



Potting substrate effect on yield and quality of strawberry (*Fragaria* × *ananassa*) in terrace gardening

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Received: 03 March 2021; Accepted: 09 December 2021

Keywords: Growth, Pot substrate, Quality, Strawberry, Terrace gardening, Yield

Terrace gardening is gaining importance because of increasing concern of city dwellers for safe and nutritious foods, besides it has potential environmental and ecological benefits (Santo *et al.* 2016). Beside supplying fresh and safe foods, it helps reduce energy consumption of buildings by acting as insulation, thus extending life-time of roofs and reducing storm water runoff (Khapte *et al.* 2019). Strawberry (*Fragaria* × *ananassa* Duchesne) is one of the most preferred crops for terrace gardening as it is short duration crop and requires relatively less care (Sharma 2002).

Soil is a natural crop growing medium that provides supports to the plants, holds and supply nutrient and water, but the weight is a major concern in its use on terrace gardening. Several alternate growing media have been tried but cocopeat is widely accepted in the cultivation. However, it does not contain any nutrient and also can not hold water for long time, so for a common person, it is difficult to grow plants completely soilless. Mixing soil to a certain extent with organic manures can ensure a reasonable supply of nutrients with adequate buffering capacity for making this practice more users friendly. In view of this, the present study was planned to evaluate different combinations of soil, organic manures (FYM and vermicompost) and cocopeat as potting substrates for producing good quality strawberries on the urban terrace.

The experiment was conducted at KVK, Ujwa, New Delhi during 2017–18. Treatments included two strawberry cultivars (Sweet Charlie and Winter Dawn), and nine potting substrates (PS), viz. PS₁: Soil + Farm yard manure (FYM); PS₂: Soil + Vermi-compost (VC); PS₃: Soil +

FYM + Cocopeat; PS₄: Soil + VC + Cocopeat; PS₅: Soil + FYM + VC + Cocopeat; PS₆: Soil; PS₇: FYM; PS₈: VC; PS₉: Cocopeat. The experiment was laid out in factorial randomized block design with three replications.

Observations were recorded on five randomly selected plants/treatment: plant height, length of stolon, number of leaves/plant, number of crowns/plant and number of fruits and fruit yield/plant were measured. Ten randomly selected fruits were taken for physico-chemical analysis from each treatment: fruit length, breadth and weight were measured and averaged. Total soluble solid (°B), acidity (%) and ascorbic acid content (mg/100 g) were estimated according to Ranganna (1997). Juice content was estimated by using the following formula:

$$\text{Juice content (\%)} = \frac{\text{Total volume of juice (ml)}}{\text{Weight of fruit (g)}} \times 100$$

Data were statistically analyzed by ANOVA using SPSS (version 22 for Windows, 2013). Duncan's Multiple Range Test was performed (P=0.05) to separate the treatment means within each variable measured.

Data on growth and yield parameters (Table 1) indicates that plant height was significantly higher in Winter Dawn than Sweet Charlie, though leaf number was higher in Sweet Charlie. These parameters were affected by potting substrates; highest plant height and leaf number was recorded in PS₄, though was statistically at par with PS₅, PS₃ and PS₂ for both parameters. Winter Dawn registered considerably higher number of crowns per plant and length of stolon as compared to Sweet Charlie. Stolon length was affected by potting substrates; longest stolon length was in PS₄ followed by in PS₅. No interaction effect of variety and potting substrate was recorded for all the growth characters. Soil and organic manures combined with cocopeat were found very useful in this study as cocopeat has likely helped maintaining better water retention, since proper density and porosity of the substrates play a decisive role for its usability for strawberry cultivation (Ameri *et al.* 2012). Hassan *et al.* (2011) observed highest number of leaves and plant height in coconut husk medium, while lowest in soil. The number

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Table 1 Effect of variety and potting substrates on growth and yield characters of strawberry

Treatment	Plant height (cm)	Number of leaves	Number of crowns/plant	Length of stolon (cm)	Number of fruits/plant	Fruit yield/plant (g)
<i>Variety (V)</i>						
Sweet Charlie	15.74 b	18.11 a	4.31 b	34.89 b	9.13	107.97 b
Winter Dawn	16.67 a	17.38 b	4.83 a	36.11 a	9.48	116.66 a
<i>Potting substrate (PS)</i>						
PS ₁	17.00 ab	18.90 a	4.25	35.20 cd	10.50 a	133.45 c
PS ₂	17.35 a	19.50 a	4.60	37.40 bc	11.20 a	152.05 bc
PS ₃	17.75 a	19.95 a	5.05	38.60 ab	11.20 a	145.00 bc
PS ₄	18.85 a	20.80 a	5.65	42.10 a	12.95 a	189.70 a
PS ₅	18.10 a	19.70 a	5.20	40.00 ab	12.45 a	167.55 ab
PS ₆	15.30 b	14.60 bc	3.90	30.80 de	6.85 b	60.05 d
PS ₇	15.20 b	14.75 bc	4.10	31.75 d	6.25 b	59.20 d
PS ₈	15.90 ab	15.85 bc	4.35	32.70 d	6.80 b	62.20 d
PS ₉	10.40 c	13.90 c	3.35	28.90 e	5.55 b	41.60 d
<i>Significance</i>						
V	**	***	***	**	NS	***
PS	*	**	NS	***	**	***
V × PS	NS	NS	NS	NS	NS	NS

NS, *, **, ***, non-significant or significant at P<0.01 or 0.001, respectively

of leaves decreased as soil proportion increased in growing media (Selda and Anapali 2010). Ericisli *et al.* (2005) also reported effectiveness of soilless substrates on the growth of above and underground parts of strawberry plants.

Data (Table 1) shows that per plant fruit number and fruit yield were higher in Winter Dawn than Sweet Charlie. Like growth parameters, substrate PS₄ provided higher number of fruits and fruit yield than other potting substrates. No interaction was found for variety and pot substrates for both parameters. Rostami *et al.* (2014) have also observed that the yield of strawberry significantly differed when substrates were composed of different ratios of cocopeat, perlite and FYM. Ebrahimi *et al.* (2012) also obtained higher yields of strawberries cultivated in the substrate containing coconut husk.

Analyzed data on various fruit physical and chemical parameters are presented in Table 2. No significant variation was observed between varieties for fruit weight and fruit length; however, these were significantly influenced by potting substrates. PS₄ recorded highest fruit weight and PS₄ has resulted in distinctly higher fruit length and fruit breadth than other potting substrates. Interaction studies between variety and pot substrate revealed non-significant results for all fruit physical parameters. Prasad *et al.* (2021) also revealed that addition of compost (of spent mushroom) in growing media improves morphology and yield in strawberry. Hassan *et al.* (2011) also reported that mixture of different organic substrates was beneficial in obtaining good fruit size of strawberry (cv. Festival).

Total soluble solids (TSS) content was statistically higher in Sweet Charlie strawberry than Winter Dawn

(Table 2). Maximum TSS content was recorded in PS₄ followed by PS₅ and PS₂. No significant variation in acidity (%) was observed due to variety or potting substrates. However, Sweet Charlie was better than Winter Dawn for TSS/acid blend. In potting substrates, PS₄ was best for TSS/acid ratio, though statistically at par with PS₃ and PS₆. Ascorbic acid content was influenced by both variety and potting substrate (Table 2); the content of ascorbic acid was higher in Winter Dawn than Sweet Charlie. Among potting substrates, PS₄ registered highest ascorbic acid content, though statistically at par with PS₅ and PS₃. Interaction studies between variety and pot substrate revealed non-significant results for TSS, acidity, TSS/acid ratio and ascorbic acid. Addition of compost or vermi-compost in soil has resulted in improvement of ascorbic acid content (Kumar *et al.* 2014) which was also clearly evident in the present study.

Juice content (%) was significantly influenced due to varieties and potting substrates (Table 2). Winter Dawn recorded higher juice content than Sweet Charlie, whereas, amongst potting substrates, it was recorded highest in PS₄ closely followed by PS₂ and PS₅. Wang and Lin (2002) have also obtained improvement in the fruit quality traits like TSS, acidity, organic acids and sugars when compost was added to the soil in 1:1 ratio and reported that beneficial effects of compost added media was due to better plant nutritional status and plants physiological activity.

SUMMARY

Terrace gardening or rooftop gardening is becoming popular in urban and peri-urban areas of metro cities

Table 2 Effect of variety and potting substrates on fruit physical and chemical characters of strawberry

Treatment	Fruit weight (g)	Fruit length (mm)	Fruit breadth (mm)	TSS (°B)	Acidity (%)	TSS/acid ratio	Ascorbic acid (mg/100 g)	Juice content (%)
<i>Variety (V)</i>								
Sweet Charlie	11.11	27.62	17.80 b	9.07 a	0.79	11.48 a	15.63 b	15.09 b
Winter Dawn	11.52	28.93	18.66 a	8.13 b	0.85	9.56 b	16.00 a	15.16 a
<i>Potting substrate (PS)</i>								
PS ₁	12.70 ab	30.90 a	20.10 a	8.70 b	0.87	10.00 bc	16.40 b	16.30 b
PS ₂	13.55 a	30.65 a	20.45 a	8.95 ab	0.85	10.53 ab	16.65 ab	17.40 a
PS ₃	12.91 ab	31.35 a	22.10 a	8.90 b	0.83	10.72 a	17.05 a	16.80 ab
PS ₄	14.65 a	33.20 a	22.90 a	9.35 a	0.85	11.00 a	17.95 a	18.15 a
PS ₅	13.45 a	31.70 a	20.15 a	8.95 ab	0.85	10.53 ab	17.50 a	17.35 a
PS ₆	8.55 bc	26.00 ab	15.70 b	8.00 cd	0.82	9.76 c	14.00 d	12.45 cd
PS ₇	9.45 bc	25.50 ab	14.90 bc	8.10 cd	0.77	10.52 ab	14.35 cd	12.95 c
PS ₈	9.15 bc	26.15 ab	16.75 abc	8.55 bc	0.82	10.43 bc	15.50 bc	13.45 c
PS ₉	7.45 c	19.05 b	11.00 c	7.90 d	0.74	10.68 ab	12.95 e	11.25 d
V	NS	NS	*	**	NS	**	**	*
PS	***	***	***	***	NS	*	***	***
V × PS	NS	NS	NS	NS	NS	NS	NS	NS

NS, *, **, ***, non-significant or significant at P<0.05, <0.01 or 0.001, respectively.

worldwide including in India. Among various crops suitable for growing in terrace garden, strawberry is a popular one as being an important annual herbaceous plant with delicious fruits which can be easily grown in pots or containers including grow bags filled with different potting substrates. In the present study, different combinations of soil, organic manure (vermi-compost and FYM) and cocopeat were tested for growth, yield and physico-chemical characteristics of two strawberry cultivars (Winter Dawn and Sweet Charlie). Winter dawn was found better than Sweet Charlie for measured growth and yield parameters, and potting substrates had similar effect on both the cultivars as no interaction effect was noticed. Combination of Soil + vermi-compost + cocopeat or soil + FYM + cocopeat in equal proportion (1:1:1) was found most appropriate potting substrate for strawberry cultivation, hence suggested as a suitable growing medium for production of strawberries in terrace or rooftop gardening in peri-urban areas of Delhi/ National Capital Territory. Further investigation is needed to standardize cost-effective management agro-techniques of strawberry cultivation in terrace garden involving some other cultivars, nutrient management and environment protective structures and so on.

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