RESEARCH ARTICLE

EVALUATION OF HYDROPONICS SYSTEM AND MICRO CLIMATIC PARAMETERS UNDER SHADE NET HOUSE

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Abstract: A study was taken up to determine the properties of the nutrient solution for the hydroponic system under shade net house and to study the micro climate parameters inside and outside the shade nethouse. EC and pH of the nutrient solution were observed for the hydroponics system. pH varies from 7.5 to 9.2 and EC varies from 1.14 to 1.43 ds/m. Temperature inside the shade net house was having slightly lesser value than outside atmospheric at range of 1.6 ºC to 2.7 ºC during the experiment period. Maximum and minimum temperature, relative humidity and light intensity were observed for the effective crop growth period.

Keywords: Hydroponics, Shade nethouse, Micro climatic parameters

INTRODUCTION

Hydroponics system provides essential nutrient supplement for the vegetable cultivation. Soil borne diseases can be completely avoided in hydroponics system of cultivation. Instead of crop growing in outside condition protected condition structure like shade net house would be the better choice for hydroponics system. Shade nethouse is covered with plastics net and available in different shade percentages. Shade net provides partially controlled atmosphere for the effective crop growth. Hence crops can be grown round the year. This study was taken up with the objective of studying the micro climate parameters inside and outside the shade nethouse and to evaluate the EC and pH of nutrient solution for the hydroponics system under shade net house in Agricultural Engineering College and Research Institute, TNAU, Kumulur, Trichy, TamilNadu.

Hydroponics is a new crop production system in which crops can be grown in a balanced nutrient solution with or without the help of an artificial medium. Nutrients and fertilizers are supplied to the crop through drip irrigation in the artificial medium or through the water in the channel system. Rosa-Rodriguez *et al.,*2020 determined that the water and fertilizer use efficiency in closed and open hydroponic systems and concluded that the closed system was good for the production of tomato with increased water and fertilizer use efficiency. Singh *et al.,* 2019 quantified the effects of different pH modifiers on growth and nutrient uptake of leafy greens in an Ebb and flow system and maintained pH between 5.5 to 6.5. Lee and Lee, 2006, found that the nutrient solution pH was stable during the entire leafy green growth period in hydroponic system, it was due to the balanced nutrient uptake during the growth cycle. The chemical properties such as pH and electrical conductivity are important parameters for optimum plant growth under hydroponics cultivation. Measurement of pH is essential to study about the fertilizer uptake rate. pH range would vary in each crop grown under soil less media. Abad *et al.,*2001 obtained that highest EC value from Peat compared to Peatmoss. Bradley and Marulanda 2000, found that increased water and nutrient efficiencies in vegetable crop under greenhouse combined with hydroponics. Affandi *et al.,* 2018 determined that the effects of pH on growth rate and yield of Cucumis sativus in different treatment media like rice husks ash, Lactobacillus and blank.

MATERIALS AND METHODS

Hydroponics set up

A wooden frame was made with the dimension of length 130 cm, width 100 cm and height 110 cm and kept inside shade net house with slope along lengthwise. The circulating channel of hydroponics system were made in 2" PVC pipe and placed on the wooden frame with the slope of 1 in 100. Holes were made in the PVC pipe with 5 cm diameter at a distance of 30 cm and small cups were placed in the holes to hold the plants. Slots were made at the bottom of the cup in order to allow the nutrient solution in continuous contact with the roots. One water tank (100 lt capacity) was kept at the ground and 200 lt capacity water tank was kept at the height of 1.5 m from the ground level in order to circulate

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the nutrient solution. A self-priming centrifugal pump (Power-0.37kW/0.5hp, Current-2.5A, Flow rate-30 lpm, Voltage-230 V, 50Hz, Head-20m, Speed-2800 rpm) was installed in order to pump nutrient solution from the bottom reservoir (tank) to the top reservoir.

The nutrient flow rate in these hydroponic system was adjusted around one litre per minute through the control valve so that the depth of re-circulating nutrient stream was very shallow, supplying nutrients with only a film (1-3mm) of water. The flow rate is adjusted through the control valves that provided on the pipe line. As water was pumped at one end, it was made to flow through the pipe channels, plants and finally it returned to the bottom reservoir (tank) and recirculation was done 5 times a day for the period 30 minutes per time. Leafy green was transplanted in the hydroponics system. Coir pith and paddy straw were used in the small cups to provide support to the plant. Urea, Potassium chloride, Diammonium phosphate, Magnesium sulphate were added as nutrient along with water.

Microclimatic Parameters of Shadenet House

Favorable climatic parameters are required for the good crop growth. Shade nets provides partial controlled environment which is feasible for crop production. Holcman and Sentelhas 2012, evaluated the influence of shading screens of different colors on the different microclimate variables in a greenhouse covered with transparent low-density polyethylene (LDPE). The highest temperature was observed under blue colour screen condition, which was 1.3 °C higher than external condition. He found that maximum difference in relative humidity in blue colour screen condition. Singh 2018 updated the concept of greenhouse effect and greenhouse gases. Briassoulis *et al.*, 2007, observed that increase in production as well as good quality of crop under shade net house condition. Goswamy and Panwar, 2014 reported the undesirable effect of elevated temperature on leaf area, total dry matter and yield in mung bean cultivation. According to Al-Helal & Abdel-Ghany, 2010 also shade net condition was favourable one especially during hot summer. Shahak *et al.*, 2002, also insisted the importance of colourful screens for the crop production as it stimulated good quality of produce.

RESULTS AND DISCUSSION

Light intensity

Light is an important factor that affects and motivates better growth of a plant. In shade net house due to shade there was low light intensity which led to equal distribution of radiation along the canopy. Aikman 1989, also supported this plant growth would be higher under low intensity light than the crop grown under high intensity light. Nangare *et al.*, 2015, found that higher yield in tomato plant under shade net house (35%) because of lower light intensity along the crop canopy. Variations in light intensity inside the shade net house during different time period is given in Fig.1.

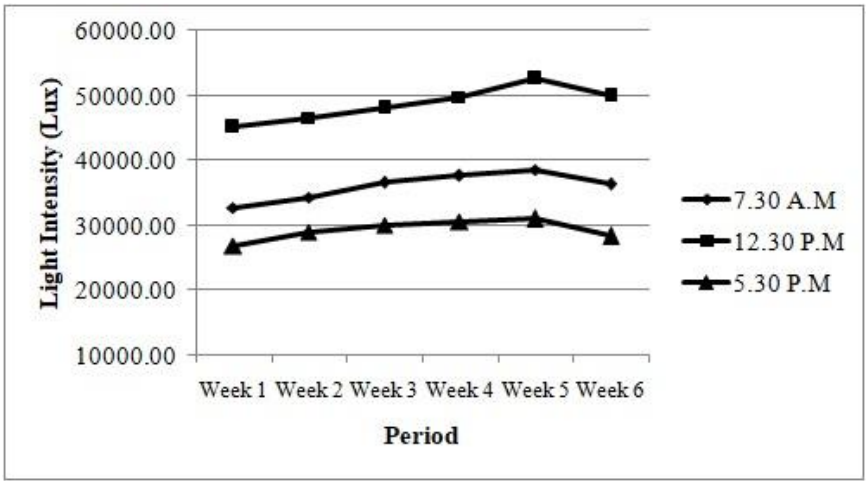

Fig. 1. Variations in light intensity inside the shade net house during different time

Relative Humidity

The relative humidity was found slightly higher inside shade net house due to the closed environment and less heat absorbance. Rajasekar *et al.*, 2013 reported that higher proportion of relative humidity led to increase in yield in sweet pepper as it stimulated vegetative growth and in case of cluster bean, bhendi and cucumber more number of branches per plant were observed for the crop grown inside shade net house and he concluded that for the better crop growth and yield control of micro climatic parameters were essential. Variations in Relative Humidity inside the shade net house during different time period is given in Fig.2.

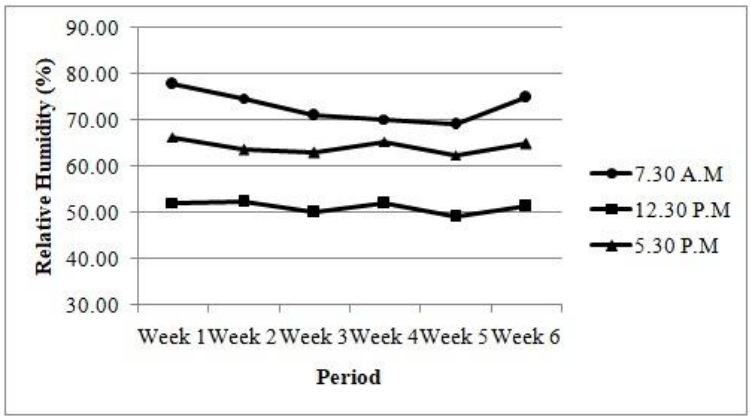

Fig. 2. Variations in Relative Humidity inside the shade net house during different time

Temperature

The average monthly maximum temperature varies from 15 to 33.4℃ and humidity varies between 30.4 to 61.2 percent during November to April in day time. There was no significant difference found in temperature and humidity in shade net as compared to open field. This was confirmed by Nangare *et al.,* 2015, that maximum solar radiation was recorded in out side cultivation of tomato plant than inside shade nethouse. Rajasekar *et al.,* 2013 observed higher yield in vegetable crops under shade net house with optimum temperature level. Variations in maximum temperature and minimum temperature inside the shade net house during different time period are given in Fig.3 and 4.

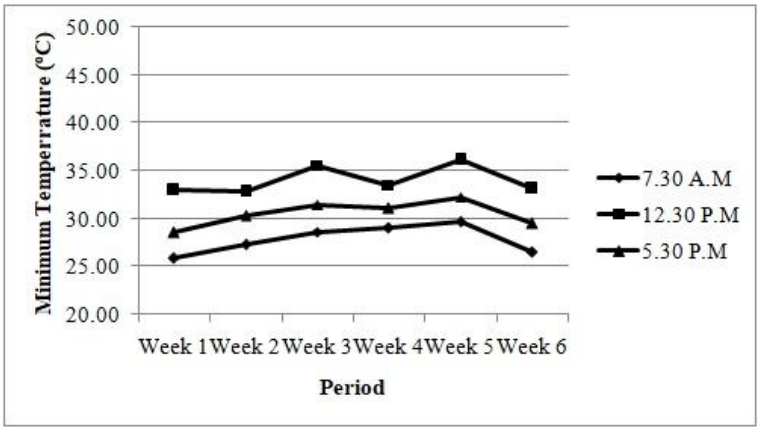

Fig. 3. Variations in Minimum Temperature inside the shade net house during different time

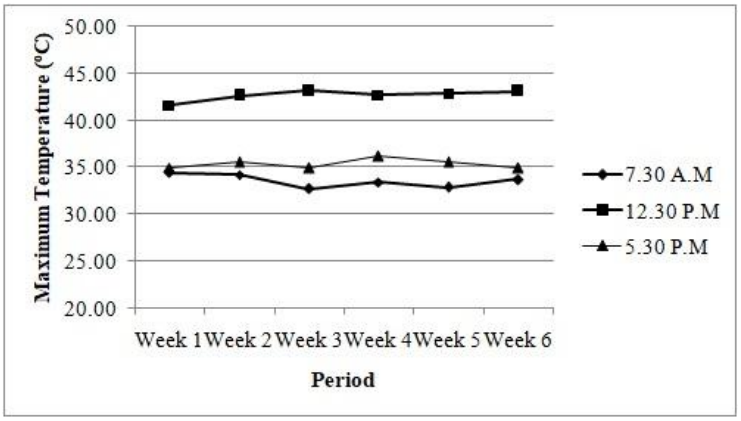

Fig. 4. Variations in Maximum Temperature inside the shade net house during different time

Climatic parameters inside shade nethouse

50% shade percentage net material was used in this study. For good quality of crop growth it requires normal light conditions. Even though there was slight light intensity reduction inside shade net house, that light intensity was enough for the crop production. More over the shade net cultivation protected the plants from direct sunlight.

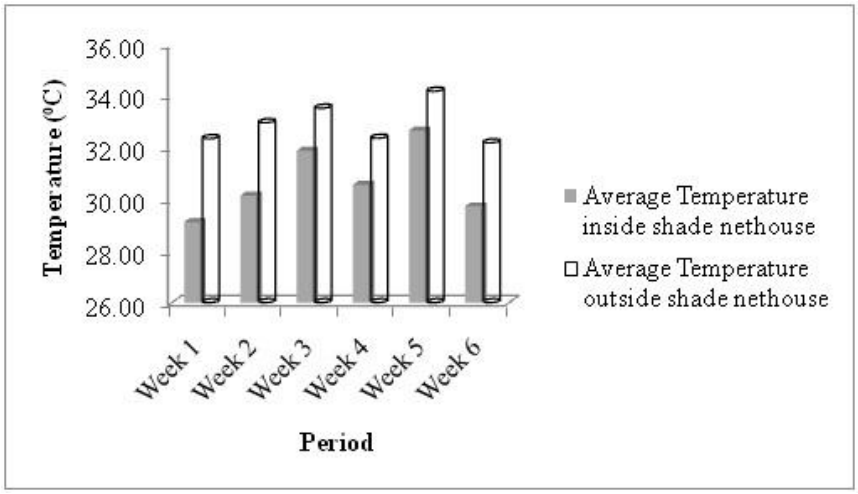

Fig. 5. Comparison of average temperature inside and outside shade net house

Temperature inside the shade net house was having slightly lesser value than outside atmospheric at range of 1.6 ºC to 2.7 ºC. Comparison of temperature inside and outside shade nethouse is given in Fig. 5. Even though the variation was very less, it played a significant role in crop growth. It reduced the loss of moisture from soil and transpiration loss from plants. This facilitated a slight reduction in crop water requirement and increased the water use efficiency.

Evaluation of EC and pH of hydroponics system

The EC and pH were monitored in the nutrient solution of Hydroponics. The pH value of media was measured and results are given in Fig 6. pH varies from 7.5 to 9.2 and EC varies from 1.14 to 1.43 ds/m. The pH was found maximum during initial stage because of nutrient concentration in the solution and decreased slightly as the plants absorbed the nutrients in the later stage.

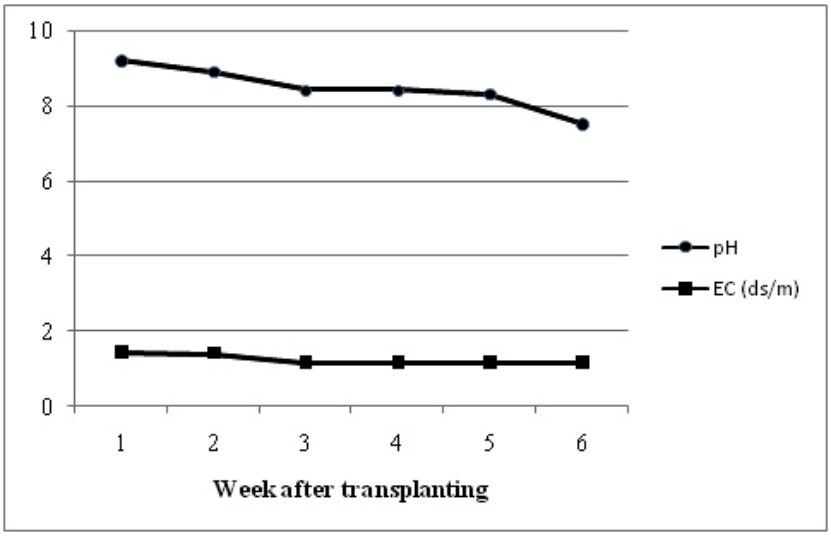

Fig. 6. pH and EC of hydroponics system

SUMMARY AND CONCLUSION

Temperature inside the shade net house was found less compared to outside condition. Relative humidity inside the shade net was higher during morning time. Light intensity was less inside the shade net house. This creates a appropriate climate inside shade net house when compared to outside condition thus ensured good crop growth. The pH was found maximum during initial stage because of nutrient concentration in the solution and decreased slightly as the plants absorbed the nutrients in the later stage.

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