RESPONSE OF ROOTING OF *Mucuna bracteata* SEEDLING FROM CUTTING AGAINST SUNLIGHT RADIATION INTENSITY

Amar Ma'ruf[1], Retni Mardu Hartati[2], Neny Andayani[2]
[1]*Department of Agrotechnology, University of Asahan*
[2]*Department of Agriculture, Stiper Agricultural Institute of Yogyakarta*

Abstract. The aims of this research was to determine the response of *Mucuna bracteata* seedling roots from cuttings to sunlight intensity, including root nodule formation as a morphological parameter of rhizobium activity. The research location has an average rainfall of 1721 mm per year. The temperature at the research location is 24º C to 32º C with air humidity 80% to 85%. This research uses an experimental method with a Split Plot Experiment design with 2 factors. The first factor: intensity of sunlight as the main plot consists of 3 levels, namely: P0 = 100% radiation intensity; P1 = radiation intensity 75%; P3 = 50% radiation intensity. The second factor: section of cutting material as a subplot consisting of 3 levels, namely: T1 = 4th section down from top; T2 = 7th section down from top; T3 = 10th section down from the top. Observation variables included: root length (cm), fresh weight of root (g), dry weight of root (g), and number of effective root nodules. The treatment of radiation intensity has a significant effect on the number of effective root nodules. Intensity of sunlight 50% (5.61) and 75% (4.81) is significantly the highest effect on the number of effective root nodules. While for the parameters of root length, fresh weight and dry weight of root, the treatment of sunlight intensity did not have a significant effect between treatments. The cutting material treatment has a significant effect on the root length parameter and the number of effective root nodules. On root length, section 7th cutting material gave the highest results with an average root length of 18.44 cm. On number of effective root nodule parameter, section 7th cutting material also gave the highest number of root nodules with an average of 5.67. There is no interaction between the intensity of sunlight and cutting material on the four parameters observed.

Keywords: rooting, *Mucuna bracteata,* seedling, cutting, radiation

INTRODUCTION

The use of Legume Cover Crop (LCC) is one of the right ways to improve or maintain soil fertility by suppressing existing weeds, reducing erosion rates, and increasing the availability of carbon and nitrogen in the soil (Choudary, 1993; Barthes, 2004).

Mucuna bracteata is a type of LCC that is known as a plant that is very tolerant and can grow well on various types of soil. *M. bracteata* which is planted can loosen the soil, so that the next main crop is not required to cultivate the soil first. Nitrogen in 66% of legumes comes from symbiotic N^2 gas with rhizobium bacteria. Nitrogen fixation carried out by legumes often faces obstacles. Nitrogen fixation is influenced by environmental factors such as soil pH, minimum nutrient content, extreme temperatures, excess or lack of water content in the soil (Vissoh, 1998). Several factors in seedling cuttings, such as root formation factors, carbohydrate storage, nitrogen, phosphorus, potassium, magnesium and calcium greatly influence root formation. According to Sinnot and Wilson (1955), root formation is more influenced by the balance of carbohydrate content with growth regulator in cuttings (Fitter and Hay, 1981). Because of the fundamental role of photosynthesis in plant metabolism, light is one of the most important environmental factors. Visible light is a small part (about 400-700 nm) of the spectrum of full solar radiation and plants are also sensitive to other wavelengths.

Hartman and Kester (1975) explains that sunlight is very necessary, but sunlight that can raise temperatures is avoided, because it can inhibit shoot formation and evaporation. Therefore sun radiation and leaves in cuttings are very important because they produce carbohydrates as an energy source to guarantee root formation (Hartmann and Kester, 1975).

The aims of this research was to determine the response of *Mucuna bracteata* seedling roots from cuttings to sunlight intensity, including root nodule formation as a morphological parameter of rhizobium activity.

RESEARCH METHODS

The research was conducted at Alur Dumai Estate Nursery, Lahan Tani Sakti Company - Minamas Plantation, located in Pondok Kresek Village, Pujud District, Rokan Hilir Regency, Riau Province. The research location has an average rainfall of 1721 mm per year. The temperature at the research location is 24º C to 32º C with air humidity 80% to 85%. The research was conducted on May to July 2013. This research uses an experimental method with a Split Plot Experiment design with 2 factors. The first factor: intensity of sunlight as the main plot consists of 3 levels, namely: P0 = 100% radiation intensity; P1 = radiation intensity 75%; P3 = 50% radiation intensity. The second factor: section of cutting material as a subplot consisting of 3 levels, namely: T1 = 4th section down from top; T2 = 7th section down from top; T3 = 10th section down from the top. The data of the observations were analyzed by Analysis of Variance, to find out the differences in the treatment carried out the smallest real difference test or Least Significant Difference (LSD) with a real level of 5%. The number of plants per sub plot was 3 plants, and the number of replications was 3 times. The number of replications for each main plot is 3 times. Observation variables included: root length (cm), root fresh weight (g), root dry weight (g), and number of effective root nodules. The root length is measured from the base of stem to the root tip that has developed at the end of the experiment. For the freh weight of root, the seed roots are first cleaned of soil that may still be attached to the roots and then weighed using analytical scales at the end of the experiment. For the dry weight of root, the cleaned root is put into the oven, until it is constant at 70^{o}C for 48 hours then weighed using analytical scales at the end of the experiment. For number of effective of root nodules, the root of seeds are cleaned from the ground which may still be attached to the root then the root nodules are calculated using a counter.

RESULTS

Root Length

Table 1.

Analysis of Variance on Root Length

SV	df	SS	Ms	F	Sig
Replication	2	28.88	14.44	0.74	6.94
Radiation Intensity	2	53.30	26.65	1.36	6.94
Error a	4	78.17	19.54		
Cutting Material	2	184	92	8.13*	3.88
Radiation x Cutting	4	94.03	23.51	2.08	3.28
Error b	12	135.78	11.32		
Total	26	574.16			

*: Significant Ns: Non Significant

Table 2.

Effect of sunlight intensity and cuttings on root length (cm)

Sunlight Radiation Intensity	Cutting Material			Average
	4th Section	7th Section	10th Section	
100%	13.33	15.58	11.67	13.53
75%	9.53	21.17	11.58	14.09
50%	14.67	18.58	17.00	16.75
Averagre	12.51	18.44	13.42	(-)

The mean number followed by the same letters in the same column or row shows no significant difference based on the LSD test at a significant level of 5%
(-): no interactions

Table 2 shows that between the intensity of sunlight 100% (13.53 cm), the intensity of sunlight 75% (14.09 cm), and the intensity of sunlight 50% (16.75 cm) did not have a significant effect on the seedling root length. The 7th cuttings material (18.44 cm) had the highest effect on root length, followed by 10th section cuttings (13.42 cm) and 4th section cuttings (12.51 cm).

Fresh Weight of Root

Table 3.

Analysis of Variance on Fresh Weight of Root

SV	df	SS	Ms	F	Sig
Replication	2	0.14	0.07	2.13	6.94
Radiation Intensity	2	0.26	0.13	4	6.94
Error a	4	0.13	0.03		
Cutting Material	2	0.11	0.06	1.68	3.88
Radiation x Cutting	4	0.27	0.07	1.94	3.28
Error b	12	0.40	0.03		
Total	26	1.31			

*: Significant
Ns: Non Significant

Table 4.

Effect of sunlight intensity and cuttings on fresh weight of root (g)

Sunlight Radiation Intensity	Cutting Material			Average
	4th Section	7th Section	10th Section	
100%	0.46	0.51	0.64	0.54
75%	0.56	0.64	0.39	0.53
50%	0.84	0.86	0.51	0.74
Average	0.62	0.67	0.51	(-)

The mean number followed by the same letters in the same column or row shows no significant difference based on the LSD test at a significant level of 5%
(-): no interactions

Table 4 shows that between the intensity of sunlight 100% (0.54 g), sunlight intensity 75% (0.53 g), and sunlight intensity 50% (0.74 g) did not give a significant effect on the

fresh weight of roots. The 4th section cuttings (0.62 g), 7th section cuttings (0.67 g), and 10th section cuttings (0.51 g) did not have a significant effect on the fresh weight of the roots.

Dry Weight of Root

Table 5.

Analysis of Variance on Dry Weight of Root

SV	df	SS	Ms	F	Sig
Replication	2	0.018	0.009	4.5	6.94
Radiation Intensity	2	0.009	0.004	2	6.94
Error a	4	0.008	0.002		
Cutting Material	2	0.023	0.011	2.75	3.88
Radiation x Cutting	4	0.03	0.007	1.75	3.28
Error b	12	0.046	0.002		
Total	26	0.135			

*: Significant
Ns: Non Significant

Table 6.

Effect of sunlight intensity and cuttings on dry weight of root (g)

Sunlight Radiation Intensity	Cutting Material			Average
	4th Section	7th Section	10th Section	
100%	0.15	0.13	0.14	0.143
75%	0.10	0.22	0.08	0.136
50%	0.21	0.21	0.12	0.18
Average	0.16	0.19	0.17	(-)

The mean number followed by the same letters in the same column or row shows no significant difference based on the LSD test at a significant level of 5%
(-): no interactions

Table 6 shows that between the intensity of sunlight 100% (0.143 g), sunlight intensity 75% (0.136 g), and sunlight intensity 50% (0.18 g) gave no significant effect on dry weight of root. The 4th cuttings material (0.16 g), 7th section cuttings (0.19 g), and 10th cuttings material (0.17 g) had no significant effect on dry weight of root.

Number of Effective Root Nodules

Table 7.

Analysis of Variance on Number of Effective Root Nodules

SV	df	SS	Ms	F	Sig
Replication	2	4.14	2.07	1.96	6.94
Radiation Intensity	2	21.62	10.81	10.16*	6.94
Error a	4	4.25	1.06		
Cutting Material	2	17.55	8.78	9.81*	3.88
Radiation x Cutting	4	11.57	2.89	3.23	3.28
Error b	12	10.74	0.90		
Total	26	69.87			

*: Significant
Ns: Non Significant

Table 8.

Effect of sunlight intensity and cuttings on the number of effective root nodules

Sunlight Radiation Intensity	Cutting Material			Average
	4th Section	7th Section	10th Section	
100%	2.67	3.83	3.83	3.44
75%	4.78	5.83	3.83	4.81
50%	3.67	7.33	5.83	5.61
Average	3.70	5.67	4.50	(-)

The mean number followed by the same letters in the same column or row shows no significant difference based on the LSD test at a significant level of 5%
(-): no interactions

Table 8 shows that the intensity of sunlight 50% (5.61) and 75% (4.81) significantly gives the highest effect on the number of effective root nodules, followed by 100% sunlight intensity (3.44). The 7th cuttings material (5.67) markedly had the highest effect on the number of effective root nodules, followed by the 10th cuttings material (4.50) and the 4th cuttings material (3.70).

CONCLUSSION

The treatment of radiation intensity has a significant effect on the number of effective root nodules. Intensity of sunlight 50% (5.61) and 75% (4.81) is significantly the highest effect on the number of effective root nodules. While for the parameters of root length, fresh weight and dry weight of root, the treatment of sunlight intensity did not have a significant effect between treatments. The cutting material treatment has a significant effect on the root length parameter and the number of effective root nodules. On root length, section 7th cutting material gave the highest results with an average root length of 18.44 cm. On number of effective root nodule parameter, section 7th cutting material also gave the highest number of root nodules with an average of 5.67. There is no interaction between the intensity of sunlight and cutting material on the four parameters observed.

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