European Journal of Medicinal Plants

30(4): 1-8, 2019; Article no.EJMP.53340
ISSN: 2231-0894, NLM ID: 101583475

Assessment of Growth Characteristics of Medicinal Plants *Ocimum tenuiflorum* L. and *Plectranthus amboinicus* (Lour.) Spreng. Under Shade Net and Open Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. Authors JA and VK designed the study, performed the statistical analysis and wrote the protocol. Author VK wrote the manuscript. Authors KS and KR carried out the experiments. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/EJMP/2019/v30i430186
Editor(s):
(1) Dr. Ghalem Bachir Raho, Department of Biology, Mascara University, Algeria.
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Reviewers:
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(2) Mary-Louise Mhazo, Mananga Centre for Regional Integration and Management Development, Eswatini.
Complete Peer review History: http://www.sdiarticle4.com/review-history/53340

Original Research Article

Received 25 October 2019
Accepted 30 December 2019
Published 04 January 2020

ABSTRACT

Aim: To study the effect of shade net on the growth characteristics of two medicinal plants viz., Tulsi and Indian Borage in terms of plant height, number of leaves, leaf area and flowering in relation to open condition.
Place and Duration of Study: Lawspet, Puducherry, India between June 2018 and October 2018.
Methodology: Tulsi and Indian Borage plants were grown in similar type of soil. The potted plants were kept in open, 35% and 75% shade net conditions and studied for 3 months. The plant height, number of leaves, and leaf area were measured including number of inflorescence branches for Tulsi.

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Results: The average air temperature was lower under shade net. Relative humidity was more in shade net conditions with maximum in 75% shade and least in open conditions. The number of leaves of Tulsi and Indian Borage recorded was maximum when grown under 35% shade and least in open conditions. Plant height was maximum in 75% shade for Tulsi and 35% shade in Indian Borage and least in open conditions on both the cases. Leaf area was maximum for both Tulsi and Indian Borage in 75% shade.
Conclusion: Growth of the two medicinal plants was influenced by the microclimate conditions. The present study shows that the medicinal plants can be grown in shade net conditions to increase the yield of medicinally useful parts.

Keywords: Medicinal plants; tulsi; Indian borage; shade net effect; growth characteristics.

1. INTRODUCTION

Plants have been an important source of traditional medicine and the historical evidence shows their usage for preparation of drugs as early as 5000 years ago [1]. About 60% to 90% of population in developing countries use medicinal plants as remedies according to World Health Organization [2] and it is estimated that approximately 25% of modern drugs are derived from natural products [3] that comes from among the 15% of plant species that have been evaluated to determine their pharmacological potential [4,5].

About 90 percent of medicinal plants used by the industries are collected from the wild. Although around 800 species are used in production by industry, less than 20 species of plants are under commercial cultivation [6]. Over 70 percent of the plant sampling involve destructive harvesting because of the use of parts like roots, bark, wood, stem and the whole plant in case of herbs. This poses a definite threat to the genetic stocks and to the diversity of medicinal plants if biodiversity is not sustainably used [7,8]. About 70 percent of rural population in India depends on the traditional Ayurvedic system of medicine. Most healers/practitioners of the traditional systems of medicine prepare formulations using their own recipes and dispense to the patients. In the Western countries, approximately 40 per cent of people are using the herbal medicine for the treatment of various diseases [9].

In India, around 7000 plant species are estimated to have medicinal usage in folk and documented systems of medicine, like Ayurveda, Siddha, Unani and Homoeopathy [9]. Medicinal plants are not only a major source for the traditional medicine and herbal industry but they also provide livelihood and health security to a bigger segment of Indian population [10]. Therefore, the demand for medicinal plant has been increasing in the recent past. There are various ways of increasing the yield of medicinal plants that include use of fertilizers, providing favourable environmental conditions, proper irrigation etc. Agro shade nets are also being used for this purpose. Shade nets have become more popular in hot and sunny regions and confer environmental benefits enhancing productivity and quality throughout the year in hot and sunny regions [11,12].

This study gives an insight into the effect of variation in microclimate including light (sunlight), temperature and relative humidity on the growth of two medicinal plants belonging to Lamiaceae viz., *Ocimum tenuiflorum* L. (Tulsi) and *Plectranthus amboinicus* (Lour.) Spreng. (Indian Borage). Both these plants have immense medicinal value. Different parts of Tulsi are used in traditional systems of medicine for prevention and cure of ailments like common cold, headache, cough, influenza, earache, fever, colic pain, sore throat, bronchitis, asthma etc. [13]. *Plectranthus amboinicus* is a perennial herb and occurs naturally throughout the tropics. It is known to have a number of medicinal properties including antimicrobial, antiinflammatory, larvicidal, antioxidant and analgesic activities. It has also been found to be effective against respiratory, cardiovascular, oral, skin, digestive and urinary diseases [14].

2. MATERIALS AND METHODS

Studies on growth parameters of Tulsi (*Ocimum tenuiflorum*) and Indian Borage (*Plectranthus amboinicus*) were initiated in 3 weeks old plants that were grown in mixture of soil, coir pith, dung manure, leaf compost and vermi-compost in the ratio 6:1:1:1:1 (modified method of Yadav et al. [15]). The plants were obtained from the experimental nursery and were identified using the species identification keys. Experiments were conducted on open terrace under three conditions as mentioned below:

- Treatment 1: Open condition
- Treatment 2: 35% shade net
- Treatment 3: 75% shade net

For each treatment 7 plants were studied i.e., each treatment replicated 7 times. The temperature and humidity were recorded at 9 a.m., 1 p.m. and 4 p.m. every day using HTC Digital thermohygrometer. The plant height (using scale), number of leaves, and leaf area were measured. The final measurements were taken after 3 months of growth.

The average number of leaves per plant for each treatment was calculated by dividing the total number of leaves and total number of plants for each treatment. Leaf area was measured for leaves in the 3rd node from the apex, by tracing the outline on a 1 cm grid and counting the number of squares within the outline (Grids/squares that are less than half covered were not taken into account); average leaf area was measured. Measurement of height of the plants were done following Heady [16].

3. RESULTS AND DISCUSSION

3.1 Microclimate

The average air temperature was lower under 35% and 75% shade net conditions and the temperature difference between open condition and shade net was more at 1 p.m. and less at 4 p.m. (Table 1). Relative humidity was more in shade net conditions with maximum in 75% shade (Average 61.05%) and least in open conditions (Average 48.57%).

3.2 Growth Parameters

The number of leaves of Tulsi and Indian Borage recorded was maximum when grown under 35% shade and least in open conditions. Plant height was maximum in 75% shade for Tulsi and 35% shade in Indian Borage and least in open conditions in both the cases. Leaf area was maximum for both Tulsi and Indian Borage in 75% shade (Figs. 1-7). Inflorescence branches were maximum for Tulsi in 35% shade (an average of 13 inflorescence branches per plant) and least for in 75% shade (an average of 7 inflorescence branches per plant). In Indian Borage flowering was not observed in the study period.

Microclimate constitutes complex of environmental variables such as temperature, humidity, light intensity and wind, to which the plants are exposed [17]. All of these variables are known to affect plant growth and development. The favourable conditions if known can be exploited in the enhancing the yield of morphologically useful part for food or traditional medicine. The present study on the effect of agro shade net on the growth parameters of Tulsi that is known to have a number of medicinal properties including anti-inflammatory, anti-pyretic, anti-allergic, antiasthmatic, anti-tussive, anti-ulcer, anti-emetic, antispasmodic and mosquito repellent [18] and growth parameters of Indian Borage that is also widely used in folk medicine to treat conditions like cold, asthma, constipation, headache, cough, fever and skin diseases [14], showed that the microclimate variation

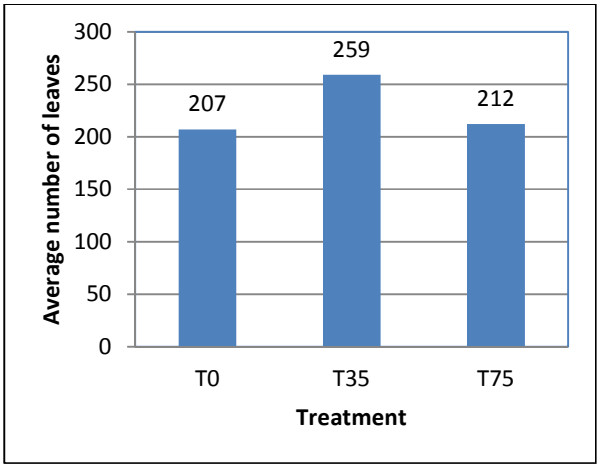

Fig. 1. Yield in terms of number of leaves in each treatment in Tulsi
(TO = Open, T35 = 35% Shade, T75 = 75% Shade)

Table 1. Results of microclimate in shade nets in relation to open condition

Time	Treatment 1 (Open)		Treatment 2 (35% shade)		Treatment 3 (75% shade)	
	Average air temp. (°C)	Average relative humidity (%)	Average air temp. (°C)	Average relative humidity (%)	Average air temp. (°C)	Average relative humidity (%)
9 a.m.	34	56.31	33.5	60.21	33	61.05
1 p.m.	39	48.57	37.4	52.12	36.9	52.9
4 p.m.	35.71	53.17	35.57	58.4	34.76	59.17

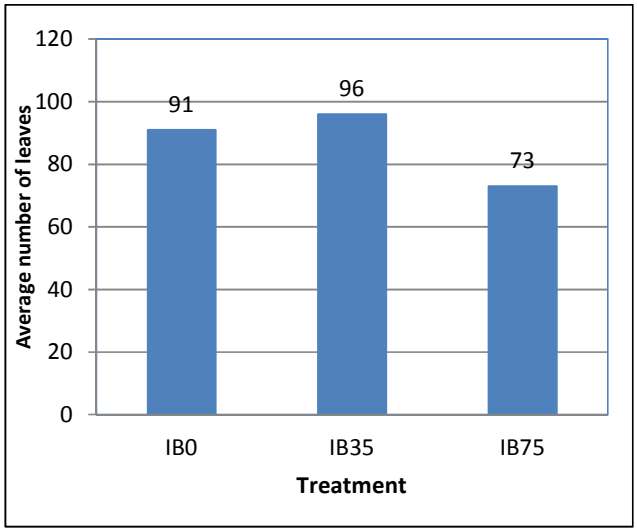

Fig. 2. Yield in terms of number of leaves in each treatment in Indian Borage
(IBO = Open, IB35 = 35% Shade, IB75 = 75% Shade)

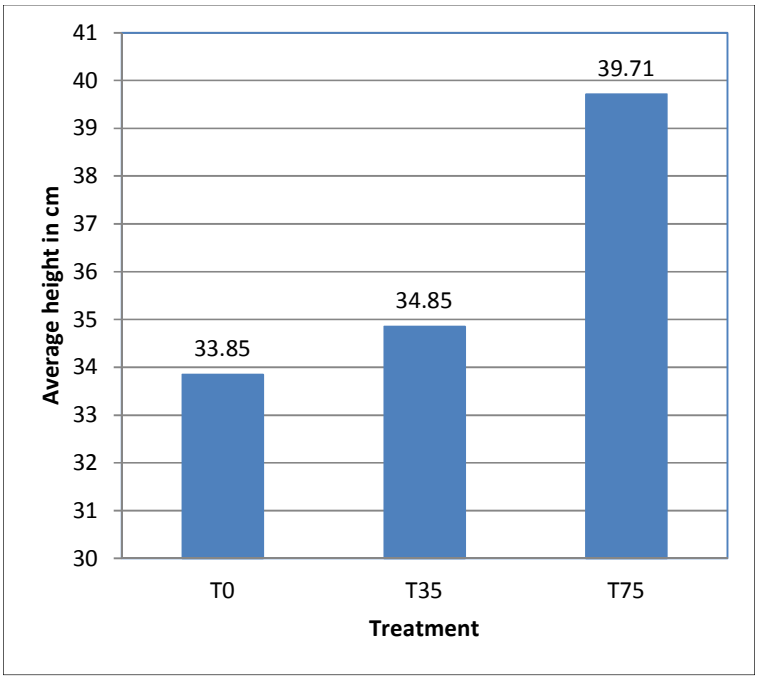

Fig. 3. Height of Tulsi plants in different treatments
(TO = Open, T35 = 35% Shade, T75 = 75% Shade)

influenced the growth favourably. Agro shade net creates an appropriate microclimate conducive to the plant growth and useful in cultivation of plants used for different purposes including medicinal plants, vegetables, ornamentals etc. [19]. The studies so far that have been done are in closed shade net condition, but the present study has been done with the shade net covering the upper portion as shown in the Fig. 7. Even with such a treatment there was change in average air temperature and relative humidity (Table 1). Relative humidity was maximum for the 75% shade net conditions and least for open conditions and the air temperature was least for the 75% shade net and highest for open conditions.

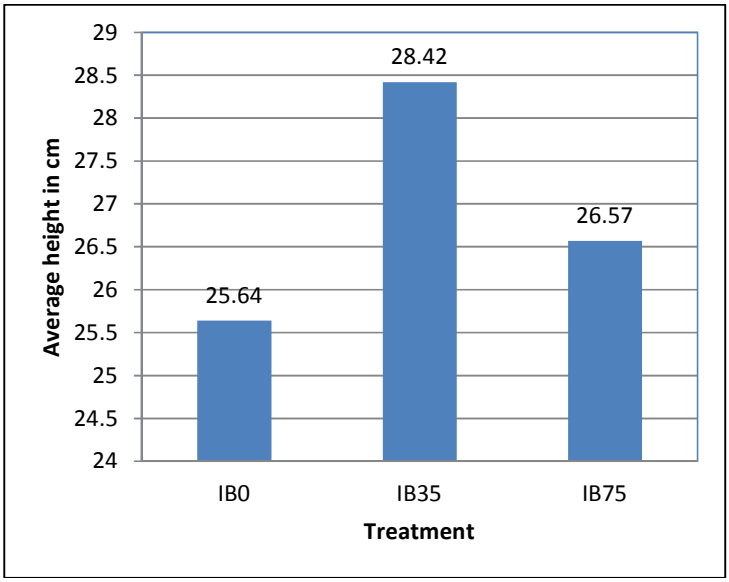

Fig. 4. Height of Indian borage plants in different treatments
(IBO = Open, IB35 = 35% Shade, IB75 = 75% Shade)

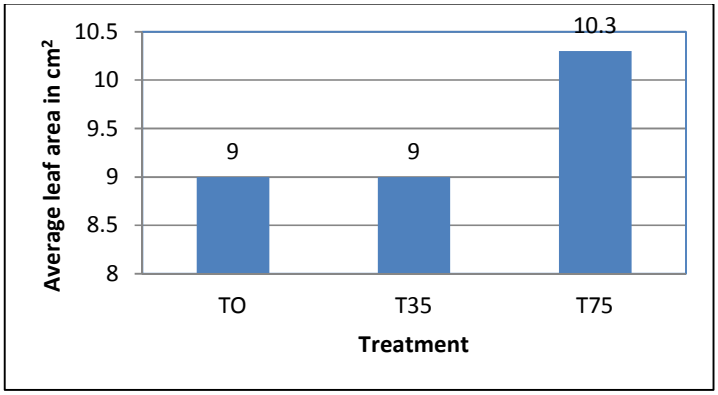

Fig. 5. Leaf area of Tulsi in different treatments
(TO = Open, T35 = 35% Shade, T75 = 75% Shade)

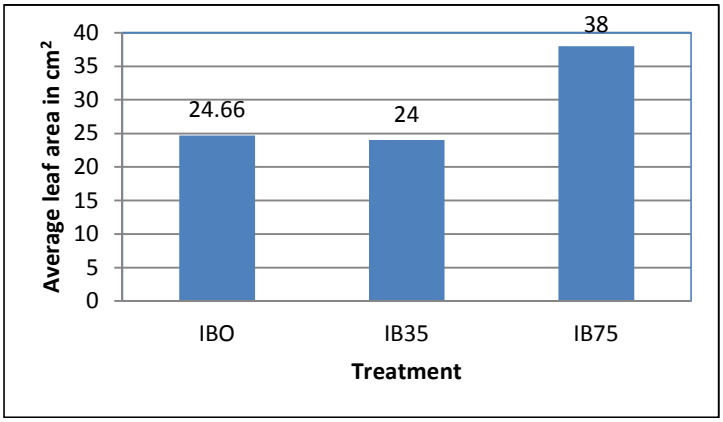

Fig. 6. Leaf area of Indian Borage in different treatments
(IBO = Open, IB35 = 35% Shade, IB75 = 75% Shade)

Fig. 7. Tulsi and Indian Borage in different treatments

Both the medicinal plants Tulsi and Indian Borage grown in shade net conditions resulted in more yield in terms of height of the plant, number of leaves and leaf area (Figs. 1-6). This is in contrary to the studies carried out by Behera et al. [19] where open conditions was found suitable for better yield of *Ocimum* and *Aloe*. There are no studies that have been done with respect of growth parameters covering with shade net only on the upper side. Such a treatment enables the plant to be protected from intense sunlight in arid conditions. In the present study only the vegetative characters are considered since the leaves are the medicinally useful parts.

4. CONCLUSION

The growth of medicinal plants were affected by the microclimate. The number of leaves and the leaf area was more for the plants grown under shade net suggesting the sunlight, temperature and relative humidity play important role in plant growth. Further, the shade conditions allow water to be retained in soil for longer periods and also reduces transpiration. To compensate the effect of low intensity sunlight conditions under shade the plants may produce more number of leaves (as in 35% shade) and greater leaf area (as in 75% shade) suggesting such adaptations can be used to obtain better returns in terms yield of medicinal plants. The plant height was more in shade net conditions which could be attributed to increase in the intermodal length. Therefore, it is concluded that the medicinal plants Tulsi and Indian Borage can be grown in 35% shade net conditions to increase the yield of medicinally useful parts.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENT

We thank Rev. Sister Rosily, Principal of St Joseph of Cluny HSS, Puducherry for encouragement. VK thanks Dr. D. Aravazhi Irissappane, Director, and Dr. B. K. Nayak, HOD of Botany, Kanchi Mamunivar Centre for Postgraduate Studies, Puducherry for encouragement.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/53340