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The effect of shade level on the growth of *Setaria splendida* and *Clitoria ternatea* Grown in association

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Abstract

Forage is very important for ruminant livestock as a source of nutrients, such as: energy, crude fiber, protein, vitamins, fats, and minerals to support livestock productivity. Research to determine the effect of shade levels on the growth of *Setaria splendida* and *Clitoria ternatea* planted in association, using a completely randomized design (CRD) with 4 treatments of shade levels, namely: N0 = 0% shade, N1 = 20% shade, N2 = 40% shade, N3 = 60% shade, and each treatment was repeated 10 times. Observed variables include: height, length, number of leaves, number of tillers, number of branches, leaf color, leaf chlorophyll, and leaf area. The results showed that the higher the shade level treatment, the lower the growth of *Setaria splendida* and *Clitoria ternatea*. In *Setaria splendida*, the 0% shade level (N0) provided the highest growth in the number of leaves, number of tillers and leaf area, respectively: 18.86 blades 3.86 tillers; and 341.18 cm^2. In *Clitoria ternatea*, the highest yield was also obtained at 0% shade (N0) with a legume length of 151.36 cm, a number of leaves of 36.29 blades, a number of branches of 6.29 branches, and a leaf area of 447.33 cm^2. It can be concluded that increasing the shade level can reduce the growth of *Setaria splendida* and *Clitoria ternatea* planted in association, and the shade levels of 0% and 20% provide the best growth in *Setaria splendida* and *Clitoria ternatea* planted in association.

Keywords: Association; *Clitoria ternatea*; Growth; *Setaria splendida*; Shade Level

1. Introduction

Ruminant livestock are highly dependent on forage-based feed, as it provides nutrients such as energy, crude fiber, protein, vitamins, and minerals, which are essential for growth and metabolism. High-quality forage can boost livestock's immune systems, reduce the risk of disease, and increase productivity. Challenges in providing high-quality forage include limited land for forage cultivation and seasonal changes that can reduce forage production and quality. Efforts can be made to utilize shaded land with an association cropping system of grass and legumes to increase forage production and quality.

Shade is useful for reducing the intensity of light received by plants. Shade acts as a barrier to light intensity, which can be in the form of natural shade (trees) or artificial shade (paranet), which can significantly affect the process of photosynthesis and plant growth. The results of research by [5], reported that higher levels of shade can reduce the number of leaves, leaf area, number of branches, and extend the harvest time, but increase plant height and the number of plant stem segments. The results of research by [13], found that a shade level of 20% in *Asystasia gangetica* plants provided the best growth and yield.

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The association of *Setaria splendida* and *Clitoria ternatea* can provide benefits in improving the quality and quantity of forage, because *Clitoria ternatea* is able to improve soil fertility through its Nitrogen fixation ability, to help the growth of *Setaria splendida* grass. *Setaria splendida* grass is resistant to less fertile environmental conditions and poor drainage, has high nutritional value, is preferred by livestock, contains 5.48% crude protein, 2.18% crude fat, and 26.72% crude fiber, and dry matter production reaches 0.4221 kg/3 m^2/defoliation [9]. *Clitoria ternatea* as a potential feed for ruminant livestock, with high nutrient content, namely: 26.95% crude protein, 4.22 mg/g phosphorus, 10.07 g/kg potassium, and 3.63 g/kg calcium [4].

The symbiotic relationship between grass and legumes in an association cropping system can improve soil structure and increase the availability of plant nutrients. This association not only increases crop productivity but also provides economic benefits by reducing the need for synthetic nitrogen fertilizers [6]. The association between Panicum maximum cv Trichoglume grass and legumes can increase the dry weight production of forage [12]. Association planting between elephant grass with *Arachis pintoi* and *Alysicarpus vaginalis* can increase leaf area and tend to increase elephant grass growth and production [7]. Research by [11], shows that the association of grass with legumes in tropical grasslands can increase biomass production by up to 74% and double Nitrogen uptake compared to grasslands planted with only grass.

2. Material and Methods

2.1. Place and time of research

The research was conducted at Raya Sading Street, No. 93, Mengwi District, Badung Regency, for 3 months from November 2024 - January 2025.

2.2. Plant seeds

The *Setaria splendida* grass seeds are seedlings and use *Clitoria ternatea* seeds. These seeds were obtained from Sading Village, Mengwi District, Badung Regency.

2.3. Shade

Artificial shade in the form of paranet. Paranet with a shade level of 0% (without a paranet layer), shade level of 20% (1 layer of paranet), shade level of 40% (2 layers of paranet), and shade level of 60% (3 layers of paranet).

2.4. Research materials and tools

The research materials and tools used include: paranet, polybags, wire sieve (2 x 2 mm), hoe and shovel, bucket and ladle, manual scales with a capacity of 10 kg with a sensitivity of 50 g, electric scales with a capacity of 500 g with a sensitivity of 0.1 g, chlorophyll meter, leaf color chart, measuring tape, and ruler.

2.5. Experimental design

This experiment used a completely randomized design (CRD), consisting of 4 treatments and 10 replications, resulting in 40 experimental units. The shade levels given were as follows: N0 = 0% shade; N1 = 20% shade; N2 = 40% shade; and N3 = 60% shade.

2.6. Observed variables

Observations of growth variables were carried out every week and the leaf area variables of the plants were observed at the end of the experiment.

2.6.1. Plant height and length (cm)

The height of *Setaria splendida* was measured using a measuring tape, starting from the base of the stem to the collar of the highest fully developed leaf.

The length of *Clitoria ternatea* was measured using a measuring tape, starting from the base of the stem to the base of the highest fully developed leaf.

2.6.2. Number of leaves (blades)

The number of leaves is counted on fully developed leaves.

2.6.3. Number of branches and number of grass tiller

Observations on the number of branches of *Clitoria ternatea* were conducted by counting all branches with fully developed leaves.

Observations on the number of grass tiller of *Setaria splendida* were conducted by counting those with fully developed leaves.

2.6.4. Leaf Color

Leaf color is observed using a leaf color chart to determine the standard leaf color of a plant. The color score ranges from 1 to 7, with higher values indicating a more intense leaf color.

2.6.5. Leaf Chlorophyll

Leaf chlorophyll is observed by clamping the leaf with a chlorophyll meter. The resulting reading indicates the chlorophyll content in the leaf.

2.6.6. Leaf area per pot (cm^2)

Leaf area per pot (LAP) was measured by randomly selecting four fully developed leaf samples, which were recorded as the leaf area sample (LAS), then weighed and recorded as the leaf weight sample (LWS), and then all leaves were weighed and recorded as leaf weight total (LWT). Leaf area per pot can be calculated using the formula:

LAP = LAS/LWS x LWT

Description

- LAP = leaf area per pot
- LAS = leaf area sample
- LWS = leaf weight sample
- LWT = leaf weight total

2.7. Data analysis

The data obtained were analyzed using analysis of variance and if the treatment showed a significant difference ($P<0.05$), then the calculation was continued with Duncan's multiple range test [10].

3. Results and discussion

The results of the study (Table 1) showed that the shade level treatment significantly ($P<0.05$) reduced the number of leaves, the number of tillers, and the leaf area, but significantly ($P<0.05$) increased the leaf color of *Setaria splendida*. In the legume *Clitoria ternatea*, the effect of shade level significantly ($P<0.05$) reduced plant height, the number of leaves, the number of branches, and the leaf area, but significantly ($P<0.05$) increased the leaf color. The shade level treatment on the variables of height *Setaria splendida* and leaf chlorophyll (*Setaria splendida* and *Clitoria ternatea*) showed no significant difference ($P>0.05$).

Table 1 Effect of shade level on the growth of *Setaria splendida* and *Clitoria ternatea* planted in association

Variable	Treatment[1)]				SEM[2)]
	N0	N1	N2	N3	
Setaria splendida					
Height (cm)	31.36[a]	30.93[a]	24.93[a]	23.79[a]	2.62
Number of leaves (blades)	18.86[a3)]	12.71[b]	11.14[b]	9.29[b]	1.43
Number of tiller (tiller)	3.86[a]	2.29[ab]	1.57[ab]	2.14[b]	0.46
Leaf color	5.29[b]	6.86[a]	6.86[a]	7.00[a]	0.14
Leaf chlorophyll	7.90[a]	11.38[a]	11.08[a]	11.21[a]	1.29
Leaf area (cm^2)	341.18[a]	224.37[b]	156.00[b]	162.08[b]	29.30
Clitoria ternatea					
Length (cm)	151.36[a]	120.57[ab]	69.29[b]	77.86[b]	13.39
Number of leaves (blades)	36.29[a]	27.00[b]	13.57[c]	15.29[c]	1.67
Number of branches (branches)	6.29[a]	3.57[b]	1.86[bc]	1.43[c]	0.46
Leaf color	5.14[b]	6.57[a]	6.71[a]	6.57[a]	0.18
Leaf chlorophyll	10.64[a]	11.23[a]	10.64[a]	9.53[a]	0.85
Leaf area (cm^2)	447.33[a]	281.52[b]	145.22[c]	140.68[c]	32.24

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 (Table 1) show that shade treatment can affect the growth of *Setaria splendida* and *Clitoria ternatea* planted in association. Shade level of 0% (N0) the highest yields in terms of leaf number and number of tiller *Setaria splendida*. The highest tiller number (N0) was 3.86 tillers, and the N3 treatment (2.14 tillers). This is because plants in N0 receive full sunlight to support photosynthesis, thereby accelerating cell division and vegetative growth. Adequate light intensity optimizes carbohydrate production through photosynthesis and encourages vegetative plant growth [13]. The number of tillers is strongly influenced by lateral meristem activity and the distribution of hormones such as auxin and cytokinin, the balance of which can be disrupted by low light intensity [8].

Light intensity plays a crucial role in plant growth, as light is the primary energy source in photosynthesis, which produces carbohydrates as the basic building blocks for growth. Optimal light intensity allows plants to maximally absorb energy and convert it into chemical energy in the form of glucose. Light also affects plant hormone synthesis, cell division and elongation, and stomata regulation. When light intensity is too low due to shade, photosynthesis is inhibited, resulting in decreased biomass production and the growth of vegetative organs, such as leaves and stems. It can be said that *Setaria splendida* requires high light levels for growth and will experience a significant decline in growth under conditions of heavy shade. Lack of light inhibits photosynthesis and limits the plant's ability to form vegetative organs [2].

The leaf area of *Setaria splendida* significantly decreased at higher shade levels. The N0 treatment produced a leaf area of 341.18 cm^2, and decreased in the N1 treatments (224.37 cm^2), 156.00 cm^2 (N2), and 162.08 cm^2 (N3). This decrease indicates that the photosynthetic surface area is reduced due to limited available light energy. According to [8], leaf formation is directly influenced by the intensity of light received, as it is related to the energy requirements for cell division and differentiation.

The highest number of leaves and length of *Clitoria ternatea* were also found in 0% shade (N0), respectively 36.29 and 151.36 cm. This condition indicates that *Clitoria ternatea* utilizes maximum light intensity to support leaf and stem development. These results are in line with the findings of [1], who stated that in full light conditions, vegetative growth of *Clitoria ternatea* increased significantly, as photosynthesis occurred more efficiently. However, in 20% shade, although the number of leaves decreased, the leaf color became more intense with a color score reaching 6.57. This figure indicates an increase in leaf pigment concentration to adapt to less bright environments. At low light intensity, plants respond by increasing chlorophyll content as a form of adaptation to limited light.

The highest number of *Clitoria ternatea* branches was also found in the N0 treatment, at 6.29 branches. This number decreased drastically in the N2 and N3 treatments, respectively 0.41 and 0.30 branches, this decrease of more than 70% indicates that lateral growth is significantly influenced by light abundance. Under shaded conditions, plants tend to prioritize vertical growth (etiolation) in search of light, thus reducing lateral meristem activity. Leaf color in *Setaria splendida* and *Clitoria ternatea* showed a tendency to increase in treatments with higher shade levels. The highest leaf color was found in the N3 treatment, with a color score of 7.00 for *Setaria splendida* and 6.71 for *Clitoria ternatea*. This indicates that leaf pigmentation becomes more intense as an adaptive response to low light, increasing chlorophyll accumulation to capture more light energy [1].

4. Conclusion

Increasing the shade level decreased the growth of *Setaria splendida* and *Clitoria ternatea* planted in association, and the shade levels of 0% and 20% gave the best growth of *Setaria splendida* and *Clitoria ternatea* planted in association.

Suggestion

It can be suggested to farmers to produce the growth of *Setaria splendida* and *Clitoria ternatea* planted in association, can be planted on land without shade with 100% sunlight to support the availability of green fodder.

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] Asnur, P., Kalsum, U., Kanny, P. I., and S. Yuliani. 2024. The influence of shade on the growth and production of Butterfly pea plants (Clitoria ternatea). International Journal on Food, Agriculture and Natural Resources. 5(2): 124-128.

[2] Haryanti, S. 2010. Number and distribution of stomata in leaves of several species of dicotyledonous and monocotyledonous plants. Anatomy and Physiology. XVIII (2): 21-28

[3] Hermanto, Dwiana, S., and Holidi. 2022. The effect of shade and animal manure fertilizer on the growth and production of caisim mustard plants (Brassica juncea L.). Kelingi Journal of Agricultural Sciences. 2(2): 205-214.

[4] Lakshan, S. A. T., Pathirana, C. K., Jayanath, N. Y., Abeysekara, W. P. K. M., and W. K. S. M. Abeysekara. 2020. Antioxidant and selected chemical properties of the flowers of three different varieties of Butterfly pea (Clitoria ternatea L.). Ceylon Journal of Science. 49(2): 195-201.

[5] Mawardy, W. D., and A. S. Karyawati. 2021. The effect of shade and urea fertilizer on the growth and yield of iler plants (Plentranthus scutellarioides (L.) R. Br.). Plantropica: Journal of Agricultural Science. 6(1): 58-67.

[6] Rinduwati, R., and A. Mujnisa. 2020. The Potential of the Legume Types in the Quality and Economic Value of Nitrogen of Setaria anceps Stapf. IOP Conference Series: Earth and Environmental Science. 492(1).

[7] Roni, N. G. K., Lindawati, S. A., and P. J. N. Dewi, 2023. Productivity of elephant grass (Pennisetum purpureum) planted with legumes at various dosage of bioorganic fertilizer. Scientific Magazine of Animal Husbandry. 26(3): 187-191.

[8] Salisbury, F. B., and C. W. Ross. 1995. Plant Physiology. Volume 1. ITB Publisher. Bandung.

[9] Singh, S., Singh, T., Koli, P., Anele, U. Y., Bhadoria, B. K., Choudhary, M., and Y. Ren. 2023. Nutrient and rumen fermentation studies of indian pasture legumes for sustainable animal feed utilisation in semiarid areas. Animals. 13(23).

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

[11] Villegas, D. M., Velasquez, J., Arango, J., Obregon, K., Rao, I. M., Rosas, G., and A. Oberson. 2020. Urochloa grasses swap nitrogen source when grown in association with legumes in tropical pastures. Diversity. 12(11): 1-16.

[12] 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.

[13] Witariadi, N. M., N. N. C. Kusumawati, and N. M. S. Sukmawati. 2023. The effect of different shade levels on the growth yield of Asystasia gangetica (L.) subsp. Micrantha. International Journal of Fauna and Biological Studies. 10(1): 19-22.