

Environmental Evaluation of Bamboo Greenhouse for Vegetable Production

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ABSTRACT: Konkan region of Maharashtra receives heavy rainfall, causing high accumulation of humidity and resulting in attraction of pest and insect towards vegetable crops. To minimize the harmful effects over vegetables production and to increase production Bamboo greenhouse were developed. Environmental parameters viz. temperature, relative humidity and light intensity were recorded at different nine locations inside the bamboo greenhouse and outside the greenhouse. The average temperature inside and outside the bamboo greenhouse were 31.6 °C and 27.9 °C respectively. The average relative humidity inside and outside the bamboo greenhouse were 73 % and 85% respectively. The maximum light intensity inside and outside the bamboo greenhouse was in the range of 26900 to 45700 lux and 44800 to 88610 lux respectively. The temperature and humidity inside the greenhouse was maintained using ventilation control (curtains). The temperature and relative humidity was successfully maintained between 27.2 °C and 34.8 °C and 64 % to 78 %. These conditions are suitable for cultivation of tomato crop in the greenhouse.

Keywords: Bamboo greenhouse, environmental parameters.

INTRODUCTION

Greenhouse technology is the technique of providing favorable environmental growth to the plants. It is rather used to the plants from the adverse climatic conditions and also providing optimum conditions of light, temperature, and humidity for the best growth of plants to achieve maximum yield and best quality. A greenhouse is covered structure, which protects plants from wind, precipitation, excess solar radiation, temperature extremes and considerable pest and disease attack. The term greenhouse refers to a structure covered with a transparent material for the purpose of admitting natural light for the plant growth.

Konkan region is long strip running between 15° 60' N and 20° 22' N latitude and 72° 39' E and 73° 48' E longitude, flanked by Sahyadri ranges on the east and Arabian Sea on west. The total geographic area of Konkan region is 25,558 sq km. The west coast hilly region is treasure of the biodiversity with 20 % area under forest and receives annual rainfall of 3000-40000 mm. The average temperature of the region ranges from 18 to 35° C. This region receives solar energy for 8-9 months with average sunshine hour ranges

between 8.5 -9.5 hours per day. The Maximum and Minimum temperatures are 11.6 and 33.8°C. The minimum and maximum relative humidity is 45% and 95%. Konkan region is famous for vegetable production. Since 1990, due to linkage of Employment Guarantee Scheme with vegetable plantation, the area under the vegetable production increased tremendously. Now a days, thousands acres of land is brought under vegetable production every year, hence there is great demand for vegetable production in this region. As this region receives heavy rainfall, there is a high accumulation of humidity and this causes attraction of pest and insect towards the vegetable crops. So, to minimize the harmful effects over the vegetable production and to increase the production of vegetable, Department of Farm Structures, College of Agricultural Engineering and Technology, Dapoli has designed and constructed bamboo polyshed and study was undertaken to evaluate its performance.

MATERIAL AND METHODS

The present investigation was carried out in bamboo polyhouse for vegetable production at Research Farm

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of College of Agricultural Engineering and technology, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli located in the humid and tropical region on the west coast of Maharashtra. It is situated at an altitude of 280 m MSL at 17°12' North latitude and 73°12' East longitude. The average annual minimum and maximum temperature of Dapoli are 11.4°C & 32.7°C respectively; whereas relative humidity ranges from 43.7 to 95.2%. The structure used for study was newly designed bamboo polyhouse for vegetable production. The bamboo polyhouse and open field conditions are denoted as S₁ & S₂ respectively throughout the literature.

Inside Environmental Control

The inside environment of bamboo vegetable polyhouse was controlled using side ventilators, and shednet fixed at 3 m eve height. The top ventilators were kept fully open during the experiment. The opening and closing times of side ventilators and inside shednet where adjusted with inside temperature and solar intensity. The environmental data was recorded by keeping the side ventilators closed, open as per the requirement. Attempt had been made during the study to control temperature between 25-36 p C and solar intensity around 30000-50000 lux. As the rising in solar intensity and temperature were controlled by spreading or opening inside shade net as per the conditions.

Instruments to be used

The daily maximum and minimum greenhouse air temperature was recorded using sensor based thermo hygrometer with error of 0 and 0.1% respectively. Relative humidity was also measured with the help of sensor based thermo hygrometer. Dry and wet bulb temperature was measured by using mercury and alcohol dry and wet bulb thermometer as shown in plate 3.2 with error of 0 and 0.1% respectively. Light intensity was measured with the help of lux meter as shown in plate 3.3 with error of 0 and 0.1% respectively. The multistem thermometer was also used for recording temperature inside the greenhouse.

Environmental Conditions

In order to know the environmental condition inside the bamboo polyhouse, environmental observation inside the structure and open field were recorded. The data was recorded for temperature, relative humidity, and light intensity. The sunlight Intensity was measured by the lux meter and the temperature, relative humidity, was recorded by sensor based

thermo-hygrometer, dry and wet bulb hygrometer, and digital thermometer.. The measurement of these environmental parameters was done at nine different locations in the greenhouse. Observations were recorded at 8.00 hr, 12.00 hr, 14.00 hr and 18.00 hr of the day. Also observations were recorded at open field condition.

RESULTS AND DISCUSSION

Temperature Characteristics

The maximum temperature inside greenhouse for study duration was ranges between 27.6 p C to 35.8p C with mean value of 31.5 p C. The maximum temperature outside greenhouse 24.8 p C to 32.2 p C with mean value of 28.5 p C. The difference between inside and outside maximum temperature very least this might be due to rainy season. The trend between average maximum temperature in greenhouse and outside is shown in fig. 1.

The minimum temperature inside greenhouse for study duration was ranges between 24.12 p C to 28.8 p C with mean value of 26.46 p C. The minimum temperature outside greenhouse was ranges from 24.8 p C to 32.20 p C with mean value of 28.5p C. The difference between inside and outside minimum temperature very least this might be due to the rainy season. The trend between average minimum temperature in greenhouse and outside greenhouse is shown in fig. 2

Also the average temperature at different locations at different duration of the day in the Greenhouse is shown in table 1

Humidity Characteristics

The maximum humidity inside greenhouse for study duration was ranges between 65 % to 85 % with mean value of 75.5 %. The maximum humidity outside

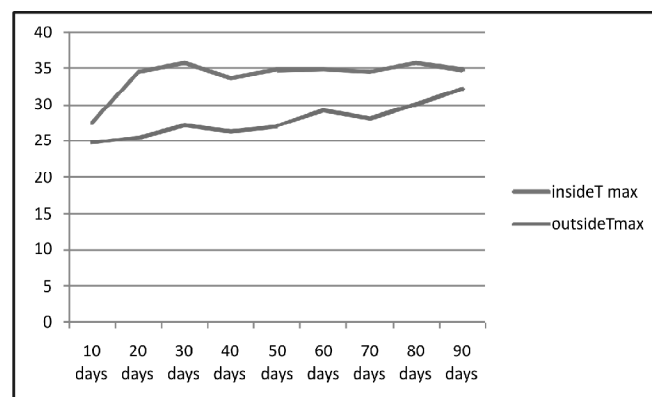


Figure 1: Trend between Average maximum temperature inside and outside greenhouse

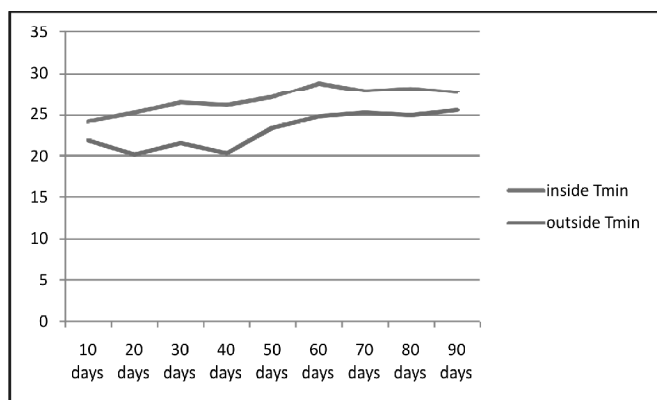


Figure 2: Trend between Average minimum temperature inside and outside greenhouse

greenhouse 82 % to 98 % with mean value of 89.9 %. The difference between inside and outside maximum humidity very least this might be due to rainy season. The trend between maximum humidity in greenhouse and outside greenhouse is shown in fig. 3.

The minimum humidity inside greenhouse for study duration was ranges between 63 % to 78 % with mean value of 70 %. The minimum humidity outside greenhouse was ranges from 75 % to 94 % with mean value of 84.5 %. The difference between inside and outside minimum humidity very least this might be due to the rainy season. The trend between Average minimum humidity in greenhouse and outside greenhouse is shown in fig. 4.

Table 1
Average Temperature at Different Location in the Greenhouse

Sr No	Duration (days)	Duration of the day (hr)											
		8.00 hr			12.00 hr			14.00 hr			18.00 hr		
		L.Z	M.Z	T.Z	L.Z	M.Z	T.Z	L.Z	M.Z	T.Z	L.Z	M.Z	T.Z
1.	10 Days	27.06	29.20	31.91	27.52	29.51	32.09	27.82	30.14	32.40	29.08	31.30	32.96
2.	20 Days	26.93	29.05	31.72	27.48	29.84	34.78	28.02	30.54	33.48	28.44	30.62	33.74
3.	30 Days	27.54	30.44	32.81	28.55	31.22	34.02	28.15	31.04	33.61	27.82	30.92	33.76
4.	40 Days	24.53	29.95	33.01	28.20	30.65	33.78	29.07	31.62	34.49	27.23	29.68	32.93
5.	50 Days	24.93	29.30	32.14	27.88	30.12	32.97	27.26	29.34	32.19	28.06	30.35	23.35
6.	60 Days	28.81	30.01	34.83	30.29	32.82	35.18	29.58	31.42	34.24	28.57	30.92	33.88
7.	70 Days	26.61	30.83	33.46	29.52	32.12	34.55	31.01	33.13	35.43	29.44	31.92	33.95
8.	80 Days	30.56	31.56	33.19	28.94	31.42	34.24	28.99	32.26	34.16	28.69	31.52	34.29
9.	90 Days	28.92	32.12	33.72	30.53	32.83	35.28	31.62	33.28	35.61	29.59	31.82	35.38
Average		27.32	30.27	32.97	28.78	31.71	34.09	29.04	31.41	33.94	26.34	31.05	32.69

LZ = Lower Zone, MZ = Middle Zone, TZ = Top Zone

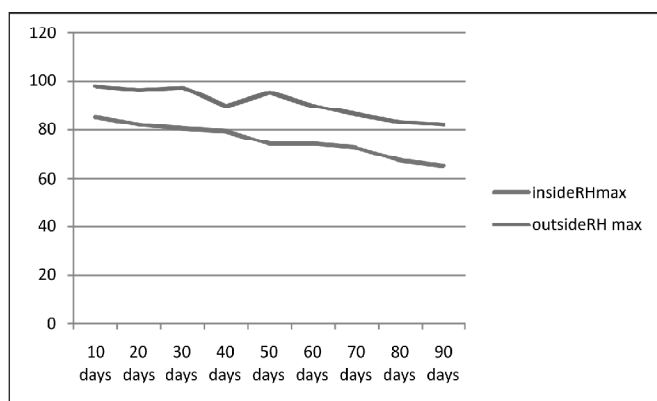


Figure 3: Trend between Average maximum humidity inside and outside greenhouse

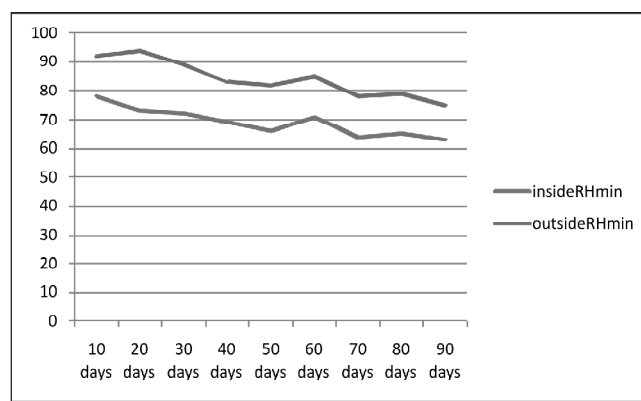


Figure 4: Trend between Average minimum humidity inside and outside greenhouse

Light Intensity Characteristics

The maximum light intensity inside greenhouse for study duration was ranges between 26900 lux to 45700 lux with mean value of 36300 lux .The maximum light intensity outside greenhouse 44800 lux to 88610 lux

with mean value of 66705 lux. The difference between inside and outside maximum light intensity very least this might be due to rainy season. The trend between maximum light intensity in greenhouse and outside greenhouse is shown in fig. 5

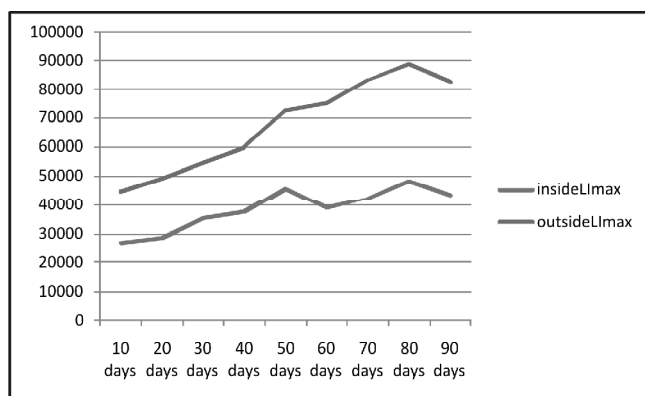


Figure 5 : Trend between Average light intensity inside and outside greenhouse

CONCLUSIONS

For Naturally Ventilated Triangular type Bamboo Greenhouse in konkan region in rainy season following conclusions were drawn:

1. The average temperature inside the greenhouse was recorded during study duration is 29.9 p C.
2. The average humidity inside the greenhouse was recorded during study duration is 73 %.
3. The temperature inside the greenhouse was successfully maintained between the range of 27.2 to 34.8 c.

4. The humidity inside the greenhouse was successfully maintained between the range 64% to 78%.
5. The maximum light intensity outside greenhouse 44800 lux to 88610 lux with mean value of 66705 lux.

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