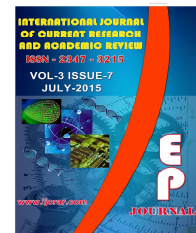




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Effect of growing substrates and pot sizes on growth, flowering and pot presentability of *Primula malacoides* Franch.

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KEYWORDS

Growing substrate,
Pot size,
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Pot
presentability

A B S T R A C T

The investigations were carried out at experimental farm during September, 2012-April, 2013. The experiment was laid out in Completely Randomized Design (factorial). Seven growing substrates viz., Soil: FYM: Sand (1:1:1, v/v), Ban Oak (*Quercus semicarpofolia*) leafmould: FYM: soil (2:1:1, v/v), Rhododendron (*Rhododendron arboreum* L.) leafmould: FYM: soil (2:1:1, v/v), Rai (*Picea smithiana* L.): FYM : soil (2:1:1, v/v), Chirpine (*Pinus roxburghii* L.) leafmould: FYM: soil (1:1:1, v/v), cocopeat : FYM : sand (1:1:1, v/v), Spent mushroom compost: FYM: sand (2:1:1, v/v) and three pot sizes i.e. 15, 20 and 25 cm diameter pots, respectively. The growing substrate comprising cocopeat: FYM: sand (1:1:1, v/v) recorded maximum values in terms of plant height, plant spread, number of inflorescences per plant, number of flowers per plant, duration of flowering and highest pot presentability score. As regards the effects of pot sizes, 25 cm diameter pots exhibited, maximum plant height, plant spread, number of inflorescences per plant, number of flowers per plant, duration of flowering and pot presentability score. Among interactions, growing substrate \times pot size, maximum plant height, plant spread, number of inflorescence per plant, number of flowers per plant, duration of flowering and pot presentability score in growing substrate comprising cocopeat : FYM : sand (1:1:1,v/v) and using 25 cm diameter pot size.

Introduction

Primula malacoides Franch. is among the most important and magnificent flowering pot plants of commercial importance in temperate zone. The names primula and primrose have been derived from the Italian word '*Primaverola*' meaning, 'first flower of spring'. It belongs to family Primulaceae. It is also known as 'fairy primrose'. It is a non-hardy species. The inflorescence is a loose, open umbel borne on graceful slender stem and the plant attains a maximum height

of 40–50 cm. The flowers are purple, pale-pink, crimson, rose-red, white or lavender-mauve in colour and delicately perfumed. The selection of suitable growing substrates and pot sizes play an important role in manipulating the growth, development and flowering of Primula. It is well documented that growing substrates have some considerable effects on growth, flowering and presentability of various container grown foliage and flowering indoor plants

including Primulas. So, selection and formulation of an appropriate growing medium is critical for the success of all production stages of primulas. Similarly, the container size also plays an important role in manipulating the growth, development and flowering besides the presentability of indoor plants in general and potted primulas in particular. Hence, present studies were undertaken to work out a suitable growing substrate and pot size for the quality growth, flowering and presentability attributes of potted primulas.

Material and Methods

Seven growing substrates viz., Soil: FYM: Sand (1:1:1, v/v), *Quercus* leaf mould: FYM: Soil (2:1:1, v/v), *Rhododendron* Leaf mould: FYM: Soil (2:1:1, v/v), *Picea smithiana* L. Leaf mould : FYM : Soil (2:1:1, v/v), *Pinus* Leaf mould : FYM : Soil (1:1:1, v/v), Cocopeat : FYM : Sand(1:1:1, v/v) and Spent mushroom compost : FYM : Sand (2:1:1, v/v) were prepared after thoroughly mixing of various ingredients on volume by volume basis and filled up in plastic pots of 15 cm, 20 cm and 25 cm diameter pots, respectively. After filling the pots, light watering is done so as to settle down the potting mixture properly and left as such in the shade net house. After 24 hours, the healthy and stocky seedling of *Primula malacoides* Franch. were planted in plastic pots of 15cm, 20 cm and 25 cm diameter pots containing a sterilized mixture of different growing substrates in the shade net house on 1st September, 2012. The requisite samples of different growing substrates was collected before planting and analyzed for various physical and chemical properties following standard procedures. The data recorded on various growth, flowering and pot present ability attributes were subjected to analysis of variances using completely Randomized Design (factorial).

Two irrigations per week were applied during September to February and four irrigations per week were applied during March-April depending upon the weather conditions. All plants were inspected for disease/insect-pest infestation at regular intervals. Drenching with Dithane M-45 @ 0.2% and Bavistin @ 0.1% was done at fortnightly intervals.

All growth and flowering parameters, except duration of flowering were recorded at the time of peak flowering. Duration of flowering was recorded as the time taken in days from first flower opening till at least a single inflorescence per plant remained fresh or presentable. Pots were evaluated for their present ability on the basis of point system modified after Conover (1986).

The parameters studied and points allotted to each parameter out of 100 points were shown in Appendix-III.

Results and Discussion

Vegetative parameters (Plant height and Plant spread)

A perusal of data presented in table 1 shows that the growing substrate comprising cocopeat : FYM : sand (1:1:1, v/v) recorded maximum values in terms of plant height (43.05 cm) and plant spread (36.58 cm). More vegetative parameters of primula plants grown in this substrate may be ascribed to the fact this growing medium have provided optimal physico-chemical properties (Appendix –I and II). These findings get the support from the earlier reports of Wazir *et al.* (2009) in *Alstroemeria*. Similar findings have also been reported in Dutch rose cv. ‘Naranga’ by Hazarika Ankita *et al.* (2010).

Similarly, the response of pot sizes on vegetative parameters varied with the diameter of pots. A pot of 25 cm size exhibited, maximum plant height (37.20 cm), and plant spread (39.50 cm). The higher vegetative parameters in large size pots could be due to the reason that bigger containers could have accommodated more amount of growing substrate that has been helpful in providing sufficient nutrients and space for growth of adequate root system. These results are also in close conformity with the findings of Vernieri *et al.* (2003) in Sunflower.

Among interactions, growing substrate \times pot size, maximum plant height (46.26 cm) and plant spread (41.71 cm). More vegetative parameters in growing substrate composed of cocopeat : FYM : sand 1:1:1, v/v grown in 25 cm pots might be attributed to the conducive interactive effects of this growing substrate and larger size of pots that could have accommodated more amount of substrate which assure better physico-chemical properties. These results are in close agreement with the earlier findings of Gepliy *et al.* (2011).

Flowering parameters

A perusal of data in table 2 indicated that the growing substrate comprising cocopeat : FYM: sand (1:1:1, v/v) recorded maximum values in terms of number of inflorescences per plant (37.54), number of flowers per plant (707.20) and duration of flowering (111.90 days). This may be due to the fact that this growing medium has provided congenial growing conditions and produced maximum number of flowering shoots per plant that have resulted in the production of increased number of inflorescences. Similar findings have been reported in *Alstroemeria* by Wazir *et al.* (2009). Similar findings have been reported by Sekar and Sujata (2001) in *gerbera* and *Geranium* by Singh (2010).

As regard the effect of pot sizes maximum number of inflorescences per plant (34.65), number of flowers per plant (703.10) and duration of flowering (99.60 days) were recorded when plants were grown in 25 cm diameter pots. Our results are in close agreement with the work of Biermann (1982) in *Cyclamen*.

The interaction of different substrates and pot sizes maximum number of inflorescences per plant (47.56), number of flowers per plant (999.50) and duration of flowering (118.70days) were recorded when the plants were grown in cocopeat: FYM: sand (1:1:1, v/v) and using 25 cm pot size. This might be due to the facts that the given growing medium exhibited with better physico-chemical properties (Appendix-I and II) as specially coupled with 25 cm pot size.

Pot present ability Score

The analysis of data exhibited the significant effects of growing substrates and pot sizes on pot presentability score (Table 3). The maximum pot presentability score (84.22) was recorded when plants were grown in cocopeat: FYM: sand (1:1:1, v/v) which might be ascribed to the fact that this growing medium assured better growing environment, supplied sufficient nutrients, besides exhibiting excellent physico-chemical and biological properties required for the production of best quality potted *primula*. Similar findings have been reported by Wazir *et al.* (2009) in *Alstroemeria*. The use of 25 cm pot size recorded maximum pot presentability score (81.67). This may be due to the fact that in small pots root restriction conditions were more pronounced and there was less space for root growth and thus growth of top biomass reduced accordingly.

Table.1 Effect of growing substrates and pot sizes on plant height and plant spread of *Primula malacoides* Franch.

Treatments	Plant Height (cm)	Plant spread (cm)
Growing substrates		
T ₁	31.49	32.41
T ₂	35.20	34.93
T ₃	33.26	33.72
T ₄	33.24	35.89
T ₅	33.14	32.30
T ₆	43.05	36.58
T ₇	37.21	33.20
Standard Error	1.13	0.56
CD _{0.05}	2.28	1.14
Pot sizes		
P ₁	32.70	28.96
P ₂	35.78	33.98
P ₃	37.20	39.50
Standard Error	0.74	0.37
CD _{0.05}	1.49	0.75
Interactions		
T ₁ P ₁	26.18	25.88
T ₁ P ₂	32.01	31.68
T ₁ P ₃	36.27	39.66
T ₂ P ₁	33.42	29.07
T ₂ P ₂	35.02	35.62
T ₂ P ₃	37.16	40.12
T ₃ P ₁	33.48	30.83
T ₃ P ₂	31.98	33.16
T ₃ P ₃	34.01	37.17
T ₄ P ₁	32.67	30.30
T ₄ P ₂	35.83	37.72
T ₄ P ₃	31.27	39.66
T ₅ P ₁	32.19	27.78
T ₅ P ₂	32.57	31.08
T ₅ P ₃	34.94	38.05
T ₆ P ₁	39.57	30.84
T ₆ P ₂	43.33	37.18
T ₆ P ₃	46.26	41.71
T ₇ P ₁	31.40	28.02
T ₇ P ₂	39.73	31.44
T ₇ P ₃	40.51	40.14
Standard Error	1.38	0.98
CD _{0.05}	3.95	1.98

Growing substrates:

- T₁ = Soil: FYM : Sand (1:1:1, v/v)
- T₂ = *Quercus* leaf mould : FYM : Soil (2:1:1, v/v)
- T₃ = *Rhododendron* leaf mould: FYM : Soil (2:1:1, v/v)
- T₄ = *Picea* leaf mould : FYM : Soil (2:1:1, v/v)
- T₅ = Chirpine leaf mould : FYM : Soil (1:1:1, v/v)
- T₆ = Cocopeat : FYM : Sand (1:1:1, v/v)
- T₇ = Spent mushroom compost: FYM : Sand (2:1:1, v/v)

Pot sizes:

- P₁ = 15 cm dia. pots
- P₂ = 20 cm dia. pots
- P₃ = 25 cm dia. pots

Table.2 Effect of growing substrates and pot sizes on various flowering parameters of *Primula malacoides* Franch.

Treatments	Number of Inflorescences per plant	Number of flowers per plant	Duration of flowering (days)
Growing substrates			
T ₁	17.86	293.90	79.30
T ₂	27.53	487.80	86.16
T ₃	23.03	404.00	84.26
T ₄	30.03	535.50	91.26
T ₅	30.13	510.60	96.82
T ₆	37.54	707.20	111.90
T ₇	33.87	587.50	88.53
Standard Error	1.60	30.86	0.08
CD _{0.05}	3.23	62.28	1.66
Pot sizes			
P ₁	21.71	322.10	83.45
P ₂	29.35	486.20	90.48
P ₃	34.65	703.10	99.60
Standard Error	1.05	20.20	0.05
CD _{0.05}	2.12	40.77	2.87
Interactions			
T ₁ P ₁	12.47	170.41	70.60
T ₁ P ₂	18.41	286.10	79.83
T ₁ P ₃	22.70	425.10	87.47
T ₂ P ₁	21.30	306.30	80.93
T ₂ P ₂	28.13	474.70	84.40
T ₂ P ₃	33.17	682.40	93.17
T ₃ P ₁	18.00	295.10	77.40
T ₃ P ₂	21.33	347.50	83.73
T ₃ P ₃	28.95	569.60	91.67
T ₄ P ₁	25.69	397.40	82.43
T ₄ P ₂	29.68	490.90	89.13
T ₄ P ₃	34.71	718.20	102.20
T ₅ P ₁	28.28	413.00	87.63
T ₅ P ₂	30.06	489.50	94.83
T ₅ P ₃	32.04	629.30	108.00
T ₆ P ₁	22.60	348.50	105.00
T ₆ P ₂	42.45	773.50	112.00
T ₆ P ₃	47.56	999.50	118.70
T ₇ P ₁	22.82	324.30	80.20
T ₇ P ₂	35.38	541.00	89.40
T ₇ P ₃	43.42	897.20	96.00
Standard Error	2.78	53.46	0.01
CD _{0.05}	5.61	107.88	2.87

Growing substrates:

- T₁ = Soil: FYM : Sand (1:1:1, v/v)
- T₂ = *Quercus* leaf mould : FYM : Soil (2:1:1, v/v)
- T₃ = *Rhododendron* leaf mould: FYM : Soil (2:1:1, v/v)
- T₄ = *Picea* leaf mould : FYM : Soil (2:1:1, v/v)
- T₅ = Chirpine leaf mould : FYM : Soil (1:1:1, v/v)
- T₆ = Cocopeat : FYM : Sand (1:1:1, v/v)
- T₇ = Spent mushroom compost : FYM : Sand (2:1:1, v/v)

Pot sizes:

- P₁ = 15 cm dia. pots
- P₂ = 20 cm dia. pots
- P₃ = 25 cm dia. pots

Table.3 Effect of growing substrates and pot sizes on pot presentability of *Primula malacoides* Franch.

Growing substrates \ Pot sizes	Pot presentability score			
	P ₁ (15 cm dia. pots)	P ₂ (20 cm dia. pots)	P ₃ (25 cm dia.pots)	Mean
T ₁	68.67	64.67	73.33	68.89
T ₂	68.67	80.00	83.67	77.44
T ₃	74.67	76.00	82.67	77.78
T ₄	75.33	74.67	77.00	75.67
T ₅	74.00	83.33	79.67	79.00
T ₆	74.00	87.00	91.67	84.22
T ₇	68.67	81.67	83.67	78.00
Mean	72.00	78.19	81.67	

SE

Growing substrates : 84.22
 Pot sizes : 81.67
 Growing substrates × Pot sizes : 91.67

CD0.05

Growing substrates : 6.88
 Pot sizes : 4.50
 Growing substrates × Pot sizes : NS

Growing substrates:

T₁ = Soil: FYM: Sand (1:1:1, v/v)

T₂ = *Quercus* leaf mould: FYM: Soil (2:1:1, v/v)

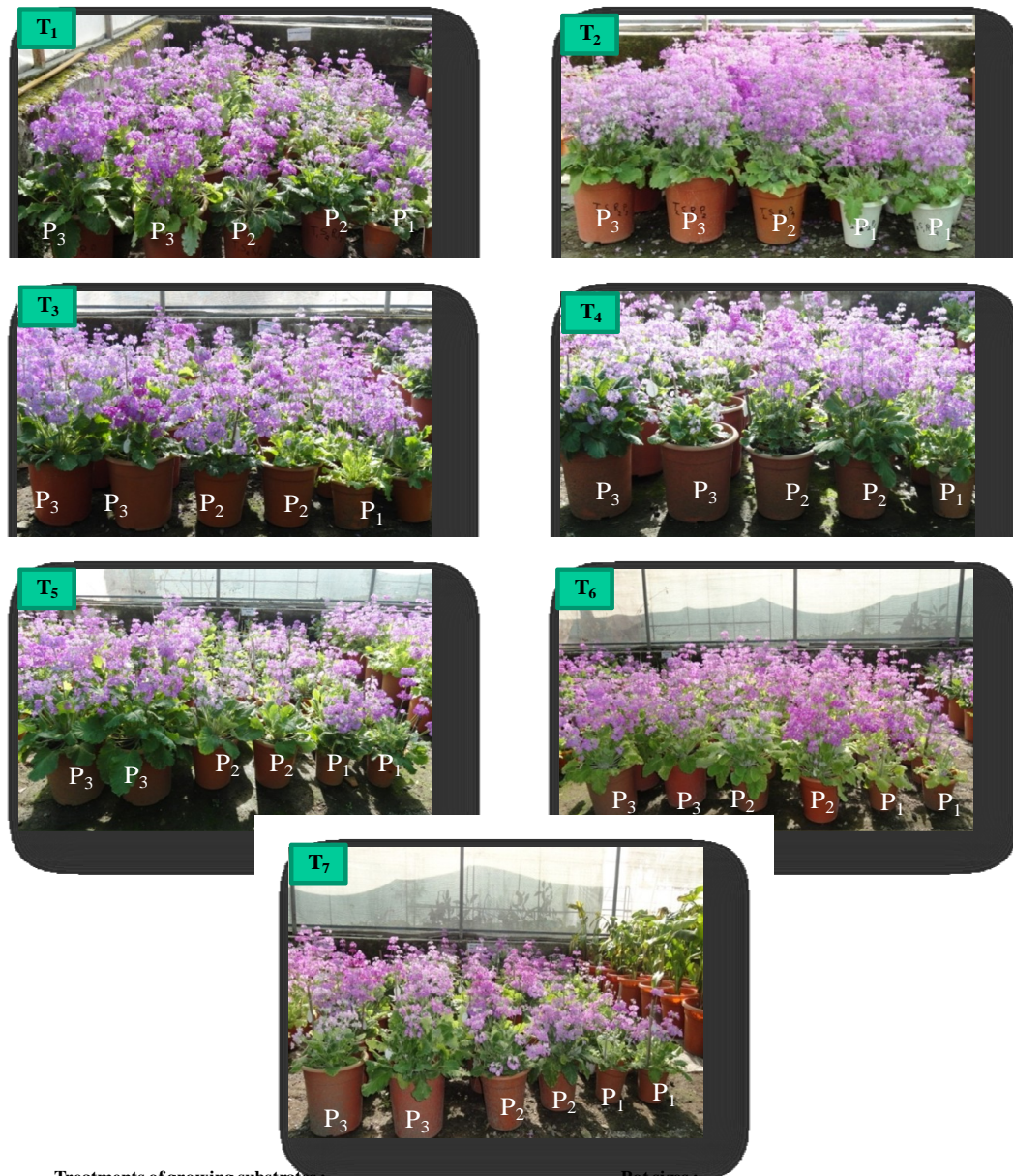
T₃ = *Rhododendron* leaf mould: FYM: Soil (2:1:1, v/v)

T₄ = *Picea* leaf mould : FYM: Soil (2:1:1, v/v)

T₅ = Chirpine leaf mould: FYM: Soil (1:1:1, v/v)

T₆ = Cocopeat: FYM: Sand (1:1:1, v/v)

T₇ = Spent mushroom compost : FYM: Sand (2:1:1, v/v)



Treatments of growing substrates :

- T₁ = Soil : FYM : Sand (1:1:1, v/v)
- T₂ = Ban Oak leafmould : FYM : soil (2:1:1, v/v)
- T₃ = Rhododendron leafmould : FYM : soil (2:1:1, v/v)
- T₄ = Rai leafmould : FYM : soil (2:1:1, v/v)
- T₅ = Chirpine leafmould : FYM : soil (1:1:1, v/v)
- T₆ = Cocopeat : FYM : sand (1:1:1, v/v)
- T₇ = Spent mushroom compost : FYM : sand (2:1:1, v/v)

Pot sizes :

- P₁ : 15 cm dia. Pots
- P₂ : 20 cm dia. Pots
- P₃ : 25 cm dia. Pots

Effect of growing substrates and pot sizes on flowering of *Primula malacoides* Franch.

The interaction effects indicated that growing substrate comprising of cocopeat: FYM: sand (1:1:1, v/v) and use of 25 cm diameter pot resulted in maximum pot presentability score (91.67). In general, as container size increased plant leaf area, shoot biomass and root biomass also increased linearly (Cantliffe, 1993).

It is concluded that primula plants grown in growing substrate comprising of cocopeat: FYM: sand (1:1:1, v/v) and using 25 cm diameter pot size resulted in most desirable and presentable potted primula.

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Appendix-I

a) Chemical properties of various Growing Substrates

Growing Substrates	Major elements (kg/ha)			pH 1:2.5	EC (ms)
	N	P	K		
T ₁ = Soil : FYM : Sand (1:1:1, v/v)	203	349.5	854	7.2	1.1
T ₂ = <i>Quercus</i> leafmould : FYM : soil (2:1:1, v/v)	287	157.4	1990	7.5	1.6
T ₃ = <i>Rhododendron</i> leafmould : FYM : soil (2:1:1, v/v)	595	241.35	990	6.8	1.8
T ₄ = <i>Picea</i> leafmould : FYM : soil (2:1:1, v/v)	707	196.64	2620	7.1	2.2
T ₅ = Chirpine leafmould : FYM : soil (2:1:1, v/v)	469	215.09	815	7.1	1.5
T ₆ = Cocopeat : FYM : sand (1:1:1, v/v)	315	377.27	1640	7.2	0.9
T ₇ = Spent mushroom compost : FYM : soil (2:1:1, v/v)	455	385.69	1995	7.3	1.2

Appendix-II

b) Physical properties of various Growing Substrates

Growing Substrates	Bulk density (g/cc)	Particle density (g/cc)	Percent Pore space (%)
T ₁ = Soil : FYM : Sand (1:1:1,v/v)	1.25	1.6	25
T ₂ = <i>Quercus</i> leafmould : FYM : soil (2:1:1, v/v)	0.92	4.5	32.4
T ₃ = <i>Rhododendron</i> leafmould : FYM : soil (2:1:1, v/v)	0.86	1.53	43.4
T ₄ = <i>Picea</i> leafmould : FYM : soil (2:1:1, v/v)	0.79	1.08	22.91
T ₅ = Chirpine leafmould : FYM : soil (2:1:1, v/v)	0.90	1.25	27.27
T ₆ = Cocopeat : FYM : sand (1:1:1, v/v)	0.80	1.33	40
T ₇ = Spent mushroom compost : FYM : soil (2:1:1, v/v)	1.25	1.42	12.5

Source: The physical and chemical properties of above cited growing media were analyzed at Directorate of Mushroom Research, Chambaghat, Solan, H.P.

Appendix-III

Parameters	Description	Maximum points
1) Appearance as whole plant	1) Fresh appearance, no indication of senescence, mechanical and insect damage in inflorescence/ stem	20 (20)
	2) Fresh appearance but very less indication of senescence	15 (20)
	3) Fresh appearance but considerable indication of senescence	10 (20)
2) Flowering (1)	Scoring of the pots at the time of peak flowering (number of inflorescences / plant)	
	i. ≥ 35	20 (20)
	ii. ≥ 30 to 34	18 (20)
	iii. ≥ 25 to 29	16 (20)
	iv. ≥ 20 to 24	15 (20)
v. < 20	10 (20)	
(2)	Number of flowers per plant	
	i. > 1000	20 (20)
	ii. $> 800-1000$	19 (20)
	iii. $> 600-800$	15 (20)
	iv. $> 400-600$	12 (20)
	v. $> 200-400$	10 (20)
vi. < 200	7 (20)	
3) Form	1) Plant in balance with pot (generally 1.5-2.0 times the height of the container) and optimum plant spread.	20 (20)
	2) Plants too large or too small and less plant spread	12 (20)
4) Stem and foliage	1) Plant self supportive with very strong stems. Foliage healthy and free of any infestation of insect-pests and diseases.	20 (20)
	2) Plants less self supportive. Foliage healthy and very less infestation of insect-pests and diseases.	15 (20)
	3) Plants not self supportive with less strong stems. Foliage unhealthy and infestation of insect-pests.	10 (20)