EFFECTS OF LIGHT ON THE GROWTH AND PRODUCTION OF EDIBLE SHOOTS OF RATTAN

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Received August 2006

RENUKA, C., THOMAS, J. P. & RUGMINI, P. 2007. Effects of light on the growth and production of edible shoots of rattan. Studies on three species of edible rattan occurring in the Western Ghats, *Calamus thwaitesii, C. hookerianus* and *C. metzianus*, under different light conditions showed that light intensity had effects on survival percentage, growth and number of shoots produced. In *C. hookerianus,* maximum survival was obtained under 75% light while in *C. thwaitesii* and *C. metzianus,* under 50%. The number of shoots produced was greater under 50% light in all the species. Light and period greatly affected the percentage survival of *C. hookerianus.* The effects of light intensities on height growth and number of shoots produced in *C. hookerianus* and *C. thwaitesii* were considerable, while those in *C. metzianus*, negligible. In an agroforestry system of the three species studied, *C. metzianus* is best suited for shoot production since it performs well under 100, 75 and 50% light.

Keywords: *Calamus thwaitesii, Calamus metzianus, Calamus hookerianus,* height, survival percentage, agroforestry

RENUKA, C., THOMAS, J. P. & RUGMINI, P. 2007. Kesan cahaya ke atas pertumbuhan dan penghasilan pucuk rotan boleh dimakan. Tiga spesies rotan boleh dimakan yang tumbuh di Ghat Barat iaitu *Calamus thwaitesii, C. hookerianus* dan *C. metzianus* ditanam di bawah keadaan cahaya berbeza-beza. Keamatan cahaya mempengaruhi peratusan kemandirian, pertumbuhan dan bilangan pucuk yang dihasilkan. Kemandirian adalah maksimum untuk *C. hookerianus* apabila cahayanya 75%, manakala untuk *C. thwaitesii* dan *C. metzianus*, 50%. Ketiga-tiga spesies menghasilkan pucuk yang banyak apabila cahayanya 50%. Keamatan cahaya dan tempohnya sangat mempengaruhi peratusan kemandirian *C. hookerianus.* Keamatan cahaya mempengaruhi pertumbuhan ketinggian dan bilangan pucuk dalam *C. hookerianus* dan *C. thwaitesii* tetapi kesannya sedikit sahaja pada *C. metzianus*. Dalam sistem agroperhutanan bagi ketiga-tiga spesies ini, *C. metzianus* amat sesuai bagi penghasilan pucuk memandangkan spesies ini menunjukkan prestasi baik di bawah keamatan cahaya 100%, 75% dan 50%.

INTRODUCTION

Although rattan is most popular as raw material for the furniture industry, it is no longer used solely for furniture. In many parts of the world, rattan is used in food and medicines. Many species of rattan supply edible shoots or 'palm hearts'. The shoots can also be a part of many delicious food and nutritious dishes. Rattan shoot is a traditional dish in some Asian countries and is considered as a delicacy in Europe and America. In the northeastern states of India, it is used as food as well as medicine (Caius 1935). Although rattan shoots are used as food in many Asian countries, intensive cultivation of rattan for the food industry has begun only in Laos and Thailand (Evans 2002). Usually small diameter rattan is preferred for shoot cultivation because it is easier to cultivate and more shoots are produced within a short period.

Rattan shoot farming is new in India. It has great potential for providing additional income to the rural population. Plantations for shoot production differ from those for cane. For shoot production, support or shade trees are not required. Open areas such as unused paddy fields can be used for raising the crop.

Even though plantations are raised for the extraction of shoots in South-East Asia, data on the effects of light on the production of shoots are lacking except for the work by Xu *et al.* (1991) and Yin *et al.* (1988). To promote cultivation of rattan for edible shoots as an agroforestry crop, the performance of three

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rattan species of the Western Ghats under different light conditions was studied.

MATERIALS AND METHODS

Three edible rattan species, *Calamus thwaitesii, C. metzianus* and *C. hookerianus*, were selected based on the data available from published literature, local knowledge and from the tribals. Seeds were collected and seedlings raised were outplanted at the Kerala Forest Research Institute Subcentre at Nilambur. To evaluate the performance of the species under different light conditions, an experiment was conducted in split plot design by considering three levels of light (50, 75 and 100%) as the levels of main-plot factor and the three different species (*C . metzianus, C. hookerianus* and *C. thwaitesii*) as the levels of the sub-plot factor (Figure 1). The experiment was replicated three times. Within each plot there were 49 plants (7 × 7) at a distance of 1 m. A total of 441 seedlings were planted for each species. Appropriate shade nets were used to cut off excess sunlight.

Observations were made on survival, height, number of new shoots produced and number of shoots extracted periodically. For the purpose of statistical analyses, data from only the net plot containing 25 plants (5 × 5) from each gross plot of 49 plants (7 × 7) were considered. Hence, the total number of plants was 75 (n = 25 × 3). Cumulative height was calculated as the sum of length of all the shoots pertaining to a plant. Similarly, cumulative number of suckers was taken as the total number of suckers produced irrespective of the extraction. The data on cumulative height were transformed to logarithmic values, cumulative number of suckers, transformed to square root scale and survival percentages, transformed to angular values before they were subjected to analysis of variance.

RESULTS AND DISCUSSION

Survival

Under full sunlight, *C. hookerianus* and *C. thwaitesii* recorded low survival percentage. *Calamus hookerianus* was the most affected; the mean survival percentage being only 47% at the end of two years (Table 1). *Calamus metzianus* performed well under all the three light conditions, although under 100% the species recorded survival of 93.2%. In *C. thwaitesii,* maximum survival was shown under 50% light.

From the analysis of variance on survival percentage, effects due to light, species, period and the interactions between species and period and between species and light turned out to be significant (Table 2). This indicates that the effects of species vary with the change in period and light intensity. This shows that light and

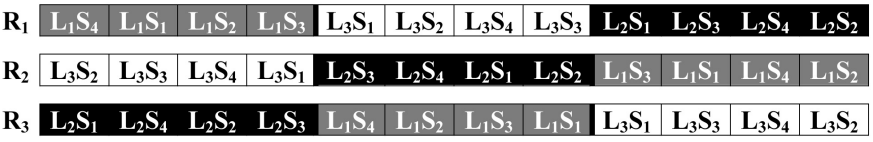

Figure 1 Randomized experimental layout under split plot design. There are three light intensities and three species. R = replications, L = light intensity, S = species.

Table 1 Mean survival percentage of seedlings under different light conditions

Species	Light (%)	Period (months)							
		10	12	14	16	18	20	22	24
C. hookerianus	50	95.92	95.24	89.80	85.76	85.03	80.95	80.27	78.91
	75	95.24	94.56	90.48	87.08	87.08	81.63	80.95	80.95
	100	78.23	77.55	70.75	63.95	57.15	48.30	47.62	46.94
C. metzianus	50	100.00	100.00	99.63	98.64	97.96	97.96	97.28	96.60
	75	99.32	99.32	97.96	97.95	97.95	97.28	97.28	95.24
	100	99.32	97.95	96.24	95.92	94.85	93.89	93.88	93.20
C. thwaitesii	50	99.56	99.56	99.32	99.32	99.32	97.96	97.96	97.28
	75	99.32	99.32	98.64	98.64	98.64	96.60	96.60	95.24
	100	93.23	91.84	91.84	91.82	90.48	90.48	90.48	89.80

period greatly affect the percentage survival of *C. hookerianus*, while their effects on *C. thwaitesii* are small and on *C. metzianus*, negligible.

Height

In *C. thwaitesii* and *C. metzianus,* maximum height was attained under 75% light whereas in *C. hookerianus*, 50%. In all species, growth was minimum under full sunlight (Table 3).

From the analysis of variance on cumulative total height, effects due to light, species, period, interactions between species and light, between species and period and between light and period were significant (Table 4). The significant interaction between species and period indicates that the species differed in their height growth pattern over time. The significant interaction between light and period indicates that the effect due to light varies over time. Light intensities had considerable effect on the height growth of *C. hookerianus* and *C. thwaitesii*. However, the effect on *C. metzianus* was small.

Shoot production

The number of shoots produced was greater under 50% light in all species (Table 5). Minimum number was produced under 100% light. *Calamus hookerianus* was most affected under full sunlight. *Calamus metzianus* was not affected greatly by the variations in light. The analysis of variance on cumulative number of shoots produced was significant due to species, light, period, interactions between species and period and, between light and period (Table 6).

Based on the total production of shoots in three species corresponding to three light intensities, it was found that the light intensity greatly affected *C. hookerianus* and *C. thwaitesii*.

Table 2 Analysis of variance of data on survival percentage in angular values

Source	Degree of freedom	Mean sum of squares	F value
Light	2	2429.95	25.11**
Replication	2	46.19	0.48
Error(1)	4	96.77	
Species	2	6271.45	72.55**
Species × light	4	424.54	4.91**
Error(2)	12	86.44	
Period	7	299.06	38.70**
Species × period	14	71.24	9.22**
Light × period	14	5.48	0.71
Light × species × period	28	3.88	0.50
Residual	126	7.73	

** significant at $p < 0.01$

Table 4 Analysis of variance of data on cumulative total height in logarithmic scale

Source	Degree of freedom	Mean sum of squares	F ratio
Light	2	7.03	58.51**
Replication	2	0.35	2.93
Error(1)	4	0.12	
Species	2	33.29	118.41**
Species × light	4	2.57	9.14**
Error(2)	12	0.28	
Period	7	7.76	169.11**
Species × period	14	0.60	13.18**
Light × period	14	0.54	11.67**
Light × species × period	28	0.14	2.97**
Residual	126	0.05	

** significant at $p < 0.01$; * significant at $p < 0.05$

Table 3 Mean height of species under three different light intensities

Period (months)	Cumulative height (cm)								
	C. thwaitesii			*C. hookerianus*			*C. metzianus*		
	50%	75%	100%	50%	75%	100%	50%	75%	100%
6	170.00	216.00	369.67	175.67	133.67	134.33	402.33	307.00	372.33
10	216.33	253.00	378.00	201.67	143.33	140.00	550.00	378.00	446.67
15	697.00	656.33	398.00	656.00	485.33	293.67	843.00	877.67	1082.67
17	732.33	685.67	296.67	643.33	491.33	171.33	989.33	985.67	1178.67
19	840.67	723.67	321.67	703.33	500.00	148.33	1332.00	1316.67	1450.33
21	921.33	998.00	328.67	730.33	537.67	132.00	2233.33	2111.33	2033.00
23	923.33	1192.33	331.67	717.33	533.67	134.33	2602.00	2585.67	2352.33
25	945.33	1310.33	365.00	737.33	559.33	137.67	2909.33	3046.33	2726.33

Table 5 Total number of shoots present under three light intensities

Species	Light (%)	Period (months)					
		15	17	19	21	23	25
C hookerianus	50	36	54	66	75	74	82
	75	20	49	54	52	52	51
	100	4	4	5	5	4	4
C. metzianus	50	97	116	116	134	140	140
	75	131	131	132	131	130	134
	100	79	109	114	117	128	129
C. thwaitesii	50	13	25	56	56	57	75
	75	16	50	64	60	61	60
	100	2	11	10	37	38	43

Table 6 Analysis of variance of data on cumulative number of shoots in square root scale

Sources	Degrees of freedom	Mean sum of squares	F ratio
Light	2	32.41	40.67**
Replication	2	5.5	6.9
Error(1)	4	0.80	
Species	2	163.06	43.04**
Species × light	4	7.13	1.88
Error(2)	12	3.79	
Period	7	92.93	255.9**
Species × period	14	9.65	26.65**
Light × period	14	2.39	6.61**
Light × species × period	28	0.53	1.47
Residual	126	0.36	

** significant at $p < 0.01$

Number of extractable shoots

Extraction could be started in *C. metzianus* 16 months after transplanting. An average of two shoots per plant could be extracted every two months. For the other two species, extraction could begin only after the 20th month (Table 7).

Table 7 Number of shoots extracted

Species	Light (%)	Period (months)					
		16	18	20	22	24	26
C hookerianus	50			39			
	75			19			
	100						
C. metzianus	50	5	21	91	46	34	81
	75	6	14	114	81	48	78
	100	26	19	43	48	43	74
C. thwaitesii	50			55			
	75			79	27	27	
	100						

CONCLUSIONS

Light intensity had an effect on the survival percentage, growth and the number of shoots produced. Light and period greatly affected the percentage survival of *C. hookerianus*. Their effects on *C. thwaitesii* were small and those on *C. metzianus*, negligible. Light intensity greatly affected the height growth and the number of shoots produced in *C. hookerianus* and *C. thwaitesii*. The number of shoots produced was greater under 50% light in all the species. This study shows that *C. metzianus* is the best species for shoot production in an agroforestry system since it performs well under 100, 75 and 50% light.

ACKNOWLEDGEMENTS

The financial support from the Western Ghat Cell, Planning and Economic Affairs Department, Government of Kerala is gratefully acknowledged. We are thankful to J. K. Sharma, Director of KFRI and R. Gnanaharan, Research Co-ordinator for the support and encouragement for the study. K. Dinesan assisted in the field work.

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