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The effect of shade level on the results of the association of *Setaria splendida* with *Clitoria ternatea*

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Abstract

Forage is the primary feed for ruminants, serving not only as a satiety but also as a source of nutrients to support animal growth. This study aimed to determine the effect of shade level on the results of the association of *Setaria splendida* with *Clitoria ternatea*. The experimental design used was a completely randomized design (CRD), consisting of four treatments and seven replications. The shade level treatments, N0 = 0% shade; N1 = 20% shade; N2 = 40% shade; and N3 = 60% shade. The observed variables were, yield variables (leaf dry weight, stem dry weight, total forage dry weight, and the ratio of leaf dry weight to stem dry weight). The results showed that increasing shade reduced the yield of stem dry weight, leaf dry weight, and total forage dry weight in the association of *Setaria splendida* with *Clitoria ternatea*. The highest yields of stem dry weight, leaf dry weight, and total forage dry weight were found in the 0% shade treatment (N0), respectively: 4.45 g; 8.17 g, and 12.62 g. The shade treatment did not affect the ratio of total leaf dry weight to total stem dry weight in the association of *Setaria splendida* with *Clitoria ternatea*. The results concluded that increasing shade level reduced the yield of the association of *Setaria splendida* with *Clitoria ternatea*, and 0% shade level provided the best results.

Keywords: Association; *Clitoria ternatea*; Yield; *Setaria splendida*; Shade level

1. Introduction

Forage is the primary food source for ruminants, serving not only as a satiating factor but also as a source of nutrition to support livestock growth. The availability of forage must be supported by efforts to provide forage continuously and meet livestock needs. Almost 90% of ruminant feed comes from forage, with fresh consumption of approximately 10-15%/day of body weight, and the remainder from concentrate feed and supplementary feed [11]. Several factors constrain the provision of forage in Indonesia, including competition for land between humans and livestock. Land conversion for residential areas, agricultural land, and plantations has limited land for forage development, and this condition can impact the availability of forage, thus decreasing livestock productivity [1].

An alternative for developing forage is to utilize land under the shade of trees or plantations and land on the edge of the forest. Research by [6], the use of shade levels of 20% and 40% was proven to affect the growth and yield of *Asystasia gangetica* in the second cutting. Land under shade is often considered less than optimal, due to limited environmental factors, such as: lack of light intensity, water, and nutrients in the soil that affect plant growth, so it is necessary to have a forage planting strategy with an association of grass with legumes.

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The association of grass and legumes can provide positive interactions between the two plant species in the physical, chemical, and biological environment [12]. This association can increase the population of microorganisms in the soil and, in certain areas, can help provide nutrients in the soil. Legume plants actively fix free nitrogen in the atmosphere through *Rhizobium* bacteria. A mixed cropping pattern between *Panicum maximum* cv Trichoglume grass and legumes can increase the production of total dry weight of forage [18]. One type of grass and legume that has high forage quality and production is *Setaria splendida* grass and *Clitoria ternatea* legume.

Setaria splendida grass has good properties, due to its high adaptability, compatibility, production and very high forage quality [8]. The nutrient content of Setaria grass as a source of energy, crude protein, and crude fiber is very useful for increasing the productivity of ruminant livestock. The nutritional value contained in Setaria grass is: crude protein 6-7%, crude fiber 42.0%, nitrogen-free extract 36.1%, and fat 2.8%. Fresh weight production of Setaria grass reaches 100-110 tons/ha/year. *Clitoria ternatea* is a high-quality legume and rich in protein [4]. The nutrient content of *Clitoria ternatea* includes: 14-20% crude protein, 21.5% crude protein in the leaves, 29.0% crude fiber, vitamins and minerals [5].

2. Material and Methods

2.1. Plant Seeds

Setaria splendida grass used was seedlings, approximately 10 cm tall, obtained from Tiga Village, Susut District, Bangli Regency, and *Clitoria ternatea* seedlings from Sading Village, Mengwi District, Badung Regency.

2.2. Land and Water

The planting medium used was Regosol soil, which was taken from land in Sading Village, Mengwi, Badung, while the water for watering the plants used well water available at the research site.

2.3. Polybag

Polybags with a height and width of 20 cm, and each polybag is filled with 4 kg of soil.

2.4. Shade

The artificial shade used is paranet with density levels of 20%, 40%, and 60%.

2.5. Equipment

The equipment used are as follows: 1) hoe, scoop, and trowel to take soil; 2) soil sieve made of 2 × 2 mm wire, to obtain uniform soil grains; 3) manual scales with a capacity of 15 kg with an accuracy of 10 g to weigh the soil; 4) digital scales with a capacity of 500 g with an accuracy of 0.1 g to weigh the dry weight of plant parts (leaves and stems); 5) buckets and dippers for watering plants; 6) scissors and knives for cutting parts of plants; 7) paper bags for storing plant samples before being oven-dried; 8) ovens for determining dry weight; and 9) stationery for recording research data.

2.6. Experimental Design

The experimental design used a completely randomized design (CRD), consisting of 4 treatments and 7 replications, resulting in 28 experimental units. The shade level treatments provided were: N0 = 0% shade, N1 = 20% shade, N2 = 40% shade, and N3 = 60% shade.

2.7. Planting and Maintenance of Plants

Seedlings are planted when the soil reaches field capacity. Each polybag is planted with one seedling of *Setaria splendida* and *Clitoria ternatea* grass. Plant maintenance includes watering once daily in the afternoon to keep the growing medium moist, and regular weeding, pest, and disease control.

2.8. Plant cutting

Cutting of 10 week old plants, by cutting the plants at ground level, then separating the plant parts (stems and leaves), then weighing and recording the fresh weight results.

2.9. Observed Variables

The observed variables were as follows

- Leaf dry weight (g), obtained by weighing plant leaves per pot that had been oven-dried at 70°C until a constant weight was reached.
- Stem dry weight (g), obtained by weighing plant stems per pot that had been oven-dried at 70°C until a constant weight was reached.
- Total forage dry weight (g), obtained by adding the leaf dry weight to the stem dry weight.
- The ratio of leaf dry weight to stem dry weight, obtained by dividing the leaf dry weight by the stem dry weight.

2.10. Data analysis

The research data was analyzed using analysis of variance. If there was a significant difference between the treatments ($P<0.05$), the calculation was continued using Duncan's multiple range test [13].

3. Results and discussion

The results of the study in Table 1 show that providing a significant level of shade ($P<0.05$) reduced the results of the association of *Setaria splendida* with *Clitoria ternatea* on the variables of dry leaf weight, dry stem weight, and total dry weight of forage, while the ratio of dry leaf weight to dry stem weight was not significantly different ($P>0.05$).

Table 1 Effect of shade level on the results of the association of *Setaria splendida* with *Clitoria ternatea*

Variable	Treatment [1)]				SEM[2)]
	N0	N1	N2	N3	
Dry leaf weight (g)	8.17[a3)]	3.86[b]	2.22[c]	1.36[c]	0.40
Dry stem weight (g)	4.45[a]	2.44[b]	1.24[c]	1.14[c]	0.34
Total dry weight of forage (g)	12.62[a]	6.30[b]	3.46[c]	2.50[c]	0.67
Ratio of dry leaf weight to dry stem weight	1.87[a]	1.84[a]	1.91[a]	1.38[a]	0.27

Description

- N0 = 0% shade, N1 = 20% shade, N2 = 40% shade, N3 = 60% shade
- SEM = *Standard Error of the Treatment Means*
- Values with different letters in the same row indicate a significant difference ($P<0.05$)

The results showed a significant decrease in dry weight of *Setaria splendida* and *Clitoria ternatea* leaves when the shade level was increased. The 0% shade treatment (N0) gave the highest yield, while the 20% shade treatment (N1), 40% shade (N2), and 60% shade (N3) were significantly ($P<0.05$) lower than the N0 treatment. The decrease in dry weight of leaves was caused by the influence of shade. The shade provided can reduce the intensity of light received by the plant, so that the photosynthesis process is disrupted and inhibits leaf growth. According to [17], a decrease in light can directly reduce the productivity of grass biomass, due to the photosynthesis process not taking place optimally. According to [2], stated that the use of shade can significantly reduce leaf productivity in tropical legumes. Furthermore, research by [15], showed that the greater the level of shade given to the plant, the lower the dry weight of vegetative parts, including leaves, due to decreased photosynthetic efficiency.

The results of stem dry weight in the association of *Setaria splendida* with *Clitoria ternatea* showed that the N0 treatment gave the best results. The N1, N2, and N3 treatments were significantly ($P<0.05$) lower than N0. The decrease in stem dry weight yield was closely related to the decrease in leaf dry weight. This is because there is a physiological relationship between the two vegetative organs in supporting overall plant growth. Leaves are the main organs in the process of photosynthesis, producing photosynthates that will be allocated to all parts of the plant including the stem. When light intensity is reduced due to shade, the photosynthesis process is disrupted, resulting in lower photosynthates production. In accordance with the opinion of [3], environmental conditions with limited sunlight can inhibit stem growth, due to minimal energy supply for cell division. According to [9], explained that plants grown in low light conditions will show a decrease in biomass accumulation, especially in the stem, in response to decreased

photosynthates production. Meanwhile, according to [16], reduced light can reduce the rate of carbon assimilation, which has an impact on reducing vegetative growth, including stems.

The total dry weight of *Setaria splendida* and *Clitoria ternatea* forages showed a significant decrease with increasing shade. The decrease in total dry weight of forage (forage biomass) is related to a decrease in plant components, namely leaves and stems. A shaded environment can inhibit the process of photosynthesis, because light is the main energy factor required for the synthesis of carbohydrates that function as fundamental materials for the growth of all plant organs [14]. According to [7], forage biomass yield is highly dependent on the intensity of light received, because light is a major factor in the process of photosynthesis. This statement is in line with [10], which states that forage yield will decrease significantly when light exposure is limited. This indicates that the total dry weight of forage yield is very sensitive to environmental elements and plant composition.

The shade level treatment showed a non-significant difference ($P>0.05$) in the ratio of leaf dry weight to stem dry weight of *Setaria splendida* and *Clitoria ternatea*. This indicates that although there was a decrease in dry weight in both leaves and stems due to increased shade, the quality of both forages remained balanced. According to [19], emphasized that the ratio can function as an indicator of plant assimilation efficiency when facing environmental stress, particularly related to light. When plants experience light stress (shade), the plant's response is not only to reduce one organ, but generally reduces total growth uniformly, so that the ratio remains maintained. According to [9], under changing environmental conditions, such as low light availability, plants tend to maintain a balanced biomass allocation between leaves and stems as an adaptive strategy. This allows plants to maintain photosynthesis and transport functions, even under limited growth conditions.

4. Conclusion

It can be concluded that the higher the level of shade treatment, the lower the association results of *Setaria splendida* with *Clitoria ternatea*, and the 0% shade level gives the best association results of *Setaria splendida* with *Clitoria ternatea*.

Compliance with ethical standards

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Disclosure of conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

References

[1] Afrizal., R. Sutrisna, and Muhtarudin. 2014. The Potential of Green Forage as Ruminant Feed in Bumi Agung District, East Lampung Regency. Department of Animal Husbandry, Faculty of Agriculture Lampung University.

[2] Angadi, S., M. R. Umesh., S. Begna., and P. H Gowda. 2021. Light interception, agronomic performance, and nutritive quality of annual forage legumes as affected by shade. Field Crops Research. 275: 108358.

[3] Chairudin, C., E. Efendi., and S. Sabaruddin. 2015. The impact of shade on changes in agronomic and morpho-physiological characteristics of leaves in soybean plants (Glycine max (L.) Merrill). Floratek Journal. 10(1): 26-35.

[4] Cook, B. G., B. C Pengelly, S. D. Brown, J. L. Donnelly, D. A. Eagles, M.A. Franco, J. Hanson, B. F. Mullen, I. J. Partridge, M. Peters, and R. Schultze-Kraft. 2005. Tropical Forages. Brisbane (Australia): CSIRO, DPI and F (Qld), CIAT and ILRI.

[5] Gomez, S. M., and A. Kalamani. 2003. Butterfly pea (Clitoria ternatea): A nutritive multipurpose forage legume for the trofics - an overview. Pakistan Juornal of Nutrition: 2 (6): 374-379

[6] Gunawan, K., N. M. Witariadi, and N. N. C. Kusumawati. 2023. The effect of different levels of shade on the growth and yield of Asystasia gangetica (L.) subsp. Micrantha plants in the second cutting. Journal of Tropical Animal Science. 11(3).

[7] Mertaningsih, N. P. L., N. N. Suryani., and M. A. P. Duarsa. 2019. Growth and production of Axonopus compressus, Stenotaphrum secundatum, and Paspalum conjugatum grasses at various biourine levels. Tropical Animal Husbandry Journal. 7(1): 864-880.

[8] McIlroy, R. J. 1976. Introduction to Tropical Grassland Cultivation. Translated by S. Susetyo, Soedarmadi, I. Kismono, and I.S. Harini. Pradnya Paramita. Jakarta.

[9] Poorter, H., K. J. Niklas., P. B. Reich., J. Oleksyn., P. Poot., and L. Mommer. 2012. Biomass allocation to leaves, stems and roots: meta-analyses of interspecific variation and environmental control. New Phytologist. 193(1): 30-50.

[10] Sawen, D., M. Junaidi., and Y. Hengky. 2021. Botanical composition and dry matter production of green forage under the shade of oil palm plantations owned by PT. Medco Papua Hijau Selaras Manokwari. Pastura Journal. 11 (1) : 57-62.

[11] Sirait, J., N. D. Purwantari, and K. Simanihuruk. 2005. Grass nitrogen production and uptake under different shade and fertilization conditions. Journal of Animal and Veterinary Science. 10 (3): 175-181

[12] Suarna, I W., N. N. K. Candraasih, and M. A. P. Duarsa. 2014. An association model of feed additive plants for post-mining land improvement in Karangasem Regency. Bumi Lestari Journal. 14(1): 9-14.

[13] Steel, R. G. D., and J. H. Torrie. 1993. Principles and Procedures of Statistics: A Biometrical Approach. Translated by B. Sumantri. Gramedia Pustaka Utama, Jakarta.

[14] Taiz, L., and E. Zeiger. 2010. Plant Physiology, 5th edn Sunderland. MA: Sinauer Associates.

[15] Umesh, M. R., S. Angadi., S. Begna., and P. H. Gowda. 2022. Shade tolerance response of legumes in terms of biomass accumulation, leaf photosynthesis, and chlorophyll pigment under reduced sunlight. Crop Science. 63(1).

[16] Widiastuti, L., T. Tohari, and E. Sulistyaningsih. 2004. The effect of light intensity and daminoside levels on the microclimate and growth of potted chrysanthemums. Agricultural Science. 11(2).

[17] Wijaya, A. K., M. Muhtarudin, L. Liman, C. Antika, and D. Febriana. 2019. Productivity of green fodder planted under the shade of oil palm trees with mixed crops. Integrated Animal Husbandry Scientific Journal. 6(3): 155-162.

[18] Witariadi, N. M., and N. N. C. Kusumawati. 2020. Productivity of several types of feed crops with different planting patterns and bioslurry dosage. Scientific Magazine of Animal Husbandry Journal. 23 (3): 101-106.

[19] Yusniawati, R., and H. Siregar. 2020. Leaf/stem ratio as an indicator of assimilation efficiency in plants under light stress. Journal of Plant Physiology. 8(3): 112–11