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Variation in growth rate and production of hydroponically grown tomatoes at various location of indigenous shed house

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Abstract

Tomato is a prominent hydroponically grown crop in the world. For offseason tomatoes production, environment controlled greenhouses are usually constructed. However, production difference was observed at various location/site in the indigenously developed shed due variation in sunlight availability, temperature and humidity regulation. Research was conducted at experimental site of Institute of Hydroponic Agriculture, PMAS-Arid Agriculture University, Rawalpindi with an objective; to assess the yield difference at various location in indigenously developed shed house constructed for hydroponic vegetable production. Greenhouse are usually made of temper glass while in indigenous model polythene sheet was used as covering material. Four sites in the shed house were selected; T_1 (sunny side), T_2 (shady side), T_3 (exhaust fan side) and T_4 (cooling pad side). Influence of environmental difference on the plant height, number of cluster and total production was observed during experiment. The recorded data was statistically analyzed by selecting Complete Randomized Design (CRD). It was concluded that highest yield was recorded at the area having more sun light hours.

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Introduction

Tomato is one of the super-food that contain sugar, protein and high beta-carotene (Perveen *et al.,* 2015). Due to its great importance in the life and compensating prices in market, tomato is one of the most profitable vegetables in the world. Tomato is one of the most popular fruits of the world (Nasir *et al.,* 2015).

Population in the world is increasing day by day. Food demand is also increasing with population growth, small cultivated area may result in increasing food. Farmer are facing a lot of problems to optimize their yield per unit area. Only Hydroponic is a solution to meet demands of peoples. Yield of tomatoes cultivated hydroponically is more than two times as compared to crop grown in field due to its high production, control environment and crop management (Heyden, 2009).

The quality of water nutrients and environmental aspects must be better in hydroponics agriculture as compared to crop grown in soil. From an environmental point of view, hydroponics agriculture give great profit due to the quality yield, higher plant survival rates, high crop quantity, low wastage of water, lower expenses of fertilizers, reduction in the environmental pollution and decreased other resources i.e., labour and pesticides. Generally, some experiments have indicated that crop grown by hydroponics have superior nutritional quality (Treftz and Omaye, 2015; Logendra *et al.,* 2001). The production of tomato by hydroponics method give higher yield as compare to the conventional agriculture (Purquerio and Tivelli, 2006).

The greenhouse sites located near human residences and the sunlight interception into the greenhouses is restricted due to shades of buildinds and trees. Scientists are proposed to avoid construct greenhouses near buildings and shady area (Dickerson, 2011). The availability of sunlight is almost round the year, farmers use polythene sheet as covering material over structure of iron pipes and bamboo to trap the sunlight rays to give optimum temperature for the growth of off-season vegetables due to which average prices are high in the market as compared to traditionally crop grown in soil (Gellani, 2012). The hydroponic greenhouses supports suitable climatic circumstances that can used to grow off-season crops round the year. Tempered glass greenhouses are expensive in building and operation as compared to indigenously developed greenhouses. These greenhouses are suitable for growing of tomatoes, cucumbers, hot pepper and sweet pepper (Black *et al.,* 2008).

Technique for growing and obtaining more yield in winter and summer season vegetables are grown in the structure which is covered with plastic sheet. The greenhouse is the environmentally controlled structure, cover with glass or plastic sheet give more production because it is protected from harsh climatic conditions (Krishna, 2008). The objective of present study was to assess the yield difference at various location in indigenously developed hydroponic shed house.

Materials and methods

Study area

Research was conducted in indigenously developed shed house (100'×100'×10') at Institute of Hydroponic Agriculture, PMAS-Arid Agriculture University, Rawalpindi during the year 2018-19. Study area falls in the jurisdiction of district Rawalpindi *Pothwar* region of North Punjab, Pakistan.

Treatments

Four sides in hydroponic shed house were selected: T_1 (sunny side), T_2 (shady side), T_3 (exhaust fan side) and T_4 (cooling pad side).

Experiment

Four rows were selected for each treatment and five healthy plants were selected randomly from four rows for collecting data to observed production difference in the indigenously developed shed house. Cooling system was installed to control the temperature of internal environment against extreme temperature during summer season according to the plant requirements. Controlled environment is the key thing to grow off-season crops.

Exhaust fans create suction from one side of shed house. To fill that suction, air come from the opposite side towards suction side. Cooling pads were installed on the opposite side of the fans. Air pass through the cooling pads. Water is continuously falling on the pads. In evaporative cooling water fall on pads, saturate the air and lower its temperature. A submersible pump was used for continuous water circulation from water reservoir to pad and vice versa. Direction of plant rows in shed were from east to west. Cooling pads were installed at east while exhaust fans were on the opposite wall of shed.

Statistical Analysis

Data recorded for measuring variables (plant height, number of cluster and yield) were statistically analyzed by selecting CRD with the help of suitable software Statistix 8.1.

Results and discussion

Research was conducted for the comparison of four different sides (Sunny side, shady side, exhaust fan side and cooling pad side) of shed house on the basis of plant height, number of clusters and yield. Data recorded during experiment was statistically analyzed by using Completely Randomized Design (CRD) with the help of appropriate software Statistix 8.1 at 5% level of probability.

Plant Height (cm)

Mean plant height in (Table 1) of treatments T_1, T_2, T_3 and T_4 was measured 688.80, 570.20, 617.40 and 513.0cm. Maximum plant height 688.80cm was measured in treatment T_1 (sunny side) while second highest plant height 617.40cm was measured in T_3 (exhaust fan side). Minimum plant height 513.0cm was measured in T_4 (cooling pad side). Results showed that treatment (T_1) was significantly differ with treatments (T_2, T_3 and T_4) at 5% level of probability. Oliveira *et al.* (1995); Papadopoulos and Hão (1997) reported that variation in plant height due to several factors, such as crop sowing, sowing season, number of branches of plant and material of greenhouse.

Number of clusters

Number of cluster (Table 2) of treatments T_1, T_2, T_3 and T_4 was counted 18.4, 15.2, 17.0 and 14.0 respectively. Maximum number of clusters 18.4 was counted in treatment T_1 (sunny side) of shed-house while second highest number of cluster 17 was counted in treatment T_3 (exhaust fan side). Minimum number of clusters 14 were counted in treatment T_4 (cooling pad side). Results showed that treatment (T_1) was non-significant with treatment (T_3) and significant with treatments (T_3 & T_4) at 5% level of probability.

Table 1. Effect of different treatments on plant height.

Treatments	Plant height
T_1 Sunny side	688.80 a
T_2 Shady side	570.20 c
T_3 Exhaust fan side	617.40 b
T_4 Cooling pad side	513.00 d
LSD	28.78

Mean with similar letters are statistically non-significant at 5% level of probability.

Table 2. Effect of different treatments on number of cluster.

Treatments	Number of cluster
T_1 Sunny side	18.4 a
T_2 Shady side	15.2 bc
T_3 Exhaust fan side	17.0 ab
T_4 Cooling pad side	14.0 c
LSD	2.6

Mean with similar letters are statistically non-significant at 5% level of probability.

Yield (kg)

Yield (Table 3) of treatments T_1, T_2, T_3 and T_4 were observed 7.5, 4.7, 4.1 and 3.9kg respectively. Maximum production 7.5kg was observed in treatment T_1 (sunny side) while second highest production 4.7kg was observed in treatment T_2 (shady side). Minimum production 3.9kg was observed in treatment T_4 (cooling pad side). Results showed that treatment (T_1) is significantly differ with treatments (T_2, T_3 and T_4) at 5% level of probability. Hachmann *et al.* (2014) reported that if planting density is higher, there will be more yield.

Table 3. Effect of different treatments on yield.

Treatments	Yield
T_1 Sunny side	7.5 a
T_2 Shady side	4.7 b
T_3 Exhaust fan side	4.1 b
T_4 Cooling pad side	3.9 b
LSD	1.1

Mean with similar letters are statistically non-significant at 5% level of probability.

Conclusion and recommendation

It was concluded from the present research that sunny side of shed house proved to be successful for production of tomatoes as it gives highest plant height, number of cluster, yield. Yield difference was observed due to inappropriate rows direction of plants as they are parallel to the path of sun. It is recommended that rows of plants should be north to south.

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