The 3rd ISTAP, Faculty of Animal Science, Gadjah Mada University, 2002 *ISBN : 979 – 97243 – 2 - 5*

GROWTH CHARACTERISTICS OF *INDIGOFERA ARRECTA* UNDER DIFFERENT SHADING LEVEL

T. Akbarillah, Sutriyono, D.A. Nugraha, and Hidayat[1]

Abstract

The experiment was conducted to evaluate the growth characteristics of *Indigofera arrecta* under different shading level. Eighty-one *Indigofera arrecta* transplanted to poly bag containing mixture soil and compost with the ratio of 5:1. The plants were randomly assigned to three groups of treatment. The groups were : (P1) without shading as a control, (P2) 55% shading, and (P3) 75% shading. Para net was used as shading material. Height of plant, number of leaves, and number of leaf branches were measured weekly for 8 weeks. The results showed that height of plant, number of leaves, and number of leaf branches were significantly different among the treatment ($P<0.01$). Plants with 55% shading was the best among three treatments especially on their growth characteristics.

Key words: Growth, Indigofera, Shading

Introduction

Indigofera (*Indigofera arrecta*), a leguminous forage crop, is harvested for animal feed. This leguminous crop has firstly been introduced in Bengkulu in 1990. Indigofera is relatively tolerant to drought condition. At least it has been proved that when there was a long dry season in 1997, indigofera had survived. Its nutrients content, based on dry matter basis, are CP 27.89%, EE 3.70%, and CF 14.96%. In fact, indigofera has been used as animal feed in some rural areas. It is widely used for goat and used as source of β-carotenes of poultry. However, information about the plant is still limited. Therefore, the experiment was carried out to study the growth characteristics of indigofera reared under shading.

Growth is a live process of plant that is showed with change in size (Sitompul and Guritno, 1995). Growth stage, an important factor on production, influences nutritional composition as well as nutritional value of forage (Person and Ison, 1987). In fact, growth of plant is influenced by several factors that are media (soil), moisture, temperature, and light intensity. Change of temperature influences growth and plant metabolism (Van Soest, 1994; McCloud and Bula, 1985). Temperature may affect respiration that produces energy for cell splitting and development. Increasing temperature and stimulating molecule tend to destroy tertiary structure, so

[1] Department of Animal Science, Faculty of Agriculture, Bengkulu University
Jalan Raya Kandang Limun, Bengkulu

that followed by decreasing enzymatic activities and rate of reaction (Fitter and Hay, 1994). Leaf transpiration are also influenced by environmental temperature. Increasing temperature may affect pressure of water vapor around the leaves, but the increased temperature is not as high as that of in the leaves, therefore diffusion from the leaves takes place (Dwidjoseputro, 1978). Increasing environmental temperature produces lignifications on cell wall and causes faster metabolic activities so that reducing metabolic pool in the cell (Van Soest, 1994).

Based on these theories, the increase of temperature will reduce cell activities at the growing stage. Humidity is needed for plant growth, but high humidity might reduce transpiration process. Transpiration is important in transporting mineral from the roots to the leaves (Dwidjoseputro, 1978). Light is needed as source of energy on photosynthesis (Fitter and Hay, 1994). Considerably high light intensity will reduce plant growth and destroy the tissue (Vasudeva, 1979 cited by Aminuddin and Hindarto, 1992). Shading on the land affects the environmental temperature, humidity, and light intensity. Heavy shading would reduce light intensity received by plants (Akbarillah, 1998). Canopy might reduce radiation intensity and direct radiation, so that it could reduce the damage of tissues, such as harder stem, thicker cell walls, and shorter leaves. Shaded plants have more succulent stems and wider leaves; furthermore it might have more chlorophyll. (Chang, 1968, cited by Edi, 1995).

Material and Method

Eighty-one Indigofera of one-month-old were transplanted into polybag containing media. The media was mixture of soil and compost with the ratio of 5:1. Transplanted Indigofera were then randomly assigned to three groups of treatments in completely randomized design (CRD), each treatments had three replications. Each replication, therefore, consisted of nine plants. The treatments were P1 without shading, P2 using 55% shading of net, and P3 using 75% shading of net. The plants were watered everyday if there was no rains. Variables measured were height of plants, number of leaves, and number of leaf branches, and environmental condition around plants, such as temperatures (°C), relative humidity (%), and light intensity (lux). Measurements were done every week within 8 weeks. The SYSTAT-statistical Package Program was used as to analyze the data. Any significant different among the treatments was further analyzed using Least Significant Different (LSD).

Result and Discussion

Environmental condition can be seen on Table 1. It can be seen that environmental condition such as temperature, relative humidity, and light intensity were significantly different among the treatments ($P<0.01$). The lowest temperature and relative humidity were shown on the plants without shading. However it has the

highest light intensity. Shading (55% and 75%) gave no differences on temperature and humidity. However, light intensity of P2 was higher than P3, this was due to the net used (Akbarillah, 1998).

Table 1. Average of environmental condition measured in the morning, noon, and evening

Environmenta Condition	Treatments								
	P1			P2			P3		
	M	N	E	M	N	E	M	N	E
Temperature (°C)	26.63^{b}	33.30^{c}	27.21^{c}	28.07^{a}	33.93^{d}	28.45^{f}	28.41^{a}	34.34^{d}	28.84^{f}
SD	1.0	0.70	1.20	1.30	0.70	0.90	0.70	0.70	0.80
Humidity (%)	76.04	58.54^{c}	76.02^{c}	80.45^{a}	60.48^{d}	77.34^{f}	82.68^{a}	61.13^{d}	78.45^{f}
SD	5.00	3.20	4.00	3.90	2.80	3.40	3.70	3.10	4.10
Light Intensity (lux)	40780^{a}	128161^{d}	13748^{g}	14971^{b}	48318^{e}	5154^{h}	4896^{c}	17787^{f}	2004^{i}

Note: 1. Different superscript of mean value on the same rows was statistically significant (P<0.01)
2. SD = standard deviation
3. M=morning; N=noon; E=evening

Plant growth

The growths of plants are indicated by the increase of it height, number of leaves, and number of leaf branches. The results showed that plant height were significantly different among the treatments (Table 2 and Figure 1).

Table 2. The average height of plants of treatment P1, P2, and P3 (cm)

Treatments	Periods (week)								Average
	1	2	3	4	5	6	7	8	
P1	0.35	0.59	1.55	2.87	3.41	4.24	5.80	6.94	3.22^{c}
SD	0.12	0.30	0.34	0.45	0.18	0.29	1.00	1.77	
P2	1.74	4.78	9.00	13.22	19.30	24.42	30.31	37.48	17.53^{b}
SD	0.38	0.48	0.40	0.92	1.05	0.86	0.87	3.44	
P3	2.85	6.09	7.13	15.26	21.91	29.04	35.21	44.63	20.26^{a}
SD	1.38	2.32	2.89	3.48	4.45	4.10	3.20	2.15	
Average	1.65^{g}	3.82^{g}	5.89^{f}	10.45^{e}	14.87^{d}	19.23^{c}	23.77^{b}	29.68^{a}	13.67
SD	1.30	2.76	3.66	6.03	8.97	11.61	13.76	17.46	

Note: 1. Different superscript of mean value on the same rows was statistically significant (P<0.01)
2. Different superscript of mean value on the same column was statistically significant (P<0.01)
3. SD = standard deviation

The plant with shading 75% (P3) showed the highest plant height. The used of 75% net caused less light passed through. Therefore, the plant tried to grow up to place where the light available. On the other hand plants without shading (P1) showed lowest. High temperature, abundant light intensity, and direct radiation depressed the plants (Vassudeva cited by Aminuddin and Hendarto, 1992). In this condition, the plants tend to thicken their cell wall in order to prevent them from sunlight. The plants started to show their growth when the plants were 3 weeks old. The plant had adapted to the environment during first and second weeks of planting.

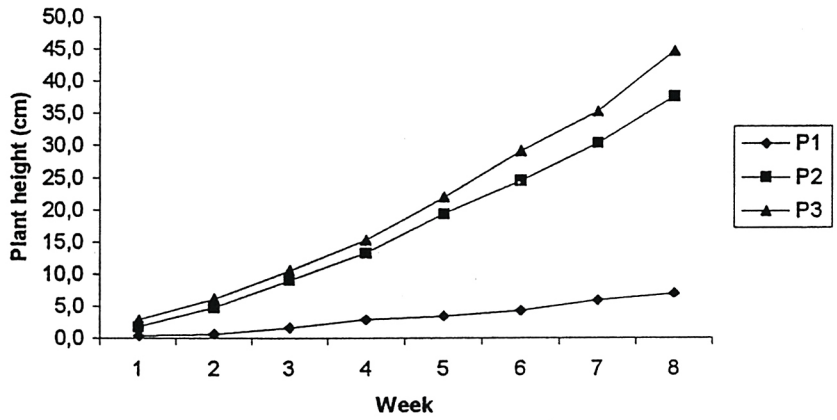

Figure 1. The height of plants with and without shading (cm)

Number of leaves

Number of leaves was presented in Table 3 and Figure 2. Plants with 55% had the highest number of leaves compare to the other two plants. It was probably the plants received an ideal environment, especially light intensity, to support their growth and directly required as source of energy on their photosynthesis (Fitter and Hay, 1994). High temperature, high humidity, and low light intensity received by the plants with 75% shading (P3) caused the plants not to increase the number of leaves. Since the plants got depressed, the plant growth in the term of number of the leaves were obviously increased at 4 weeks of age.

Number of leaf branches

The number of leaf branches was showed on Table 3 and Figure 3. Shading on plants significantly affected the number of leaf branches ($P<0.01$). Plants shaded by 55% net (P2) had the highest number of leaves. The reason was that the

environmental condition, such as temperature, humidity, and light intensity, supported an ideal growth of new branches (Fitter and Hay 1994). The plants showed additional leaf branches when the plants were 2 weeks old.

Table 3. The average number of leaves of plants with and without shading

Treatments	Periods (week)								Average
	1	2	3	4	5	6	7	8	
P1	-1.04	2.82	6.26	10.67	12.67	18.52	30.37	43.56	15.74^{c}
SD	0.06	1.52	2.27	2.47	3.30	4.21	9.93	12.34	
P2	10.11	17.92	35.52	53.74	72.82	101.59	123.04	182.44	74.65^{a}
SD	1.39	1.33	3.64	6.10	12.22	8.84	7.44	16.09	
P3	5.56	13.22	27.37	39.63	59.60	82.67	116.74	157.44	62.78^{b}
SD	2.23	3.20	3.85	4.75	10.54	8.98	17.37	13.32	
Average	5.57^{g}	11.32^{fg}	23.05^{ef}	34.68^{e}	48.36^{d}	67.59^{c}	90.05^{b}	127.81^{a}	51.05
SD	3.43	6.14	12.28	17.85	22.99	35.31	47.59	66.13	

Note: 1. Different superscript of mean value on the same rows was statistically significant ($P<0.01$)
2. Different superscript of mean value on the same column was statistically significant ($P<0.01$)
3. SD = standard deviation

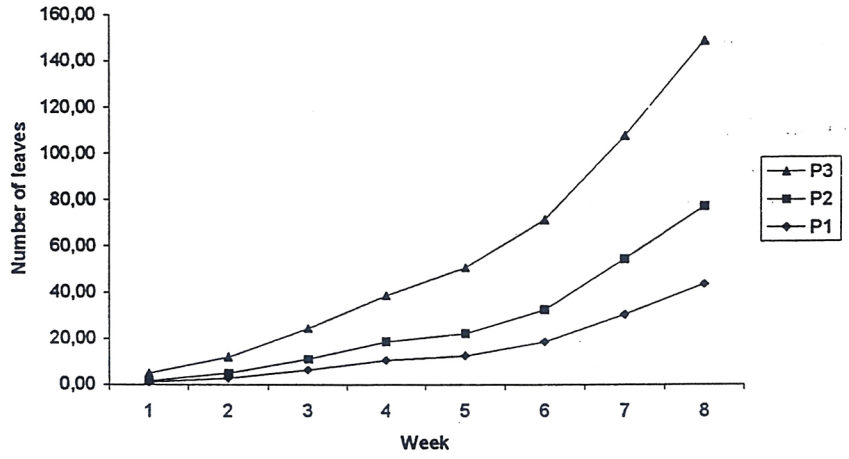

Figure 2. The number of leaves of plants with and without shading

Table 4. The average number of leaf branches of plants with and without shading

Treatments	Period (week)								Average
	1	2	3	4	5	6	7	8	
P1	0.63	1.44	2.63	3.59	4.04	5.26	8.07	11.48	4.64^{c}
SD	0.34	0.12	0.32	0.36	0.35	0.42	2.03	2.56	
P2	1.78	4.22	6.26	8.81	8.81	11.37	16.33	20.96	9.82^{b}
SD	0.19	0.73	0.57	0.50	0.50	1.33	2.41	2.73	
P3	1.41	2.89	4.71	6.33	8.15	9.59	11.22	14.67	7.37^{b}
SD	0.34	0.84	0.67	0.61	0.68	0.74	1.11	0.88	
Average	1.27^{g}	2.85^{f}	4.53^{e}	6.24^{d}	7.00^{d}	8.74^{c}	11.88^{b}	15.70^{a}	7.28
SD	0.58	1.22	2.07	3.00	3.37	4.00	5.17	6.86	

Note: 1. Different superscript of mean value on the same rows was statistically significant ($P<0.01$)
2. Different superscript of mean value on the same column was statistically significant ($P<0.01$)
3. SD = standard deviation

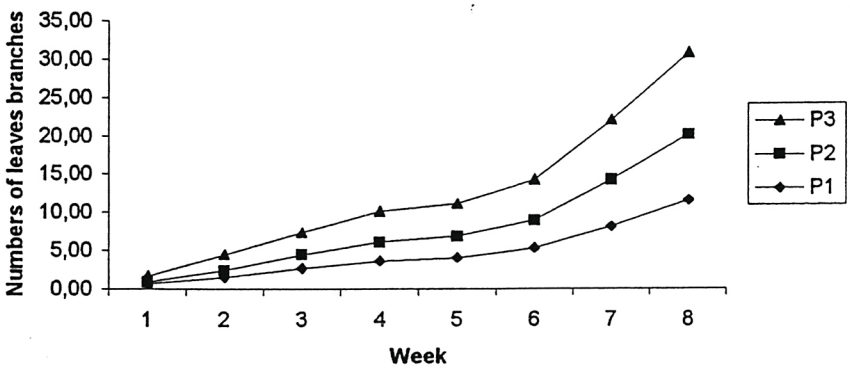

Figure 3. Number of leaf branches

Conclusion

It can be concluded that the growth of *Indigofera arrecta* was affected by the environmental condition, such as temperature, relative humidity, and light intensity. Shading was different level would change the environmental condition received by the plants. Shading plant with 55% net resulted the best environmental condition to support plant growth.

References

Akbarillah, T., 1998. Produksi dan Kecernaan Nutrien Secara *In Vitro* dan *In Sacco* Hijauan Legum di Lahan Perkebunan Karet Pada Umur Tanaman Karet Yang Berbeda. Tesis. Program Pasca Sarjana. Universitas gadjah Mada. Yogyakarta.

Aminuddin,S da E. Hindarto, 1992. Pengaruh Intensitas Sinar Matahari Pada Empat Tingkat Naungan Terhadap Ketegaran Lima Jenis Rumput Unggul. Fakultas Peternakan Universitas Soedirman. Purwokerto.

Dwidjoseputro, D., 1978. Pengantar Fisiologi Tumbuhan . PT Gramedia. Jakarta.

Edi, 1995. Pengaruh Tingkat Persentase Naungan Terhadap Pertumbuhan dan Perkembangan Tanaman Krisian (*Chrysanthemum morifolium*). Fakultas Matematika dan IPA Institute Pertanian Bogor.

Fitter, AH.dan RKM. Hay. 1994. Fisiologi LingkunganTanaman. Dalam : PR Goldworthy dan N.M.Fisher (Eds), Fisiologi Tanaman Budidaya Tropik. Gadjah Mada University Press. Yogyakarta.

Mclloud, DE.and RJ Bula. 1985. Climatic factor in forage production. In: Heath, ME.,FB.Robert and SM Darrel (Eds.), Forages. The Science of Grassland Agriculture. 4th Ed. Iowa State University Press. Ames. Iowa. USA. 33.

Person, CJ and RL. Ison. 1987. Agronomy of Grassland System. Pub. Cambridge University Press. New York.

Van Soest., PJ. 1994. Nutritional Ecology of Ruminant. 2nd Edts. Cornell University Press. Itaca. New York.