

Effect of Shade on Noni (*Morinda citrifolia* L.) under Bay Island conditions

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Abstract

High radiation, temperature and relative humidity are being major concern for growing crops in Bay Islands. The aim of this study is to evaluate the effect of shade on yield and growth parameters of *Morinda citrifolia* L. We have studied two consecutive years (2015-2017). The study was laid out in Randomized Block Design with four treatments. Results have showed significant difference among all the treatments. The highest yield was recorded in the open field (17.75 Kg/Plant) followed by tree grown under coconut plantation (16.00). Highest plant height (3.89 m) was recorded in tree grown under arecanut plantation and the least plant height was found in open field (3.05 m) while same treatment recorded the highest number of branches per plant, Diameter at Breast height and crown diameter (21.70, 14.81 cm, 3.70 m respectively). This study revealed that severe shade reduces the growth and fruit yield of Noni. To improve the growth and yield of noni it is suggested to maintain appropriate sunlight through management of crown architecture of the plantation.

Keywords : Noni, *Morinda citrifolia* L, Shade effect, intercrop, fruit yield, Light transmission ratio

Introduction

Light, temperature, water, fertility of soil and relative humidity are the important components for growing vegetative plants around equatorial regions. If any one of the above components absent or deficit will reflect in the growth and yield of the plants. Shading to 40% of full sunlight reduced flower and fruit numbers, total yield, and fruit dry weight in five-year-old apple trees subjected to two training systems (Chen *et al.*, 1997). To study the effect of shade on growth and yield of fruit crops like noni (*Morinda citrifolia* L.) is the need of the hour. *Morinda citrifolia* L is a small ever green tree growing to a height of 3 – 6 m at maturity of 20-25 years. It is popularly known as Indian mulberry belongs to family Rubiaceae and also known as in commercially Noni. Noni is native to South East Asia (Indonesia), Northern Australia, Western Pacific and Indian Ocean (Stevens *et al.*, 2001). Noni has a rooting habit similar to that of coffee and citrus with an extensive lateral roots system and deep tap root (Abu Saleha *et al.*, 2007). It spread widely by native people to many parts of the world before 2000 year ago.

In India, Noni occurs in wild forms in coastal areas and grows wide climatic conditions throughout the country find in shady forests as well as on open rocky

or sandy shores. It can also be grown in adverse climatic condition, from dry to humid areas of tropics to sub tropical zones. It can be grown from sea level to 2000 m above mol and can be planted during rainy season is the best. It reaches maturity in about 18 months and then yields between 4–8 kilograms (8.8–18 lb) of fruit every month throughout the year. It comes up very well between 20-38° C temperatures. Noni is well suited for intercropping within traditional agroforestry subsistence farming systems or as a monocrop in full sun. Noni has extensive range of environmental tolerances including exposure to wind, fire, flooding, saline soils, drought conditions and secondary soils. Andaman and Nicobar Islands are having moderate climate with occurring of high rainfall (more than 3000 mm/ year) from April to November every year. Due to necessity of this plant, most of the farmers are interesting or willing to make the noni planation for more benefits. Planting of these type of trees slowly will give additional income to the farmers without additional manpower within short period. Noni is being used in folk remedies by Polynesians for over 2000 years, and is reported to have a broad range of therapeutic effects, including antibacterial, antiviral, antifungal, antitumor, antihelmin, analgesic, hypotensive, anti-inflammatory, and immune enhancing effects (Wang *et al.*, 2002).

The growth rate is moderate, generally 0.75-1.5 m/yr, slowing as the tree reached maturity. Noni plant can grow up to 9 metres (30 ft) tall associated with plant species include breadfruit (*Artocarpus altilis*), banana (*Musa* spp.), papaya (*Carica papaya*), palms (e.g. betel nut palm, *Arecaca* spp and coconut, *Cocos nucifera*), pandanus (*Pandanus* spp.), beach hibiscus (*Hibiscus tiliaceus*), til (*Cordylinie fruticosa*) and piper species (e.g. kava, *Piper methysticum*). Some of these associated species are understory and some are overstory from Noni. It grows as a recent introduction around villages or in home gardens, in backyards and along streams and gulches. Flowering and fruiting is continuous throughout year and fluctuations may occur due to seasonal effects (temperature, rainfall, sunlight intensity and duration). Cultivation of morinda has recently undergone revival in Andaman and Nicobar Islands owing to its high medicinal and market value Noni has emerged as one of the hot favorites of the famers for cultivation under saline soil in Andaman and Nicobar islands. This plant has been tested recently in research farm as well as salt affected land caused due to tsunami and found to be highly adaptive to the available agro niches of Bay Islands (Singh and Rai 2007). Studies with partial shade are very limited and concerning the effect of limited shade during a specific diurnal period on growth and yield of noni cultivated under different shade condition. hence, the present study was carried out with the aim to study the effect of shade on growth and yield of noni cultivated under different shade situations.

Materials and Methods

The study was conducted for two consecutive years in four different locations at Research farm of ICAR-Central Island Agricultural Research Institute, Port Blair during 2015-2017 to find out the effect of shade on growth and yield of noni. The treatment includes, direct sunlight i.e. open field (T_1), Partial shade under coconut plantation (T_2), Moderate shade under Areca nut plantation (T_3), and Full shade -under associated forest trees (T_4) each area having one acre. The age of trees were eight years old from all four sights. About 100 nos. of trees have been observed in each sights during the study period. During the study period the area is characterized by a pronounced warm and humid tropic type of climate in general is

prevailing in the islands. The temperatures ranges from 20° to 32° C and the mean relative humidity is 78% with an annual rainfall between 300 to 310 cm. The study was laid out in a Randomized Block Design (RBD) having four replications.

Plant height was recorded by measuring the length of the plant from the soil line to the top and average was calculated. Number of branches was counted on the plants in each treatment and average branches/plant was calculated. Diameter at Breast Height (DBH) was observed by using vernier caliper. The fruits were harvested at mature stage in weekly basis in year round with different ranges. Light Intensity was measured by lux meter to determine its correlation between growth and light intensity.

The data has been collected according to above mentioned parameters were subjected to Analysis of Variance method to determine the difference between different treatment and their interactions. While Least Significant Difference (LSD) test was used to determine mean differences at 5% level of significance. Statistical Product for Service Solutions software version 14.0 (SPSS V14.0), was applied for calculating both ANOVA and LSD.

Result and Discussion

The mean data of two year study clearly stated that the shade having significant influence both growth and yield parameters of noni the highest number of branch (21.70) DBH (14.81cm), crown diameter (3.70 m) and yield per tree (17.75 kg) was recorded in pure plantation (T_1) which is receiving 100 percent sunlight followed by T_2 and T_3 where the noni trees grown under coconut and arecanut plantations. While the highest tree height was recorded in T_3 (3.89 m). The least number of branch (9.15), DBH (10.83 cm), crown diameter (1.80m) and yield per tree (10.90 kg) was recorded under the forest trees (T_4) (Table 1). According to earlier studies from various plants, the high temperature and the light intensity in the control treated open field may responsible for the increasing the yield. Our results are concordant with Bepete and Lakso (1998) they reported that apple fruit yield under shade was low as compared to open field. These results are also

coincide with those obtained by Adugna and Paul (2011) that highest yields per hectare were obtained from coffee plants in Ethiopia under the direct sun light. The yield was found very less from the site T₄ due to more deficit of light intensity. These results are supported by results obtained earlier (John *et al.*, 1982, David *et al.* 1979)

which found that leaf biomass, branch biomass and the saplings exhibit fuller crown under open field conditions was higher than shady conditions. Given the fact that all growth parameters were reduced in shade, it seems reasonable to speculate that Noni cultivation do not adapt well to shaded conditions.

Table:1 Performance of Noni under different shade levels.

Treatment	Height (m)	Branch (Nos.)	DBH (cm)	Crown Diameter (m)	Yield Kg/Plant
T ₁	3.05	21.70	14.81	3.70	17.75
T ₂	3.40	18.30	12.41	2.84	16.00
T ₃	3.89	19.15	13.78	2.96	14.85
T ₄	3.07	9.15	10.83	1.80	10.90
SEd	0.20	0.04	0.44	0.88	0.60
CD (p=0.05)	0.43	2.91	1.22	0.42	2.05
CV	14.97	18.42	10.46	16.37	15.04

The LTR differed significantly between the treatments both at morning and afternoon. The intensity was higher in open field and lesser in the field that was cropped at under forest trees (Table 2). The increased transmission ratio in the open field showed an augmentative effect on noni yield which is in conformity with the report of Dabral and Premnath (1972) who reported that increased yield in wheat was attributed to the increased photosynthetic activity of the crops due to sustained radiation. The

reduction in LTR due to tree canopies was reported by many researchers including Dasthagir (1986) and Srinivasan *et al.* (1990). Regarding air temperature, the pure noni plantation recorded the maximum values. The air temperature was reduced under intercropping situation when compared to open. This might be due to the dense foliage of forest trees. Light intensity might have been influenced the air temperature in intercropped as well as open conditions. This is in conformity with the findings of many researchers (Yu *et al.*, 1989; Tang *et al.*, 1990).

Table:2. Various environmental factors for Shaded and direct sunlight of noni plant.

Treatments	Air Temperature (°C)	RH (%)	Light Intensity (lux)			
			At morning		At afternoon	
			max	min	max	min
T1	35.2	59.6	35553.8	21377.0	142920.0	76860.0
T2	33.0	62.9	25499.8	12666.2	106160.0	62820.0
T3	32.2	65.8	2836.8	1890.4	100360.0	50340.0
T4	30.3	73.2	2796.0	1767.8	4708.6.0	2869.4.0
SEd	1.01	2.89	8258.37	4732.49	29488.78	16058.69
CD (p=0.05)	1.51	3.24	3916.59	1257.17	28830.80	6018.63
CV	0.68	2.84	17.04	12.24	23.62	9.050

The results of the present study demonstrate that the different shading levels used has an effect on Noni production. Best results of vegetative growth and fruit yield were obtained by the Control treatment whereas the

maximum height was obtained under Arecanut plantation. To improve the growth and yield of noni it is suggested to maintain appropriate sunlight through management of crown architecture of the plantation. These results suggest

that to increase the marketable fruit yield of Noni can be planted under partial and moderate sunlight.

Acknowledgement

The authors would like to express their gratitude to PPV & FRA, New Delhi for financial support to conduct

this study. The authors are also thankful to the Director and the Head of the Division, Horticulture and Forestry Division, ICAR-CIARI, Port Blair for their constant encouragement during the study period.



Noni pure plantation



Noni trees under Arecanut plantation



Noni trees under forest trees

Fig1. Field view of the noni trees grown under various shade condition

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