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A COMPREHENSIVE REVIEW OF CONTAINER ROSE GARDENING: A MODERN APPROACH FOR MAXIMIZING SPACE AND BEAUTY

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ABSTRACT

Rose belongs to the genus *Rosa*, sub family Rosoideae, family Rosaceae and contains 200 species and more than 20,000 varieties. Rose is a symbol of affection, elegance, inspiration and an important source of aesthetic gratification. Rose is also the most famous and popular cut flower in the global floriculture trade. Several types of roses *viz*., micro-mini, miniflora and other classes such as floribunda and a few varieties of hybrid tea are highly suitable for pot and container culture and could be shifted wherever, it is required for beautification. The pot plant production of different types of plants especially roses are the most popular in urban dwellings. Growing media always play a vital role in the growth and quality of pot plants. Rose is one such classical plant that requires good medium for better growth and quality of flower production. Rose plants require well balanced fertilizer application for optimum flower production. For a successful pot culture of rose, growing environmental elements such as light and temperature also play a vital role. Pruning and pruning intensity decide the flushing and number of flowers. Forcing of potted roses is now a days popular for exhibitions and special occasions such as Independent Day, Mother Day, Christmas Day *etc*.

Keywords **:** Rose, Pots, Containers, Growing media, Pruning, Forcing

Introduction

Roses are one of the most beloved and versatile flower in gardening, valued for their stunning beauty, delightful fragrance and wide range of colors. Rose belongs to genus *Rosa* and family rosaceae. Genus rosa contains 200 species and more than 20,000 varieties. Roses can be used as cut flower, loose flower, potted or patio plants, treated as climber for beautification of gardens and parks, used for extraction of essential oil and having great importance in pharmaceutical industries. In the today's era of urbanization majority people of cities lives in apartment, high rise buildings and societies thus, there is scare of adequate space to grow ornamental plants. Peoples are very passionate to grow beautiful ornamental plants in their resident area. Rose is one of the most rated flowering shrub by gardeners and common peoples so there is great scope to grow beautiful roses in containers and pots in residence, terrace of houses and balconies of apartment or building. Containerized rose gardening is modern approach to grow beautiful roses in containers and pots to maximize the space and beauty. Containerized rose gardening allows people to grow beautiful vibrant roses without much need of space. People can utilize their balconies, terraces, window boxes *etc*. In today's stressed life of people, containerized rose gardening helps to relives the stress by their beautiful vibrant blooms, scent of flowers and there is scope of physical exercise by involving in caring, maintenance and cultural practices of plants. In modern era, children of cities are addicted to mobiles video games *etc*. So containerized rose gardening allows to children can learn and understand the growth and flowering behavior of plant which stimulates the hobby towards the rose growing among the children. Ultimately, there are numerous benefits of rose gardening in pots and containers especially in urban and city area. Thus, this paper is initiated to review the various scientific

aspects of growing roses in containers and pots with objective to maximize the space and beauty.

Origin, distribution and botanical description

According to the generally accepted classification of Rehder, there are about 120 species of roses. They are extensively distributed in the north temperate and subtropical parts of both the Eastern and the Western hemispheres. Rose having different growth habit from erect or spreading or trailing shrub to climber and sometimes dwarf shrubs according species and varieties. The stem with or without prickles and sometimes pigmented. Leaves are alternate and pinnately compound. The flowers are bisexual, single, semi-double and fully double having solitary type inflorescence. Fruit of rose is known as hips and it is rich source of vitamin-C. Roots are mostly fibrous having short tap root.

Classification

According to American Rose Society (ARS), roses are classified in to main three groups *viz*., wild roses, old garden roses and modern garden roses. Wild roses have lack of hybridization history and hybridization of other modern varieties. Old garden roses referred as "Antique" roses and "Historic" roses. Roses like China rose (*Rosa chinensis*), bourbon rose (*Rosa bourboniana*), damask rose (*Rosa damascene*), French rose (*Rosa gallica*) and other roses are tea rose, Persian rose, Himalayan musk rose and cabbage rose are falls in old garden roses. The old garden rose has been around since before 1867. Modern garden roses developed by hybridization. Today's varieties of roses fall under the category of modern garden roses. Modern garden roses include hybrid tea (hybrid perpetual × tea rose), floribunda (hybrid tea × polyantha), grandiflora (hybrid tea × floribunda) and other are miniature, miniflora, David Austin English roses, *etc*.

Cultivation in pot

Climatic requirement

It prefers a cool climate. Ideal day temperature between 25°C to 28 °C while ideal night temperature should lies between 13 °C to 17 °C. It requires at least 4 to 5 hours of direct sunlight for proper growth. High humidity with cloudy weather cause black spot and powdery mildew while low humidity with low night temperature is responsible for blind shoots. Nell and Rasmussen (1979) recorded a low percentage of blind shoots in fall, winter, spring and summer (50 %, 53 %, 40 % and 35 % respectively) by providing continuous high-intensity lighting (640 W/m^2) following flower removal. Mortensen (1991) found that the increasing temperature from 18 °C to 30C with an 18 hours daylength decreased the number of flowers in 'Meijikatar' potted miniature roses. Kyalo and Pemberton (1996) observed that potted rose varieties 'Meirutral' and 'Meijikatar' grown under high temperature and long day conditions (Day: 30°C, Night: 21°C, Light: 725 µmol. m^{-2} Light duration: 14 hours per day) produced highest flowering shoots (13.2) with minimum number of blind shoots (2.9) than grown under low temperature and short-day conditions. Jiao and Grodzinski (1998) revealed that carbohydrate export rate of expanded leaves on the flowering shoot was reduced by 80% under high temperature (40°C) condition and revealed that temperature influences export and partitioning of assimilates. Shin *et al.* (2001) found that the number of days from bud break to flowering increased from 21.6 to 63.0 days as temperature decreased from 30 °C to 15°C and the number of days to flowering was influenced by the temperature after the visible bud in rose cultivar Kardinal.

Location

The location receives at least 4 to 5 hours of direct sun light. North –South direction of terrace or building is ideal for better exposure of light. The location should be well ventilated. Poor ventilation creates development of fungal diseases such as black spot-on and powdery mildew leaves. Location or place quickly cool during night. Excessive heat during night deteriorates the flower quality. Avoid the location or place that surrounded by high concrete walls. At least one side of place or location should be open enough to avoid excessive heating during night through heated concrete walls. Flower size in rose is depended on temperature and inheritance factors. Jawaharlal *et al*. (1999) reported that plants grown with mean temperature 15 °C to 21 °C with 55 % to 80 % RH recorded large sized flowers.

Selection of varieties

The ideal characters of varieties that suitable for containers are free and profuse flowering, dwarf growth habit, less root bounding, tolerant to wet and dry feet condition, profuse side branching. Varieties like Tropicana (Hybrid tea), Valentine (Floribunda), Pussta (Floribunda), Summer Snow (Floribunda), Ahlalya (Floribunda), Gruss En Teplitz (China), Vedrun (Miniature) are suitable for pots and containers.

Selection of pots and containers

This criteria decides your overall plant spread and structure. Most of the feeder roots of rose found at **10 to 25 cm** depth from surface.

Table 1 : Ideal size of pots and container for rose

Sr. no	Container Size	Suitable rose type
1.	10" to 14" × 10" to 14"	Hybrid tea, grandiflora and floribunda
2.	8'' to 11" × 8'' to 11"	Polyantha and miniatures.
3.	6'' to 8'' × 6''	Miniflora

Pots like plastic, earthen, cement and fabric pots are suitable for roses. Plastic containers are light in weight, easy to available and facilitate better handling compared to other containers. Fabric pots containers cool down the root temperature by evaporative cooling. Arnold and McDonald (2006) found that the maximum dry weight of roots and shoots (12.3 g and 114.5 g respectively) and minimum root zone temperature (36°C) were observed in rose cv. 'Radrazz' grown in Smart Pot™ fabric container with pine bark growing substrate. Gruda (2019) reported that the pots can affect the volume of roots of plant and constrict the root system, leading to further growth of aerial parts.

Criteria for selection of rose plant

Select always fresh plants rather than old plants. Fresh plants rapidly establish than old plants. Avoid plants that are heavily infected with pest and diseases. Make sure that the bud or graft union of plant is well formed. Select the plants which have an adequate amount of foliage. At least 5 to 7 well-developed healthy leaflets should be there in case of small plants. Avoid the plants that's roots are bounded heavily by bag or pot in nursery.

Preparation of potting media

Rose prefers slightly acidic media between 6.0 to 6.5. Growing media plays important role for growth and flowering performance of plant. Maloupa *et al.* (2001) noted that rose variety Binca grown in the mixture of perlite: cocopeat (3:1 v/v) recorded better yield, while variety First Red showed more prospering flower quality when grown in media containing cocopeat only. Jiang *et al.* (2009) found that Rosa *chinensis* enters into the dormancy when grown under salt tress. Therefore, saline and alkaline growing medium is not suitable for rose. The media should be well drained with good water retentive capacity. Rajasekar and Suresh (2015) found that *Rosa chinensis* grown in a pot containing medium of soil: FYM (1:1 v/v) was significantly improved the growth parameters such as plant height at the time of first flower bud (46.92 cm), plant spread E-W direction (24.90 cm), While number of branches per plant (12.62) was highest in medium containing soil: FYM: leaf mould (1:1:1 v/v). Younis *et al.* (2015) observed the best performance of miniature rose cv. Baby Boomer in medium containing leaf compost only in terms of vegetative growth parameters such as plant height (75.44 cm), number of leaves (259.78) and number of branches per plant (16.44) were highest, While flowering parameters such as number of flowers per plant (49.11), diameter of flower (4.50 cm), fresh weight of flower and dry weight of flower (1.96 g and 0.66 g respectively) were highest in media containing peatmoss only. Chavada *et al.* (2017) found that rose cv. Top Secret grown in pot under protected condition performed better in terms of days taken to bud initiation (13.23), number of flowers per plant (19.48), flower diameter (8.23 cm) and stalk length (36.23 cm) in medium containing soil: cocopeat: leaf mould (1:1:1 v/v). Hissam *et al.* (2017) found that rose plant grown with silt: leafmold resulted maximum number of leaves (5.72) per plant, shoot diameter (1.29 cm), shoot length (1.74 inch) and number of buds per plant (4.27).

Planting

After selection of pots/containers and suitable growing media, planting operation is carried out. Before planting, place a piece of broken bit on drainage hole of pot to prevent media clogging. The media is filled up to half of the pot. The root ball of plants is removed. The care should be taken that, root ball not disturbed. Plant is placed on center of the pots filled with half of media. The pots are filled with media and upper 1 inch gap is leaved to facilitate better water absorption. The media is gently pressed to remove the air large air pocket. At last, plants are watered. If required, plants are staked to prevent from wind damage.

Water management

Rose plant requires regular watering for better growth and flowering specially in containers and pots. Generally watering is done when the upper surface (up to 1 inch) of the pot become dry. If the day temperature is more than 32°C, then watering is done once in a day. If the day temperature is less than 32 °C, then watering is done every alternate day. In the case of plants less than 6 months old, daily light watering is required. The ideal time of watering is early morning or evening hours before 7 pm. Watering is done with help of watering can (for small scale) and high-pressure pipes or overhead sprinklers (For large scale). Showering of the entire plant is done during watering. It reduces the infestation of mites and aphids and keeps the plant

clean from dust and pollution. Williams et al. (2000) reported that plants grown with cyclic water availability (10 days cycle in which 4 days without water followed by recovery phase in which plants are watered regularly) tolerated water stress better than regular watering as control in potted rose cv. Charming and Binca Parade. Pavlidou (2003) revealed that the minimum number of non-malformed flowers (04) and the maximum number of malformed flowers (1.5) was reported when drought stress applied from stage 4 to stage 6 (the second five-leaflet leaf clearly separated and the bud not yet separated), While maximum number of blind shoots (0.75) was reported when drought stress applied from stage 2 to stage 4 (the second three-leaflet leaf clearly separated).

Nutrient management

Rose is a heavy feeder plant. It requires regular feeding for profuse growth and flowering. Apply organic manures @ 250 g/pot at every October pruning. Ghaffoor *et al*. (2000) noted that application of NPK fertilizer @ 20-00-12 g per plant after pruning significantly improved the vegetative and flowering parameters such as days to sprouting (95.67), plant height (67.67 cm) branches per bush (04), days to flowering (88), flowers per plant (20.33) and flower size (8.08 cm). Hazen *et al*. (1994) reported that the lower fertilizers rate are preferred for growing roses in rock wool. Ahmad et al. (2015) found that the maximum number of branches per plant (6.67), number of leaves per plant (207.00) and number of flowers per plant (6.73) recorded when 400 ml solution of 17-17-17 N-P-K @ 0.2 % applied per plant at the sprouting stage after pruning. Neima *et al*. (2020) found that flower yield and quality of flower were significantly increased with application of PRO.SOL.USA fertilizer (N: 30 %, P: 10 %, K: 10 %, B: 200 ppm, Chelated Cu: 500 ppm, Chelated Fe: 1000 ppm, Chelated Mg: 500 ppm, Chelated Zn: 500 ppm, Mo: 5 ppm) @ 1.5 g and 1.0 g/liter.

Pruning

Rose bears flowers on new flush, so pruning is done regularly to encourage new growth. Pruning is carried out on plant more than 1 year old in pot. In plains of India under pot condition, pruning is done during October to November month. Generally, in pot conditions, plants are pruned every year moderately. Heavy pruning should be avoided in pot condition. During pruning, all leaves are removed. Weak, dead/diseased and sucker shoots are thinned out. Remaining healthy shoots are headed back at ½ of its length. Denison (1979) discovered that moderate intensity of pruning is recommended for established roses of hybrid tea, grandiflora, floribunda and tree roses. Amitabha (1987) observed that the rose pruned starting from 31st May to 15th August is desirable to obtain continuous flower production in cultivar Happiness. Malhotra and Kumar (2000) reported that pruning intensity has definite role in regulation of flowering in roses. Pinkard and Beadle (2000) reported that the branch diameter increased with increased severity of pruning. Khattak *et al.* (2011) observed that the roses respond well to pruning and are accurately confided to be pruned every year frequently. Younis *et al*. (2013) found that *Rosa centifolia* pruned on 31st December produced maximum number of flowers per plant (555) and diameter of flower (5.2 cm). Adhikari *et al*. (2014) found that heavily pruned rose plant produced lowest numbers of rose flowers (8.66) followed by medium pruned plant (13.00) while, highest numbers flowers (19.67) were produced by lightly pruned rose plant. Shyamalee *et al*. (2021) noted that the maximum number of shoots per plant (16) and flowers (10) were recorded when pruning of shoot was done at 15 cm above the bud union. Selvavinayagam and Rameshkumar (2022) found that pruning of Button rose at 45 cm height from bud union during 3rd week of November significantly improved flowering parameters such as the diameter of flower (5.85 cm), number of flowers per plant per day (1.61), weight of flower (3.58 g) and flower yield per plant per day (5.76 g).

Use of plant growth regulators

Plant growth regulators are the organic or inorganic compounds that modifies the growth of plant by promoting or inhibiting the growth. Bhattacharjee and Singh (1995) revealed the daminozide and CCC compounds cause significant effect on vegetative and flowering parameters and ultimately increased the yield of flowers up to 9 %. Hashimabadi and Zarchini (2010) recorded the highest flower yield, bud length and fresh weight of flower with GA_3 @ 200 ppm in *Rosa hybrida* cv. Poison. Thao *et al*. (2023) recorded that application of BA @ 25 ppm significantly improved the flower quality parameters such as the height of bud (2.71 cm), diameter of flower (8.48 cm), higher number of days from flowering to fading (9.20) and number of days from budding to fading (22.33), While GA3 @ 25 ppm showed maximum colour parameter R on RGB colour model (221.00) of potted rose. Zahid *et al*. (2021) found that application of thiourea @ 60 mg/l significantly improved the growth parameters such as plant height (125 cm), flower diameter (12.5 cm), flower stalk length (19 cm) and number of flowers per plant (10).

Forcing

In tropical climate of India, growth of rose is continued thought the year, hence it require induced dormancy to get flowering flush in particular season. Forced potted roses are used for exhibition for special days such as Christmas day, Independent day, Rose show exhibitions, *etc.* Wintering is one of the technique of forcing in roses to produce good quality roses during winter season in India (Raut and Singh, 1999). Irrigation of plant is stopped prior to 60 days of exhibition for 7 days. Top 3 inch of media layer is removed in periphery of pot. This cause root damage to bring down the plants in stress. After root pruning, media is enriched by adding manures. Therefore, shoot pruning is carried. Then plants are irrigated regularly to break the dormancy and induce new growth.

Flush management

Rose produces flowering in flushes. Generally, in one flowering season, plant produce 2 to 4 flushes depending upon weather condition. Whenever one flowering flush is over, induction of second flush is required for new flowering. For new flush, heading back of shoots at 4 to 8th node from base of shoots depending upon shoot diameter. This disturbs the root: shoot ratio and plant start to maintain its root: shoot ratio by throwing out new shoots.

Other management practices

Removal of rootstock suckers: In case of budded or grafted plants, any shoot below bud or graft union is removed at regularly to prevent the unwanted sink flow.

Deadheading: Any kinds of spent or old flowers are removed at regular basis to prevents the fungal diseases spreads and hips developments.

Disbudding: In case of hybrid tea group, disbudding of side buds is practiced to increase the size of central bud.

Major diseases and pests

Major pests: Thrips, red scale, spider mites. For management, regularly checking of plants and any infected portion of plant is removed and discarded. Spray the any systemic insecticides for control of sucking pests in rotations. For control of mites, propagate can be used.

Major diseases: Black spot, powdery mildew and die back are serious diseases of rose plant. For management, any diseased infected parts or plants removed and discarded. Spraying of contact and systemic fungicides in rotation is effective. Amin *et al.* (2018) revealed that *Pseudomonas fluorescence* (75 % concentration) is effective for control of black spot and powdery mildew of rose followed by *Trichoderma viridi* (75 % concentration). Jannings *et al.* (2024) found that application of Pydiflumetofen + Difenoconazole @ 1 ml/litre at four week interval is the most cost effective method to control the black spot of rose.

Physiological disorders

Blind shoots: It is the type of shoot but flower bud fails to develop at apical region. The probable causes are low night temperature and low light intensity. For management, prune out the blind shoot at 2 or 4 nodes from base as it will stimulate another new shoots from lateral. Make sure that, plants get receives enough sun light for better photosynthesis.

Bull head: The term bullhead is used commercially to describe a flower which fails to open normally and has short petals or an excessive number of petals' (Post, 1956). Moe (1971) evaluated the different rose cultivars under various temperature condition and reported that the cultivar Baccara is most sensitive to bull head formation. This is indicated that genetics is also play a significant role in bull head formation. In this disorder, flower buds flattened and resembles to head. This can reduce the aesthetic value of flowers. The probable causes are high nitrogenous fertilizers, excessive rain and humidity, high vigour of plants *etc.* For management, avoid excessive nitrogenous fertilizers especially during bud emergence stage.

Conclusion

Potted rose grown under High Temperature Long Day (HTLD) condition favours the minimum number of blind shoots. Providing continuous high-intensity lighting (640 W/m^2) following flower removal results minimum percentage of blind shoots in all four seasons. A fabric container is suitable for reducing the root zone temperature in rose and improves the growth parameters. Drought stress from stage 4 to stage 6 (the second five-leaflet leaf clearly separated, and the bud not yet separated) negatively affect the flower quality. Application of NPK 20-00-12 g/plant after pruning is desirable for early sprouting of shoots in potted rose, while application of NPK: 17-17-17 @ 0.2 % 400 ml per plant at sprouting stage after pruning is desirable to improve the vegetative and flower quality. Pruning of *Rosa centifolia* is advisable for higher flower yield and diameter of flower. Pruning of Button roses should be carried out during 3rd week of November at the height of 45 cm from bud union for optimum growth and flowering. Application of BA @ 25 ppm improves flower quality parameters, while application of GA_3 @ 25 ppm improves the colour of the flower. Application

of thiourea @ 60 mg/litre after pruning significantly improves the physical and flowering characteristics in the case of *Rosa hybrida.*

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