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EFFECTS OF LIGHT INTENSITY AND SEEDLING MEDIA ON THE GROWTH OF *Reutealis trisperma* (Blanco) Airy Shaw SEEDLING

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ABSRACT

This experiment was conducted at Pakuwon Experimental Station with altitude about 450 m above sea level and Latosol type of soil beginning from January until June 2009. It aimed to investigate the effect of light intensity and seedling media on growth of "Sunan" candle nut (*R. trisperma*) seedling. Split plot design with 4 replications was used in this study. The main plots factor are percentage of light intensity (I) consisted of two levels : I_1 (65%) and I_2 (100%), and the split plots factor are seedling media (M) consisted of five kinds of media: M_1 (50% soil and 50% sheep dung), M_2 (50% soil and 50% rice husk), M_3 (50% sheep dung and 50% rice husk), M_4 (33.3% soil, 33.3% sheep dung, and 33.3% rice husk), and M_5 (100% soil). Result showed that: (1) for better growth of *R. trisperma* seedling suggested to be shaded, and (2) mixed of the 50% soil and 50% sheep dung are the best media for it growth.

Keywords: *Reutealis trisperma* (Blanco) Airy Shaw, light intensity, seedling media, organic matter

INTRODUCTION

Development of a dynamic world energy consumption within the limitation of fossil energy reserve as well as the awareness on the environmental conservation evoke the increase of interest on a renewable energy, especially a renewable energy resources from a agricultural sector such as food crops, horticulture, estate commodities and animal husbandry (Prastowo, 2007).

Reutealis trisperma (Blanco) Airy Shaw, is one biofuel-producing plants from estate commodities which has a good prospect to develop in Indonesia. Until now, the study and research publication of these plant are still relatively limited. As well as the research publication about the optimal needs of light intensity and various of seedling media on the growth of *R. trisperma* seedling.

Light plays a critical role in plant growth and development; both quantity and quality, as well as direction of light, are perceived by photosensory systems which, collectively, regulate plant development, presumably to maintain photosynthetic efficiency (Hanganter, 1997). Growth of autotropic plants is directly and dramatically influenced by light intensity (i.e. quantum flux density) which is the driving force of photosynthetic and provides nearly all of the carbon and chemical energy needed for plant growth (Bjorkman, 1981).

Each species of the plant has a different level of tolerance to light intensity. There are plants that grow well in the fully light intensity, on the contrary there are some plants that grow well in shaded places. Similarly, the plant needs different light intensities for each stage of development. At the seedling stage requires a low light intensity relatively, but at the old ages requires more higher light intensity (Faridah, 1995; Suhardi, 1995).

Besides the light intensity, the application of various materials for seedling media (i.e. soil and several kinds of organic matters) are also plays an important role for better growth of seedling. The organic matters is a material that commonly used as a mixture to the soil in making the seedling media. The function of organic matters is to improve the soil physical, i.e. soil structure and aeration, in order to facilitate the penetration of plant roots. And also plays a role in improving the soil chemical properties.

Organic matters have important functions in the soil : (1) physical functions, which can improve soil physical properties such as improving soil aggregation and permeability; (2) chemical functions, which can increase the capacity of cations exchange, improve the buffer capacity of soil, increase the availability of some nutrients, and improve the efficiency of P absorption; and (3) biological functions, as the source of main energy for soil microorganism activities (Suhartatik and Sismiyati, 2000). Organic matters such as crop waste, green manure and cattle manure in a soil-plant systems can improve the soil structure and assist in the development of soil microorganism (Matsushita *et al.,* 2000; Belay *et al.,* 2001), increase the content of P available directly or indirectly (Sukristiyonubowo *et al.* 1993), and increase the saprophyitic and inhibit the parasitic organisms in the plants (Stevenson, 1982). The objective of this study is to analyze the effect of light intensity and seedling media on the growth of *R. trisperma* seedling.

MATERIALS AND METHODS

This experiment was conducted at Pakuwon Experimental Station with altitude of 450 m above sea level, with the Latosol type of soil and C type of climate beginning from January to May 2009. The split plot design with four replications was used in this study. The main plot factor are the light intensity treatments (I) consisted of two levels :

1. I_1 (65% light intensity)
2. I_2 (100% light intensity),

and the split factor are the seedling media treatments (M) consisted of five levels :

1. M_1 (mixture of soil and sheep dung with a ratio 50: 50%),
2. M_2 (mixture of soil and rice husk with a ratio 50: 50%),
3. M_3 (mixture of sheep dung and rice husk with a ratio 50: 50%),
4. M_4 (mixture of soil, sheep dung, and rice husk with a ratio 33.3 : 33.3 : 33.3%),
5. M_5 (soil 100%, as control).

The seed of *R. trisperma* come from the composite population of two districts and five villages in Majalengka, West Java. The seed were germinated in the nursery with media that consisted of soil, sand and sawdust materials. After three months of germination, the seedling were transferred in to polybag of 20 x 25 cm size with seedling media in accordance to the treatment used. An application of 65% light intensity treatment using a black paranets that made from nylon materials and had available in public market, while the 100% light intensity were applicated without paranet (not shade).

The effect of treatment were observed at one and two Months After Treatment (MAT). Variables measured were: plant height, leaf number, leaf length, leaf width, diameter of lower stem, diameter of upper stem, fresh weight and the dry weight of roots, stems, leaves, and total, and Relative Growth Rate (RGR). Data were analyzed by ANOVA *(Analysis of Variance)* and followed by average difference test of LSD *(Least Significant Difference)* at 5% level.

RESULTS AND DISCUSSION

Based on analysis of variance that the interaction effect of main plot and split plot factors did not differ significantly in all variables measured. Therefore, further discussion will be more focused on each factor.

Light Intensity

The effect of light intensity on vegetative growth of *R. trisperma* seedling at 1 and 2 MAT showed significanty different (Table 1). At 1 MAT, *R. trisperma* seedlings that received 65% of light intensity gave the higher number of leaves, leaf length and leaf wide than the 100% light intensity (not shaded), but to the contrary occurred in height of plant. The diameter of lower and upper stem showed no significantly difference among the treatment. These results (number of leaves, leaf length and width leaves) are also consistent to the 2 MAT. Even on the diameter of upper stem was significantly different, whereas the height of plant showed no significantly different (Table 2).

The same result occurred in the Meranti (*Shorea spp.*) planted under shading condition at nursery level wich showed the larger of leaves size than without shading (Marjenah, 2001). Turmeric grown under lower RLI (Relative Light Intensity) had increased vegetative parameters, and a higher shoot biomass (Hossain *et al*., 2005[b]). Other research result showed that the reduction in light intensity until 60% (in screenhouse*)* has positive effect on the early growth of Kapur plant (*Hopea gregaria*) (Suhardi, 19955). Also reported that rice can grow well with partial shading, but heavy shading reduce yield (Kobata *et al.,* 2000). Percentage of brix*,* pH level and phenolic content of grape vary with the light intensity (Joscelyne *et al.,* 2007).

The leaves of plant in the fully light intensity and shaded conditions, or in the tolerant and intolerant plant species, has the high variability in the morphological characters. At the same species and ages, the leaves of plant under shading conditions are generally more smaller, thicker, and rougher texture, fewer number of stomata, thicker cuticule layer and cell wall, and smaller space between cells (Daniel *et al.,* 1992; Sutarmi, 1983). Generally, adaptive responses of plant to low irradiance are increase of leaf area ratio, chlorophyll content, leaf to stem mass and stem length. On the other hand, adaptive responses also include decreased of leaf thickness, chlorophyll *a* to *b* ratio and root growth relative to shoot growth (Corre, 1983; Fujita *et al.,* 1993; Singh, 1994).

Other research results showed that the growth of *R. trisperma* seedlings planted under 100% light intensity had better than 50% light intensity. The differences results may be due to the light intensity that used by Saefudin *et al.* (2009) is relatively too low (50%). If light intensity is too low can decrease plant photosynthesis rates and RGR.

Fresh and dry weight of roots, leaves, stems, and total of *R. trisperma* seedling planted under 65% light intensity was significantly higher if compared to the full light intensity (100%) (Table 3). The better growth of leaves and stems of *R. trisperma* planted under 65% compared to the 100% light intensity (in Table 1 and 2) will positive effect to the plant photosynthesis rates. The photosynthates were produced by photosynthesis process stored in plant tissues and partly used as chemical energy to support plant growth and development. One indicators of the total photosynthates deposit were reflected in the form of dry matter accumulation. This indicator are identic to the value of RGR in Table 3.

The shoot biomass increased with increasing plant height, leaf number and tiller number of turmeric (Hossain *et al*., 2005[a]; 2005[b]; Hossain and Ishimine, 2005). The light plays a decisive role in morphogenesis and resource allocation pattern in plants. It is well-establhised that shaded plants allocate much of their photosynthates into the shoot structures to allow interception of more light (Begna *et al*., 2002).

Table 1. Vegetative growth of *R. trisperma* seedling at 1 month ages after treatment (MAT)

Treatments	Plant Height (cm)	No. of leaves	Length of Leaves (cm)	Widht of leaves (cm)	Diameter of upper stem (cm)	Diameter of lower stem (cm)
Light intensity :						
I_1. 65% Light intensity	21.72 b	5.91 a	10.65 a	9.71 a	0.34 a	0.64 a
I_2. 100% Light intensity	23.58 a	5.40 b	9.76 b	8.94 b	0.31 a	0.60 a
Seedling media :						
M_1. Soil + Sheep dung (50:50%)	22.98 a	5.73 ab	10.50 ab	9.73 ab	0.35 a	0.65 a
M_2. Soil + rice husk (50:50%)	22.48 a	5.65 ab	9.83 c	8.90 b	0.31 a	0.63 a
M_3. Sheep dung + rice husk (50:50%)	22.93 a	5.18 b	9.99 bc	9.11 ab	0.31 a	0.62 a
M_4. Soil + sheep dung+rice husk (33.3:33.3:33.3%)	23.20 a	5.83 ab	10.80 a	9.98 a	0.34 a	0.61 a
M_5. Soil (100%)	21.68 a	5.91 a	9.92 bc	8.91 ab	033 a	0.60 a
CV (%)	13.95	2.95	1.97	5.69	0.41	0.54

Remarks= Number are followed by same letters in each coloumn are not significantly different at 5% level

Table 2. Vegetative growth of *R. trisperma* seedling at 2 month ages after treatment (MAT)

Treatments	Plant Height (cm)	No. of leaves	Length of leaves (cm)	Widht of leaves (cm)	Diameter of upper stem (cm)	Diameter of lower stem (cm)
Light intensity :						
I_1. 65% Light intensity	23.05 a	8.17 a	12.79 a	13.53 a	0.49 a	0.74 a
I_2. 100% Light intensity	24.62 a	7.50 b	11.10 b	11.19 b	0.39 b	0.70 a
Seedling media :						
M_1. Soil + Sheep dung (50:50%)	25.49 a	8.13 ab	13.17 a	14.05 a	0.46 a	0.75 a
M_2. Soil + rice husk (50:50%)	23.48 a	7.63 ab	10.81 b	11.25bc	0.41 a	0.69 b
M_3. Sheep dung + rice husk (50:50%)	24.08 a	7.50 ab	12.39 a	12.35 b	0.46 a	0.73ab
M_4. Soil + sheep dung+rice husk (33.3:33.3:33.3%)	23.49 a	8.49 a	12.97 a	14.00 a	0.46 a	0.75 a
M_5. Soil (100%)	22.63 a	7.41 b	10.40 b	10.13 c	0.41 a	0.69 b
CV (%)	22.13	4.80	6.92	9.22	0.61	0.20

Remarks= Number are followed by same letters in each coloumn are not significantly different at 5% level

Based on the result and discussion above had known that the plant growth of *R. trisperma* seedling does not needs a full light intensity. On the other hand, for better growth of *R. trisperma* seedling is require the shading condition. The process of plant photosynthesis seem to be quite more efficient under 65% light intensity and produce the optimally photosynthates if compared to 100% light intensity. Whereas, if the light intensity below of 65% will decrease plant photosynthesis rates, and while on 100% light intensity the plant photosynthesis rates may have exceed to the light saturation point. Simarangkir (2000) reported that the rates of plant photosynthesis will be proportional to the light intensity and respiration. However, at the light saturation point, plants cannot increase the photosynthates although the light sufficiently available.

The high growth of leaves, stems, fresh weight and dry weight of *R. trisperma* seedlings under 65% light intensity does not means that the crop varieties has tolerance to the shading condition. This phenomenon is due to the need of light intensity at seedling stage is still remainly low. Generally, the plant needs different light intensity for each stage of development. At the seedling stage requires a low light intensity, but at the old ages requires more higher light intensity (Faridah, 1995; Suhardi, 1995).

In the seedling stage the application of shading has several important benefits. For areas with high solar radiation intensity, shading plant can reduce the evapotranspiration rates; where as the high of evapotranspiration rates would lead to the occurrence of drought stress in the plants. Drought stress in the plants caused by insufficient supply of water in the root zone; the high amount of water need by the leaves due to the high of evapotranspiration rates can not be balanced by the amount of water absorption by the roots (Bray, 1997). Drought stress had occured if the amount of water absorption by the roots cannot exceed the amount of water loss caused by transpiration, although the soil water is sufficiently available (Islami and Utomo, 1995). In the areas with the high rainfall intensity, shading plant can reduce the high sparking of rain waters that will negative effect on the canophy development and the structure and stability of seedling media. Furthermore, the damage of structure and stability of seedling media will negative effect on the root growth and development.

Table 3. Fresh and dry weight of root, stem, leaves, and total and value of RGR of *R. trisperma* seedling at 2 MAT

Treatments	Fresh weight/tree (g)				Dry weight/tree (g)				Relative Growth Rate (RGR) (g/8 weeks)
	Root	**Stem**	**Leaves**	**Total**	**Root**	**Stem**	**Leaves**	**Total**	
Light intensity :									
I_1. 65% Light intensity	6.54 a	16.25 a	14.36 a	37.15 a	1.21 a	3.14 a	3.83 a	8.18 a	1.02 a
I_2. 100% Light intensity	4.02 b	13.80 b	8.44 b	26.27 b	0.90 b	2.99 b	2.74 b	6.64 b	0.83 b
Seedling media :									
M_1. Soil + Sheep dung (50:50%)	5.64 a	19.35 a	15.99 a	40.97 a	1.18 a	3.82 a	4.32 a	9.32 a	1.17 a
M_2. Soil + rice husk (50:50%)	4.97 a	13.29 b	9.17 c	27.43 b	1.01 a	2.91 b	2.83 bc	6.74 b	0.84 b
M_3. Sheep dung + rice husk (50:50%)	5.98 a	14.51 b	10.08 bc	30.57 ab	1.12 a	2.76 b	2.90 bc	6.78 b	0.85 b
M_4. Soil + sheep dung+rice husk (33.3:33.3:33.3%)	4.96 a	15.61 b	13.78 ab	32.22 ab	1.02 a	2.95 b	3.80 ab	7.77 ab	0.97 ab
M_5. Soil (100%)	4.85 a	12.36 b	7.99 c	25.21 b	0.94 a	2.19 b	2.58 c	6.44 b	0.81 b
CV (%)	28.54	29.56	52.37	54.32	10.48	20.85	30.40	31.09	12.13

Remarks= number are followed by same letters in each coloumn are not significantly different at 5% level

Seedling media

Seedling media that consisted of soil and sheep dung (M_1), and soil, sheep dung and rice husk (M_4) gave more better effect on vegetative growth and fresh and dry weight of plant if compared to the 100% soil (M_5) (Table 1 and 2). M_1 had better than M_4 particularly on the fresh and dry weight of stem (Table 3). This result is mainly due to improvement in the chemical and physical properties of the soil caused by the application of organic fertilizer (sheep dung and rice husk). Improvements in soil physical properties will facilitate the process of root penetration, while the improvement in soil chemical properties means there is increasing availability of nutrients needed for plant growth and development.

Positive effect of organic fertilizer on growth and yield of various plants species have been reported by Stevenson (1982); Sukristiyo-nubowo *et al.* (1993); Suhartatik and Sismiyati (2000); Matsushita *et al.* (2000); Belay *et al*. (2000); Padmini *et al*. (2009). Specially, the effect of organic fertilizer (sheep dung) on soil improvement and production of various plants species have also been reported by Hobir *et al.* (1998); Adimihardja *et al.* (2000); Hadipoentyanti and Shahid (2007); Mayadewi (2007); and Djazuli and Pitono (2008). In soil physic also reported that combination of chicken manure doses with polyacrilamide were effective on soil mechanical resistance and oxygen diffusion coefficient (Haridjaya, 2009).

The application of rice husk as an additional component on soil + sheep dung ($M_{4)}$ not yet positive effect particularly on the fresh and dry weight of stem (Table 3), because the rice husk require a long time in their minerali-zation and decomposition process if compared to the sheep dung. Dhalimi (2003) reported that using the ash of rice husk more better than rice husk on the growth of vanilla seedling. This is caused by slowly process of decomposition and mineralization of rice husks. The decomposition process of 15% rice husk in the limed soil needs time of eight weeks.

CONCLUSIONS

For better growth of *R. trisperma* seedling suggested to be shaded, and mixed of the 50% soil and 50% sheep dung are the best media for it growth.

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