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Effect of different growing media on Mexican snow ball (*Echeveria elegans*) under Prayagraj agroclimatic conditions

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Abstract
Succulents are on the rising trend of popularity due to its compromising behavior with watering and durability indoors. Mexican snow ball is a bluish green succulent that has a great potential as an ornamental. Hence finding a better potting media is the need of the hour. The plants were propagated from leaves of mother plant and transplanted to terracotta pots according to treatment combinations. The experiment was laid out in 12 treatments replicated thrice in Randomized Block Design. Based on the investigation it is concluded that the treatment T_{12} with Vermicompost + Cocopeat + Perlite (1:1:1) was found best in terms for propagation (90% survival percentage), attaining plant height, maximum number of leaves and maximum significant root length which are most desired characters. However, maximum plant spread was found in T_9, Leaf compost + Vermicompost (1:1). In terms economics maximum cost benefit ratio, (1: 3.71) found in T_{12} Vermicompost + Cocopeat + Perlite (1:1:1).

Keywords: Cocopeat, cost benefit ratio, leaf compost, Mexican snow ball, perlite, propagation, succulents, survival percentage, vermicompost

Introduction
During the last few decades, we have witnessed a drastic change in the modern urban housing system. Humans are more and more attracted to growing plants indoors since the initial setup in urban areas are not providing them an expanded space. Hence, primarily depending upon potted plants for a touch of greenery in the premises. The recent pandemic situation brought a boom in people buying indoor plants majorly for therapeutical purposes.

Echeveria is a large genus of flowering plants in the family Crassulaceae and are native to semi desert areas of Central America, Mexico and northwestern South America, mountainous terrain between 1,000 and 4,000 feet elevation. They are the most beloved of succulents, and are described as everlasting flowers, for their colorful rosettes that resembles the tightly cupped petals of rose (Kapitany, 2007) [7]. Echeveria shows a great potential as an ornamental plant majorly as a cut flower rather than being the usual pot plant on national and international markets (Borys and Borys, 2013) [2]. They range from Mexico to Argentina and grow in rock faces and ledges on near-vertical cliffs, considered to have originated primarily in Mexico.

The Echeveria succulent plant is slow growing and usually doesn't exceed 12 inches in height or spread. Mexican snow ball (*Echeveria elegans*) is a bluish-green succulent that takes on a pink hue in the corners when exposed to bright sunlight and the light green rosettes tend to perform well indoors when provided sufficient light. They form a compact rosette pattern and fleshy spoon shaped leaves. The leaves are usually 6cm long and 2cm wide. It offsets freely and forms a dense carpet of rosettes over time. Echeveria is floriferous (O' Connell, 2014) [9], from late winter to mid-summer it sends up slender pinkish stems up to 1 foot tall which bears pinkish red flowers tipped with yellow. The specific epithet "*elegans*" refers to its elegant appearance. The plants are also popular as it can be propagated from leaves (Raju and Mann, 1970) [11]. Once detached from shoots of their parent plant succulent and semi-succulent leaves can survive longer than non-succulent leaves, enabling them to differentiate and establish a root system before desiccation and/or starvation (Gorelick, 2015) [5]. For the successful establishment of the plantlets, a suitable potting media is the need of the hour. Potting media plays an important role in the efficient growth of plants as well as succulents. Effective potting media results in luscious growth of the plants. Succulents need soil with a better drainage and it can only be achieved by using a mixture of different medias. For allocating media into structures like roof, it needs to be light in weight to support the structure as plants on growth will also acquire a certain weight, overtime.

Different proportions of soilless medias like cocopeat, vermicompost, perlite, leaf compost was used along with garden soil and sand as control were tried on to assess the growth of *Echeveria elegans.*

Materials and Methods

The field experiment was carried out at Horticultural Research Field in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj during the session of 2020-2021. The experiment consists of 6 different growing medias including garden soil, sand, perlite, cocopeat, vermicompost and leaf compost with 12 different treatment combinations with 3 replications was laid out in RBD as shown in Table 1. Three randomly selected plants in each treatment were tagged for the recording of observation. All the parameters were subjected to statistical analysis. Observations recorded were Survival percentage (%), Plant height (cm), Number of leaves, Plant spread (cm), Root length (cm) Rhizosphere spread (cm).

Table 1: Treatment Combinations

No. of Treatments	Treatment combinations
T_1	Sand + Garden soil (1:1)
T_2	Vermicompost + Perlite (3:1)
T_3	Vermicompost + Perlite (1:1)
T_4	Vermicompost+ Cocopeat (3:1)
T_5	Vermicompost + Cocopeat (1:1)
T_6	Leaf compost + Perlite (3:1)
T_7	Leaf compost + Perlite (1:1)
T_8	Leaf compost + Vermicompost (3:1)
T_9	Leaf compost + Vermicompost (1:1)
T_{10}	Leaf compost + Cocopeat (3:1)
T_{11}	Leaf compost + Cocopeat (1:1)
T_{12}	Vermicompost + Cocopeat + Perlite (1:1:1)

Results and Discussion

Survival Percentage of Mexican snow ball

The survival percentage was 75% in all treatments with different medias. The detached leaves produced plantlets in a duration of 60-80 days and they were later transplanted into different medias for the experiment. Meanwhile, T12, Vermicompost + Cocopeat + Perlite (1:1:1) showed 90% followed by T10 and T8 (85%) of survival percentage and the least i.e., 60% was found in control (T1) with Sand + Garden soil (1:1).

The probable reasons for such findings can be because of the presence of Vermicompost (Kala *et al*., 2020) [6], it may be due to vermicompost having which is rich in humus and having valuable vitamins, enzymes and hormones like auxins, gibberellins, etc. helpful for better growth and development and high nitrogen content available to plants which are grown in cocopeat (Kavana *et al*., 2019; Sandeep *et al*., 2018) [8, 12].

Effect of potting media on plant height (cm) in Mexican snow ball

Significantly taller plants were observed in T12, Vermicompost + Cocopeat + Perlite (1:1:1) 90 DAT. Significantly short plant was observed in T1 (3.69), with Sand + Garden soil (1:1).

Significant plant height was observed in T12, probably because of the presence of cocopeat which may have provided better water holding capacity and aeration. This result is confirmed by Awang *et al*., 2019 [1] and Dubey *et al*., 2013 [4].

Effect of potting media on plant spread (cm) in Mexican snow ball

Maximum significant plant spread was found in T9, (6.35) Leaf compost + Vermicompost (1:1) followed by T12 (5.98) at 90 DAT. And minimum significant plant spread was found in T3 (4.22), Vermicompost + Perlite (1:1) at 90 DAT.

Probable reasons for improved plant spread in T9 would be because of the good soil air circulation, nutrient content of potting media and high photosynthetic effect of plants (Dubey *et al*., 2013; Rajasekar *et al*., 2015) [4, 10].

Effect of potting media in number of leaves in Mexican snow ball

Maximum significant number of leaves in 90 DAT was observed in T12 (20.67), Vermicompost + Cocopeat + Perlite (1:1:1) followed by T10 while, minimum significant growth at 90 DAT was in T8 (15.84) with Leaf compost + Vermicompost (3:1).

This variation may be due to the effects of cocopeat, which has the ability to store and release nutrients to plants for an extended period of time. Vermicompost has considerable amounts of humic substances and improves plant nutrition (Kavana *et al*., 2019) [8] And leaf compost played an important role in producing maximum number of leaves because it contained rotten plant residues and had more organic matter and humus in which nutrients which were available for plant growth. (Waseem *et al*., 2013) [13].

Effect of potting media on root length (cm) in Mexican snow ball (*Echeveria elegans*)

Among the different treatments applied in Echeveria, the maximum significant root length at 90 DAT was observed in T12 (11.80) Vermicompost + Cocopeat + Perlite (1:1:1) followed by T10 and minimum significant root length was observed in T1 (5.83) with Vermicompost + Perlite (3:1).

The physical and chemical characteristics of the growing media greatly affect the developing of the root system, as cocopeat provides better aeration and has good carbon content of 18.95% (Dubey *et al*.) and vermicompost can form synergistic relationships in plant rhizospheres, thereby increasing the capacity of plants to utilize soil moisture and nutrients. (Kavana *et al*., 2019) [8] and then indirectly affect the morphogenesis of the aboveground. Perlite also aids in providing better drainage and space for root growth. There is a physical contact between the root system and the growing medium, the medium of superior quality can afford a favorable root rhizosphere and steady supplying of the water and nutrients (Chao *et al*., 2014) [3].

Effect of potting media in rhizosphere spread (cm) in Mexican snow ball (*Echeveria elegans*)

Among the different treatments applied in Echeveria, the maximum significant rhizosphere spread at 90 DAT was observed in T11 (7.25) Leaf compost+ Cocopeat (1:1) followed by T10 and minimum significant was observed in T1 (3.42) with Vermicompost + Perlite (3:1).

Maximum significant rhizosphere spread might be due to the rich source of nutrients present in vermicompost (Sandeep *et al*., 2018) [12] and the suitable environmental conditions prevailing during the time of plant growth.

Table 2: Survival Percentage of Mexican snow ball (*Echeveria elegans*)

Treatment no.	Treatments	Survival Percentage
T_1	Sand + Garden soil (1:1)	60%
T_2	Vermicompost + Perlite (3:1)	70%
T_3	Vermicompost + Perlite (1:1)	65%
T_4	Vermicompost+ Cocopeat (3:1)	80%
T_5	Vermicompost + Cocopeat (1:1)	75%
T_6	Leaf compost + Perlite (3:1)	80%
T_7	Leaf compost + Perlite (1:1)	65%
T_8	Leaf compost + Vermicompost (3:1)	85%
T_9	Leaf compost + Vermicompost (1:1)	75%
T_{10}	Leaf compost + Cocopeat (3:1)	85%
T_{11}	Leaf compost + Cocopeat (1:1)	70%
T_{12}	Vermicompost + Cocopeat + Perlite (1:1:1)	90%
Total		75%

Table 3: Effect of potting media on plant height (cm), number of leaves, plant spread (cm), root length (cm) rhizosphere spread (cm) in Mexican snow ball (*Echeveria elegans)*

Treatment no.	Treatment Combinations	Plant Height (cm)	Plant Spread (cm)	No. of Leaves	Root Length (cm)	Rhizosphere Spread (cm)
T_1	Sand + Garden soil (1:1)	3.69	5.51	16.08	5.83	3.42
T_2	Vermicompost + Perlite (3:1)	4.63	5.19	16.67	5.90	3.67
T_3	Vermicompost + Perlite (1:1)	3.81	4.22	16.11	9.17	5.42
T_4	Vermicompost+ Cocopeat (3:1)	4.74	5.11	16.71	10.50	6.50
T_5	Vermicompost + Cocopeat (1:1)	5.13	5.49	16.33	6.77	4.92
T_6	Leaf compost + Perlite (3:1)	4.56	5.01	16.25	8.47	4.58
T_7	Leaf compost + Perlite (1:1)	5.11	5.92	17.25	6.40	4.07
T_8	Leaf compost + Vermicompost (3:1)	4.75	5.61	15.84	9.53	5.92
T_9	Leaf compost + Vermicompost (1:1)	4.88	6.35	20.58	7.40	4.75
T_{10}	Leaf compost + Cocopeat (3:1)	4.77	5.58	19.33	10.83	7.00
T_{11}	Leaf compost + Cocopeat (1:1)	5.24	5.72	19.17	7.67	7.25
T_{12}	Vermicompost + Cocopeat + Perlite (1:1:1)	5.41	5.98	20.67	11.80	5.42
	F Test	S	S	S	S	S
	CD at 5%	0.95	0.81	2.86	2.58	2.03
	S.Ed.	0.46	0.39	1.38	1.25	0.98

Conclusion

On the basis of the findings obtained, it is concluded that potting media in T_{12} with Vermicompost + Cocopeat + Perlite (1:1:1) found the best in terms for propagation (90% survival percentage), attaining plant height and maximum number of leaves which are most desired characters. However, maximum plant spread was found in T_9, Leaf compost + Vermicompost (1:1). hence, can be recommended for cultivation in pot under Prayagraj agro climatic conditions.

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