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EFFECT OF GROWING MEDIA AND CONTAINERS ON THE VEGETATIVE, BIOCHEMICAL AND ORGANOLEPTIC PARAMETERS OF STRAWBERRY (*FRAGARIA ANANASSA* DUCH.) CV. WINTER DAWN

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ABSTRACT

Strawberry (*Fragaria* × *ananassa* Duch) is one of the most important widely consumed small fruit in the world. The fruit is renowned for its vibrant color, captivating aroma and delightful texture, which contain various nutrients for good health. The study was conducted at the experimental field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during 2022-2024. The aim of the experiment was to determine the effect of growing media and container on the vegetative, biochemical and organoleptic parameters of strawberry *cv*. Winter Dawn. The experiment consisted of different container types and different combination of growing media. The study revealed that the media combination of cocopeat, perlite and vermicompost in the ratio of 1:1:2 was found to be superior. Better vegetative, biochemical and organoleptic score were observed in plants grown in earthen pots. Based on the interaction effect, plants raised in PVC pots with a growing media ratio of 1:1:2 cocopeat + perlite + vermicompost (C2M1) result in highest survival percentage (88.89 %), leaf chlorophyll content (40.00 SPAD value), number of runners per plant (15.63) number of flowers per plant (20.91), TSS (11.87^{o} Brix), titratable acidity (0.60 %), ascorbic acid content (49.80 mg per 100 g fruit) and organoleptic rating of 8.83, 8.97,8.80, 8.87, 8.80 for colour, taste, flavour, texture and overall acceptability, respectively. Also, the cost and returns were reported to be higher in PVC pots with a growing media ratio of 1:1:2 (C2M1) with a benefit cost ratio of 1.53. Thus, strawberry production using cocopeat + perlite + vermicompost in 1:1:2 ratio in PVC Pots will ensure greater success in plant establishment and produce healthy and disease-free strawberries.

Key words : Strawberry, Vegetative, Biochemical, Organoleptic test.

Introduction

Strawberry (*Fragaria* × *ananassa* Duch.) is one of the most popular soft berry fruits consumed worldwide (Thoudam, 2022). It is a temperate fruit, which can be cultivated in tropical and subtropical climates. Strawberry belongs to Rosaceae family. The octoploid *Fragaria* × *ananassa* (2n=8x=56), having a basic chromosome number of x=7commonly known as the garden cultivated strawberry, is a hybrid species (*Fragaria virginiana x Fragaria chiloensis*) that is believed to have originated in Europe (Unal *et al*., 2023; Finn, 2013 and Singh *et al*., 2022). Strawberry is a short-day herbaceous perennial plant that can grow successfully in the day temperatures of 22°C to 25°C and cold night temperatures of 7°C to 13°C (De and Bhattacharjee, 2012). It is commercially propagated by runners. Strawberries are valued for their taste and essential nutrition and are rich in anthocyaninsth at give strawberries their red color and also contain a wide range of phytochemicals, including flavonoids, ellagic acid, and vitamin C. Vitamin C also called as ascorbic acid is an important antioxidant that is found in high amounts in strawberries. It has an important effect on various physiological processes, including collagen biosynthesis, immune function, antioxidant defense as well as preventing cardiovascular disease, inflammation, and some forms of cancers (Nile *et al*., 2014; Miao *et al*., 2017; Walia 2019 and Chambial *et al*., 2013).

Around the world, strawberries are grown in a variety of environments, from open fields to greenhouses. The selection of growing media is an important factor that influences fruit quality, fruit performance and plant development. Traditionally, soil has been the most often utilized growing medium for strawberries. However, it can also harbor soil-borne diseases and pests, which can hinder the plant growth and yield (Bhardwaj, 2013 and Unal *et al*., 2023). However, in the recent past, the use of soilless growing media is gaining popularity as they are mostly free from soil borne diseases, pests and nematodes, acts as a reservoir for nutrients and water and can be customized to provide optimal conditions for plant growth. However, they require careful management of nutrient and pH levels, as well as regular irrigation. Both soil and soilless media have their own advantages and disadvantages (Raja *et al*., 2018; Unal *et al*., 2023 and Tehranifar *et al*., 2007).

According to Lakshmikanth *et al*. (2020), the pot culture with various combinations of media creates the ideal growing environment with an adequate supply of water, macro nutrients, micro nutrients and other required hormones. Using varying amounts of growing material in pots of varying sizes significantly influences the quality, growth, canopy area and yield indicators. The use of artificial media may further reduce the depth of roots as the plant can meet the requirement easily due to appropriate air, water relation and nutrient holding capacity. The size and shape of the container interact with plant biomass and its allocation and therefore have consequences for on-field performance (Poorter *et al*., 2012). The biological activity and growth parameters of the plants are also significantly affected by the type of pot used (Sharma *et al*., 2016). The larger pots affect various characteristics related to photosynthetic matter as a result, improving source-sink relationship and their impact on yield and nutritional quality (Kasai *et al*., 2012). Thus, strawberries being a shallow-rooted and small-statured plant can be cultivated in containers to meet the nutritional security of people living in urban and peri-urban are as and intends to augment the farmer's income and increase the overall production of strawberry by utilizing the unallocated spaces (like balconies, rooftops etc.).

Materials and Methods

During 2022-2024 the experiment was conducted at the experimental field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) in open field condition. The aim of the experiment was to determine the effect of growing media and container on the vegetative, biochemical and organoleptic parameters of strawberry *cv*. Winter Dawn. The present investigation was carried out in different growing media and different types of containers. Growing media like cocopeat, perlite, vermicompost, Soil, Sand and FYM were used to create four media combination *i.e.* M1: cocopeat + perlite + vermicompost (1:1:2), M2: cocopeat + perlite + vermicompost (1:2:1), M3: cocopeat + perlite + vermicompost (2:1:1) and M4: soil + sand + FYM (1:1:1). Three types of containers namely C1 (earthen pot), C2 (PVC pot) and C3 (Thermoform pot) were used in this study which is tabulated in Table 1. The experiment was laid out according to factorial completely randomized block design and each combination was replicated thrice with three plants in each replication.

Prayagraj is situated at latitude of 20^o and 15^o north and longitude of 60^o east and at an altitude of 98 metre above mean sea level. The area of Prayagraj district comes under sub-tropical belt in the South-east of Uttar Pradesh, which experiences extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^o C to 48^o C and seldom falls down as low as 4^o C to 5^o C. The relative humidity ranges between 20-94 %. The average rainfall in this area is around 1013.4 mm annually.

The plants of the strawberry cultivar Winter Dawn were planted under natural light conditions in the evening during the last week of October. All plants were given uniform cultural practices during the course of the investigation. Various vegetative and biochemical parameter like leaf chlorophyll content, number of runners per plant, number of flowers per plant, survival percentage, total soluble solids, titratableacidity, ascorbic acid and organoleptic rating like colour, taste, flavour, texture and overall acceptability were measured in this experiment.

The leaf chlorophyll content was determined using a chlorophyll meter SPAD-502. The number runners, flowers were counted at the end of the growing season and an average number was worked out. The survival percentage of the potted plants was calculated by dividing the total number of plants survived after planting by the total number of plants planted, multiplied by 100. The fruit TSS was estimated by using a hand refractometer. The titratable acidity and ascorbic acid were calculated by the procedure described by A.O.A.C. (1990). A ten-

Table 1 : Details of different potting media and container types used in the experiment.

S. no.	Media Code	Media used	Ratio	Container Code	Container Types
1	M1	Cocopeat + Perlite + Vermicompost	1:1:2	C1	Earthen Pots
2	M2	Cocopeat + Perlite + Vermicompost	1:2:1	C2	PVC Pots
3	M3	Cocopeat + Perlite + Vermicompost	2:1:1	C3	Thermoform Pots
4	M4	Sand + Soil + FYM	1:1:1		

point hedonic scale was used to collect data for the organoleptic test. The overall significance of the difference among the treatments was tested, using critical differences (C.D.) at a 5% level of significance. The results were statistically analyzed with the help of the Windows -based computer package OPSTAT (Sheoran, 2004).

Results and Discussion

Effect of growing media and container on the vegetative parameters

The statistical analysis revealed that there were significant differences among various combination of media, container types and their interaction effect. The data in Table 2 revealed that growing media M1: cocopeat + perlite + vermicompost (1:1:2) resulted in maximum leaf chlorophyll content of 36.72 SPAD value and the minimum leaf chlorophyll content of 32.54 SPAD value was observed in M3 comprising of cocopeat, perlite, vermicompost in the ratio of 2:1:1. Earthen pot reported the maximum leaf chlorophyll content of 36.71 SPAD value and the minimum leaf chlorophyll content of 30.46 SPAD value was recorded in thermoform pot (C3). It is evident from the data that, the interaction between growing media and container types resulted in a significant effect and that the maximum leaf chlorophyll content 40.00 SPAD value was obtained in C2M1: PVC Pot {cocopeat + Perlite + Vermicompost (1:1:2)}. The minimum leaf chlorophyll content of 28.78 SPAD value was recorded in C3M4: Thermoform Pot {Soil + Sand+ FYM (1:1:1)}. The amount of chlorophyll content is influenced by nutrient availability as cocopeat, perlite, and vermicompost media are rich in nutrients. Thus, resulting in more accumulation of photosynthates. Perlite provides proper environment for cultivation as it has properties of interchanging gases in soil and ultimately improves the root zone environment. The growing media helps in improving the aeration condition, which strengthened the root system, maintained the translocation of nutrients in the shoot system and also influenced the capturing of light. Islam *et al*. (2023) studied the impact of different shade houses and growing media on growth, yield and quality of strawberry and revealed that strawberries grown in a net house with cocopeat substrate had the highest chlorophyll content (46.1 SPAD value). Similarly, Lakshmikanth *et al*. (2020) reported that highest leaf chlorophyll content of 2.36 (mg/g of fresh weight) in treatment combination of Soil + cocopeat + vermicompost (1:1:1). Sharma *et al*. (2022) reported that the highest leaf chlorophyll content of 43.28 SPAD value when plant grown in PVC pot with a growing media of cocopeat, perlite and vermicompost in the ratio of 3:1:1. The result were similar to the findings of Hesami *et al*. (2012).

It is evident from Table 2 that all soilless media

Table 2 : Effect of container types and growing media on the leaf chlorophyll content (SPAD value) andsurvival percentage (%) of strawberry *cv*. Winter Dawn.

	Leaf Chlorophyll Content					Survival Percentage				
	M1	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
C1	39.00	38.95	33.11	35.78	36.71	80.55	80.14	71.24	76.47	77.10
C2	40.00	32.89	34.78	37.00	36.17	88.89	69.32	73.62	79.10	77.73
C3	31.17	32.17	29.72	28.78	30.46	68.06	68.34	65.67	64.10	66.54
Mean	36.72	34.67	32.54	33.85		79.17	72.60	70.18	73.23	
Factor	**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**		**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**	
Factor C	0.66	0.47	1.37	2.51		1.61	1.14	3.34	6.12	
Factor M	0.76	0.54	1.58	2.89		1.86	1.32	3.86	7.07	
Factor C x M	1.32	0.93	2.74	5.02		3.22	2.28	6.69	12.24	
C1 - Earthen Pot		C2 - PVC Pot				C3 – Thermoform Pot				

M1- Cocopeat+ Perlite + Vermicompost (1:1:2)
M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1)
M4- Soil + Sand + FYM (1:1:1)

Plate 1 : Crop at vegetative stage.

Table 3 : Effect of container types and growing media on the number of runners and number of flowers of strawberry *cv*. Winter Dawn

	Number of runners per plant					Number of flowers per plant				
	M1	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
C1	13.64	11.98	7.18	9.37	10.54	20.33	19.25	16.58	18.07	18.56
C2	15.63	7.02	8.14	11.13	10.48	20.91	16.34	17.43	19.24	18.48
C3	6.40	6.28	6.22	6.14	6.26	15.09	14.50	13.46	12.08	13.78
Mean	11.89	8.43	7.18	8.88		18.78	16.69	15.82	16.46	
Factor	**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**		**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**	
Factor C	1.16	0.82	2.41	4.41		0.18	0.13	0.38	0.68	
Factor M	1.34	0.95	2.78	5.09		0.21	0.15	0.44	0.80	
Factor C x M	2.32	1.64	4.82	8.82		0.37	0.26	0.76	1.41	
C1 - Earthen Pot			C2 - PVC Pot				C3 – Thermoform Pot			

M1- Cocopeat+ Perlite + Vermicompost (1:1:2)
M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1)
M4- Soil + Sand + FYM (1:1:1)

improved survival percent of plants. Among the growing media use, M1: cocopeat + perlite + vermicompost (1:1:2) recorded in the highest survival percentage of 79.17 % whereas, the lowest survival percentage of 73.23 % was recorded in M4 treatment comprising of Soil, Sand and FYM with combination ratio of 1:1:1. Among the container PVC pot (C2) recorded the highest survival percentage of 77.73% whereas lowest survival percentage (66.54%) was observed in thermoform pot (C3). The result of the statistical analysis of the interaction effect revealed that the maximum survival percentage (88.89%), was obtained in C2M1: PVC Pot {cocopeat + Perlite + Vermicompost (1:1:2)} whereas the minimum survival percentage (64.10%) was found in C3M4: Thermoform Pot {Soil + Sand+ FYM (1:1:1)}. This is because of the properties of growing media, which helped in maintaining the moisture around the root zonal area and strengthened the root system which ultimately provides a better survival rate for strawberry plants (Schie, 1999). Similar findings were reported by Sharma *et al.* (2022). According to them, highest survival percentage (100%) was recorded when plant were grown in PVC potin the growing media consisting of cocopeat, perlite and vermicompost in the ratio of 3:1:1. The study revealed that the growing media with ratio 1:1:2 (cocopeat + perlite + vermicompost) reported better survival percentage, which was analogous with the results of Rai *et al.* (2014) and was in conformity with the earlier findings of Haddadi *et al.* (2010) and Sharma and Godara (2017).

The perusal of data presented in Table 3 revealed that the number of runners per plant recorded varied significantly in response to the use of different growing media and container types. The maximum number of runners per plant (11.89) was produced by growing media M1: Cocopeat + Perlite + Vermicompost (1:1:2), whereas minimum of 7.83 number of runners per plant was observed in media M2: Cocopeat + Perlite + Vermicompost (1:2:1). Amongst the different containers used, the maximum number of runners per plant (10.54) was observed in earthen pot (C1), whereas the minimum (6.26) number of runners per plant was reported in thermoform pot (C3). It is evident from the data that, the

Table 4 : Effect of container types and growing media on the Total Soluble Solids and Titratable Acidity of strawberry *cv.* Winter Dawn.

	Total Soluble Solids (^{0} Brix)					Titratable Acidity (%)				
	M1	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
C1	11.00	10.83	9.30	10.33	10.37	0.56	0.49	0.40	0.45	0.47
C2	11.87	8.57	9.63	10.50	10.14	0.60	0.38	0.40	0.47	0.46
C3	8.45	8.30	8.12	8.03	8.23	0.35	0.28	0.25	0.20	0.27
Mean	10.44	9.23	9.02	9.62		0.50	0.38	0.35	0.37	
Factor	**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**		**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**	
Factor C	0.19	0.14	0.40	0.72		0.03	0.02	0.07	0.11	
Factor M	0.22	0.16	0.46	0.84		0.04	0.03	0.08	0.15	
Factor C x M	0.38	0.27	0.79	1.44		0.06	0.04	0.13	0.23	
C1 - Earthen Pot			C2 - PVC Pot				C3 – Thermoform Pot			

M1- Cocopeat+ Perlite + Vermicompost (1:1:2)
M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1)
M4- Soil + Sand + FYM (1:1:1)

Table 5 : Effect of container types and growing media on the ascorbic acid content of strawberry *cv.* Winter Dawn.

	Ascorbic acid content (mg per 100g)				
	M1	**M2**	**M3**	**M4**	**Mean**
C1	48.26	47.48	39.48	43.95	44.79
C2	49.80	39.19	42.08	46.55	44.41
C3	34.61	35.02	32.74	30.80	33.29
Mean	44.22	40.56	38.10	40.43	
Factor	**SE (d)**	**SE(m)**	**CD (5%)**	**CV**	
Factor C	0.71	0.50	1.48	0.70	
Factor M	0.82	0.58	1.71	3.12	
Factor C x M	1.42	1.01	2.96	5.40	
C1 - Earthen Pot		C2- PVC Pot		C3-Thermoform Pot	

M1- Cocopeat+ Perlite + Vermicompost (1:1:2)
M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1)
M4- Soil + Sand + FYM (1:1:1)

interaction between growing media and container types resulted in a significant effect and revealed that the maximum (26.67) number of runners per plant was observed in C2M1: PVC Pot {cocopeat + perlite + vermicompost (1:1:2)} and the minimum of 6.14 number of runners per plant was obtained in C3M4: Thermoform Pot {Soil + Sand+ FYM (1:1:1)}. Joshi (2003) reported that better aeration and good nutrient supply was observed when perlite was used in combination as a growing media. This ultimately results in more runner production and subsequently more plantlets per runner. Similar findings were reported by Ameri *et al.* (2012) that the perlite having properties like better aeration, helps in translocation of nutrients in the shoot system and due to this reason, the production of runners is found to be maximum in growing media with perlite combination. Shylla and Sharma (2014) also concluded that the maximum number of runners were produced, when perlite was used as a growing media as compared to control (soil). Similarly, Thakur and Shylla (2018) also reported that the maximum number of runners (40.00) was produced under perlite with the combination of FYM. These findings are in line with the observations made by Sharma *et al.* (2022), who reported that the maximum number of runners per plant was obtained when plants were grown in PVC pot with a growing media of cocopeat, perlite and vermicompost in the ratio of 3:1:1. The result was similar to the findings of Lakshmikanth *et al.* (2020).

It is evident from the data that the growing media and container types showed a significant impact on the number of flowers per plant in strawberry. It was found that media M1: cocopeat + perlite + vermicompost (1:1:2) resulted in maximum number of 18.78 flowers per plant and the minimum of 15.82 flowers per plant was observed in M3 comprising of cocopeat, perlite, vermicompost in the ratio of 2:1:1. Among the container used earthen pot reported the maximum of 18.56 number of flowers per plant whereas the minimum number of flowers per plant (13.78) was obtained in thermoform pot (C3). It is evident from the data that the interaction effect of C2M1: PVC pots {cocopeat +perlite + vermicompost (1:1:2)} reported maximum of 20.91 number of flowers per plant whereas minimum (12.08) number of flowers per plant was observed in C3M4: Thermoform Pot {Soil + Sand+ FYM (1:1:1)}. This is because vermicompost with perlite increases the photosynthetic rate which resulted in a break of bud dormancy and improved flowering (Prasad, 2017). Villagra *et al.* (2012) reported that the number of flowers differed significantly with different cultivation systems, where maximum flowers were found in plants grown in a conventional system (3.605, soil) compared to soilless culture system in vertical sleeves (2.813). Similar finding was reported by Sharma *et al*. (2022) that the maximum total number of flowers (35.66) per plant were obtained from the plant grown in earthen pot with a growing media comprising of cocopeat, perlite and vermicompost in the ratio of 3:1:1. Similarly, Yeganeh *et al*. (2024) conducted a study on vermicompost as an alternative substrate to peat moss for strawberry in soilless culture and revealed that highest number of inflorescences were recorded in Camarosa cultivar when grown with 50% perlite and 50% peat moss. The present results are similar to the finding of Sharma and Godara (2017).

Effect of growing media and container on the biochemical parameters

The results of the statistical analysis of the data recorded on biochemical parameters are shown in Tables 4 and 5. As per the developed protocol in the present study, it was recorded that the maximum total soluble solids of 10.44 °Brix was produced by growing media M1 comprising of cocopeat + perlite + vermicompost (1:1:2), whereas minimum TSS (9.02° Brix) was observed in M3 comprising of Cocopeat, Perlite, Vermicompost in the ratio of 2:1:1. Among the container used the maximum Total Soluble Solids (10.37 ^{0} Brix) was observed in earthen pot (C1) and the minimum TSS (8.23°Brix) was recorded in thermoform pot (C3). The result of the statistical analysis of the interaction effect revealed that the maximum Total soluble solids (11.87 ^{0} Brix) was produced by C2M1: PVC pots {cocopeat + perlite + vermicompost (1:1:2)} whereas, the minimum total soluble solids of 8.03 °Brix was noted in C3M4: thermoform pots {soil + sand + FYM (1:1:1)}. These results might be due to the fact that cocopeat, perlite and vermicompost enhanced the total soluble solids due to the presence of macro and micronutrients of media. The presence of potassium improves vegetative growth and also promotes sugar accumulation, which ultimately yields higher total soluble solids. According to Tehranifar *et al*. (2007) revealed that strawberry plant grown with 100 per cent perlite gave maximum soluble solid of 9.50 per cent. Similar findings were reported by Jafarnia *et al*. (2010) that higher percentage of total soluble solid from the combination of perlite and peat moss than 100 percent perlite. Islam *et al*. (2023) reported similar result that higher TSS content was found in fruits grown with vermicompost treated soil. Yeganeh *et al.* (2024) reported that Selva cultivar grown in a media of 50% perlite and 50% vermicompost had the highest amount of total soluble solids. The results of present study are similar to the findings of Massetani *et al.* (2017), Maher *et al*. (2020), Sharma *et al*. (2022), Kumar *et al*. (2022) and Lakshmikanth *et al*. (2020).

Titratable acidity recorded in the present study also showed significant variation among different media, container types and the interaction effect. It is evident from the data that the maximum titratable acidity of 0.50 % was observed under M1: cocopeat + perlite + vermicompost (1:1:2). However, minimum titratable acidity of 0.35 % was recorded under M3 treatment comprising of cocopeat, perlite, vermicompost in the ratio of 2:1:1. Among the container earthen pots recorded the maximum titratable acidity (0.47%), whereas minimum titratable acidity of 0.27% was obtained by thermoform pot (C3). It is evident from the data that the interaction effect of C2M1: PVC pots {cocopeat +perlite + vermicompost (1:1:2)} resulted in maximum titratable acidity of 0.60 %whereas, the minimum titratable acidity of 0.20 % was found in C3M4: Thermoform pots {soil + sand + FYM (1:1:1). Tulipani *et al.* (2008) revealed that the highest titratable acidity was observed when Camarosa strawberry grown in the media combination of vermiculite, perlite and cocopeat. Similar finding was reported by Islam *et al.* (2023) that strawberry plant grown in the net house with cocopeat-treated plants had the highest (0.62%) titratable acidity. Similarly, Maher *et al*. (2020) reported that strawberry plant grown in a media combination of soil and FYM recorded the highest (0.73 per cent) titratable acidity. The present results are in line with the finding of Asghari (2014), who reported that highest TSS content in the strawberry plant grown in a medium of 15% vermicompost, 15% golja, 10% cocopeat and 60% perlite. The results are similar to the earlier findings of Lakshmikanth *et al*. (2020) and Kumar *et al*. (2022).

It is evident from the data presented in table 5 that the growing media and container yielded significant effect on ascorbic acid content in strawberry. The maximum ascorbic acid of 44.22 mg per 100 g of fruit was observed under M1: Cocopeat + Perlite + Vermicompost (1:1:2) However, minimum ascorbic acid of 38.10 mg per 100 g of fruit was recorded under M3 treatment comprising of Cocopeat, Perlite, Vermicompost in the ratio of 2:1:1. Among the containers maximum ascorbic acid of 44.79 mg per 100 g of fruit was recorded by earthen pot (C1). However, the minimum ascorbic acid 33.29 mg per 100 g of fruit was recorded by thermoform pot (C3). It is evident from the data that, the interaction between growing media and container types resulted in a significant effect and that the maximum ascorbic acid 49.80 mg per 100 g of fruit was obtained in C2M1: PVC pot {cocopeat + perlite + vermicompost, (1:1:2)} and the

Table 6 : Effect of container types and growing media on the organoleptic score of colour and taste of strawberry *cv*. Winter Dawn.

	Colour					Taste				
	M1	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
C1	8.60	7.43	8.10	7.70	7.96	8.63	7.43	8.17	8.30	8.13
C2	8.83	7.73	8.37	7.37	8.08	8.97	8.10	7.67	8.27	8.25
C3	8.30	7.60	8.30	7.10	7.83	7.50	8.03	7.83	7.37	7.68
Mean	8.58	7.59	8.26	7.39		8.37	7.86	7.89	7.98	
Factor	**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**		**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**	
Factor C	0.09	0.06	0.18	0.34		0.13	0.09	0.27	0.49	
Factor M	0.10	0.07	0.21	0.38		0.15	0.11	0.32	0.57	
Factor C x M	0.17	0.12	0.36	0.65		0.26	0.19	0.55	0.99	
C1 - Earthen Pot			C2 - PVC Pot				C3 – Thermoform Pot			

M1- Cocopeat+ Perlite + Vermicompost (1:1:2) M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1) M4- Soil + Sand + FYM (1:1:1)

Table 7 : Effect of container types and growing media on the organoleptic score of flavour and texture of strawberry *cv*. Winter Dawn.

	Flavour					Texture				
	M1	**M2**	**M3**	**M4**	**Mean**	**M1**	**M2**	**M3**	**M4**	**Mean**
C1	8.77	7.97	8.40	8.10	8.31	8.73	8.10	7.60	8.10	8.13
C2	8.80	7.60	8.13	8.37	8.23	8.87	7.70	8.13	7.47	8.04
C3	8.17	7.77	8.20	7.50	7.91	8.30	7.57	8.10	7.37	7.83
Mean	8.58	7.78	8.24	7.99		8.63	7.79	7.94	7.64	
Factor	**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**		**SE(d)**	**SE(m)**	**C.D(5%)**	**CV**	
Factor C	0.09	0.07	0.20	0.34		0.09	0.06	0.18	0.34	
Factor M	0.11	0.08	0.23	0.42		0.10	0.07	0.21	0.38	
Factor C x M	0.19	0.13	0.39	0.72		0.18	0.12	0.36	0.68	
C1 - Earthen Pot			C2 - PVC Pot				C3 – Thermoform Pot			

M1- Cocopeat+ Perlite + Vermicompost (1:1:2) M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1) M4- Soil + Sand + FYM (1:1:1)

minimum ascorbic acid (30.80 mg per 100 g of fruit) was found in C3M4: Thermoform pot {soil+ sand+ FYM (1:1:1}. This might be due to the physicochemical properties of growing media which alter by mixing of organic (cocopeat and vermicompost) and inorganic (perlite) substrates, resulting in the synthesis of vitamin C and thereby improving fruit quality. Yeganeh *et al*. (2024) revealed that highest vitamin C content when Camarosa cultivar grown in the substrate based in vermicompost. Similarly, Unal *et al*. (2023) recorded that vitamin Cwere significantly more in soilless cultivated strawberry in comparison with the soil grown strawberry. The findings in the present study are in line with Sharma *et al*. (2022), who reported that from among all the treatments the plants raised in PVC pots with a growing media cocopeat, perlite and vermicompost in the ratio of 3:1:1 had significantly highest ascorbic acid content (54.68 mg per 100 g of fruit). Likely, Hassan *et al*. (2011) showed that the highest vitamin C content in the fruits produced using coconut husk and lowest under soil cultivation. Islam *et al*. (2023) found that the fruits of cocopeat-treated plants that are grown in UV poly sheds and open fields have the highest ascorbic acid content (approximately 46 mg 100 g^{-1}). Lakshmikanth *et al.* (2020) revealed that highest ascorbic acid content (54.80 mg/100 g) was recorded in plants grown in media comprising of soil, cocopeat, vermicompost in the ratio of 1:1:1. Kumar *et al*. (2022) revealed that among the potting substrate combination of soil, vermicompost and cocopeat reported highest ascorbic acid content of 17.95mg/100 g. Addition of compost or vermicompost in soil has resulted in improvement of ascorbic acid content (Kumar *et al*., 2014) which was also clearly evident in the present study. These results were similar to the earlier finding of Asghari (2014) and Raja *et al*. (2018).

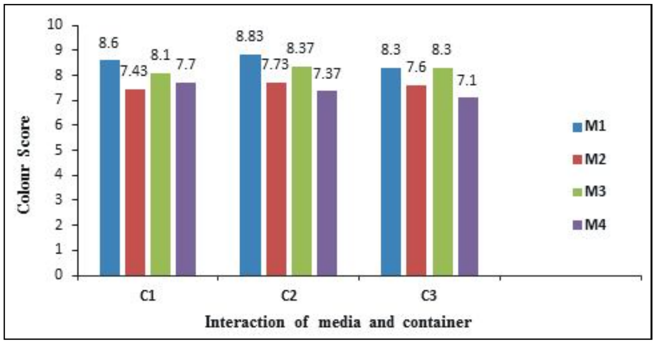

Fig. 1 : Effect of container types and growing media on organoleptic score for colour in strawberry *cv*. Winter Dawn.

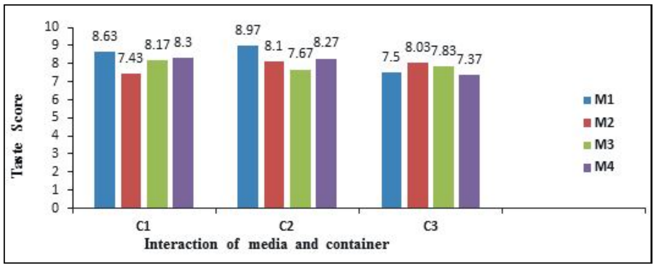

Fig. 2 : Effect of container types and growing media onorganoleptic score for taste in strawberry *cv*. Winter Dawn.

Table 8 : Effect of container types and growing media on the organoleptic score of overall acceptability of strawberry *cv*. Winter Dawn.

	Overall acceptability				
	M1	**M2**	**M3**	**M4**	**Mean**
C1	8.67	8.33	8.13	8.63	8.44
C2	8.80	8.07	8.13	8.23	8.31
C3	8.27	8.10	8.10	7.94	8.10
Mean	8.58	8.17	8.12	8.27	
Factor	**SE (d)**	**SE(m)**	**CD (5%)**	**CV**	
Factor C	0.08	0.06	0.16	0.31	
Factor M	0.09	0.06	0.19	0.34	
Factor C x M	0.15	0.11	0.32	0.57	
C1 - Earthen Pot		C2- PVC Pot		C3-Thermoform Pot	

M1- Cocopeat+ Perlite + Vermicompost (1:1:2)
M2- Cocopeat+ Perlite + Vermicompost (1:2:1)
M3- Cocopeat+ Perlite + Vermicompost (2:1:1)
M4- Soil + Sand + FYM (1:1:1)

Effect of growing media and container on the organoleptic score

The results of the organoleptic test score on the colour, taste, flavour, texture and overall acceptability of strawberry fruit is shown in Tables 6, 7 and 8 and presented in Figs. 1, 2, 3, 4 and 5. The different growing media and container types have been found to show pronounced interaction effect on different organoleptic test of strawberry plant. Based on the organoleptic test, the maximum score for colour (8.83), taste (8.97), flavour (8.80), texture (8.87) and overall acceptability (8.80) was obtained in PVC pots filled with growing media cocopeat + perlite + vermicompost in a ratio of 1:1:2. However, the minimum organoleptic score of 7.10 for colour, 7.37 for taste, 7.50 for flavour, 7.37 for texture and 7.94 for overall acceptability was obtained by C3M4: Thermoform pots {soil + sand + FYM (1:1:1). Similar result was reported by Shylla *et al.* (2018) that strawberry taste better when grown in combinations of Perlite and FYM in 1:1 ratio as compared to soil.

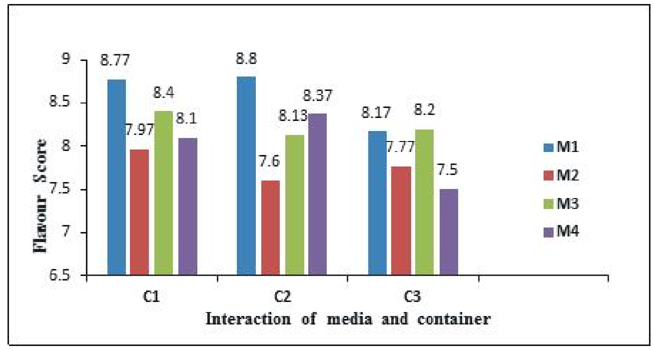

Fig. 3 : Effect of container types and growing media on organoleptic score forflavourin strawberry *cv*. Winter Dawn.

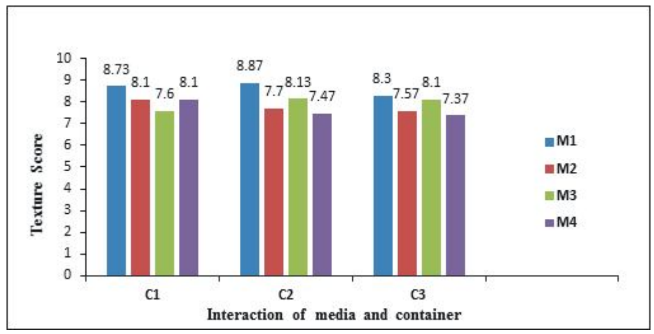

Fig. 4 : Effect of container types and growing media on organoleptic score for texture in strawberry *cv*. Winter Dawn.

Economics

The economics of strawberry cultivation was estimated to be positive for all the treatments combination, (Table 9). The maximum net return of 29639.22 was recorded in C2M1: {PVC Pots (Cocopeat : Perlite : Vermicompost) (1:1:2)}, while the minimum net return (12816.10) was observed in C3M4: {(Thermoform Pots (Soil + Sand + FYM) (1:1:1)}. From the interaction between the container types and potting media it was found that C2M1: PVC Pot {cocopeat + Perlite + Vermicompost (1:1:2)} gave highest (1.53) benefit cost

Table 9 : Gross return, Net return and Benefit cost ratio.

Treatments details	Yield/ 250m	Selling rate (Rs/ Kg)	Gross Return	Net Return	B: C Ratio
C1M1:Earthen Pot{(Cocopeat:Perlite:Vermicompost)(1:1:2)}	922.30	90	83006.64	27389.04	1.49
C1M2:Earthen Pot{(Cocopeat:Perlite:Vermicompost)(1:2:1)}	887.93	90	79913.89	23296.29	1.41
C1M3:Earthen Pot{(Cocopeat:Perlite:Vermicompost) (2:1:1)}	761.64	90	68547.98	13930.38	1.26
C1M4:Earthen Pot{(Soil+Sand+FYM)(1:1:1)}	838.71	90	75483.54	19865.94	1.36
C2M1:PVC Pot{(Cocopeat:Perlite:Vermicompost)(1:1:2)	947.30	90	85256.82	29639.22	1.53
C2M2:PVC Pot{(Cocopeat:Perlite:Vermicompost)(1:2:1)}	789.98	90	71098.20	14480.60	1.26
C2M3:PVC Pot{(Cocopeat:Perlite:Vermicompost)(2:1:1)}	833.59	90	75023.50	18905.90	1.34
C2M4:PVC Pot{(Soil +Sand+FYM)(1:1:1)}	838.82	90	75493.54	19875.94	1.36
C3M1:Thermoform Pot{(Cocopeat:Perlite:Vermicompost)(1:1:2)}	778.98	90	70108.20	14490.60	1.26
C3M2:Thermoform Pot{(Cocopeat:Perlite:Vermicompost)(1:1:2)}	781.54	90	70338.60	13721.00	1.24
C3M3:Thermoform Pot{(Cocopeat:Perlite:Vermicompost)(1:1:2)}	783.67	90	70530.30	14412.70	1.26
C3M4:Thermoform Pot{(Soil + Sand+FYM)(1:1:1)}	765.93	90	68933.70	12816.10	1.23

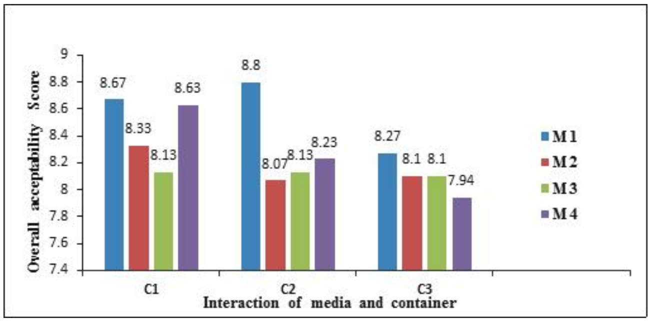

Fig. 5 : Effect of container types and growing media on organoleptic score for overall acceptability in strawberry *cv*. Winter Dawn.

ratio while lowest (1.23) benefit cost ratio was reported in C3M4: Thermoform Pot {Soil + Sand+ FYM (1:1:1)}. It is clear that Thermoform Pot results is less productivity due to decreased per cent of mortality due to competition between plants for components essential for growth (Prasad, 2017). In addition, the total cost of cultivation and the market price for the produce plays a vital role on the net returns.

Conclusion

On the basis of the results obtained in the present course of investigation it can be concluded that media combination of cocopeat + perlite + vermicompost, 1:1:2 was found to be superior among other growing media. Among the different containers used earthen pot showed best performance in the vegetative, biochemical and organoleptic test of strawberry. From the interaction between growing media and container types it can be concluded that plant grown in PVC pot with media combination of cocopeat, perlite and vermicompost in the ratio of 1:1:2 showed significantly superior in the vegetative, biochemical and organoleptic score of strawberry *cv*. Winter Dawn. Therefore cultivation of strawberries in various container using growing media other than soil can be an effective method in the production of disease-free strawberries and augment the farmer's income through containerized methods for growing strawberries by utilizing the unallocated spaces (like balconies, rooftops etc.). Growing strawberries in unconventional methods as in this experiment also significantly increase the production capacity within urban settings without compromising on taste or nutrient content.

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