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Physico-chemical characteristics of rooftop grown petunia in different growing media

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Abstract
A study was conducted on the rooftop of the Administrative Building, Assam Agricultural University, Jorhat during the year 2021-22, with the objective of studying the chlorophyll content and net assimilation rate of petunia (variety-Tritunia star mix) planting on different growing media and pot size in rooftop garden.
The crop is grown in seven growing media with various components by volume in three different pots, *viz*., S_1: 20 cm, S_2: 25 cm and S_3: 30 cm. The media compositions were G_0: Soil (as control), G_1: Soil + Sand +Vermicompost (1:1:1), G_2: Soil + Sand + Cocopeat + Vermicompost (1:1:2:2), G_3: Sand + cocopeat +Vermicompost (2:5:5), G_4: Sand + cocopeat + Vermicompost +Vermiculite (1:2:2:1), G_5: Sand + cocopeat + Vermicompost + Perlite (1:2:2:1), G_6: Sand + cocopeat + Vermicompost + Vermiculite + Perlite (1:2:2:0.25:0.25). The experimental design of the study was factorial Completely Randomized Block Design with three replications. The maximum chlorophyll content of 1.92 mg g^{-1} FW and net assimilation rate of 0.023 was recorded for S_3G_6. Among the pot size, S_3 (30 cm) gave the best results in physiological characters.

Keywords: Rooftop, petunia, vermicompost, vermiculite, perlite

1. Introduction

A garden on the roof of a building is the rooftop garden. The main objective of a rooftop garden is to exploit the space to grow flowering and ornamental plants for food and recreational activities. Roof top gardens can also be a source of garden-fresh and nourishing food of preference for urban duelers. The roof spaces are generally unused. Many of the urban homemakers create their own garden, either vegetable or ornamental or a combination of both on the rooftop due to lack of space around their houses. Rapid urbanization, industrialization, construction of multistoried buildings, wide roads, offices, markets have resulted in non-availability of land for gardening work in big cities and towns. Therefore, plant lovers in cities and towns have the only option for roof top gardening or indoor gardening.

The earliest documented roof gardens were the hanging gardens of Semiramis in what is now Syria, considered as one of the seven wonders of the ancient world. Today, similar elaborate and modem roof-garden projects have been designed for high-profile international hotels, business centres, and private homes.

Germany was the birthplace of the modern green roof concept around the turn of the 20th century, where the physical impacts of solar radiation on the roof structure were lessened by installing flora on roofs. In the past, green roofs were frequently used as fire-retardant building materials. As enhanced green spaces result in improved aesthetics, higher air quality, increased energy efficiency, and a host of other benefits, green-roof technology was swiftly adopted and gained popularity. By collecting sound waves from outside buildings and blocking inside transmission, living roofs also lessen noise pollution (Dunnet and Kingsbury, 2004) [2].

Since forests, agricultural fields, and suburban and urban lands are replaced with impervious surfaces resulting from development. The necessity to recover green space is becoming increasingly critical to maintain environmental quality (Getter and Rowe, 2006) [3].

The present experiment is conducted to see the highest chlorophyll content and net assimilation rate of petunia planting on different growing media and pot size in rooftop garden.

2. Materials and methods

The experiment was conducted in the roof top of New Administrative Building, Assam Agricultural University, Jorhat during 2021-2022.

Details of the experiment

Design and layout

Location: Rooftop of Administrative Building. AAU, Jorhat-13
Design: Factorial CRD (Completely Randomized Design)
Replication: 3
Number of Treatments: 21 (Growing media:7, Pot size: 3)
Total number of pots: 63
Individual pot size: 20 cm, 25 cm and 30 cm

Treatment details

Crops: Petunia (*Petunia grandiflora*) cv. Tritunia star mix
Three distinct pot sizes were available, in addition to seven distinct media compositions made up of varied amounts of components blended by volume. They are as follows:

Growing media composition

G_0 = Soil.
G_1 = Soil+ Sand + Vermicompost (1:1:1).
G_2 = Soil+ Sand + Cocopeat + Vermicompost (1:1:2:2).
G_3 = Sand + cocopeat + Vermicompost (2:5:5).
G_4 = Sand + cocopeat + Vermicompost + Vermiculite (1:2:2:1).
G_5 = Sand + cocopeat + Vermicompost + Perlite (1:2:2:1).
G_6= Sand + cocopeat + Vermicompost +Vermiculite + Perlite (1:2:2:0.25:0.25).

Treatment combinations

Notation	Treatments
T_1	20 cm + G_0 (Soil)
T_2	25 cm + G_0 (Soil)
T_3	30 cm + G_0 (Soil)
T_4	20 cm + G_1 (Soil+ Sand + Vermicompost)
T_5	25 cm + G_1 (Soil+ Sand + Vermicompost)
T_6	30 cm + G_1 (Soil + Sand + Vermicompost)
T_7	20 cm+ G_2 (Soil+ Sand + Cocopeat + Vermicompost)
T_8	25 cm + G_2 (Soil+ Sand + Cocopeat + Vermicompost)
T_9	30 cm + G_2 (Soil+ Sand + Cocopeat + Vermicompost)
T_{10}	20 cm + G_3 (Sand + cocopeat + Vermicompost)
T_{11}	25 cm + G_3 (Sand + cocopeat + Vermicompost)
T_{12}	30 cm+G_3 (Sand + cocopeat + Vermicompost)
T_{13}	20 cm + G_4 (Sand + cocopeat + Vermicompost + Vermiculite)
T_{14}	25 cm +G_4 (Sand + cocopeat + Vermicompost +Vermiculite)
T_{15}	30 cm+ G_4 (Sand + cocopeat + Vermicompost +Vermiculite)
T_{16}	20 cm+ G_5 (Sand + cocopeat + Vermicompost + Perlite)
T_{17}	25 cm + G_5 (Sand + cocopeat + Vermicompost + Perlite)
T_{18}	30 cm + G_5 (Sand + cocopeat + Vermicompost + Perlite)
T_{19}	25 cm + G_6 (Sand + cocopeat + Vermicompost + Vermiculite Perlite)
T_{20}	25 cm + G_6 (Sand + cocopeat + Vermicompost +Vermiculite + Perlite)
T_{21}	30 cm+ G_6 (Sand + cocopeat + Vermicompost +Vermiculite + Perlite)

Observations recorded

Pant analysis

Chlorophyll content (mg g^{-1}FW)

Total chlorophyll estimation was done according to the method developed by Anderson and Boardman (1964) [1]. The absorbance of the extract was measured at 645 and 663 nm wavelength filters in UV-VIS spectrophotometer for the determination of total chlorophyll content and was obtained as follows:

Total chlorophyll (mg g^{-1}FW) = 20.2 x (D.645) + 8.02 x (D.663) x $^{V/1000}$ x W

Where,
V= Final volume of extract (ml)
W= Weight of sample taken (g) D.645 = O.D.at 645 nm
D.663= O.D.at 663 nm

Net Assimilation Rate (NAR) (mg $cm^{-2}day^{-1}$)

It is the measurement of average photosynthetic efficiency and calculation was based on increase in dry weight of the plant per unit leaf area per unit time and expressed as mg $cm^{-2}day^{-1}$.NAR was calculated using following formula.

NAR = (W_2W_1/A_2A_1) $(InA_2\ InA_1)/t_2\text{-}t_1$

Where, W_1	Dry weight (g) of the leaf at time, t_1
W_2	Dry weight (g) of the leaf at time, t_2
A_1	Leaf area at time, t_1
A_2	Leaf area at time, t_2

3. Results and Discussion

Plant Analysis

3.1. Chlorophyll content (mg g^{-1}FW)

Chlorophyll content (mgg^{-1}FW) as influenced by each of growing media, pot size and their interactions are presented in Table 1. Among the growing media, the highest chlorophyll content of 1.56mg g^{-1}FW was recorded for growing media G_6. This might be due to the high availability of N in the growing media G_6 Similarly, the highest chlorophyll content of 1.74mg g^{-1} FW was recorded in pot size S_3 (30 cm), which might be due to the increase in media volume resulting in an increase in N availability. The interaction effect of different growing media and pot size on

Chlorophyll content was recorded highest in S_3G_6 (1.92 mg g^{-1}FW). This might be due to the high CEC of vermiculite present in the media which made N available to the plant. There was no significant difference among the interactions.

3.2. Net Assimilation Rate (mg cm^{-2}day^{-1})

Net assimilation rate (NAR) in leaf at vegetative stage was found to be significant due to effect of organic inputs (Table 2). The highest net assimilation rate in leaf (0.020mgcm^{-2}day^{-}) was recorded in the growing media G_6 followed by G_5. This might be due to the present of vermiculite in the media G_6 and G_5 which helps to provide N and increase photosynthetic rate, ultimately the NAR is increased.

With the increase of the pot size NAR also increased with the highest in S_3(0.019). This might be due to the increase in media volume that made more available N for the plant (Table 2). There was no significant difference among the interactions.

The interaction effect of different growing media and pot size S_3G_6 exhibited highest NAR in plants due to better co relation of media which consist of vermiculite and perlite with increased pot size. Almost for all the parameter, the growing media G_6 was seen to be at par with the growing media G_5. This could be due to the nearly same physicochemical properties of G6 and G_5, like pH, bulk density, water holding capacity and nutrient status.

Table 1: Chlorophyll content (mg/g FW)

Media	**Growing Media**					**Mean**		
Depth	**G_0**	**G_1**	**G_2**	**G_3**	**G_4**	**G_5**	**G_6**	
S_1	0.61	0.65	0.74	0.79	0.93	1.08	1.16	0.82
S_2	0.99	1.23	1.28	1.34	1.37	1.47	1.61	1.32
S_3	1.23	1.69	1.77	1.85	1.89	1.90	1.92	1.74
Mean G	0.94	1.19	1.26	1.32	1.39	1.48	1.56	
Factors						C.D. (5%)	SEd (±)	
Pot size (S)						0.02	0.008	
Growing media (G)						0.03	0.01	
Interaction (S X)						NS	0.01	

Table 2: NAR (mg cm-2 day-1)

Media	**Growing Media**					**Mean**		
Depth	**G_0**	**G_1**	**G_2**	**G_3**	**G_4**	**G_5**	**G_6**	
S_1	0.0078	0.008	0.008	0.009	0.011	0.012	0.015	0.010
S_2	0.0098	0.013	0.015	0.017	0.018	0.019	0.023	0.016
S_3	0.013	0.017	0.018	0.019	0.020	0.022	0.023	0.019
Mean G	0.010	0.013	0.013	0.015	0.016	0.017	0.020	
Factors						C.D. (5%)	SEd (±)	
Pot size (S)						0.001	0.001	
Growing media (G)						0.002	0.001	
Interaction (S X G)						NS	0.002	

4. Conclusion

From the experiments it can be concluded that the highest chlorophyll content and net assimilation rate (NAR) of petunia was recorded for the treatment S_3G_6 for petunia in rooftop garden. The growing media G_6 was seen to be at par with growing media G_5 which might be due to the similar physicochemical properties and nutrient status of G_6 and G_5. Consequently, based on the data, it may recommended that rooftop gardening using growing media G_6 (sand, cocopeat, vermicompost, vermiculite, and perlite at 1:2:2:0.25:0.25) in pot size S_3 (30 cm) is suitable in Assam.

5. References

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