

Original Research Article

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Effect of Growth Regulators and Growth Media on Rooting of Semi Hardwood Cuttings of Rose Root Stocks

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ABSTRACT

The present investigation was carried out at Research Farm, Division of Floriculture and Landscape Architecture, SKUAST-Kashmir, Shalimar, Srinagar, J&K (India) during the year 2010 to evaluate the effect of two growth regulators IBA and NAA @ 500, 1000, 1500 ppm in comparison to control (without any growth regulator treatment) and growing medium combinations (sand 100%, sand 85% + manure 15%, sand 70% + manure 30%, sand 70% + manure 15% + soil 15%, sand 85% + soil 15%) on the rooting of three rootstocks of rose (*Rosa indica*, *Rosa banksiae* and *Rosa bourboniana*). Main effect of growth regulators and genotype was significant on majority of rooting characteristics. IBA (1000 ppm) recorded minimum days to root initiation (23.33), maximum rooting (72.22%), root length (6.42 cm) and field survival (82.38%). Among the genotype, *Rosa indica* performed better, recording maximum rooting (75.24%), primary root number (9.48), root length (6.40 cm), new leaf growth on cuttings (59.05%) and field survival (96.98%) followed by *Rosa banksiae*. Performance of *Rosa bourboniana* was poor recording lowest values for all these parameters. Interaction effects were significant. NAA produced superior results in *Rosa indica* while, IBA gave promising results in *Rosa banksiae* and *Rosa bourboniana*. Growing medium significantly improved various rooting characteristics of cuttings. Superior results were obtained with sand 70%+ manure 30% which, recorded minimum days to root initiation (22.13), maximum rooting (83.33%), primary root number (15.52), root length (8.88 cm), new leaf growth (51.11%) and field survival (85.46%). Among the genotypes, *Rosa indica* consistently gave better results recording minimum days to root initiation (22.70), maximum rooting (90.00%), primary root number (21.21), root length (10.10 cm), new leaf growth (47.33%) and field survival (97.78%).

Keywords

Growing medium,
IBA, NAA,
Rootstocks,
Rooting, Rose.

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Introduction

Rose is the best known and most popular of all the garden flowers throughout the world. Rose occupies the second position among the top cut flowers in the world flower trade

(Sudhagar, 2013). The Netherland is the leading rose exporter followed by Columbia and Israel (Bose *et al.*, 2002). India is emerging rose cut flower producing country

and the crops is grown on an approximately 20% of the total area under ornamental plants in India (Sudhagar, 2013). Roses are conveniently propagated by cuttings, budding, grafting and layering. Among these, the use of stem cuttings is most easy and common method of growing roses. Propagation through cuttings is the simplest way to increase the desirable rose cultivars but success rate is limited in many types due to failure in root formation. Plant growth regulators have been used to promote rooting in many ornamental plants including roses (Pandey and Sinha, 1997).

The performance of varieties depends to a large extent on the availability of rootstock suitable for local soil and climatic conditions. Kaicker and Dhayani (1986) evaluated twelve indigenous and exotic rootstocks of rose and found *Rosa indica* var. *odorata* suitable for North Indian plains particularly for saline soils and *Rosa bourboniana* suitable for whole country. The commercial cultivation of rose in Jammu and Kashmir state depends upon the availability of planting material of good cut flower cultivars and their suitability to the local environment. Performance of the new cultivars can be increased to some extent if budded upon the locally available rootstocks. Thus multiplication of local rootstocks is very important for commercialization of rose in the state so that quality planting material budded on suitable rootstocks can be distributed among the growers for large scale cultivation. Accordingly present experiment was planned to multiply the local rootstocks of roses through stem cuttings using different auxins and growing media for increasing their rooting characteristics.

Materials and Methods

The present investigations were carried out at the Research Farm of Division of Floriculture

and Landscape Architecture, SKUAST- (K), Shalimar Campus, Srinagar (J&K) during the year 2010. Mature plants of three rose genotypes viz., *Rosa indica*, *Rosa bourboniana* and *Rosa banksiae* var. *lutea*, growing under open conditions for the last 5 years, were selected as stock plants for collecting semi-hardwood cutting material. First experiment was conducted to find out the effect of indole butyric acid (IBA) and naphthalene acetic acid (NAA) on various rooting parameters of rose. The stock solutions of growth regulators were prepared in ethanol and diluted to various concentrations (viz., 500, 1000 and 1500 ppm) using distilled water. The experiment was laid out in the underground cellars (propagation chambers) with a dimension of 2m × 1m × 0.5m. The cellars were covered with transparent polythene from top using wooden frames for providing support to sheets. Tin trays (60cm × 40cm × 10cm) were filled with rooting medium (washed river sand) and drenched with 0.02% bavistin five days before planting cuttings into the medium. Sand filled trays were kept under semi-shade conditions for the first two days and shifted to underground cellars for planting of cuttings.

The semi-hard wood cuttings consisting of 4 nodes with leaves intact on each node were taken from the middle portion of the vigorously growing shoots during morning hours. Each cutting was prepared by giving a flat round cut at the basal portion just below the lower bud and another slanting cut 2.0 cm away from the top node. Lower leaves on the cuttings were removed to avoid their contact with the rooting medium. The cuttings were bundled into sets of 5cutting/treatment/replication. The basal portion of cuttings (1.0 cm) was dipped into the freshly prepared auxin solution as per treatment for 20 seconds. For control, cuttings were dipped in distilled water for same

duration. Treated cuttings were immediately planted in sand filled trays with the help of a dibbler at a distance of 5.0 cm from cutting and 0.8 cm between rows. Light overhead watering was done to settle the cuttings without any risk of leaching off of the rooting chemical.

Second experiment was conducted to find out the effect of growing media combinations on the various rooting parameters of rose. Different combinations of growing media (sand, garden soil, well rotten farmyard manure) were made on volume basis using one liter plastic bucket for mixing required quantities of growing medium. Different medium components were then thoroughly mixed and filled in the plastic glasses up to brim. Few holes were made at the bottom of each glass to ensure free drainage. Medium filled plastic glasses were thoroughly watered with the 0.02% bavistin solution and kept under semi-shade for a few days. Semi hardwood cuttings treated with IBA (1000 ppm) were planted in these glasses and kept in underground cellars for rooting. The cellars were covered with transparent polythene from top using wooden frames for providing support to sheets.

The experiments were conducted in a completely randomized design with each treatment replicated three times. The data recorded after 31 days on different rooting parameters was subjected to analysis of variance using Minitab statistical package. Days to root initiation was recorded by taking out extra cuttings after 3 days interval starting from 5th day onwards and field survival was recorded one month after transplanting the rooted cuttings in the field. Temperature in the cellars ranged between 18-22°C and humidity between 80-90% during the study period. To satisfy the model assumptions for analysis of variance, percentage data was subjected to angular transformation. Mean

comparison was performed by using least significant difference (LSD) test.

Results and Discussion

Growth regulators and genotypes had a significant effect on various rooting characteristics of stem cuttings of rose (Table 1). Significant variation was observed in time taken to root initiation in cuttings. Minimum number of days (23.33) taken to root initiation was observed in cuttings treated with IBA @ 1000 ppm which was at par with IBA @ 500 ppm (23.67 days). However, maximum time (26.00 days) taken to root initiation was noticed in untreated cuttings in control. These results are in close conformity with the findings of Bharathy *et al.*, (2004) in carnation. The decrease in time taken to root initiation may be attributed to the fact that application of exogenous growth regulators might have supplemented endogenous auxin levels and brought about certain anatomical and physiological changes in the cuttings leading to early root initiation. *Rosa indica* took minimum number of days (22.81 days) to root initiation while *Rosa bourboniana* took maximum time (25.71 days). Difference in root initiation among genotypes might be due to different amounts of carbohydrates and phenolic compounds in cuttings, which get reduced at the time of root initiation and favour rooting in cuttings (Patil and Shirol, 1991). The interaction between growth regulator and genotype was found non-significant.

Highest rooting (72.22%) and maximum root length (6.42 cm) was recorded with IBA 1000 ppm, while lowest of 55.56% and 4.26 cm in control. Maximum root number (8.59) was observed with NAA 1000 ppm. IBA was found more effective than NAA in improving rooting percentage and root length in cuttings. The increase in percentage of rooting as a result of IBA treatments may be due to the

fact that IBA helps in mobilization of reserve food materials, elongation of meristematic cells and differentiation of cambial initials into root primordial (Younis and Riaz, 2005). Exogenous auxin treatment have been reported to increase the number of root primordia in the basal part of the cuttings, which led to increased rooting and root number (Rolston *et al.*, 1996). Similar finding have been observed by Akhtar *et al.*, (2002) in different species of rose, Bhuse *et al.*, (2003) in *Pelargonium graveolens* and Pandey *et al.*, (2011) in *Gingko biloba* following auxin treatments.

Among the genotypes tested, highest rooting (75.24%), root number (9.48) and root length (6.40 cm) was recorded in *Rosa indica*. All these rooting parameters recorded lowest values in *Rosa bourboniana*. Differences in rooting characteristics among the rootstocks may be attributed to genetic compositions and carbohydrate content of cuttings. Cuttings of *Rosa indica* might have higher amount of internal stored carbohydrates and other root promoting factors as compared to other two species, which resulted better rooting characteristics. These results are in close conformity with the findings of Demetrios *et al.*, (2004) in *Arbutus unedo* and *Taxus baccata*. The interaction between growth regulators and genotypes was significant with highest rooting (93.33%) and primary root number (16.53) in *Rosa indica* with NAA 1000 ppm, while lowest in *Rosa bourboniana* under control.

Production of new leaves on the cuttings and their field survival was significantly influenced by growth regulators. Maximum number of cuttings (43.33%) which developed new leaves was recorded with NAA @ 1000 ppm, which was at par (42.22%) with IBA @ 1000 ppm and highest field survival (82.38%) with IBA @1000 ppm. Both these parameters recorded minimum values under control. Development

of new leaves in cuttings might be associated with the increased root number and length in treated cuttings, which helped them in better nutrient and moisture utilization from the growing medium and hence more growth in the form of new leaves and better survival. These findings are in conformity with the results of Hayashi and Kawano (2003) in *Rosa cv. Tinek*.

Number of cuttings with new leaves (59.05%) and their field survival (96.98%) was recorded maximum in *Rosa indica* and minimum of 20.95% and 43.38% in *Rosa bourboniana*. Superiority of *Rosa indica* with respect to development of new leaves and survival might be attributed to better utilization of nutrients from the growing medium by dent of its maximum root number and root length. Similar results were reported by Abbas *et al.*, (2006) in *Rosa damascena* and *Rosa centifolia*, Bharathy *et al.*, (2004) in carnation, Majeed *et al.*, (2009) in *Aesculus indica*, Rahman *et al.*, (2003) in guava and Hussain and Khan (2004) in *Rosa bourboniana*. Significant interaction resulted in the production of maximum cuttings with new leaves (80.00%) in *Rosa indica* when treated with NAA 1000 ppm, while it was non-significant for survival.

Growth media and genotypes had a significant effect on various rooting characteristics (Table 2). Days taken to root initiation was observed minimum (22.13) in cuttings rooted in medium containing sand 70% + manure 30% and maximum (27.00 days) in medium containing sand 85% + soil 15%. The decrease in time taken to root initiation might be due to the excellent drainage, good aeration and higher temperature in manure supplemented media. These results are in close conformity with the findings of Ochoa *et al.*, (2003) in oleander cuttings and Dvin *et al.*, (2011) in cuttings of MM111 apple.

Table.1 Effect of growth regulators and genotype on various rooting characteristics of semi-hardwood cuttings of rose

PGRs/ Genotypes	Days take to root initiation				Rooting (%)				Primary root number				Root length (cm)				Cutting with new leaves (%)				Field survival (%)			
	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean
Control	28.00	26.00	24.00	26.00	33.33 (35.22)	63.33 (52.78)	70.00 (56.9)	55.56 (48.3)	2.23	4.6	4.8	3.88	3.03	4.2	5.53	4.26	13.33 (21.15)	30.00 (33.00)	46.67 (43.08)	30.00 (32.41)	30.16 (33.29)	79.26 (62.91)	89.63 (71.22)	66.35 (55.81)
IBA 500 ppm	25.00	24.00	22.00	23.67	56.67 (48.85)	73.33 (59.01)	80.00 (63.9)	70.00 (57.2)	3.2	8.2	6.6 7	6.02	3.27	6.2	6.1	5.19	20.00 (26.07)	30.00 (33.00)	56.67 (48.85)	35.56 (35.97)	47.50 (43.56)	92.96 (77.36)	96.29 (83.51)	78.92 (68.14)
IBA 1000 ppm	24.00	23.00	23.00	23.33	63.33 (52.78)	83.33 (66.15)	70.00 (56.9)	72.22 (58.6)	4.47	9.1 3	7.3 3	6.98	3.87	8.6	6.8	6.42	33.33 (35.22)	40.00 (39.23)	53.33 (47.01)	42.22 (40.49)	54.17 (47.41)	96.29 (83.51)	96.67 (83.85)	82.38 (71.59)
IBA 1500 ppm	24.33	25.00	24.00	24.44	50.00 (45.00)	66.67 (54.78)	56.67 (48.8)	57.79 (49.5)	3.03	7.3	6	5.44	3.77	7.8	5.2	5.59	26.67 (30.99)	26.67 (30.99)	46.67 (43.01)	33.33 (35.02)	47.50 (43.56)	89.26 (74.48)	96.29 (83.51)	77.68 (67.18)
NAA 500 ppm	27.00	25.00	21.00	24.33	50.00 (45.00)	56.67 (48.85)	83.33 (66.1)	63.33 (53.3)	2.4	7.6	10. 8	6.93	3.1	5	7.1	5.07	16.67 (23.85)	26.67 (30.99)	66.67 (54.99)	36.67 (36.67)	40.54 (39.42)	86.67 (72.29)	100.00 (90.00)	75.77 (67.24)
NAA 1000 ppm	25.00	24.00	23.00	24.00	43.33 (41.16)	70.00 (56.99)	93.33 (77.7)	68.88 (58.6)	3.03	6.2	16. 53	8.59	3.03	5.6	7.67	5.43	20.00 (26.07)	30.00 (33.00)	80.00 (63.93)	43.33 (41.00)	43.33 (41.15)	90.47 (79.23)	100.00 (90.00)	77.94 (70.13)
NAA 1500 ppm	26.67	24.00	22.67	24.44	43.33 (41.16)	50.00 (45.00)	73.33 (59.7)	55.57 (48.6)	2.83	5.4	14. 2	7.48	2.97	4.9	6.4	4.76	16.67 (23.85)	26.68 (30.99)	63.33 (52.78)	35.56 (35.88)	40.47 (39.40)	86.29 (68.51)	100.00 (90.00)	75.59 (65.99)
Mean	25.71	24.43	22.81		48.57 (44.16)	66.19 (54.79)	75.24 (61.48)		3.03	6.9 2	9.4 8		3.29	6.0 4	6.4		20.95 (26.74)	30.00 (33.03)	59.05 (50.53)		43.38 (41.12)	88.74 (74.04)	96.98 (84.58)	
C.D.(p ≤ 0.05)																								
Growth regulator	1.408				5.081				0.559				0.568				5.089				8.321			
Genotype	0.922				3.326				0.366				0.371				3.332				5.448			
Interaction	NS				8.799				0.969				0.981				8.814				NS			

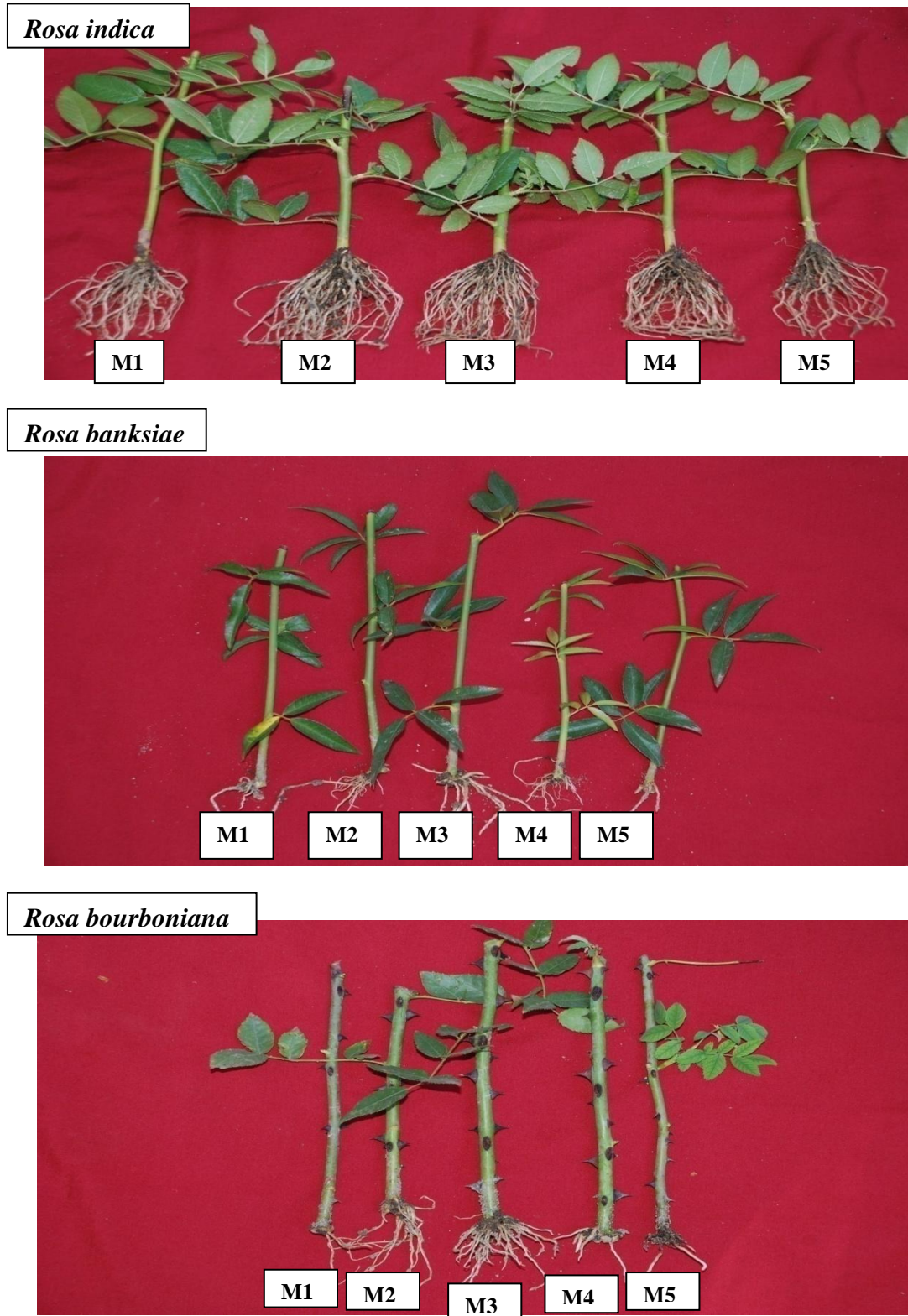
G1= *Rosa bourboniana*, G2= *Rosa banksiae* G3= *Rosa indica*

Table.2 Effect of growing media and genotype on various rooting characteristics of semi-hardwood cuttings of rose

Media / Genotypes	Days to root initiation				Rooting (%)				Primary root number				Root length (cm)				Cuttings with new leaves (%)				Field survival (%)			
	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean	G1	G2	G3	Mean
Sand (100%)	25.20	24.60	22.00	23.93	50.00 (45.00)	70.00 (56.99)	86.67 (72.29)	68.89 (58.09)	6.33	4.23	18.43	9.67	4.60	5.87	9.57	6.68	33.33	40.00	43.33	38.89	43.91 (41.45)	85.92 (68.16)	96.29 (83.51)	75.37 (64.37)
Sand 85% + Manure 15%	24.10	24.80	21.20	23.37	63.33 (52.78)	80.00 (63.93)	96.67 (83.86)	80.00 (66.85)	11.93	6.77	24.07	14.26	7.13	6.87	11.10	8.37	40.00	43.33	56.67	46.67	60.47 (51.15)	90.74 (75.48)	100.00 (90.00)	83.74 (72.21)
Sand 70% + Manure 30%	23.40	23.00	20.00	22.13	70.00 (56.99)	83.33 (66.15)	96.67 (83.86)	83.33 (68.99)	12.57	8.47	25.53	15.52	8.23	7.13	11.27	8.88	43.33	46.67	63.33	51.11	63.05 (52.58)	93.33 (77.71)	100.00 (90.00)	85.46 (73.43)
Sand 70% + Manure 15% + Soil 15%	24.40	25.80	24.10	24.77	56.67 (48.85)	63.33 (52.86)	90.00 (75.00)	70.00 (58.90)	5.23	6.37	21.37	10.99	4.13	6.07	10.03	6.74	30.00	36.67	40.00	35.56	47.62 (43.63)	89.63 (74.65)	96.29 (83.51)	77.85 (67.26)
Sand 85% + Soil 15%	28.00	26.80	26.20	27.00	36.67 (27.23)	46.67 (43.08)	80.00 (63.93)	54.44 (48.08)	4.13	3.63	16.63	8.13	3.37	4.13	8.53	5.34	26.67	30.00	33.33	30.00	40.65 (39.60)	85.92 (68.16)	96.29 (83.51)	74.29 (63.76)
Mean	25.02	25.00	22.70		55.33 (48.17)	68.67 (56.60)	90.00 (75.79)		8.04	5.89	21.21		5.49	6.01	10.10		34.67	39.33	47.33		51.14 (45.68)	89.12 (72.83)	97.78 (86.10)	
C.D.(p ≤ 0.05)	1.212				7.932				0.909				0.524				9.733				7.762			
Growing medium	0.939				6.144				0.703				0.406				7.539				6.013			
Genotype	NS				NS				1.573				0.907				NS				NS			
Interaction																								

G1= *Rosa bourboniana*, G2= *Rosa banksiae* G3= *Rosa indica*

Plate.1 Effect of growing medium on rooting in rose genotypes



[M1= Sand 100%; M2= Sand 85% + Manure 15%; M3=Sand 70% + Manure 30%; M4=Sand 70% + Manure 15% + Sand 15%; M5= Sand 85% + Soil 15%].

Among the genotypes, minimum number of days (22.70) to root initiation was recorded in *Rosa indica* and maximum (25.02 days) in *Rosa bourboniana* which was at par with *Rosa banksiae* (25.00 days). Similar findings were reported by Abbas *et al.*, (2006) in *Rosa damascena* and *Rosa centifolia*. The interaction between growing medium and genotype was found non-significant.

There was a significant effect of growing media on the rooting of cuttings. Highest rooting (83.33%), primary root number (15.52) and root length (8.88 cc) was observed in media containing sand 70%+manure 30% and lowest rooting (54.44%), primary root number (8.13) and root length (5.34 cm) in media supplemented with sand 85%+soil 15% (Plate 1). Improved rooting characteristics in manure and sand based medium might be due to good drainage, aeration, better nutrition and water holding capacity of media. These results lend support from the results of Ercisli *et al.*, (2002) in hardwood cuttings of kiwifruit. These results are supported with the results of Ochoa *et al.*, (2003) in oleander cuttings and Uemale *et al.*, (2003) in rose cuttings. These results are in close agreement with the findings of Ochoa *et al.*, (2003) in oleander cuttings and Khan *et al.*, (2007) in rose cuttings.

Among the genotypes, maximum rooting (90.00%), primary root number (21.21) and root length (10.10 cm) was observed in *Rosa indica*. Minimum rooting (55.33%) and root length (5.49 cm) was observed in *Rosa bourboniana*. Primary root number was observed minimum (5.89) in *Rosa banksiae*. Variation in rooting characteristics of different genotypes may be attributed to their genetic characteristics or variation in auxin and carbohydrate content in cuttings, due to which some plants root profusely while others fail to root. Similar results were reported by Polat and Caliskan (2009) in pomegranate;

Abbas *et al.*, (2006), Hussain and Khan (2004) and Akhtar *et al.*, (2002) in rose. Significant differences in rooting percentage among genotypes were also reported by Yazici *et al.*, (2009) in cherry laurel and Saed (2010) in pomegranate. The interaction between growing medium and genotype was found non-significant for all these parameters.

Medium had a significant effect on the growth of new leaves on the cuttings (Table 2). Maximum number of cuttings (51.11%) which developed new leaves was recorded in media (sand 70%+ manure 30%) and minimum of 30% in (sand 85%+soil 15%). The increase in new leaf emergence might be due to high porosity and water holding capacity, good nutrient content and aeration of media containing sand and manure. These results are in close conformity with findings of Mamba and Wahome (2010) in geranium, where inclusion of compost with sand and soil increased the number of new leaves on cuttings. Among the genotypes, the number of cuttings with new leaves was maximum (47.33%) in *Rosa indica* and minimum (34.67%) in *Rosa bourboniana*. Similar findings were also recorded by Shah *et al.*, (2006) in *Ficus binnendijkii* and Akhtar *et al.*, (2002) in stem cuttings of *Rosa centifolia* and *Rosa damascena*. The interaction between growing medium and genotype was found non-significant.

Survival of rooted cuttings in the field was significantly increased when cuttings were rooted in manure supplemented medium. Maximum survival (85.46%) was recorded in cuttings grown in manure supplemented media (sand 70%+ manure 30%) and minimum (74.29%) in cuttings grown in (sand 85%+soil 15%). The increase in field survival percentage might be due to the profuse root production of cuttings in manure rich media having more nutrients, good aeration and water holding capacity. Similar findings were

also reported by Khan *et al.*, (2007) in rose. Among the genotypes, maximum survival (97.78%) was recorded in *Rosa indica* and minimum (51.14%) in *Rosa bourboniana*. Similar findings were also reported by Gupta and Kher (1991) in *Bougainvillea*. cv. Garnet Glory. The interaction between growing medium and genotype was found non-significant.

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