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Interaction of betelvine with different shading materials

Dinkar J Gaikwad, Riyajul Islam and Subhasis Mondal

Abstract
Present investigation is carried out to find out response of betelvine to different shading materials. The experiment was carried out in the Research Farm, Kalyani, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, during the year 2013 to 2015 under boroja condition. Popular bangla cultivar of betelvine Ghanagatte was used for the present study. In control treatment (T1) plants were grown in normal *boroja* condition while in full light treatment (T2) entire shading material was removed and plants were exposed to direct sunlight throughout different seasons. In 35% light treatments (T3), more paddy straws were added over normal *boroja* while in 70% light treatment (T4), little bit paddy straws were removed from normal *boroja* and plants were moderately exposed to sunlight. In Blue Shaded treatment (T5), *boroja* was covered with blue colored plastic shading material, in Green shaded treatment (T6) and Red shaded treatments (T7), Green and red colour plastic shade was used respectively. Observations were recorded on the traits like leaf length (cm), leaf width (cm), vine elongation (cm), 100 leaves dry weight (g), SPAD values, leaf area (cm^2), and leaf yield $vine^{-1}$. Growth of the betelvines shaded with polythene (perforated) sheets (blue, red, and green) was better than those shaded with cereal straw of different density or those completely unshaded. Betelvines shaded with blue polythene sheet produced longer vines with more number of leaves which were better in all dimensions like length, width, area and dry weight. Yield and yield quality of betelvine can be improved by using perforated polythene as shading material instead of cereal straw and blue colored polythene was best shading material for betelvine.

Keywords: Betelvine, light intensity, shading material, yield

Introduction

Betelvine (*Piper betle* L.) is a perennial, evergreen, dioecious shade loving creeper commonly known as Paan. Being a natural habitat of tropical humid forest ecosystem, the crop requires diffused light intensity, high available soil moisture and high relative humidity for its successful cultivation. Light is one of the most important limiting factors for the growth and biomass production of all the crops. Betel vine owing to its inherent shade loving property is grown under either natural or artificial shade of shading standard or *boroja* where its parts are exposed only to sun-flecks or transmitted light. Bhutia *et al.*, (2015) [2] reported that if the light intensity is not properly governed pungency of leaf sometimes become beyond consumption. However the optimum light requirement for its better growth and yield has not been studied appropriately. Balasubramanyam *et al.* (1994) [1] claimed that betelvine may require around 25% of full sunlight.

Red and blue light is an effective light source for all crops. It is known that red light is important for shoot/stem elongation, phytochrome responses and changes in plant anatomy (Schuerger, 1997) [10]. In contrast, blue light is important in chlorophyll biosynthesis, stomatal opening, enzyme synthesis, maturation of chloroplast and photosynthesis. Since the solar radiation has decisive importance in all plant vital processes such as photosynthesis, respiration, photoperiod, tissue growth and flowering, among others, a correct choice for protected environment cover material is a crucial issue for plant development (Sapounas *et al.*, 2010) [9]. On the other hand, shade netting is frequently used to protect agricultural crops from excessive solar radiation, improving the thermal climate (Kittas *et al.*, 2009) [4]. All wavelengths of photons within the range of PAR are not equally efficient in driving photosynthesis. Each pigment has its signature spectral property that defines its physiological activity at a certain wavelength of light. Chlorophyll a and b strongly absorb red light and blue light but weakly absorb green light (Nishio, 2000) [8]. Photosynthetic photon flux (µmol photons m^{-2} s^{-1}) is used to measure photosynthetically active radiation and gives equal weight to all photons within the photosynthetically active radiation range (McCree, 1972b). Photosynthetic efficiency curves over the light spectrum served as the foundation for the relative quantum efficiency curves established by McCree (1972a), which is cited in most current research related to photobiology and light quality. The relative quantum efficiency curve indicates that red light (600 to 700 nm) is 25 to 35% more efficient than blue light (400 to 500 nm) and 5 to 30% more efficient than green light (500 to 600 nm) in driving photosynthesis (Inada, 1976; McCree, 1972a) [3, 5] In the studies conducted by Mohanta and Pariari, (2016) [7] found that in winter season, due to low temperature and low humidity slow growth of vine was seen. High humidity and optimum temperature prevailing in rainy season influenced the growth of betelvine to a maximum extent. This variation is mainly due to change in climatic factors like temperature, relative humidity and canopy temperature (inside the *Boroja*) etc. Under such background the present investigation is conducted to study the interaction of betelvine with different intensity of light.

Materials and Methods

The present investigation was carried out at the Research Farm, Kalyani, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, during the year 2013 to 2015 in an established *boroja* (an artificially constructed structure with bamboo, jute sticks, paddy straws and ulu grass). Bangla type of betelvine cultivar Ghanagatte was used for study. At the time of experiment all necessary measure were undertaken when required such as vine lowering, irrigation, plant protection etc. The vines were watered regularly and fertilized with organic manures like FYM and oil cake. In control treatment (T1) plants were grown in normal *Boroja* condition while in full light treatment (T2) entire shading material was removed and plants were exposed to direct sunlight throughout different seasons. In 35% light treatments (T3), more paddy straws were added over normal *boroja* while in 70% light treatment (T4), little bit paddy straws were removed from normal *boroja* and plants were moderately exposed to sunlight. In Blue Shaded treatment (T5), *boroja* was covered with blue colored plastic shading material, in Green shaded treatment (T6) and Red shaded treatments (T7), Green and red colour plastic shade was used respectively. Amount of light passing through different shade creating material was recorded using LUX meter. Data is taken at three different spots *viz*. just above the shade in direct sunlight, one feet below the shed and one feet above the ground/soil level inside *boroja* and is mentioned in the table 1.

Table 1: LUX meter values under different shade creating materials

Varieties	Simurali Bhabna			Ghanagette		
Treatments	Upper	Below	Base	Upper	Below	Base
T1	1481	157	124	1463	164	117
T2	1403	1323	918	1241	1120	824
T3	1384	134	107	1405	140	98
T4	1457	763	571	1363	853	510
T5	1515	314	276	1486	287	198
T6	1445	198	177	1379	153	134
T7	1411	437	222	1411	270	173

The individual data of morphological characteristics were recorded in the field at the three season’s namely rainy season, winter season and summer season. Only the harvestable leaves were used for measurement of leaf characteristics. The parameters considered for analysis were leaf length (cm), leaf width (cm), vine elongation (cm), 100 leaves dry weight (g), SPAD values, leaf area (cm^2), and leaf yield $vine^{-1}$. Statistical analysis was done using factorial randomized block design.

Results and Discussion

Pooled values of the betelvine leaf length, leaf width and plant height over two years (2013-14 and 2014-15) of the seasons and treatments were shown in table 2.

Data showed that the variations in leaf length, leaf width and vine elongation due to seasons as well as light treatments were found to be highly significant indicating that there was substantial difference in leaf length, leaf width and vine elongation of the betelvine among the seasons as well as among the treatments. The leaf length values in the month of November (10.24 cm) were largest followed by those in the months of July (9.86 cm) and April (9.63 cm). Among the treatments, blue polythene shaded vines (13.46 cm) exhibited largest leaf length followed by red polythene shaded vines (11.29 cm), Green polythene shaded vines (10.27 cm), *Boroja* condition vines (9.41 cm), 35% light shaded vines (9.23 cm), 70% light shaded vines (8.27 cm) and in Full light (7.45 cm).

Leaf width values were fluctuated due to seasons between 8.48cm in the month of April and 9.08 cm in the month of November. However, due to different light treatments, values were fluctuated between 7.48 cm in full light and 10.74 cm in blue polythene shaded vine. Rahaman *et al.* (1997) in their study with twenty-seven cultivars reported the similar result in respect leaf length and leaf width over seasons.

Vine elongation: The length of betelvine increased significantly due to seasons as well as different light of treatments. Highest growth of the vines observed in the month of November (111.29 cm) followed by 104.0 cm in the month of July and lowest vine growth is observed in the month of April (99.28 cm). On the other hand, vine length of betelvine due to different light treatments significantly fluctuated between 92.38 cm in the vines grown in full light to 120.69 cm in blue polythene shaded vines. The variation due to treatment x season interaction was found to be non-significant indicating very less differential response on leaf length and leaf width but interaction was found to be significant in case of vine elongation indicating differential response due to treatments and seasons.

100 leaves dry weight: A value of 100 leaf dry weights is shown in figure 1. Dry weight values were found a significant effect under the different light treatments as well as seasons. Highest dry weight of leaf observed in the month of November (37.9 g) followed by July month (34.85 g) and least was in the month of April (32.83 g). Among treatments values were fluctuated between 23.74g in full light to 40.07g in blue polythene shaded vines. Treatment x season interaction was found to be highly significant in case of SPAD values.

SPAD values: Figure 2 shows that SPAD values were significantly higher among all three seasons as well as different light treatments. SPAD values were higher in polythene shaded vines than *boroja* condition. However, SPAD values were least in vines grown in 35% light, 70% light and full light. Treatment x season interaction was found to be nonsignificant in case of SPAD values.

Leaf area (cm²): The variations in leaf area (Fig. 3) due to seasons as well as light treatments were found to be highly significant indicating that there was substantial difference in leaf area between the seasons as well as among the treatments. The leaf area values in the month of November were largest followed by those in the months of July and April. Among the treatments, blue polythene shaded vines exhibited largest leaf area followed by red polythene shaded vines, green polythene shaded vines, *Boroja* condition vines, 35% light shaded vines, 75% light shaded vines and in Full light. The variation due to season x treatment interaction was also found significant.

Leaf yield vine^{-1}: The number of leaves differed significantly among seasons and in different light treatments (Fig. 4). The yield values in the month of November were highest followed by those in the months of July and April. Similarly, Among the treatments, blue polythene shaded vines exhibited highest number of leaves followed by red polythene shaded vines, green polythene shaded vines, *Boroja* condition vines, 35% light shaded vines, 75% light shaded vines and in full light. These results are akin to the findings of Mohanta and Pariari (2016) [7] who conducted the experiment on eight cultivars of betelvine with an objective to study the effect of various climatic factors on growth and leaf yield of the crop for consecutive two growing seasons and his result showed that growth and leaf yield of betelvine was more in rainy season and less in winter season.

In cases of straw thatched *boroja*, vine canopy is illuminated with sunflakes were only a small fraction of the canopy only is illuminated. As a result, in conventional *boroja* condition, assimilate production capacity is comparatively less. The order of performance of vines under colored polyethene's was Blue polythene > Red polythene > Green polythene. Blue colored polythene allowed only red and green light to the canopy. Similarly, red colored polythene allowed only blue and green light to the canopy and green colored polythene allowed only red and blue light to the canopy. Blue and red light is actively absorbed by photosynthetic pigments and is quickly absorbed by the upper canopy whereas green light is poorly absorbed by the photosynthetic pigments and penetrates down the canopy to be absorbed slowly. Besides, photosynthetic effectivity light has some regulatory role also. Blue light has inhibitory role on growth and expansion whereas red light has promoting effect in this aspect. Considering above aspects of the different light, the differential performance of the vines under different colored polythene may be interpreted. Under blue shaded polythene, vines received red and green light, the former was effective in photosynthesis as well as in growth promotion and the later had better penetration through the canopy. Hence, performance of vines under such polythene was best.

Table 2: Pooled effect of light intensity as well as season on the leaf length, leaf width and vine elongation of the betelvine cultivar Ghanagatte during year 2013-14 and 2014-15

	Leaf Length (cm)				Leaf Width (cm)				Vine elongation (cm)			
Treatments	**S1**	**S2**	**S3**	**Mean S**	**S1**	**S2**	**S3**	**Mean S**	**S1**	**S2**	**S3**	**Mean S**
T1	9.37	9.62	9.23	9.41	8.43	8.93	8.25	8.54	105.56	111.82	99.79	105.72
T2	7.39	7.66	7.30	7.45	7.41	7.82	7.21	7.48	91.29	96.16	89.69	92.38
T3	9.20	9.44	9.06	9.23	8.17	8.57	7.99	8.24	100.3	104.33	95.47	100.03
T4	8.15	8.60	8.05	8.27	7.75	8.01	7.48	7.75	95.69	99.54	92.85	96.03
T5	13.42	14.20	12.74	13.46	10.76	11.13	10.33	10.74	120.19	130.47	111.4	120.69
T6	10.19	10.58	10.05	10.27	8.95	9.21	8.81	8.99	104.94	115.38	101.78	107.37
T7	11.27	11.61	10.99	11.29	9.54	9.91	9.28	9.57	112.08	121.3	103.99	112.46
Mean T	9.86	10.24	9.63	9.91	8.71	9.08	8.48	8.76	104.29	111.29	99.28	104.95
Factor	S	T	S X T		S	T	S X T		S	T	S X T	
C.D. (*P*=0.05)	0.159	0.243	NS		0.117	0.179	NS		1.469	2.245	3.888	
S.Em (±)	0.055	0.085	0.147		0.041	0.062	0.108		0.512	0.782	1.355	

* S- Seasons (S1-Rainy, S2-Winter, S3-Summer); **T- Treatments (T1- *Boroja*, T2-Full light, T3-35% light, T4-70% light, T5- Blue polythene shaded T6-Green polythene shaded, T7-Red polythene shaded).

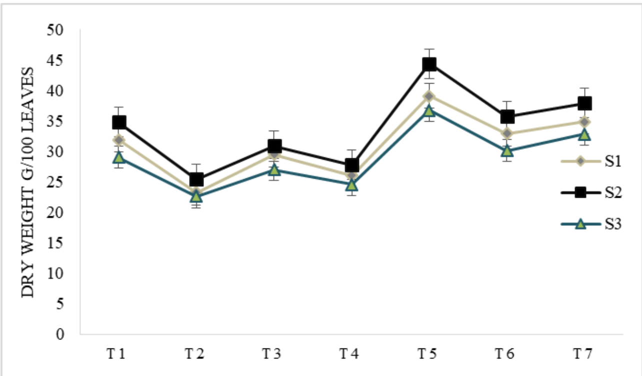

Fig 1: 100 leaves dry weight (g) of betelvine

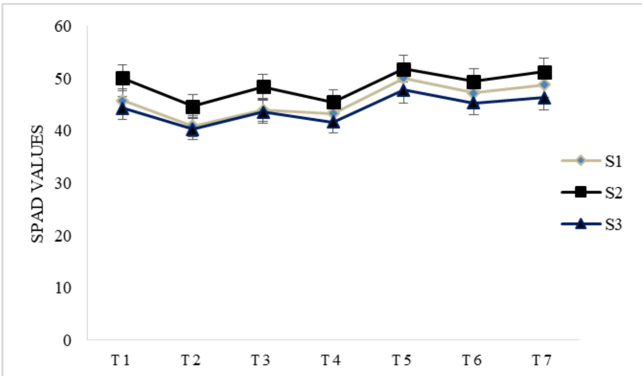

Fig 2: SPAD values of betelvine

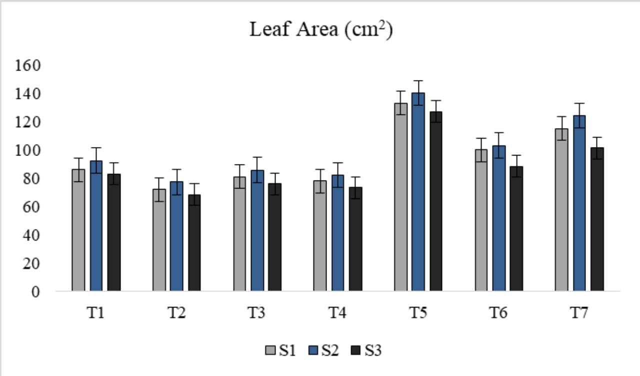

Fig 3: Leaf area (cm^2) of betelvine

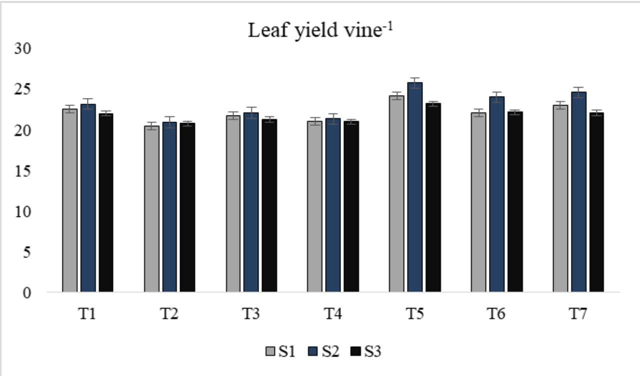

Fig 4: Leaf yield $vine^{-1}$ of betelvine

Conclusion

The leaf dimensions, Plant height, 100 leaves dry weight, SPAD values, Leaf area and yield of leaves were higher in the vines grown under polythene shade in comparison to those grown under unshaded condition or partially shaded with cereal straw conditions. Such better results in cases of polythene shaded condition may be due to uniform illumination of the canopy of the vines. Yield of the betelvine varies with the season. Leaves harvested in the month of April shown slowest growth of vine. It may be due to low temperature and low humidity received by vines during the winter season. High humidity, adequate rainfall and optimum temperature prevailing in the month of August to October influenced the growth of betelvine to a maximum extent which was harvested in the month of November.

References

1. Balasubramanyam VR, Johri JK, Rawat AKS, Tripathi RP, Chaurasia RS. Betelvine (*Piper betle* L.) National Botanical Research Institute Publication Lucknow, 1995, 453.
2. Bhutia N, Medda PS, Choudhuri P, Ghosh A, Pandit G. Effect of light intensity on different betelvine germplasm under terai region of West Bengal. The bioscan. 2015;10(3):1163-1168.
3. Inada K. Action spectra for photosynthesis in higher plants. Plant Cell Physiology. 1976;17(3):55-65.
4. Kittas C, Rigakis N, Katsoulas N, Bartzanas T. Influence of shading screens on microclimate, growth and productivity of tomato. Acta Horticulturae. 2009;807:97-102.
5. McCree KJ. The action spectrum absorptance and quantum yield of photosynthesis in crop plants. Agricultural Meteorology. 1972a;9:191-216.
6. McCree KJ. Test of current definitions of photosynthetically active radiation against leaf photosynthesis data. Agricultural Meteorology. 1972b;10(4):43-53.
7. Mohanta H, Pariari A. Effect of climatic factors on the growth and leaf yield of betelvine (*Piper betle* L.). Journal of Applied and Natural Science. 2016;8(2):1006-1009.
8. Nishio JN. Why are higher plants green? Evolution of the higher plant photosynthetic pigment complement. Plant Cell Environment. 2000;23(5):39-48.
9. Sapounas AA, Hemming S, De Zwart HF, Campen JB. Influence of insect nets and thermal screens on climate conditions of commercial scale greenhouses: A CFD approach. In Congress of the International Commission of Agricultural and Biosystems Engineering Proceedings, 2010, 379p.
10. Schuerger AC, Brown CS, Stryjewski EC. Anatomical features of pepper plants (*Capsicum annum* L.) grown under red light-emitting diodes supplemented with blue of far red light. Annals of Botany. 1997;79(3):273-82. doi: 10.1006/anbo.1996.0341.