants with legumes, fertilizer application is also very important because besides increasing productivity, solid fertilizer (compost) and liquid fertilizer (bio-urine) are highly recommended because besides being able to provide various nutrients in the soil and can also improve soil structure [9-11]. Giving and placing the right fertilizer is needed when plants need it [12]. Compost not only increases nutrients but also maintains soil function so plants can grow well [13]. While liquid fertilizer (bio-urine), in addition to being able to provide nutrients in the soil, can also function as a control against plant pest attacks [14,15], besides that its use is more efficient and easier through spraying and watering [16]. Another advantage of organic fertilizer is that it can overcome the lack of various nutrients, does not damage plants and soil even if given as often as possible, and has a binding agent [17]. The formation of Simantri livestock groups in Bali is very effective in processing compost and biochar, which are used in various applications in agricultural systems [18]. From some manure which is processed into compost and biochar fertilizer, it turns out that chicken manure has better quality than cow and goat manure [19].

Provision of forage for ruminants is largely determined by the quantity and quality of available feed ingredients. Quantity is related to the amount of feed material given which is determined by the dry matter consumed (DMI). While the quality is related to physical properties, chemical properties, and biological properties, which are closely related to the level of degradability and fermentability in the rumen [20]. Physical properties have a very close relationship both positively and negatively with quality in terms of chemical and biological properties [21], and these physical properties include physical density, hydration capacity, cation exchange and fermentation rate [2]. Based on the foregoing, a study was carried out aimed at finding out whether there were differences in the physical quality of some types of grass in the association of planting several types of grass with the *Arachis* legume and applying organic fertilizer.

2. Research methods

2.1. Research design

Field experiments were carried out using a Randomized Block Design (RCBD) with a Factorial 3 X 2 pattern. The factor I consists of 3 grass and legume plant associations, namely: R₁ (*Paspalum notatum* with *Arachis pintoi*), R₂ (*Paspalum conyugatum* with *Arachis pintoi*), and R₃ (*Axonopus compressus* with *Arachis pintoi*). Whereas factor II organic fertilization, namely: C (compost fertilizer) and B (bio-urine liquid fertilizer). Then the combination of treatments is R₁C, R₂C, R₃C, R₁B, R₂B, R₃B, as well as control treatment without association and fertilizer (R₀) and each treatment with 3 replications (blocks).

2.2. Plant seeds and fertilizers

Plant seeds were obtained at BPTU-HPT Pangyangan-Pekutatan-Jemberana Village in the form of pols, then each plant was first planted in a polybag for 14 days before being planted in the research plot. Whereas the compost and bio-urine diapers were taken from the Simantri Manik Tirta Rahayu Group in Baha-Mengwi-Badung Village.

2.3. Planting and fertilizing

Each research block was divided into several plots according to treatment with a size of 1.6 X 1.3 m. Each plot was planted with 20 grass poles and 15 legume cuttings, with a spacing of 15 cm between...
plants (see Figure). Compost is given 1 week before planting as much as 3 tons/ha, or as much as 576 g/plot, while liquid bio-urine fertilizer is given 2 weeks after planting at a dose of 450 liters/ha (86.4 ml/plot) dissolved in water then splashed at the base of the stems of plants.

![Figure 1](image_url)

* = Grass, # = Legume

**Figure 1.** Planting association grass and legume.

### 2.4. Cutting
Cropping is carried out after 45 days after planting, with a height of 10 cm above the soil surface, then weighing all plants in each plot. Each plant in 1 experimental plot was sampled for laboratory testing of the plant's physical quality. All samples that have been taken are dried in a drought oven at 70°C to get the air-dry weight (DW), then all samples are ground and sieved.

### 2.5. Plant physical quality test
- Dry Matter (DM); carried out by drying the sample in a 105°C oven until it reaches a constant weight
- Bulk Density; by inserting the sample into a 15 ml volume cylindrical tube then weighing, a weight/volume (g/ml) is obtained.
- Water Regain Capacity (WRC); by immersing the sample as much as 2 g in a centrifuge tube filled with water as much as 1ml for 24 hours. Next centrifuge and water that has been separated from the sample are poured in a measuring cup.

\[
WRC(\%) = \frac{\text{the volume of water before the sample is immersed} - \text{volume of water after the sample is muted}}{\text{the volume of water before the sample is immersed}} \times 100\%
\]  
(1)

- Water Solubility (WS); by taking the remaining sample after soaking, then dried in the 105°C oven to get DM

\[
WS(\%) = \frac{\text{DM sample before immersion} - \text{DM sample after immersion}}{\text{DM sample before immersion}} \times 100\%
\]  
(2)

### 2.6. Data analysis
The research data were analyzed by analysis of variance, and if there were significant differences (P <0.05) between treatments followed by Duncan Multiple Range Test (DMRT).

### 3. Results and discussion

#### 3.1. Grass association with legumes
The association of several types of grass with *Arachis* legume was not significantly different (P>0.05) on the physical quality of the forage, only on treatment R3 (*Axonopus* with *Arachis*) showed the driest matter (Table 1). This shows that *Paspalum* and *Axonopus* grass are very suitable to be planted with the *Arachis pintoi* legume, because they produce the same dry matter. Planting a mixture of legumes with grass produces higher dry matter production than monoculture planting because the *Arachis* legume
plant can substitute the use of nitrogen through cooperation with *Rhizobium* bacteria fixing N from the air, the nitrogen requirements for grass plants can be fulfilled. Besides being able to provide nitrogen elements in planting a mixture of grass and legume, it can also strengthen the grass stands so that the vegetation spreads evenly and strengthens adaptation to drought [8].

Placing a mixture of grass and legumes shows the same bulk density in 3 types of grass plants. Bulk density is one indicator in assessing the quality of forage because forages that have higher coarse fibers tend to have lower bulk density [2]. This is evidenced from the results of research by Sudita et al., that natural grass has a higher fiber content than superior grass, consequently the lower the bulk density, the higher the longevity [4]. Animals that consume food with a high appetite will quickly feel full while their nutritional needs have not been met.

### Table 1. Forage quality of grass plant associations with legumes.

| Variable                        | Treatment |
|---------------------------------|-----------|
|                                 | R₁        | R₂        | R₃        |
| Dry Matter (% DM/DW)            | 0.94<sup>a</sup> | 0.94<sup>a</sup> | 0.95<sup>a</sup> |
| Bulk Density (%/ml)             | 0.33<sup>a</sup> | 0.33<sup>a</sup> | 0.31<sup>a</sup> |
| Water Regain Capacity (%)      | 30.45<sup>a</sup> | 30.78<sup>a</sup> | 30.22<sup>a</sup> |
| Water Solubility (%)            | 49.28<sup>a</sup> | 49.46<sup>a</sup> | 49.29<sup>a</sup> |

*) The same letters behind the numbers in the same column are not significantly different (P <0.05)

R₁: Mixed planting *Paspalum notatum* with *Arachis pintoi*
R₂: Mixed planting *Paspalum conyugatum* with *Arachis pintoi*
R₃: Mixed planting *Axonopus compressus* with *Arachis pintoi*

### 3.2. Provision of organic fertilizers

The application of compost and biourine organic fertilizer also showed that the physical quality of forage was not significantly different (P>0.05) both for dry matter (DM), bulk density, water regain capacity (WRC) and water solubility (WS) (Table 2).

### Table 2. Physical quality of forage with organic fertilizer.

| Variable                        | Treatment |
|---------------------------------|-----------|
|                                 | C         | B         |
| Dry Matter (% DM/DW)            | 0.95<sup>a</sup> | 0.95<sup>a</sup> |
| Bulk Density (%/ml)             | 0.33<sup>a</sup> | 0.33<sup>a</sup> |
| Water Regain Capacity (%)      | 30.52<sup>a</sup> | 30.52<sup>a</sup> |
| Water Solubility (%)            | 49.29<sup>a</sup> | 49.29<sup>a</sup> |

*) The same letters behind the numbers in the same column are not significantly different (P <0.05)

C: Compost fertilizer, B: Biourin fertilizer

However, compost fertilizer tends to show better physical quality in terms of dry matter (DM) and bulk density. Compost can provide more types of nutrients in the soil, compared to biourine which is only richer in nitrogen. This affects the maturation of plant cell walls which involves thickening of the secondary layer, along with the occurrence of lignification resulting in cell wall density [2].

Composting can increase nutrient availability for plants, especially N, P, K, Ca, and Mg nutrients, and reduce the C/N ratio and water content [22]. One indicator of good compost quality is determined by the C/N ratio because the higher the C/N ratio causes high levels of C will suppress plant growth due to microbial decomposers will use the available N to decompose organic matter so that plants lack N. Good compost is characterized by a color that is different from the color of its constituent material, odorless, low moisture content and according to room temperature. A good standard of compost usually has a C/N of 12-15, with temperatures almost the same as the ambient temperature. With more complete
nutrient elements in compost than biourine, the water regains capacity (WRC) is better, but water solubility (WS) is lower.

3.3. Interaction of plant association and fertilization

In the interaction of mixed planting with organic fertilization, it was also seen that associations of Paspalum grass with legumes given compost fertilizer had better physical quality on DM and Bulk Density variables than biourine fertilizer, but all interaction treatments were not significantly different (P> 0.05). Whereas the association of Axonopus grass with Arachis legume given biourine fertilizer (R1B) was better on DM and Bulk Density variables (Table 3). This shows the response of grass plants to fertilization differs according to the type of grass. Likewise, WRC and WS compost fertilizer are better for planting mixtures that are given compost.

| Variable                      | Treatment | R1C | R1B | R2C | R2B | R3C | R3B |
|-------------------------------|-----------|-----|-----|-----|-----|-----|-----|
| Dry Matter (% DM/low)         | 0.95*      | 0.93| 0.95| 0.93| 0.94| 0.96|     |
| Bulk Density (g/ml)           | 0.35       | 0.31| 0.33| 0.33| 0.30| 0.32|     |
| Water Regain Capacity (%)     | 30.45      | 30.45| 30.67| 30.69| 30.45| 30.00|     |
| Water Solubility (%)          | 49.27      | 49.28| 49.65| 49.27| 49.93| 49.64|     |

*) The same letters behind the numbers in the same column are not significantly different (P <0.05)

The better water regains capacity will cause the feed to be more open to bacterial attack in the rumen, the better the digestibility of the feed [23]. Feed material which has low water solubility means it is slower to dissolve in rumen fluid, but low water solubility will be very beneficial for feed ingredients that have high quality.

4. Conclusion

Planting a mixture of Paspalum and Axonopus grass with an Arachis legume does not affect the physical quality of the forage. Differences in composting with biourine do not affect the physical quality of the forage, but composting is better. There is no interaction between planting a mixture of grass and legume with fertilization on the physical quality of forage.

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References

[1] Sanchez P A 1993 Sifat dan Pengelolaan Tanah Tropika (Penerbit: Institut Teknologi Bandung)
[2] Reksohadiprodjo S 1996 Teknik Evaluasi Pakan Ruminansia (Yogyakarta: Universitas Gajah Mada)
[3] Sudita I D N 2019 In Journal of Physics: Conference Series 1402 3 033062
[4] Sudita I D N, Mahardika I G, Suarna I W and Partama I G 2015 International Journal on Advanced Science, Engineering and Information Technology 5 6 495-500
[5] Chullank 2012 Kompatabilitas Rumput Gajah Mini (Pennisitum purpureum cv. Mott) dengan Kacang Pinto (Arachis pintoi) pada Berbagai Proporsi [Online] Retrieved from: http://chullank.blogspot.co.id 11 Desember 2018
[6] Susetya 1980 Padang Pengembalaan Penataan Manager Ranch (Direktorat Bina Sarana Peternakan. Dirjen Peternakan, Departemen Pertanian)
[7] Marhaeniyanto E 2009 Integrasi Rumput dan Leguminosa [Online] Retrieved from: http://mrhaen03.blogspot.com 8 Desember 2018
[8] Sudomo R 1985 Produksi Tanaman Hijauan Makanan Ternak Tropik (Jakarta: PT.Gramedia)
[9] Syarief E S 1986 *Ilmu Tanah Pertanian* (Bandung: Pustaka Buana)
[10] Suriatna S 1997 *Pupuk dan Pemupukan* (Jakarta: PT. Mediatama Sarana Perkasa)
[11] Setyamidjaja D 1986 *Pupuk dan Pemupukan Tanah Pertanian* (Jakarta: PT. Simplex)
[12] Haryadi M 1988 *Pengantar Agronomi* (Jakarta: PT. Gramedia)
[13] Yuwono 2005 *Kompos* (Jakarta: Penebar Swadaya)
[14] Affandi 2008 *Pemanfaatan Urine Sapi yang Difermentasi Sebagai Nutrisi Tanaman*
[15] Rizal 2012 *Produksi Tanaman Hijaun Makanan Ternak Tropik* [Online] Retrieved from: http://www.hear.org 21 Desember 2018
[16] Warasfarm 2013 *Potensi Urine Sebagai Pupuk Organik Cair* [Online] Retrieved from: http://warasfarm 26 Desember 2018
[17] Afghanus 2011 *Pupuk Cair* [Online] Retrieved from: http://www.afghanus.com 20 Desember 2018
[18] Sudita I D N, Suariani Y T L, Kaca N and Yudiastari N M 2018 *MATEC Web of Conferences* 197 13002
[19] Situmeang Y P, Sudita I D N and Suarta M 2019 *International Journal on Advanced Science, Engineering and Information Technology* 9 6 2188-2095
[20] Sutardi T 1997 *Peluang dan Tantangan Pengembangan Ilmu-ilmu Nutrisi Ternak* (Bogor: Fakultas Peternakan Institut Pertanian Bogor)
[21] Putra S 2006 *Jurnal Protein* 13 2 113-123
[22] Hartatik W and Widowati L R 2006 *Pupuk Kandang, Pupuk Organik dan Pupuk Hayati*. (Balai Besar Litbang Sumberdaya Lahan Pertanian Badan Penelitian dan Pengembangan Pertanian) ISBN 978-979-9474-57-5
[23] Popopa M, Martin C, Eugene M, Mialon M M, Doreau M and Morgavi D P 2011 *Animal Feed Science and Technology* *Elsevier* 166 113-121