RESPONSES OF BRINJAL TO DIFFERENT PLANT GROWING STRUCTURES AND COMPOSITION OF GROWING MEDIA IN THE ROOFTOP GARDEN

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CERTIFICATE

This is to certify that the thesis entitled, " RESPONSES OF BRINJAL TO DIFFERENT PLANT GROWING STRUCTURES AND COMPOSITION OF GROWING MEDIA IN THE ROOFTOP GARDEN " submitted to the Department of Agricultural Botany, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE IN AGRICULTURAL BOTANY, embodies the result of a piece of bonafide research work carried out by TANBIN NAHAR Registration No. 17-08271 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Prof. Dr. Mohammad Mahbub Islam

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Date: December, 2018

Place: Dhaka, Bangladesh

DEDICATED TO

MY

BELOVED PARENTS

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The Author

RESPONSES OF BRINJAL TO DIFFERENT PLANT GROWING STRUCTURES AND COMPOSITION OF PLANT GROWING MEDIA IN THE ROOFTOP GARDEN

ABSTRACT

This experiment was carried out at the rooftop garden of the Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh from May 2018 to October 2018 to evaluate responses of brinjal to different plant growing structures and different growing media in the rooftop garden. The experiment consisted of two factors, factor A-plant growing structures, *viz*., S_1= Plastic pot, S_2= Earthen pot and factor B-six different plant growing medium *viz*. M_0=Soil 100%(w\w) with Recommended Dose of Inorganic Fertilizers (RDIF)/ (control), M_1=Soil 80% (w\w) +20% Cow dung (w\w) along with RDIF, M_2=Soil 60% (w\w) + Cow dung 40% (w\w) along with RDIF, M_3=Soil 90% (w\w) +10% Vermicompost (w\w) along with RDIF, M_4=Soil 80% (w\w) +20% Vermicompost (w\w) along with RDIF and M_5=Soil 70% (w\w) +20%Cowdung (w\w) +10% Vermicompost (w\w) along with RIDF. The factorial experiment was laid out in a Completely Randomized Design (CRD) with four replications. The experimental result such as morphological character and yield of brinjal significantly influenced by different plant growing structures and plant growing media and their combination. As for plant growing structures, the plastic pot (S_1) gave the highest plant height, number of leaves per plant, branch per plant, flowers per cluster, flowers per plant, fruit length, fruit diameter, fruits per plant. The highest yield of fruits per plant (740.16 g) was obtained from plastic pot(S_2) and Soil 70%(w\w) +20% cow dung(w\w) +10% vermicompost(w\w) along with RDIF marked as S_1M_5. The lowest yield of fruits per plant (144.72 g) was obtained from earthen pot and Soil 100% (w\w) along with RDIF marked as S_2M_0. Considering the stated findings, it may be concluded that BARI Begun-8 planted in plastic pot and Soil 70% (w\w) +20% Cow dung (w\w) +10% Vermicompost (w\w) along with RDIF would be beneficial for increasing the yield of brinjal during *kharif* season in the rooftop garden under the climatic conditions of SAU.

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BARI	=	Bangladesh Agricultural Research Institute
HRC	=	Horticulture Research Centre
BBS	=	Bangladesh Bureau of Statistics
CRD	=	Completely Randomized Design
FAO	=	Food and Agricultural Organization
N	=	Nitrogen
et al.	=	And others
TSP	=	Triple Super Phosphate
MOP	=	Muriate of Potash
DAT	=	Days after Transplanting
ha^{-1}	=	Per hectare
g	=	gram (s)
kg	=	Kilogram
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resources and Development Institute
wt	=	Weight
LSD	=	Least Significant Difference
^0C	=	Degree Celsius
NS	=	Not significant
Max	=	Maximum
Min	=	Minimum
%	=	Percent
NPK	=	Nitrogen, Phosphorus and Potassium
CV%	=	Percentage of Co-efficient of Variance
UHI	=	Urban Heat Island

CHAPTER I

INTRODUCTION

Brinjal (*Solanum melongena L.)* is an important vegetable for its commercial and nutritional value in the world as well as in Bangladesh. Brinjal or Eggplant is a very common and favorite vegetable in Bangladesh which has link with the social, cultural and economic lives both rural and urban people. It is a member of the *Solanaceae* family, which includes tomatoes, potatoes, peppers etc. Its origin is considered to be Africa and were dispersed throughout the Middle East to Asia (Terri L., 2010). Regarding nutritional value, eggplant has a very low caloric value and is considered among the healthiest vegetables for its high content of vitamins, minerals and bioactive compounds for human health (Raigon *et al.*, 2008). In this respect, eggplant is ranked among the top 10 vegetables in terms of oxygen radical absorbance capacity (Cao *et al.*, 1996). It has no fat and supplies calories. It consists of almost 92.7 percent of water and is superior in terms of fiber, folic acid, manganese, thiamin, vitamin B6, magnesium and potassium contents to that most of other vegetables (Chadha and Kalloo, 1993)

Brinjal is by far the major vegetable representing some 41% by weight of all vegetables produced, occupying 19% of the land used to cultivate them. Farmers cultivate brinjal over the years due to higher profit, relatively fast-growing capacity, low risk involvement, easy technological adoption etc. (Rashid, 2002). Farmers are provided with an assured income and resource-poor consumers have access to a much-needed, nutritious vegetable, in the summer months when other vegetables are in short supply (Ferdous, 2007). Bangladesh is obtained the food sufficiency but in the nutritional point of view, it has far away from achieve the safety and quality food production.

Brinjal is a delicate, tropical and perennial plant. It grows 40 to 150 cm tall with large, coarsely lobed leaves. The total world production for eggplant in 2017 was 52,309,119 metric tons (FAO STAT 2016-2017). In Bangladesh, over 45665 acres of total cultivable land is devoted to brinjal production of 159891 metric ton of brinjal (BBS, 2018). Brinjal is the second most important vegetables in Bangladesh in terms of both production area and yield. In Bangladesh, brinjal is classified into two categories in respect of production period. These are *rabi*-brinjal and *kharif*-brinjal. Brinjal grown in Bangladesh are of different varieties. They differ in size, shape and color as well.

Yield of brinjal are very low in Bangladesh however, it is not an indication of low yielding potentially of this crop but the fact of low yield may be attributed to a number of reasons *viz.*, unavailability of quality seeds of high yielding varieties, land for production based on fertilizer management, judicious application of organic and inorganic manure, pest infestation and improper irrigation facilities as well as production in abiotic stress conditions. The environmental stresses for brinjal cultivation resulting from nutrient, drought, temperature, salinity, air pollution, pesticides and soil pH are major limiting factors in crop production (Hernandez *et at*., 2001; Alqudah *et al.*, 2011). In Bangladesh, nutrient stresses of soils are increasing day by day. Depletion of soil fertility has been identified as a major constraint for higher crop yield. Use of fertilizer is an essential component of modem farming of today with about 50% of the world crop production (Prodhan. 1992). Among the cultural technologies like application of organic manures with other inorganic fertilizers and selection of right variety is the important one.

The roof garden is a garden on the roof. This means that each roof covers with plants such as trees, shrubs, bushes and grasses. Roof gardening can also be defined as 'environment or nature in the sky'. Similarly, if vegetables are allowed to grow on the roof in place of other ornamental plants then it is called roof top vegetable garden. Green roofs are roofs of buildings covered with a growth substrate and plants, which are also known as roof gardens, living roofs, and eco-roofs. In the rooftop garden, plant growing structure such as wooden and concrete bed, earthen and plastic pot and their sizes are major concern to grow different crops including tomato, brinjal, chili etc. (NeSmith and Duval, 1998). The concrete structure including building roof occupies almost 60% area of the total area along with decreased vegetation which increases urban temperature and create UHI in dhaka city (ahmed et al., 2013). Proper irrigation and drainage are necessary for the availability of nutrients along with improved microclimate of the rooftop garden. Water requirement is different is unequal in different season. In addition, growing vegetable on roof top reduces the expenditure on purchase of vegetable from the market. It also provides minerals rich good quality fresh organic vegetable free from chemical, thus contributing to nutritional security. However, to my knowledge limited study have been done for the growing of brinjal as *kharif* season vegetable in the rooftop garden of SAU.

As plant growing structure, plant growing media is also a major concern for the development of sustainable rooftop garden. The choice for composition of the growing medium depends on weight and on the space and nutrients that different plants need for their growth. It is thus more efficient to choose a lighter medium in order to have a deeper soil depth and as a result a more efficient plant growth and health. Several growing materials like vermicompost, sand, wood chips, grass clippings that have spent several weeks in a pile, household compost, corncobs, rice hulls, shredded coconut husks, sugar cane bagasse (what is left after the juice is squeezed from the cane), coffee pulp etc. and perlite can be used to make up the medium. The growing medium should contain sufficient organic matter and allow the roots to aerate sufficiently. Rooftop containers can range from simple pots to more elaborate systems. As much as possible locally available and recycled material could be used. Here plant growing media holds an importance in rooftop gardening as it contains nutrition and other requirements for plant to survive in adverse condition. Plant growing media should be light weight. However, to my knowledge no study has been done to find out best composition of soil, organic nutrition as cow dung, vermicompost, inorganic fertilizer for growing brinjal as *Kharif* season crops in the rooftop garden of SAU.

Objectives:

1.To identify the suitable plant growing structure/structures in support of brinjal cultivation during *kharif* season for the rooftop garden.

2.To find the suitable plant growing medium\media in support of brinjal cultivation during *kharif* season for the rooftop garden.

3.To study the interaction effects between plant growing structures and plant growing media on changes in morpho-physiology and yield of brinjal cultivation during *kharif* season in the rooftop garden.

CHAPTER II

REVIEW OF LITERATURE

Brinjal is one of the popular and important vegetable crops throughout the tropic and subtropics and also Bangladesh. A large number of varieties/tines of brinjal having wide variability in different characters are being cultivated in Bangladesh and some of the variations are so localized that their cultivation beyond the particular zone is completely unknown. The crop has received much concentration by the researchers on various aspects especially application of manure and fertilizers. Many studies in relation to different aspects such as pest control, seedling age, planting geometry, fertilizers and irrigation management for different variety have been carried out in Bangladesh and as well as many countries of the world, but for the different aspect of rooftop garden for brinjal production the conducted research is rare.

This research was conducted to identify the effects of different plant growing structures on brinjal in rooftop garden as well as to analyze the effect of different plant growing medium on them with their best possible interaction. Different research work in this respect has been reviewed below.

2.1 Effect of different plant growing structures on morpho-physiological parameters and yield of various plants including brinjal

Bouzo and Favaro (2016) conducted trials to examine the effects of container size during spring-summer on tomato. The first experiment was conducted in a greenhouse to measure the effect on the initial yield. A second experiment was performed outdoors to incorporate the effect of plant age on the development and yield. Commercial hybrid tomato seeds of the cv. 'Tauro' were dry sown in containers of different volumes (20, 40, 70 and 350 mL) and with variable transplant times (14, 21, 28 and 35 days). The authors found that an increase in the container size results in plants of higher size and yield.

Arabi *et al.* (2015) stated that green roofs are alleviating urban heat island (UHI). Rooftop garden as green roof mitigate the air pollution, improving management of run-off water, improving public health and enhancing the aesthetic value of the urban environment. They recommend that the using green roofs as a main strategy for decreasing the harmful impacts of UHI especially the high air temperatures as well as their ability to add to the greening of cities.

Metwally (2016) carried out an experiment with different substrate culture systems in relation to growth and production of hot pepper; beds system (100 liter of substrate/m2, depth 10 cm), big pots system (60 liters of substrate/m2, depth 15 cm), small pots system (30 liters of substrate/m2, depth 13 cm) and horizontal bags system (90 liter of substrate/m2, depth 10 cm). The author found that hot pepper plants grown in big pots system has the highest values regarding: plant height, number of leaves, aerial parts fresh and dry weights, root fresh and dry weights, yield per m2 and highest nitrogen and phosphorus percentages in leaves and suggest that the big pots system could be recorded as the most suitable substrate culture system for producing hot pepper in rooftops gardens.

An investigation aimed to fertility management for tomato production on an extensive green roof by Ouellette (2013). This research project evaluated four fertilizer treatments on ‘Bush Champion II’ tomato (*Solanum lycopersicum*) growth and yield in a 7.62 cm green roof production system: (1) vermicompost tea, 2) Miracle-Gro fertilizer, 3) Organic Miracle-Gro fertilizer, 4) no fertilizer. Results indicated that Miracle-Gro provided the highest total tomato fruit yield, which was 30% and 50% more in 2011 and 2012, respectively, compared to the next highest treatment - Organic Miracle-Gro®. Therefore, these results suggested that tomato can be successfully grown in a 7.62 cm green roof medium when given adequate fertilizer applications.

Ahmed *et al.* (2013) reported that the amount of built-up area of Dhaka city built-up area increased by 88.78% in the past 20 years (from 1989 to 2009) and is expected to increase three-fold and four-fold by 2019 and 2029, respectively. In 1989, a larger part of the Dhaka Metropolitan (DMP) area (74%) fell within the lower temperature zones (<18°C to < 21 °C). But in 1999, a majority of the area (91.40%) was found to fall into the mid-temperature zones (21 °C to < 27 °C). This trend continues, and a larger portion of the DMP area (44%) moved into the higher temperature zones (27 °C to <30 °C) in 2009. Therefore, it is suggesting that the temperature of Dhaka city is gradually increasing day by day with changing environment.

Celik (2010) performed a theoretical analysis of air-conditioning energy savings with different green roof applications. Thermal data was collected from a typical non-reflective (EPDM) roof membrane and model green roof systems with three types of growth media (lava, arkalyte and hadite) matched with three sedum types (*Sedum kamtchaticum, S. spurium,* and S. *sexangulare*). Temperature readings underneath the growth media and from the non-reflective roof membrane were recorded for 32 months continuously. Results demonstrated that the right combination of growth media and vegetation can yield significant energy savings for air-conditioning.

Carter and Rasmussen (2006) reported that rooftop garden reduces ambient air temperatures, extends the roof life, energy savings, increases bird and insect habitat, increase the beauty of the building or city, improve ecosystem, source of food and nutrition.

Hui (2006) stated that green roof system showed a positive effect on mitigation of urban heat island and enhance the building thermal and environmental performance.

Liu (2002) identified rooftop garden as an important component of any strategy to reduce greenhouse gas (GHG) emissions. He stated that Rooftop garden reduce energy demand on space conditioning, and hence GHG emissions, through direct shading of the roof, evapo-transpiration and improved insulation values. From his experiment, he indicated that rooftop gardens could reduce the airborne pollutants, UHI, heat stress, energy consumption and improve storm water management.

2.2 Effect of different plant growing medium on the growth and yield of brinjal

Shilpi *et al.* (2014) conducted an experiment at 1-Lorticultural Research Farm to study the effect of different doses of organic manures and inorganic fertilizers on growth, yield and quality of brinjal. The experiment consisted of different doses of FYM (100.75, 50 and 25 %), Vermicompost (100, 75, 50 and 25 %) and Neem cake (100, 75, 50 and 25 %) along with recommended dose of fertilizer. The result showed that the yield attributing parameters were recorded maximum in terms of fruit length (22.33 cm), fruit diameter (4.88 cm), fruit weight (123.11 g), number of fruits per plant (16.66), fruit yield per plant (2.05 kg), fruit yield per plot (32.80 kg) and fruit yield per hectare (75.93 ton) under 25% RDF+ 75% Neem cake while, all the yield and yield attributing parameters found minimum under control.

Agbo *et al.* (2012) carried out an experiment to ascertain the optimal rate of organic manure and the frequency of its application on the growth, yield, and some vitamins and mineral composition of the fruits of *S. melongena L*. Four rates of organic manure (0, 10, 20, and 30 t hi') were applied at three varying frequencies namely: single, split, and split-split. Data revealed that days to flowering, plant height, number of trusses per plant, and number of leaves per plant increased with increase in rate of organic manure. At maturity, 30 t/ha of organic manure gave the highest mean value on number of leaves per plant, and plant height which was statistically similar to the values obtained in plants that received 20 t/ha Increase in rates of organic manure increased the individual fruit weight of the harvested fruits, which declined as the harvest progressed.

Split-split method of organic manure application increased the individual fruit weight over the split, and single dose applications, respectively. study was conducted by Suge *et al.* (2011) at Bukura Agricultural college farm aimed at evaluating the effect of combination between two levels of the recommended mineral fertilizers (50% and 100% of research recommended rates) with three types of organic manures on growth, fruit yield and quality of eggplant (*Solarium inelongena* L.) var. black beauty. The experimental design was split plot design with three replications, where two levels of mineral fertilizers treatments (50% and 100%) were randomized in main plots while three types of organic manures (FYM, Compost and Tithonia) and control treatments were randomized in the subplots. Results showed significant differences in eggplant growth, fruit yield and quality between the two main treatments (50% RRR and 100% RRR), the three organic manures and their control. The plants in the organic manure treated plots were characterized with vigorous vegetative growth, which in turn led to increase in total fruit yields as well as improving fruit quality. The farm yard manure was considered the superior source of manure to obtaining the highest value of the parameters under study as compared to compost.

Castro *et al.* (2005) evaluated no tillage systems in aubergine (*Solanum melongena*) based organic cropping systems in Seropedica, Rio de Janeiro State, Brazil. inter-cropping with leguminous species did not reduce aubergine yield. In a succeeding experiment, no-tillage (with *Crozalaria juncea* and spontaneous weed mulches) and conventional ploughing were compared. These treatments were combined with increasing levels of poultry manure (0, 100, 200 and 400 kg N/ha). In terms of biomass input, *C. juncea* was superior to spontaneous weeds. The highest yield of aubergine (50.6 t/ha) was obtained with the highest rate of manure (36.9 t/ha for the control plots).

Yadav *et al.* (2002) stated that a field experiment was conducted on sandy loam typic Ustocrept soil, in Ilisar, Haryana, India to study the effect of high RSC water along with gypsum and farmyard manure (FYM) oil the soil, growth and yield of brinjal (aubergine) cv. Hisar Pragati. The initial soil pH, ECE, ESP, CEC and organic carbon was 7.2, 1.5 dS/m. 6.7, 9.3 cmol per kg soil and 0.30%, respectively. It was observed that the pH and the ESP of the soil decreased significantly both with the addition of FYM and gypsum. The yield and growth parameters also creased up to addition of FYM @ 10 t/ha.

Khattak *et al.* (2001) studied the effect of different levels of nitrogen on the growth and yield of different cultivars of eggplant under the agro-climatic conditions of Peshawar. Effect of different nitrogen levels (0, 50, 75, 100, 125, 150 kg/ha) on aubergines (Solarium melongena) cultivars Black Bahar, Long Purple, Neelam Long and Special Black were studied at Agriculture Research Institute Tamab, Peshawar, Pakistan, in 2000. Different levels of nitrogen significantly increased number of branches, leaves and fruits/plant, stem thickness, plant height and yield at 125 kg nitrogen/ha, while minimum values for these parameters were observed in different treatments. Maximum number of branches (7.84), leaves (285.380) and fruits/plant (13.67), stem thickness (1.19 cm) and yield (17674.91 kg/ha) were noted for the plants receiving 125 kg nitrogen/ha, while minimum number of branches (6.37), leaves (280.77) and fruits/plant (11.08) were obtained in control treatment and minimum stem thickness (1.01 cm) and yield (14062.41 kg/ha) were found when 50 kg nitrogen/ha was applied.

Godase and Patel (2001) studied the influence of organic manures and fertilizer doses on the intensity of sucking pests: (*Amrasca biguttula biguttula*) and Aphid (*Aphid gossypii* Glover) infesting brinjal. The nine treatments of organic manures and fertilizers, namely 100:37.5:37:5 kg NPK, 50 t FYM, 10 t FYM+50.T 8.75:18.75 kg NPK, 4 t vermicompost, 1.7 t neem cake, 200:37.5:37.5 kg NPK, 50:37.5:75 kg NPK, 0.85 t neem cake+50:18.75:18.75 kg NPK and zerofertilizer application were evaluated against jassid (*Amrasca biguttula biguttula*) and aphid (*Aphis gossypii*) infesting aubergine at N.M.

Prasanna, Rajan (2001) showed that brinjal [aubergine] cv. Surya plants were supplied with farmyard manure (FYM, at 20 and 38 t/ha); poultry manure (at 6.67 and 12.92 t/ha); FYM at20 t/ha and NPK at 75 : 40 : 25 kg/ha; and fertilizers equivalent to the NPK content in 20 and 38.5 t/ha FYM, and 6.67 and 12.92 t/ha poultry manure, in an experiment conducted during 1993-97. Fruits from the different treatments were harvested and stored in paper plates under open conditions. After 5 and 7 days of storage, the highest number of unmarketable fruits were from plants treated with inorganic fertilizers, while the lowest were from plants treated with organic fertilizers.

Yadav *et al.* (2002) stated that a field experiment was conducted on sandy loam Typic Ustocrept soil, in Hisar, Haryana, India, during 1996-97 and 1998-99 to study the effect of high RSC water along with gypsum and farmyard manure (FYM) on the soil, growth and yield of brinjal [aubergine] cv. Hisar Pragati. The initial soil pH, ECE, ESP, CEC and organic carbon was 7.2, 1.5 dS/m, 6.7,9.3 cmol/kg soil and 0.30%, respectively. It was observed that the pH and the ESP of the soil decreased significantly both with the addition of FYM and gypsum. There was a significant increase in growth and yield of brinjal with the addition of gypsum in both the years. The yield and growth parameters also increased up to addition of 10 t FYM/ha.

Bhattacharyya and Ghosh, 2001 showed the effects of phosphorus, sulfur and farmyard manure (FYM) application on yield, availability of phosphorus from fertilizer sources, its uptake and utilization by the crop were studied by a pot culture experiment with brinjal (*Solarium melongena*) in a typic Ustocrept soil of IARI farm, New Delhi, India. Four levels of phosphorus viz. 0, 5.95, 11.90 and 17.85 mg kg (0, 30, 60 and 90kg P205 per ha), three levels of sulfur viz. 0, 6.82 and 13.64mg kg (0, 15 and 30kg S hi') and two levels of FYM viz. 0 and 77.78 g (0 and 25 tones ha) were applied in all possible combinations. Maximum beneficial effect with respect to fruit yield on dry weight basis was noted in the combined application of 11.90 mg kg' phosphorus, 6.82 mg/kg sulfur with FYM. Percent utilization of added phosphorus was maximum when lowest level of phosphorus was applied with highest level of sulfur. Available phosphorus content in soil both at pre-flowering and harvesting stages increased due to application of highest levels of phosphorus, FYM and sulfur but synergistic effect was found only up to 6.82 mg kg' level of sulfur. Combined application of phosphorus with FYM and sulfur was beneficial as percent phosphorus derived from fertilizer values increased in soil at both stages of crop growth.

CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials and methods that were used in carrying out the experiment. It includes a short description of location of the experimental site *i.e,* rooftop garden, analysis of soil, cowdung, vermicompost, climate and materials used for the experiment. The details are to evaluate morpho-physiology and yield of brinjal is influenced by different kinds of plant growing structures and plant growing media during *kharif* season in the rooftop garden.

3.1 location of the experimental area

The experiment was done at the rooftop garden of the Department of Agricultural Botany, Sher-e-bangla Agricultural University, Dhaka-1207, Bangladesh from May 2018 to October 2018 to appraise morpho-physiology and yield of brinjal is influenced by different kinds of plant growing structures and plant growing media during *Kharif* season in the rooftop garden (Appendix I).

3.2 Climate of the experimental area

The area is characterized by hot and humid climate. The average rainfall of the locality of the experimental area is 220.06 mm, the minimum and maximum temperature is 20.12°C and 41.80ºC respectively. The average relative humidity was 65.8 % during May 2018 to October 2018.

3.3Analysis of soil, cowdung and vermicompost

The soil and cowdung were collected from Amin Bazar, Dhaka. Vermicompost was purchased from a nursery owner, Agargaon, Dhaka. The soil, cowdung and vermicompost were analyzed and given in Appendix II.

3.4Plant materials used

In this research work, the seed of one brinjal variety was used as planting materials. The brinjal varieties used in the experiments were BARI Begun-8. BARI Begun-8 was collected on 11 April 2018 from the Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI) at Joydebpur, Gazipur.

3.5 Raising of seedlings

Brinjal seedlings were raised in seedbeds of 2.0 m × 1.0 m size at the farm of SAU. The soil was well prepared and converted into loose friable and dried for seedbed. All weeds and stubbles were removed and well rotten cow dung was mixed with the soil. Before sowing, 50gm Furadan was applied around each seedbed as precautionary measure against fungus, ants, worm and other harmful insects. In each seedbed seeds were sown on 25 April 2018. The emergence of the seedlings took place with 7 to 8 days after sowing. Diathane M-45 was sprayed in the seedbeds @ 2 g/l immediately after the emergence of seedlings to protect the seedlings from damping off and other diseases. Weeding, mulching and irrigation were done as and when required.

3.6 Treatments

The experiment consisted of two factors; (A) Different types of plant growing structures and (B) Different plant growing medium. The levels of the two factors were as follows:

Factor (A) Different types of plant growing structures

i. S_1=Plastic pot (16 liters). ii. S_2=Earthen pot (16 liters)

Factor (B) Different plant growing medium

i. M_0=Soil 100%(w/w) with Recommended Dose of Inorganic Fertilizers (RDIF)/ (control)
ii. M_1=Soil 80% (w/w) +20% Cow dung (w/w) along with RDIF
iii. M_2=Soil 70% (w/w) + 30% Cow dung (w/w) along with RDIF
iv. M_3=Soil 90% (w/w) +10% Vermicompost (w/w) along with RDIF
v. M_4=Soil 80% (w/w) +20% Vermicompost (w/w) along with RDIF
vi. M_5=Soil 80% (w/w) +10%Cowdung (w/w) +10% Vermicompost (w/w) along with RDIF

Treatment combinations:

S_1M_0	S_2M_0
S_1M_1	S_2M_1
S_1M_2	S_2M_2
S_1M_3	S_2M_3
S_1M_4	S_2M_4
S_1M_5	S_1M_5

3.7 Design and layout of the experiment

The experiment was laid out in a Complete Randomized Design (CRD) with four replications. The 48 plants were planted in the earthen pot and plastic pot. The earthen and plastic pot size were 40 cm in diameter and 30 cm in height with the depth of 25 cm.

3.8 Pot preparation

Earthen pots and plastic pots were filled 10 days before transplanting. Plant growing media were made completely stubbles and weed free.

3.9 Preparation of plant growing media

The soil, cow dung and vermicompost were used according to treatments. The following inorganic fertilizers such as Urea, TSP, MOP, Gypsum, Boric acid and Zinc oxide were applied as a source of N, P_2O_5, K_2O, S, B and Zn respectively. All inorganic fertilizer and 1/3 Urea and 1/2 MOP were mixed in the soil during plant growing media preparation. The rest Urea and MOP were applied into three equal splits as required.

3.10 Uprooting and Transplanting of seedlings

The seedbed was watered before uprooting the seedlings from the seedbed so as to minimize damage to the roots. All healthy and uniform brinjal seedlings were uprooted separately from the seedbed and were transplanted in the experimental pots in the afternoon of 25 May 2018 with maintaining 70 cm distance from row to row and 70 cm from plant to plant. Each seedling was transplanted at the center of the pot. After transplanting shading was provided and kept till the establishment of seedlings.

3.11 Intercultural operation

After transplanting of seedlings, various intercultural operations such as irrigation, weeding and top dressing etc. were accomplished for better growth and development of the brinjal plants.

a) Weeding and Mulching

Weeding and mulching was done to keep the pots clean and for easy aeration of soil which ultimately ensured better growth and development of plants. The newly emerged weeds were uprooted carefully.

b) Staking

When the plants were well established, staking was done by giving bamboo sticks to each plant to keep them erect.

c) Irrigation

Irrigation was provided with a watering can immediately after transplanting the seedlings and continued till the seedlings established in the pots.

d) Top dressing

Urea and MOP was used as top-dressed in 3 equal installments at 30, 50 and 70 DAT. The fertilizers were applied on each plant and mixed well with the soil. Earthing up operation was done immediately after top-dressing with fertilizer.

e) Plant protection

Shobicron 425 EC, Syngenta, Bangladesh was applied 2ml/L to control Brinjal shoot and fruit borer. The insecticide application was made fortnightly for a week after transplanting to a week before first harvesting. Furadan 10 G was also applied during final land preparation as soil insecticide.

3.12 Data collection

Each plant was considered for data collection on the following parameters:

Plant height(cm), number of leaves per plant, number of primary and secondary branches per plant, number of flowers cluster per plant, number of flowers per plant, SPAD values of leaf, fruit length(cm), fruit diameter(cm), fruits per plant, individual fruit weight(g)

3.12.1 Plant height

Plant height at 60, 90 and 120 days after transplanting (DAT) was taken from each plant from the ground level to the tip of the plant by a measuring scale and mean value was calculated in centimeter (cm).

3.12.2 Number of leaves plant^{-1}

Number of leaves per plant was counted at per plant at 60,90 and 120 days after transplanting (DAT).

3.12.3 Number of primary and secondary branches plant^{-1}

Number of primary branches was counted at 60 days after transplanting (DAT).

3.12.4 SPAD value of leaf

SPAD value of leaf were measured at 40 DAT by SPAD meter

3.12.5 Number of flower cluster plant^{-1}

Total number of flowers was counted up to 100 DAT from each plant and was calculated.

3.12.6 Number of flowers plant^{-1}

Total number of flowers were counted up to 100 DAT from each plant and was calculated.

3.12.7 Fruit length (cm)

The length of fruit was measured with a measuring scale from the neck of the fruit to the bottom of each fruits from each plant and their average was taken in centimeter (cm) as the length fruit.

3.12.8 Fruit diameter (cm)

Diameter of fruit was measured at the middle portion of each harvested fruits from each plant with a slide calipers and their average was taken in centimeter (cm) as the diameter of fruit.

3.12.9 Fruits plant^{-1}

Total number of fruits were counted after harvested from each plant and was calculated.

3.12.10 Fruits weight plant^{-1} (g)

A per scale balance was used to take the weight of individual fruit from each plant. It was measured by Individual fruit separately during the period of final harvest and was recorded in gram (g).

3.13 Harvesting

Harvesting was done after the fruits reached at maturity stage. Brinjal fruits were harvested when the attained full maturity indicating deep violet in color and hard in consistency. Harvesting was started 78 DAT and was continued up to 150 DAT at 10 days interval as economic production.

3.14 Statistical analysis

The recorded data on various parameters were statistically analyzed by using MSTAT-C statistical package program. The mean for all the treatments was calculated and analysis of variance (ANOVA) for all the characters was performed by F-test. Difference between treatment means were determined by Duncans' new Multiple Range Test (DMRT) according to Gomez and Gomes, (1984).

CHAPTER IV

RESULTS AND DISCUSSION

This chapter comprises the presentation and discussion of the results from the experiment. The experiment was conducted to determine the effects of morpho-physiology and yield of brinjal as influenced by different kinds of plant growing structures and plant growing media during *kharif* season in the rooftop garden. The data of this study have been presented and expressed in table (s) and figures for discussion, comparison and understanding of the experimental findings. A summary of all the parameters have been shown in possible interpretation wherever necessary have given under the following headings.

4.1 Plant height (cm)

Plant height is one of the important morphological parameters which is always considered as the yield contributor for brinjal plants. Plant height at 60, 90 and 120 days after transplanting (DAT) was taken from each plant from the ground level to the tip of the plant and mean value was calculated in centimeter (cm) and showed significant difference of plant height to different plant growing structures (Table 1, Appendix III). The plant growing structure of plastic pot (S_1) had the highest plant height (78.16 cm) at 60 DAT. The lowest plant height (63.56 cm) was obtained from the earthen pot (S_2). At 90 DAT, plant growing structure plastic pot (S_1) had the highest plant height (94.95 cm). The lowest plant height (83.11 cm) was obtained from the plant growing structure earthen pot (S_2). For 120 DAT, plant growing structure plastic pot (S_1) had the highest plant height (103.02 cm). The lowest plant height (94.42 cm) was obtained from the plant growing structure earthen pot (S_2). An increase in the container size results in plants of higher size and yield, also plants grown in big pots system has the highest values regarding plant height (Bouzo and Favaro, Metwally2016). These results suggest that plastic container could promote the vegetative growth of brinjal for *kharif* season.

As plant growing structures, plant growing media *i.e*. different composition of inorganic and organic materials also showed significant difference on plant height at 60, 90 and 120 days after transplanting (DAT) of brinjal (Table 2 Appendix III). At 60 DAT, the composition of soil and organic matter (soil(w/w) + 10% cow dung(w/w) + 10%vermicompost (w/w) along with Recommended Dose of Inorganic Fertilizer (RDIF)

M_5 produced the tallest plant (77.45 cm) while the shortest plant (65.57cm) was produced by control M_0 condition. At 90 DAT, the tallest plant (96.10 cm) was obtained from M_5 and shortest plant (83.09 cm) was obtained from control condition. At 120 DAT, the tallest plant (108.3 cm) was produced by M_5 and shortest plant (89.54 cm) was produced by M_0. Application of cowdung and organic fertilizers record higher plant height, number of leaves, leaf area and leaf area index (Jagadeesha, 2008). This experimental result suggests that the height of brinjal plant increases with the addition of organic matter either sole or together use of cowdung or vermicompost.

Table. 1. Effect of plant growing structures on the plant height of brinjal

Plant Growing structure (S)	**Plant height at different days after transplanting (DAT)**		
	60	**90**	**120**
S_1	8.16 a	94.95 a	103.02 a
S_2	63.56 b	83.11 b	94.42 b
LSD $_{(0.05)}$	**3.15**	**4.05**	**4.73**
Level of sig.	*	*	*
CV %	**7.08**	**7.25**	**7.62**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of variation

*Significant at 5% level of significance

S_1= Plastic pot, S_2= Earthen pot

Table. 2. Effect of different plant growing medium on the plant height of brinjal

Plant growing media (M)	Plant height at different days after transplanting (DAT)		
	60	**90**	**120**
M_0	65.57 c	83.09 d	89.54 c
M_1	68.21 bc	85.08 cd	92.60 c
M_2	69.22 bc	87.70 b-d	96.21 bc
M_3	71.57 b	89.91 a-c	101.5 ab
M_4	73.13 ab	92.29 ab	104.2 a
M_5	77.45 a	96.10 a	108.3 a
$LSD_{(0.05)}$	**5.10**	**6.56**	**7.66**
Level of sig.	*	*	*
CV %	**7.08**	**7.25**	**7.62**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

* Significant at 5% level of significance

M_0=Soil 100%(w/w) with Recommended Dose of Inorganic Fertilizers (RDIF)/ (control)

M_1=Soil 80% (w/w) +20% Cow dung (w/w) along with RDIF

M_2=Soil 70% (w/w) + 30% Cow dung (w/w) along with RDIF

M_3=Soil 90% (w/w) +10% Vermicompost (w/w) along with RDIF

M_4=Soil 80% (w/w) +20% Vermicompost (w/w) along with RDIF

M_5=Soil 80% (w/w) +10%Cowdung (w/w) +10% Vermicompost (w/w) along with RDIF

The interaction effect of plant growing structures and plant growing media indicated a significant variation in plant height at 60, 90 and 120 DAT (Table 3, Appendix III). At 60 DAT, the tallest plant height (85.68 cm) was found in S_1M_5 plastic pot treatment combination with soil 80%(w/w) + 10% cowdung (w/w) + 10% vermicompost (w/w) along with RDIF and the smallest plant (57.50 cm) was found in S_2M_0 earthen pot with control treatment combination. The tallest plant height (102.6 cm) was obtained from S_1M_5 and smallest plant height (77.55 cm) was found in S_2M_0 at 90 DAT. At 120 DAT, the tallest plant (113.6 cm) was produced by S_1M_5 and smallest plant height (85.11 cm) was found in S_2M_0 treatment. These results suggest that plastic pot along with together use of cowdung and vermicompost gave the highest plant height compared to earthen pot with sole or together application of cowdung and vermicompost.

Table 3. Interaction of different plant growing medium and plant growing structures on plant height of brinjal

Interactions (S×M)	Plant height at different days after transplanting (DAT)		
	60	90	120
S_1M_0	73.65 b-d	88.62 b-e	93.98 d-f
S_1M_1	75.50 bc	90.62 b-d	95.21 c-f
S_1M_2	76.97 b	93.60 a-c	100.6 b-e
S_1M_3	77.50 b	96.75 ab	105.1 a-c
S_1M_4	79.68 ab	97.50 ab	109.6 ab
S_1M_5	85.68 a	102.6 a	113.6 a
S_2M_0	57.50 g	77.55 f	85.11 f
S_2M_1	60.92 fg	79.55 ef	89.97 ef
S_2M_2	61.47 fg	81.80 d-f	91.84 ef
S_2M_3	65.65 ef	83.07 d-f	97.90 c-e
S_2M_4	66.57 d-f	87.07 c-e	98.74 c-e
S_2M_5	69.22 c-e	89.57 b-d	102.9 a-d
LSD $_{(0.05)}$	**7.22**	**9.28**	**10.83**
Level of sig.	*	*	*
CV %	**7.08**	**7.25**	**7.62**

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance.

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

S_1= Plastic pot, S_2= Earthen pot

M_0= Soil 100% (w/w) with Recommended Dose of Inorganic Fertilizer (RDIF)/control, M_1= Soil 80%(w/w) +20% cowdung (w/w) along with RDIF, M_2= Soil 70%(w/w)+ 30% cowdung (w/w) along with RDIF, M_3= Soil 90%+10% vermicompost (w/w) along with RDIF, M_4= Soil 80% (w/w) +20% vermicompost (w/w) along with RDIF, M_5= Soil 80%(w/w)+ 10% cowdung (w/w) +10% vermicompost (w/w) along with RDIF

4.2 Number of leaves plant^{-1}

The effect of different plant growing structures was influenced on number of leaves per plant at 60, 90 and 120 DAT (Table 4 Appendix IV). At 60 DAT, the plant growing structures, plastic pot had the highest number of leaves per plant (27.79) and the lowest number of branches per plant (21.23) was obtained from the earthen pot (S_2). The plastic pot S_1 had the highest number of leaves per plant (39.25) at 90 DAT and the lowest number of leaves per plant (32.90) was obtained from S_2, earthen pot. Again 120 DAT, the plant growing structures, plastic pot had the highest number of leaves per plant (42.93) and the lowest number of branches per plant (37.00) was obtained from the earthen pot (S_2). These results also consistent with the plant height of brinjal of this study (Table). These results showed that plastic pot has given highest number of leaves per plant whereas from earthen pot show the lower number of leaves per plant.

Table 4. Effect of plant growing structures on the number of leaf plant^{-1} of brinjal

Plant Growing structure (S)	**Number of leaf plant^{-1} at different days after transplanting (DAT)**		
	60	**90**	**120**
S_1	27.79 a	39.25 a	42.93 a
S_2	21.23 b	32.90 b	37.00 b
LSD $_{(0.05)}$	**1.07**	**1.83**	**2.01**
Level of sig.	*	*	*
CV %	**6.92**	**8.07**	**8.02**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

S_1= Plastic pot, S_2= Earthen pot

As plant growing structures, plant growing media *i.e*. different composition of inorganic and organic materials also showed significant difference on leaves per plant at 60, 90 and 120 date after transplanting (DAT) of brinjal (Table 5 Appendix IV). At 60 DAT, the maximum number of leaves per plant (29.82) was produced by M_5 treatment. The control condition M_0 produced the minimum number of leaves per plant (18.00). At 90 DAT, the maximum number of leaves per plant (40.63) was produced by M_5 treatment. The control condition M_0 produced the minimum number of leaves per plant (29.88). At 120 DAT, the maximum number of leaves per plant (44.13) was produced by M_5 treatment. The control condition M_0 produced the minimum number of leaves per plant (33.13). These result also consistent with the plant height of brinjal (Table 1). Therefore, now it indicates that higher composition of organic substance creates a favorable environment by supplying required amount of nutrients along with increasing water holding capacity increase the number of leaves of brinjal.

Table 5. Effect of different plant growing medium on the number of leaf plant^{-1} of brinjal

Plant growing media (M)	Number of leaf plant^{-1} at different days after transplanting (DAT)		
	60	**90**	**120**
M_0	18.00 e	29.88 d	33.13 d
M_1	22.67 d	34.26 c	38.76 c
M_2	24.50 c	36.03 bc	39.99 bc
M_3	25.73 bc	37.38 b	41.66 a-c
M_4	26.53 b	38.28 ab	42.12 ab
M_5	29.82 a	40.63 a	44.13 a
LSD $_{(0.05)}$	**1.73**	**2.96**	**3.26**
Level of sig.	*	*	*
CV%	**6.92**	**8.07**	**8.02**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

The interaction between different plant growing structures and different plant growing medium was found significant on the number of leaves per plant at 60, 90 and 120 DAT (Table 6 Appendix IV). At 60 DAT, the maximum number of leaves per plant (32.75) was found in S_1M_5 treatment combination. Whereas the lowest number of leaves per plant (14.50) was found in S_2M_0 treatment combination.

Table 6. Interaction of different plant growing medium and plant growing structures on number of leaf plant^{-1} of brinjal

Interactions (S×M)	Number of leaf plant^{-1} at different days after transplanting (DAT)		
	60	90	120
S_1M_0	21.50 ef	32.25 fg	35.25 ef
S_1M_1	25.85 d	36.42 d-f	42.00 bc
S_1M_2	28.01 b-d	39.25 b-d	43.25 a-c
S_1M_3	28.96 bc	41.50 a-c	44.56 ab
S_1M_4	29.66 b	42.32 ab	45.25 ab
S_1M_5	32.75 a	43.75 a	47.25 a
S_2M_0	14.50 g	27.50 h	31.00 f
S_2M_1	19.50 f	32.10 g	35.51 ef
S_2M_2	20.99 ef	32.81 fg	36.72 de
S_2M_3	22.50 e	33.25 fg	38.75 c-e
S_2M_4	23.40 e	34.25 e-g	38.99 c-e
S_2M_5	26.90 cd	37.50 c-e	41.00 b-d
LSD $_{(0.05)}$	**2.44**	**4.19**	**4.61**
Level of sig.	*	*	*
CV %	**6.92**	**8.07**	**8.02**

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance.
LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

At 90 DAT, the maximum number of leaves per plant (43.75) was found in S_1M_5 treatment combination, Where as the lowest number of leaves per plant (27.50) was found in S_2M_0 treatment combination. At 120 DAT, the maximum number of leaves per plant (47.25) was found in S_1M_5 treatment combination and the lowest number of leaves per plant (31.00) was found in S_2M_0 treatment combination. These data are also similar with other morphological characters, plant height of this study (Table 3). These results suggest that plastic pot along with together use of cowdung and vermicompost gave the highest leaves per plant compared to earthen pot along with together or sole use of cowdung and vermicompost.

4.3 Number of branches plant^{-1}

It is established that proper vegetative growth is an important factor for increasing the fruit yields of different crops including brinjal. The formation of branches of a plant is the character of vegetative growth. In this study counted number of primary branches of brinjal with reference to different plant growing structures. The data of number of branches per plant showed significant differences at 60 days after transplanting (DAT) (Table 7, Appendix V). Number of primary branches per plant was influenced by plant growing structures. The plant growing structures of plastic pot had the highest number of primary branches per plant (3.18) and the lowest number of primary branches per plant (2.54) was obtained from earthen pot. These experimental data are also consistent with other morphological parameters such as plant height, leaf number (Table 1&4). Therefore, it suggests that plastic pot is more suitable than earthen pot to enhance the vegetative growth of brinjal in the rooftop garden.

Table. 7. Effect of plant growing structures on the primary branches plant^{-1} of brinjal

Plant Growing structure (S)	Primary branches plant^{-1} (No.) at 60 DAT
S_1	3.18 a
S_2	2.54 b
LSD $_{(0.05)}$	**0.13**
Level of sig.	*
CV%	**7.25**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

* Significant at 5% level of significance

S_1= Plastic pot, S_2= Earthen pot

The different plant growing medium showed significant variation in the length of branch (Table. 8, Appendix V). The maximum number of primary branch (3.61) was produced by M_5 treatment. The control (M_0) produced the minimum number of primary branch (2.00). These experimental data show consistent with other parameters such as plant height and leaf number of brinjal of this study (Table 2&4). Therefore, it suggests that together use of organic fertilizer along with inorganic fertilizer create a good soil condition for promoting the vegetative growth of brinjal in the rooftop garden.

Table 8. Effect of different plant growing medium on the primary branches plant^{-1} of brinjal

Plant growing medium (M)	Primary branches plant^{-1} (No.) at 60 DAT
M_0	2.00 f
M_1	2.50 e
M_2	2.75 d
M_3	3.02 c
M_4	3.26 b
M_5	3.61 a
LSD $_{(0.05)}$	**0.21**
Level of sig.	*
CV%	**7.25**

LSD= Least Significant Difference,

CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

The combined effect of plant growing structures and different plant growing medium was found significant on the number of primary branches per plant. The maximum number of primary branches per plant (3.75) was found in S_1M_5 treatment, whereas the lowest number of primary branch (1.75) was found in S_2M_0 treatment (Table 9, Appendix V). These experimental data show consistent with other parameters such as plant height and leaf number of brinjal of this study (Table 3&9). Therefore, it suggests that together use of organic and inorganic fertilizer create good soil composition for promoting the vegetative growth of brinjal in the rooftop garden.

Table 9. Interaction of different plant growing medium and plant growing structures on primary branches plant^{-1} of brinjal

Interactions (S×M)	Primary branches plant^{-1} (No.) at 60 DAT
S_1M_0	2.25 e
S_1M_1	3.00 cd
S_1M_2	3.25 bc
S_1M_3	3.28 bc
S_1M_4	3.53 ab
S_1M_5	3.75 a
S_2M_0	1.75 f
S_2M_1	2.00 ef
S_2M_2	2.25 e
S_2M_3	2.75 d
S_2M_4	3.00 cd
S_2M_5	3.46 ab
LSD $_{(0.05)}$	**0.30**
Level of sig.	*
CV%	**7.25**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

4.4 SPAD Value of leaf

SPAD value of leaf at 40 DAT was influenced by plant growing structures. However, the S_1 treatment had the highest SPAD value of leaf at 40 DAT (48.57) and the lowest SPAD Value of leaf at 40 DAT (42.24) was obtained from the S_2 treatment (Figure 1, Appendix V).

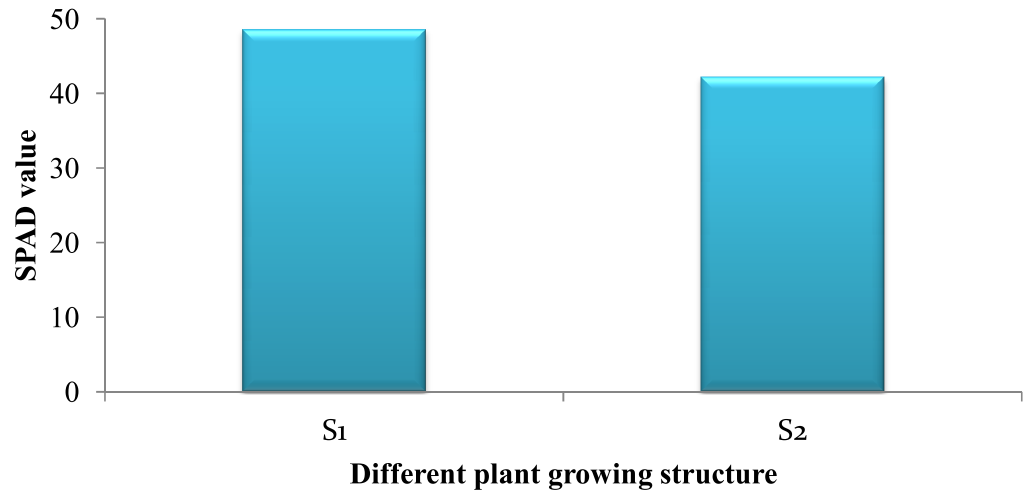

Figure 1. Effect of plant growing structure on the SPAD value at 40 DAT (LSD $_{0.05}$=1.94)

The different plant growing medium was significantly influenced on the SPAD Value of leaf at 40 DAT (Figure 2, Appendix V). The maximum SPAD value of leaf at 40 DAT (49.67) was produced by M_5 treatment. The treatment M_0 produced the minimum SPAD value of leaf at 40 DAT (42.28).

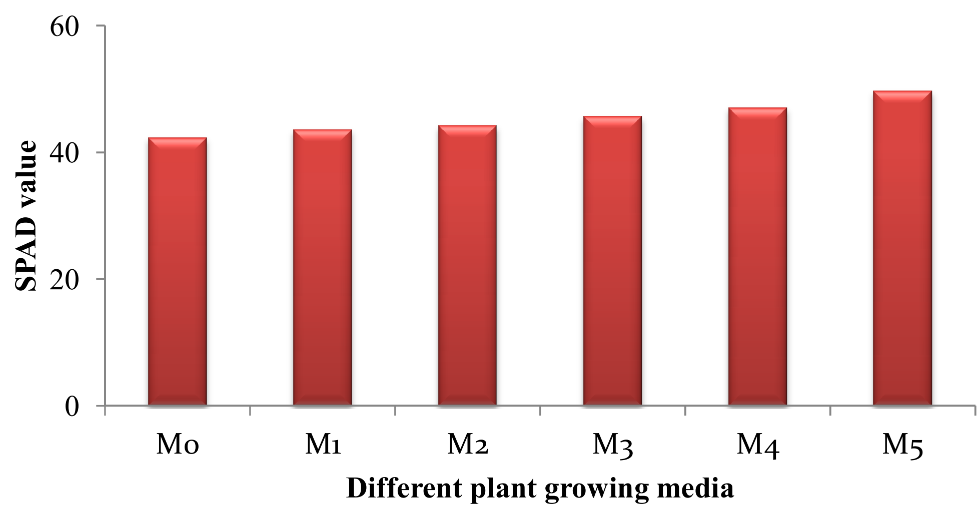

Figure 2. Effect of plant growing media on the SPAD value at 40 DAT (LSD $_{0.05}$=3.14)

The interaction between different plant growing structures and plant growing medium have significant effect on the SPAD value of leaf at 40 DAT (Figure 3, Appendix V). The maximum SPAD Value of leaf at 40 DAT (52.88) was found in S_1M_5 treatment. The lowest SPAD Value of leaf at 40 DAT (39.20) was found in S_2M_0 treatment**.**

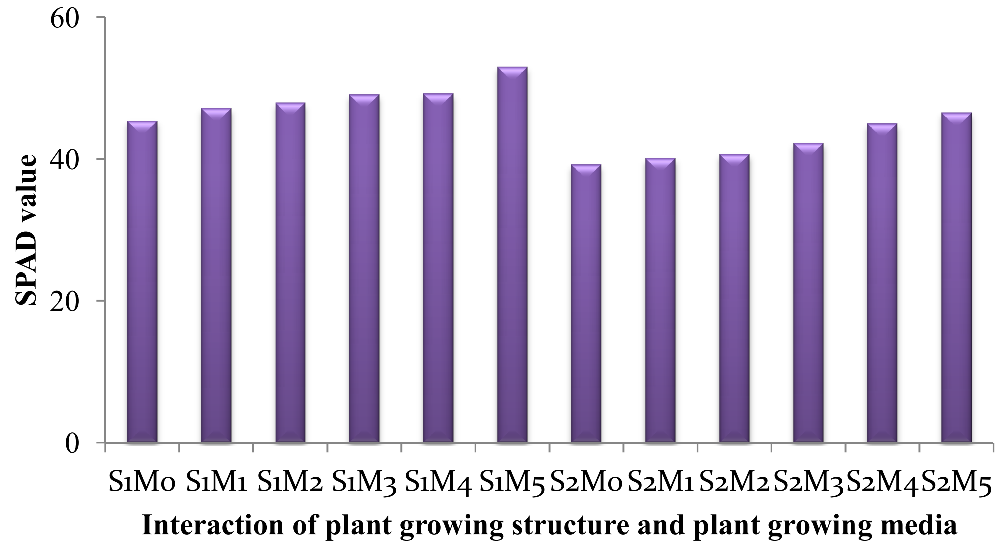

Figure 3. Interaction effect of plant growing structure and media on the SPAD value at 40 DAT (LSD $_{0.05}$=4.44)

4.5 Number of flowers cluster plant^{-1}

There was a significant difference among the plant growing structures in the number of flower clusters per plant up to 100 DAT (Table 10, Appendix VI). As evident from Table-10, the maximum number of flower cluster (3.08) was produced in S_1 treatment. The minimum number of flower cluster per plant (1.98) was produced in S_2 treatment. These results are consistent with the vegetative parameters of the study (Table 1&4). Therefore, it suggests that plants from plastic pot have given more flowers cluster than the plants from earthen pot.

The different plant growing media showed significant variation in the number of flowers cluster per plant. The maximum number of flower cluster per plant (3.38) was produced from M_5 treatment and M_0 treatment produced the minimum number of flowers cluster per plant (1.63) (Table 11, Appendix VI). These results are almost similar with other vegetative characters including plant height, leaf number and number of branches per plant of this experiment. Therefore, it suggests that the formation or development of number of flowers cluster per plant of brinjal is mediated by the composition of soil media.

Table 10. Effect of plant growing structures on the number of flower clusters plant^{-1} and number of flowers plant^{-1} of brinjal

Plant growing structure (S)	Number of flower clusters plant^{-1}	Number of flowers plant^{-1}
S_1	3.08 a	15.39 a
S_2	1.98 b	12.12 b
LSD $_{(0.05)}$	**0.11**	**0.75**
Level of sig.	*	*
CV%	**7.08**	**8.69**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

Table 11. Effect of different plant growing medium on the number of flower clusters plant^{-1} and number of flowers plant^{-1} of brinjal

Plant growing medium (M)	Number of flower clusters plant^{-1}	Number of flowers plant^{-1}
M_0	1.63 e	9.00 f
M_1	1.90 d	10.29 e
M_2	2.38 c	11.53 d
M_3	2.88 b	14.84 c
M_4	3.05 b	16.83 b
M_5	3.38 a	20.03 a
LSD $_{(0.05)}$	**0.18**	**1.22**
Level of sig.	*	*
CV%	**7.08**	**8.69**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

There is a significant variation among the treatment combinations in the number of flowers cluster per plant. The maximum number of flowers cluster per plant (4.00) was found in S_1M_5 whereas the minimum number of flowers cluster per plant (1.00) was found in S_2M_0 (Table 12, Appendix VI). These experimental data are also consistent with other vegetative parameters such as plant height, leaf number and number of branches per plant of this study. Therefore, it suggests that plastic pot is more suitable than the earthen pot for the development of flowers cluster of brinjal in the rooftop garden.

Table 12. Interaction of different plant growing medium and plant growing structures on number of flower clusters plant^{-1}and number of flowers plant^{-1}of brinjal

Interactions (S×M)	Number of flower clusters plant^{-1}	Number of flowers plant^{-1}
S_1M_0	2.25 de	10.61 e
S_1M_1	2.50 cd	11.70 de
S_1M_2	2.75 c	13.03 d
S_1M_3	3.50 b	16.85 bc
S_1M_4	3.50 b	18.34 b
S_1M_5	4.00 a	21.78 a
S_2M_0	1.00 g	7.39 g
S_2M_1	1.29 f	8.89 fg
S_2M_2	2.00 e	10.02 ef
S_2M_3	2.25 de	12.82 d
S_2M_4	2.61 c	15.32 c
S_2M_5	2.75 c	18.29 b
LSD $_{(0.05)}$	**0.26**	**1.72**
Level of sig.	*	*
CV%	**7.08**	**8.69**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*Significant at 5% level of significance

4.6 Number of flowers plant^{-1}

There was a difference among the plant growing structures in the number of flowers per plant. The maximum number of flowers (15.39) was produced in S_1 treatment (plastic pot). The minimum number of flowers per plant (12.12) was produced in S_2 treatment (earthen pot). (Table-10, Appendix VI). These experimental data are consistent with other parameters of this study. Therefore, it suggests that together application of cowdung and vermicompost along with inorganic fertilizer promote the formation of flowers of brinjal in the rooftop garden.

The different plant growing medium showed significant variation in the number of flowers per plant. The maximum number of flowers per plant (20.03) was produced from M_5 treatment and treatment M_0 treatment produced the minimum number of flowers per plant (9.00) (table 11, Appendix VI). These data are also similar with other parameters of the study. Therefore, it suggests that application of organic fertilizer with inorganic fertilizer increase the formation of flowers per plant of brinjal.

A significant variation was observed among the treatment combinations in the number of flowers per plant. The maximum number of flowers per plant (21.78) was found in S_1M_5 treatment combination, whereas the minimum number of flowers per plant (7.39) was found in S_2M_0 (Table 12, Appendix VI). These data are also consistent with other parameters of this study. Therefore, it suggests that plastic pot along with together use of cowdung and vermicompost gave maximum number of flowers per plant compared to earthen pot along with together or sole use of cowdung and vermicompost.

4.7 Fruit length (cm)

The plant growing structures was exhibited variation in the length of fruit. However, the longest fruit length (18.22 cm) was produced by S_1 and S_2 produced the shortest fruit length (16.05 cm), (Table 13, Appendix VII).

A significant variation in the length of fruit was found among the plant growing media. The longest fruit length (20.58 cm) was obtained from M_5 and the shortest fruit length (13.13 cm) was obtained from M_0 (Table 14, Appendix VII).

The variation in fruit length due to combined effect of plant growing structures and plant growing medium was found statistically significant (Table 15, Appendix VII). The longest fruit length (21.63 cm) was found in S_1M_5, whereas the shortest fruit length (11.27 cm) was found from S_2M_0.

4.8 Fruit diameter (cm)

The diameter of fruit was influenced by plant growing structures. The largest fruit diameter (2.70 cm) was produced by S_1 and S_2 produced the shortest fruit diameter (2.52 cm), (Table 13, Appendix VII).

A significant variation in the diameter of fruit was found among the plant growing medium. The largest fruit diameter (2.83 cm) was obtained from M_5 and the shortest fruit diameter (2.34 cm) was obtained from M_0 (Table 14, Appendix VII).

The variation in fruit diameter due to combined effect of plant growing structures and plant growing media was found statistically significant. The largest fruit diameter (2.90 cm) was found in S_1M_5. The shortest fruit diameter (2.22 cm) was found in S_2M_0 treatment. (Table 15, Appendix VII).

4.9 Fruits plant^{-1}

The number of fruits per plant was influenced by different plant growing structures. The maximum number of fruits per plant (6.76) was produced by S_1 and S_2 produced the least number of fruits per plant (5.35), (Table 13, Appendix VII)

A significant variation in the number of fruits per plant was found among the plant growing medium. The maximum number of fruits per plant (8.13) was obtained from M_5 and the minimum number of fruits per plant (4.25) was obtained from M_0, (Table 14, Appendix VII)

Table. 13. Effect of plant growing structures on the length of fruit, fruit Diameter, fruits plant^{-1}, individual fruit weight and fruit weight plant^{-1} of brinjal

Plant Growing structure (S)	Length of fruit (cm)	Fruit Diameter (cm)	Fruits plant^{-1}
S_1	18.22 a	2.70 a	6.76 a
S_2	16.05 b	2.52 b	5.35 b
LSD $_{(0.05)}$	**0.89**	**0.12**	**0.32**
Level of sig.	*	*	*
CV%	**8.28**	**7.44**	**8.29**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*= Significant at 5% level of significance

Table. 14. Effect of plant growing structures on the length of fruit, fruit Diameter, fruits plant^{-1}, individual fruit weight and fruit weight plant^{-1} of brinjal

Plant Growing Media (M)	Length of fruit (cm)	Fruit Diameter (cm)	Fruits plant^{-1}
M_0	13.13 e	2.34 d	4.25 e
M_1	15.96 d	2.44 cd	5.12 d
M_2	16.70 cd	2.58 bc	5.53 d
M_3	17.47 c	2.72 ab	6.24 c
M_4	18.97b	2.77 ab	7.06 b
M_5	20.58 a	2.83 a	8.13 a
LSD $_{(0.05)}$	**1.44**	**0.20**	**0.51**
Level of sig.	*	*	*
CV (%)	**8.28**	**7.44**	**8.29**

LSD=Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*= Significant at 5% level of significance

The variation in number of fruits per plant due to combined effect of plant growing structures and plant growing media was found statistically significant. The highest number of fruits per plant (9.00) was found in S_1M_5. The lowest no. of fruits per plant (3.25) was found in S_2M_0 treatment (Table 15, Appendix VII).

Table 15. Interaction of different plant growing medium and plant growing structures on the length of fruit, fruit Diameter, fruits plant^{-1}, individual fruit weight and fruit weight plant^{-1} of brinjal

Interactions	Length of fruit (cm)	Fruit Diameter (cm)	Fruits plant^{-1}
S_1M_0	15.00 e	2.47 d-f	5.25 d
S_1M_1	16.63 c-e	2.56 b-e	6.00 c
S_1M_2	17.79 b-d	2.68 a-d	6.19 c
S_1M_3	18.58 bc	2.79 ab	6.50 c
S_1M_4	19.69 ab	2.82 ab	7.63 b
S_1M_5	21.63 a	2.90 a	9.00 a
S_2M_0	11.27 f	2.22 f	3.25 f
S_2M_1	15.30 e	2.33 ef	4.24 e
S_2M_2	15.60 e	2.47 c-f	4.88 de
S_2M_3	16.35 de	2.66 a-d	5.98 c
S_2M_4	18.25 b-d	2.71 a-d	6.50 c
S_2M_5	19.54 b	2.75 a-c	7.25 b
LSD $_{(0.05)}$	**2.04**	**0.28**	**0.72**
Level of sig.	*	*	*
CV%	**8.28**	**7.44**	**8.29**

LSD= Least Significant Difference, CV%= Percentage of Co-efficient of Variation

*= Significant at 5% level of significance

4.10 Fruit weight plant^{-1}(g)

The different plant growing structures of brinjal influenced the yield fruits per plant of brinjal. The maximum yield of fruit (448.79 g) was obtained from plastic pot(S_1) and the minimum yield of fruits (306.18 g) was obtained from earthen pot (S_2) (Figure 4, Appendix VII). This is partially supported by Bouzo and Favaro (2016) who reported an increase in the container size results in plants of higher size and yield. These findings were also partially supported by Metwally (2016) who found that plants grown in big pots system has the highest values regarding yield.

The different plant growing medium had significant effect on the yield of fruits per plant of brinjal. The maximum yield of fruits (613.74 g) was produced by M_5 treatment and control treatment produced the minimum yield of fruits (207.01 g), (Figure 5, Appendix VII).

The interaction effect of plant growing structures and different plant growing medium has significant effect on yield of fruits per plant. The highest yield of fruits per plant (740.16 g) was obtained from plastic pot with Soil 80% (w/w) +10%Cowdung (w/w) +10% Vermicompost (w/w) along with RDIF, (S_1M_5) which was statistically identical with other. The lowest yield of fruits (144.72 g) was obtained from earthen pot with control, S_2M_0 (Figure 6, Appendix VII).

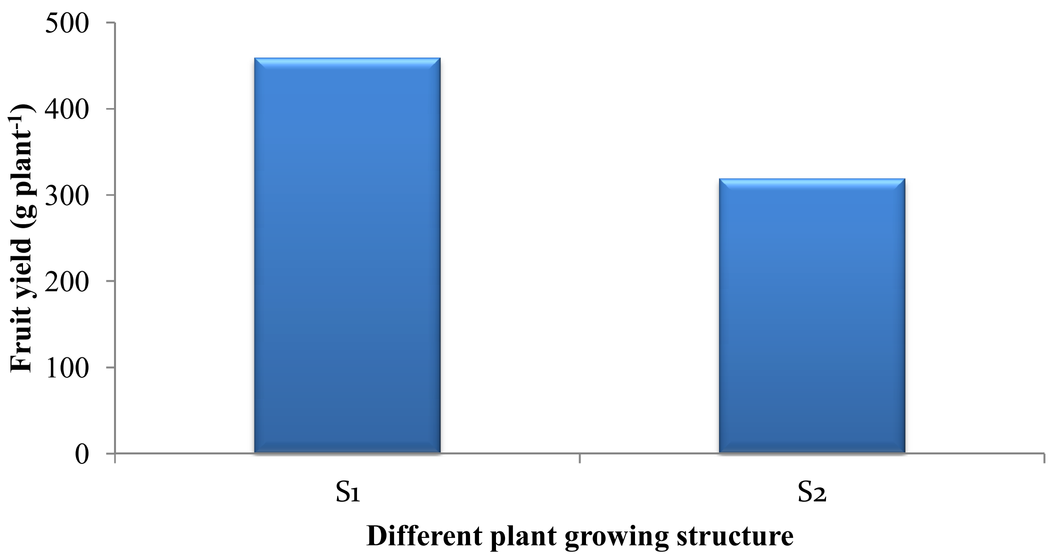

Figure 4. Effect of plant growing structure on the fruit yield of brinjal (LSD $_{0.05}$=22.25)

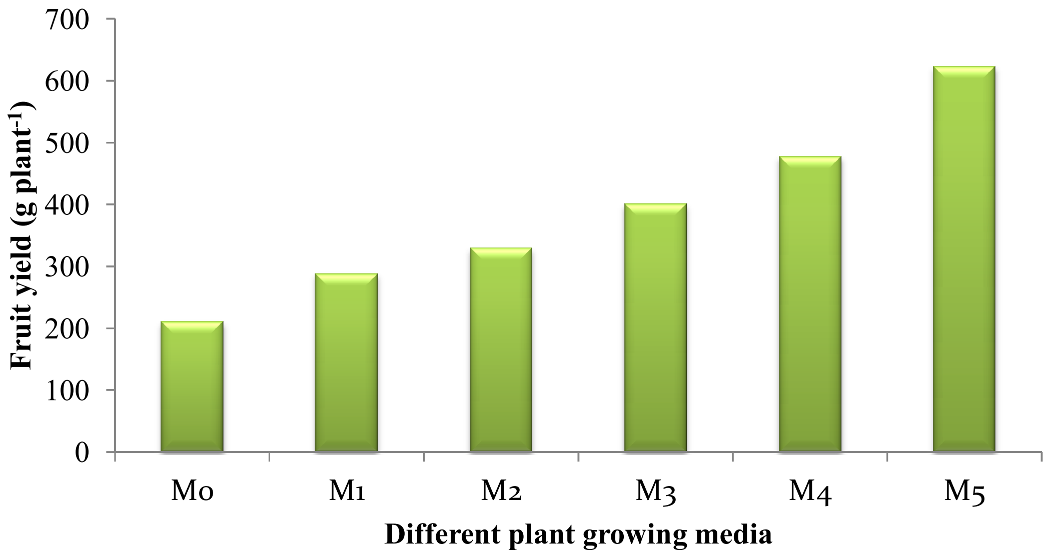

Figure 5. Effect of plant growing media on the fruit yield of brinjal (LSD $_{0.05}$=36.03)

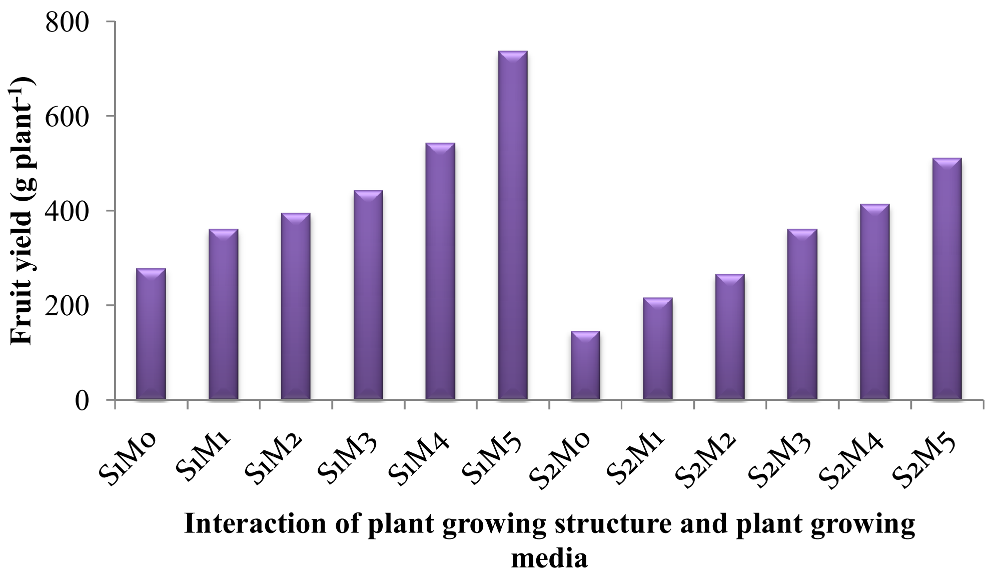

Figure 6. Interaction effect of plant growing structure and media on the fruit yield of brinjal (LSD $_{0.05}$=50.95)

CHAPTER V

SUMMARY AND CONCLUSION

This experiment was carried out at the rooftop garden of the Department of Agricultural Botany, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh from May 2018 to October 2018 to evaluate responses of brinjal to different plant growing structures and composition of growing media in the rooftop garden. The experiment consisted of two plant growing structures, *viz*., S_1= Plastic pot, S_2= Earthen pot and six different plant growing medium *viz*. M_0=Soil 100%(w\w) with Recommended Dose of Inorganic Fertilizers (RDIF)/ (control), M_1=Soil 80% (w/w) +20% Cow dung (w/w) along with RDIF, M_2=Soil 70% (w/w) + Cow dung 30% (w/w) along with RDIF, M_3=Soil 90% (w/w) +10% Vermicompost (w/w) along with RDIF, M_4=Soil 80% (w/w) +20% Vermicompost (w/w) along with RDIF and M_5=Soil 80% (w/w) +10%Cowdung (w/w) +10% Vermicompost (w/w) and Recommended Dose of Fertilizers (RIDF). The factorial experiment was laid out in a Completely Randomized Design (CRD) with four replications. The 48 plants were planted in the earthen pot and plastic pot. Data on growth and yield parameters were recorded and analyzed statistically. The recorded data on various parameters were statistically analyzed using MSTAT-C statistical package programmed. Difference between treatment means were determined by Duncan's new Multiple Range Test (DMRT).

Data were taken on growth and yield contributing characters and the collected data were statistically analyzed for the evaluation of the treatment effects. The summary of the results has been described in this chapter. Plant height at 60, 90 and 120 days after transplanting (DAT) was taken from each plant. The plastic pot (S_1) had the highest plant height (78.16, 94.95, 103.02 cm at 60, 90 and 120 DAT, respectively). The plant growing structures of plastic pot had the highest number of leaves per plant (27.79, 39.25 and 42.93 at 60, 90 and 120 DAT, respectively). The effect of different plant growing media influenced the number of branches per plant. Plastic pot had the highest number of branches per plant (3.18). SPAD value of leaf was influenced by plant growing structures. The S_1 treatment had the highest SPAD value of leaf (48.57). There was a significant difference among the plant growing structures in the number of flowers cluster per plant. The maximum number of flowers cluster (3.08) was produced in S_1 treatment. There was a difference among the plant growing structures in the number of flowers per plant. The maximum number of flowers (15.39) was produced in S_1 treatment. Plant growing structures showed variation in fruit length. However, the longest fruit length (18.22 cm) was produced by S_1. Plant growing structures also influence fruit diameter. The largest fruit diameter (2.70 cm) was produced by S_1. The number of fruits per plant of brinjal was influenced by different plant growing structures. Maximum number of fruits per plant (6.76) was produced by S_1. The variation in fruit weight was found among the plant growing structures. The highest fruit yield (448.79 g) was obtained from S_1.

The effect of different plant growing media on plant height at 60, 90 and 120 DAT. The doses of soil 80% (w/w) +10% cowdung (w/w) +10%vermicompost (w/w) along with RDIF, M_5 produced the tallest plant (77.45, 96.10, 108.3 cm at 60, 90 and 120 DAT, respectively). The different plant growing media also show variation in the number of leaves per plant. Maximum number of leaves per plant was obtained from M_5. The effect of different plant growing media show variation in the number of branches per plant. The maximum number of primary branches per plant (3.61)) was found in M_5 treatment, whereas the lowest number of primary branches (2.00) was found in M_0 treatment. SPAD value of leaf show considerable differences to different plant growing media. The maximum SPAD value of leaf (49.67) was obtained from M_5. The maximum number of flowers cluster per plant and flowers per plant up to 100 DAT was found in M_5 treatment. The different plant growing media show a significant difference in fruit length, fruit diameter, fruits per plant and yield of fruits. The longest fruit length (20.58 cm) was found in M_5. The highest fruit diameter (2.83 cm) was also obtained from M_5. The maximum fruits per plant (8.13) was obtained from M_5 treatment. The maximum fruit yield (613.74 g) was produced by M_5 and minimum individual fruit weight (207.01 g) was produced by M_0.

The combined effect of plant growing structures and different plant growing media exhibited a significant variation in all parameter. The tallest plant height (85.68, 102.6, 104.8 cm at 60, 90 and 120 DAT, respectively) was found in S_1M_5 (plastic pot with soil 80%(w/w) +10% cowdung(w/w) + 10%vermicompost (w/w) along with RDIF). The maximum number of leaves per plant (32.75, 43.75, 47.25 at 60, 90 and 120 DAT, respectively) was found in S_1M_5 treatment combination. The maximum number of branches per plant (3.75) was obtained from S_1M_5 treatment combination. The maximum SPAD Value of leaf at 40 DAT (52.88) was found in S_1M_5 treatment. The lowest SPAD Value of leaf at 40 DAT (39.20) was found in S_2M_0 treatment. The maximum number of flowers cluster per plant (4.00) was found in S_1M_5. The maximum number of flowers per plant (21.78) was produced by S_1M_5 treatment combination. The longest fruit length (21.63 cm) was found in S_1M_5, whereas the shortest fruit length (11.27 cm) was found from S_2M_0. The largest fruit diameter (2.90 cm) was found in S_1M_5. The highest no. of fruits per plant (9.00) was found in S_1M_5. The highest yield of fruits per plant (740.16 g) was obtained from plastic pot with soil 80% (w/w) +10%Cowdung (w/w) +10% Vermicompost (w/w) along with RIDF (S_1M_5), which was statistically identical with other.

Conclusion

Considering the stated findings, it may be concluded that yield and yield contributing parameters are positively correlated with plant growing structures and plant growing medium. However, BARI Begun-8 planted with plastic pot and Soil 80% (w/w) +10% Cow dung (w/w) +10% Vermicompost (w/w) along with RDIF would be beneficial for the farmers or urban rooftop gardeners.

Considering the situation of the present experiment, further studies in the following areas may be suggested:

a. Repeated trial is needed in the rooftop garden for analogy the accuracy of the experiment.
b. It needs to conduct related experiment with other summer varieties.
c. Scope to conduct similar experiment for *kharif* season in the rooftop garden.
d. Scope to conduct advance experiments how, plant growing structures and plant growing medium physiologically increase yield of brinjal.

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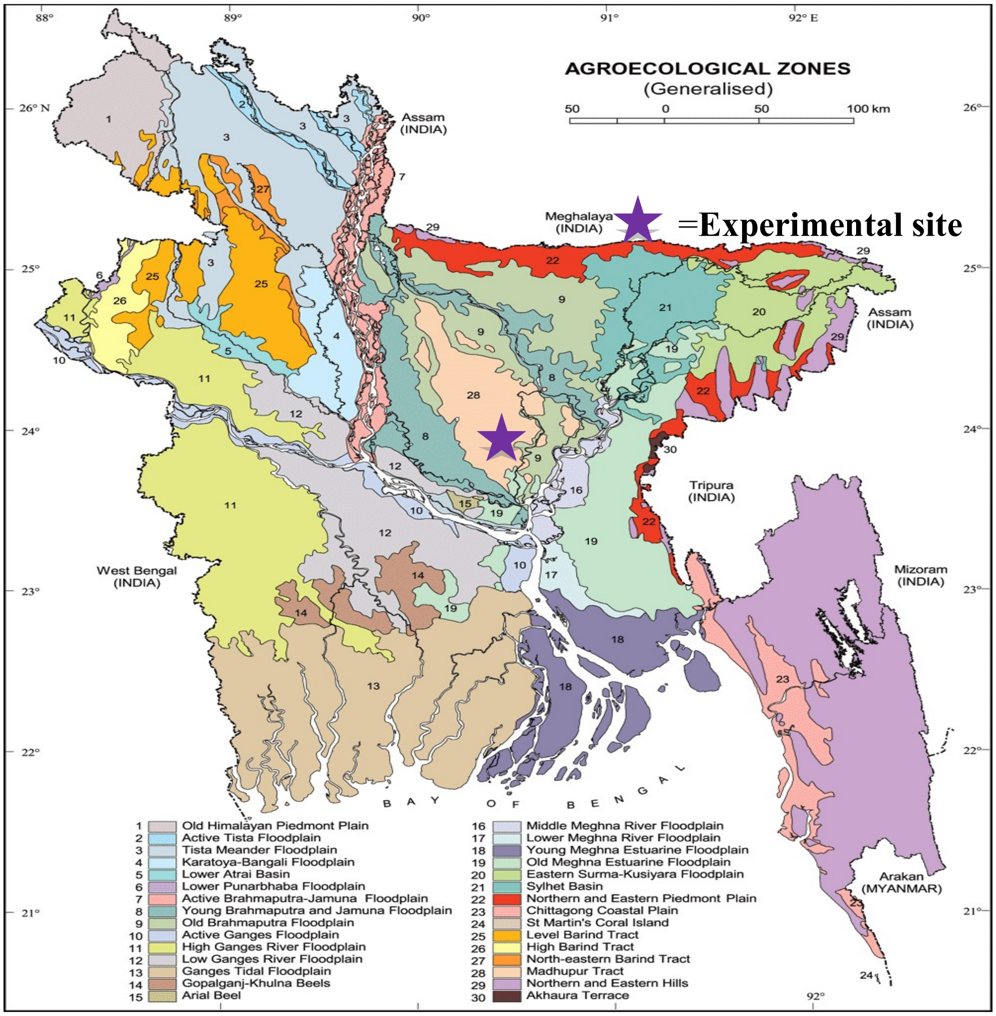
APPENDICES

Appendix I. Map showing the experimental site under study



Appendix II: Analytical result of soil, cow dung and vermicompost

Soil	**Cowdung**	**Vermicompost**
pH: 6.0	Moisture: 44.5%	Moisture: 53.80%
Organic matter: 1.21%	pH: 6.7	pH: 7.1
Total nitrogen: 0.061%	Organic carbon: 10.2%	Organic carbon: 10.7%
Potassium: 0.19meq/100g	Total nitrogen: 0.65%	Total nitrogen: 1.12%
Phosphorus: 1.31 ppm	Phosphorus:0.39%	Phosphorus: 0.67%
Sulphur: 42.13 ppm	Potassium: 0.40%	Potassium: 0.95%
Zinc: 0.95	Sulphur: 0.02%	Sulphur: 0.01%
	Boron: 0.02%	Boron: 0.007%
	Iron: 0.003%	Iron: 0.01%
	Manganese: 0.006%	Manganese: 0.004%
	Zinc: 0.01%	Zinc: 0.01%
	Copper: 0.002%	Copper: 0.003%
	Chromium: 10.12ppm	Chromium: 22.43ppm
	Cadmium: 0.19ppm	Cadmium: 0.44ppm
	Lead: 5.76ppm	Lead: 2.97ppm

Appendix III. Analysis of variance of the data on plant height of brinjal as influenced by combined effect of different plant growing structures and plant growing media

Source of variation	df	Mean square of plant height at different days after transplanting		
		60	90	120
Replication	3	16.75	27.26	63.45
Plant growing structure (A)	1	2560.11*	1684.48*	887.69*
Plant growing media (B)	5	138.72*	182.46*	410.77*
Plant growing structure (A) X Plant growing media (B)	5	6.58*	3.21*	9.13*
Error	33	25.17	41.64	56.63

*Significant at 5% level of significance

^{NS} Non significant

Appendix IV. Analysis of variance of the data on number of leaves plant^{-1} of brinjal as influenced by combined effect of different plant growing structures and plant growing media

Source of variation	df	Mean square of number of leaves plant^{-1} at different days after transplanting		
		60	90	120
Replication	3	1.28	9.46	4.89
Plant growing structure (A)	1	505.77*	483.30*	422.22*
Plant growing media (B)	5	127.26*	110.39*	116.89*
Plant growing structure (A) X Plant growing media (B)	5	0.41*	5.30*	1.49*
Error	33	2.89	8.47	10.28

*Significant at 5% level of significance

^{NS} Non significant

Appendix V. Analysis of variance of the data on primary branches plant^{-1} at 60 DAT and SPAD value at 40 DAT of brinjal as influenced by combined effect of different plant growing structures and plant growing media

Source of variation	df	Mean square of	
		Primary branches plant^{-1} at 60 DAT	SPAD value at 40 DAT
Replication	3	0.05	12.68
Plant growing structure (A)	1	4.92*	481.52*
Plant growing media (B)	5	2.60*	56.58*
Plant growing structure (A) X Plant growing media (B)	5	0.17*	2.46*
Error	33	0.04	9.51

*Significant at 5% level of significance

^{NS} Non significant

Appendix VI. Analysis of variance of the data on number of flower clusters plant^{-1} and number of flowers plant^{-1} of brinjal as influenced by combined effect of different plant growing structures and plant growing media

Source of variation	df	Mean square of	
		Number of flower clusters plant^{-1}	Number of flowers plant^{-1}
Replication	3	0.01	3.81
Plant growing structure (A)	1	14.52*	127.89*
Plant growing media (B)	5	3.76*	143.39*
Plant growing structure (A) X Plant growing media (B)	5	0.10*	0.38*
Error	33	0.03	1.43

*Significant at 5% level of significance
^{NS} Non significant

Appendix VII. Analysis of variance of the data on length of fruit, fruit diameter fruits plant^{-1}, individual fruit weight and fruit weight plant^{-1}of brinjal as influenced by combined effect of different plant growing structures and plant growing media

Source of variation	df	Mean square of			
		Length of fruit	Fruit Diameter	Fruits plant^{-1}	Fruit weight plant^{-1}
Replication	3	1.34	0.02	0.35	746.28
Plant growing structure (A)	1	56.38*	0.39*	23.94*	237436.89*
Plant growing media (B)	5	52.72*	0.29*	15.59*	173307.48*
Plant growing structure (A) X Plant growing media (B)	5	1.48*	0.01*	0.59*	4482.88*
Error	33	2.01	0.04	0.25	1254.34

*Significant at 5% level of significance

^{NS} Non significant