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Influence of rooting media, IBA and humic acid on semi hardwood cutting of acid lime cv. Kagzi grown in Protrays under Southern region of Rajasthan

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Abstract
The present investigation entitled "Influence of Rooting Media, IBA and Humic Acid on Semi Hardwood Cutting of Acid Lime cv. Kagzi Grown in Protrays Under Southern Region of Rajasthan" was performed under shade net house condition at Krishi Vigyan Kendra Farm, Dungarpur during the year 2024-25. In the present study, Media-(M_6) Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) and Rooting media dip-(G_4) IBA @ 2000 ppm were better to influence shoot parameters significantly in acid lime cuttings. The twenty-four treatment combinations of media and rooting media dip were evaluated with three replications under factorial completely randomized design. The results exhibited significant effect of various treatment combinations on shoot parameters of acid lime during investigation. Maximum number of sprouting percentage (77.17%), shoot length (8.58 cm) at 90 DAP, final survival (73.17%) at 90 DAP and minimum days taken for sprout initiation (10.33) were recorded in M_6G_4 treatment combination *i.e.*, (M_6) Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) + (G_4) IBA @ 2000 ppm.

Keywords: Acid lime, cutting, IBA, vermicompost, cocopeat, perlite, humic acid, alcohol, vermiculite

Introduction
The acid lime (*Citrus aurantifolia* Swingle) is one of the most significant fruits in India, belonging to the Rutaceae family and the Aurantioideae subfamily, with a chromosome number of (2n = 18). It ranks as the third most important fruit after mandarin and sweet orange in citrus group. This fruit is commonly known by several English names like Pati lime, Spur lime, Acid lime and Mexican lime. Limes and lemons are thought to have originated in northeastern India, as well as in nearby regions of Burma and northern Malaysia. Acid lime is typically propagated through seeds, but this method presents challenges such as non-uniform offspring and a high risk of viral disease transmission due to the high rate of polyembryony (90-100%) and minimal risk of viral contamination in Kagzi lime (Babu, 2001) [2]. Additionally, using seeds for commercial cultivation is not recommended as they do not yield true-to-type fruits. To counter this issue, vegetative propagation is useful. Because it enables the production of citrus plants that retain the desired characteristics of the parent plant. Methods like cuttings, budding, grafting and layering ensure true-to-type propagation (Seran and Umadevi, 2011) [16].

Stem cutting is considered the most effective method for regenerating the species. This approach is cost-effective, fast, simple and does not require the specialized techniques needed in other vegetative methods. The success of stem cuttings is influenced by factors like the age of the mother plant, the tree part used, planting time, rainfall, humidity, temperature, rooting medium and aftercare (Frey *et al.*, 2006) [8]. Additionally, mechanical treatments such as ringing and girdling significantly promote rooting (Biswas, 1995) [5] by blocking the downward movement of carbohydrates, hormones and other rooting-promoting substances which aids in shoot initiation and root formation. These techniques are applied to shoots before being taken from the mother plant, enhancing rooting in the cuttings (Evert and Smittle, 1990) [7].

However, plants have immense potentiality of plasticity and adaptability, therefore makes the possibility to form new organs such as lateral roots, shoot and flowers including meristems. Therefore, within short time a greater number of clonal plants can be prepared by cutting as compared to other asexual and sexual propagation methods.

2. Materials and Methods

The present research work entitled "Influence of Rooting Media, IBA and Humic Acid on Semi Hardwood Cutting of Acid Lime cv. Kagzi Grown in Protrays Under Southern Region of Rajasthan" was conducted conducted with twenty four treatment combinations comprised of different media and rooting media dip *i.e.*, M_1G_1-(M_1) Cocopeat + (G_1) Humic acid 2g L^{-1}, M_1G_2-(M_1) Cocopeat + (G_2) Humic acid 4g L^{-1}, M_1G_3-(M_1) Cocopeat + (G_3) IBA @ 1000 ppm, M_1G_4-(M_1) Cocopeat + (G_4) IBA @ 2000 ppm, M_2G_1-(M_2) Vermicompost + (G_1) Humic acid 2g L^{-1}, M_2G_2-(M_2) Vermicompost + (G_2) Humic acid 4g L^{-1}, M_2G_3-(M_2) Vermicompost + (G_3) IBA @ 1000 ppm, M_2G_4-(M_2) Vermicompost + (G_4) IBA @ 2000 ppm, M_3G_1-(M_3) Cocopeat + Alcohol (10 ml) + (G_1) Humic acid 2g L^{-1}, M_3G_2-(M_3) Cocopeat + Alcohol (10 ml) + (G_2) Humic acid 4g L^{-1}, M_3G_3-(M_3) Cocopeat + Alcohol (10 ml) + (G_3) IBA @ 1000 ppm, M_3G_4-(M_3) Cocopeat + Alcohol (10 ml) + (G_4) IBA @ 2000 ppm, M_4G_1-(M_4) Cocopeat + Vermicompost (1:1) + Alcohol (10 ml) + (G_1) Humic acid 2g L^{-1}, M_4G_2-(M_4) Cocopeat + Vermicompost (1:1) + Alcohol (10 ml) + (G_2) Humic acid 4g L^{-1}, M_4G_3-(M_4) Cocopeat + Vermicompost (1:1) + Alcohol (10 ml) + (G_3) IBA @ 1000 ppm, M_4G_4-(M_4) Cocopeat + Vermicompost (1:1) + Alcohol (10 ml) + (G_4) IBA @ 2000 ppm, M_5G_1-(M_5) Cocopeat + Vermiculite (2:1) + (G_1) Humic acid 2g L^{-1}, M_5G_2-(M_5) Cocopeat + Vermiculite (2:1) + (G_2) Humic acid 4g L^{-1}, M_5G_3-(M_5) Cocopeat + Vermiculite (2:1) + (G_3) IBA @ 1000 ppm, M_5G_4-(M_5) Cocopeat + Vermiculite (2:1) + (G_4) IBA @ 2000 ppm, M_6G_1-(M_6) Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) + (G_1) Humic acid 2g L^{-1}, M_6G_2-(M_6) Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) + (G_2) Humic acid 4g L^{-1}, M_6G_3-(M_6) Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) + (G_3) IBA @ 1000 ppm, M_6G_4-(M_6) Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) + (G_4) IBA @ 2000 ppm were evaluated with three replications under factorial completely randomized design. The shoot parameters of the cutting were recorded at 90 days after planting (DAP) except sprouting percentage which was recorded on 30 DAP with 3 replications in Factorial Completely Randomized Design (F-CRD).

2.1 Experimental site

The experiment for the research work was conducted during the year 2024-2025 at the Krishi Vigyan Kendra Farm, Dungarpur. The experiment was laid in the nursery. Krishi Vigyan Kendra, Dungarpur is situated at 23°86'50"N latitude 73°85'99"E longitude at an elevation of 579.5 meter above mean sea level. The region falls under the Agro-climatic Zone IV B which is humid southern plain and Aravalli hills of Rajasthan.

2.2 Climatic and weather conditions

Dungarpur comes under typical sub-tropical climatic condition, *i.e.*, both winters and summers are experienced in this region at their appropriate time. The average rainfall ranges from 729.2 mm per year. More than 90 percent rainfall is received during mid-June to September with scanty showers during winter months.

2.3 Preparation of cuttings

Acid lime (*Citrus aurantifolia* Swingle) stem cuttings were taken from healthy mother plants which is not completely covered in bark, but still has some green growth from the current year, moderate in vigour and disease free. The cuttings of 15-20 cm in length with 4-5 buds were retained on cutting for planting by removing the leaves completely. 1 cm of bark removed from lower side of each cutting to enhance rooting.

2.4 Preparation of rooting media DIP

For the weighing of growth regulators, electronic chemical balance was used. The requisite quantity of IBA was weighed separately and transferred to two different volumetric flasks by using soft brushes and then these weighed, growth regulator samples were first dissolved in 10 ml of ethyl alcohol (95%) by thoroughly shaking and then measured quantity of distilled water was added in to the flask to make up the volume to 1 litre. This yields 1000 ppm and 2000 ppm of IBA solutions. In the same manner humic acid solution of 2g L^{-1} and 4g L^{-1} concentration were also prepared**.**

2.5 Preparation of media

Each rooting medium was sterilized by direct exposure to sunlight continuously for five days and then drenched with fungicide captan (0.2%) to prevent rotting of cuttings. The six media Cocopeat, Vermicompost, Cocopeat + Alcohol (10 ml), Cocopeat + Vermicompost + Alcohol (10 ml), Cocopeat + Vermiculite (1:1), Cocopeat + Vermicompost + Perlite (3:1:1) + Alcohol (10 ml) were prepared on volume/volume basis. Alcohol (10 ml) also added on volume/volume basis in the respective treatments. Meanwhile, 10 ml of alcohol was added per 2 litre media. The prepared media was filled in protrays.

2.6 Filling of protrays

Two protrays were taken for each treatment along with its replication. Protrays should be filled by pressing the rooting media to make it tight enough to hold the protray and to promote the rooting of cutting. Protrays were filled as per treatments with rooting media and kept treatment wise for planting of cuttings.

2.7 Application of rooting media dip and planting of cuttings

The above prepared cutting's one third portion were dipped in IBA and Humic acid solution for half minute as quick dip method. After that cuttings were dried before final transplanting in the protrays. The cuttings were planted in protrays by inserting one third part of it in rooting media.

2.8 After care

Irrigation was applied as per the need of the cuttings and the humidity was maintained by misting. Misting increases humidity in indoor spaces, which was beneficial for plants. No incidence of insect and disease was noticed in the experimental cuttings. The protrays were also kept free from weeds. Cuttings were transferred into polybags after 60 DAP carefully.

3. Results and Discussion

3.1 Sprouting percentage

Significantly, the maximum sprouting percentage 67.88 percent was recorded with M_6 treatment and the minimum sprouting percentage 56.13 percent was observed with M_2 treatment at 30 days after planting in media. The highest sprouting percentage 69.47 percent was recorded with G_4 treatment and the lowest sprouting percentage 53.39 percent was observed in G_1 treatment at 30 days after planting in rooting media dip. The interaction of these factors found significant at 30 days after planting where, maximum sprouting percentage 77.33 percent was recorded in M_6G_4 treatment combination and the minimum sprouting percentage 48.83 percent was observed in M_2G_1 treatment combination at 30 days after planting. Earliness in sprouting may be due to better utilization of stored carbohydrates, nitrogen and other factors with the help of IBA which promoted the shoot growth (Bhosale *et al.*, 2014) [4]. The results of present study were also similar with the finding of Bhatt and Tomar (2011) [3] in *Citrus auriantifolia* Swingle (Kagzi-lime). Maanik *et al.*, (2023) [11] revealed that IBA at 8000 ppm and sucrose at 4 percent and planted in vermiculite showed shortest time to first sprouting (9.5 days after planting) in karonda. Kumar and Singh (2020) [10] reported IBA @ 2500 ppm + PHB 1000 ppm induced earliest (20.64 days) bud sprouting in Kagzi lime.

3.2 Days taken for sprout initiation

The minimum days taken for sprouting 13.08 days was recorded with M_6 and maximum days taken for sprouting 18.98 days was observed with M_2 treatment in case of media. The lowest days taken for sprouting 12.43 days was observed with G_4 treatment and the highest days taken for sprouting 18.82 days was noted in G_1 treatment in rooting media dip. The synergistic effect of media and rooting media dip was found significant wherein, minimum days taken for sprouting 10.33 days was recorded in M_6G_4 treatment combination which was statistically at par with M_6G_3 treatment combination and the maximum days taken for sprouting 22.08 days was observed in M_2G_1 treatment. However, Kareem *et al.*, (2016) [9] reported that the minimum days taken for sprout initiation was about 22 days in the softwood cuttings of Gola variety of guava treated with 4000 ppm IBA. Similar results have been reported by Kumar *et al.*, (1995) [13] in lemon cv. Baramasi.

3.3 Number of leaves per cutting

The highest number of leaves per cutting 16.52 was recorded with M_6 treatment which was statistically at par with M_4 treatment and the lowest number of leaves per cutting 12.35 was recorded under M_2 treatment on 90 days after planting in media. The maximum number of leaves per cutting 16.78 was observed with G_4 treatment which was statistically at par with G_3 treatment and minimum number of leaves per cutting 12.21 was noticed in G_1 treatment at 90 days after planting in case of rooting media dip. The interaction effect of media and rooting media dip on number of leaves per cutting of cutting was found non-significant at 90 days after planting (DAP). Similarly, Singh (2014) [18] obtained better results with respect to average number of leaves (25.33) in hardwood cuttings of *Punica granatum* L. However, Sadiq *et al.*, (1991) [15] attained maximum number of leaves (21.25) in semi-hardwood stems cuttings of peach cv. Early Grande treated with 400 ppm IBA. Mehta *et al.*, (2018) briefed that C_1 (500ppm IBA) treatment was beneficial for the rooting in pomegranate (*Punica granatum* L.) cuttings with respect to number of leaves on new shoots (10.66).

3.4 Shoot length at 90 days after planting (cm)

The best shoot length 6.90 cm was recorded with M_6 treatment and the least shoot length was observed 4.23 cm was observed under M_2 treatment at 90 days after planting in media. The maximum shoot length 7.26 cm was recorded with G_4 treatment and minimum shoot length 4.01 cm was recorded in G_1 treatment at 90 days after planting in rooting media dip. The interaction effect of media and rooting media dip on shoot length of cutting was found significant at 90 days after planting (DAP) where, maximum shoot length 8.58 cm was recorded in M_6G_4 treatment combination and the minimum shoot length 2.42 cm was observed under M_2G_1 treatment combination. Similarly, El-Shazly *et al.*, (1994) [6] reported shoot length/cutting in lemon cv. Eureka. These findings were also in confirmation with Al-zebari *et al.*, (2013) [1] in Citron (*Citrus medica* L) cuttings.

3.5 Diameter of shoot (mm)

The highest diameter of shoot 3.24 mm was recorded with M_6 and the lowest diameter of shoot 2.85 mm was observed under M_2 treatment at 90 days after planting in media. The maximum diameter of shoot 3.28 mm was recorded in G_4 treatment and the minimum diameter of shoot 2.79 mm was recorded with G_1 treatment at 90 days after planting in rooting media dip. The interaction effect of media and rooting media dip on diameter of shoot of cutting was found non-significant at 90 days after planting (DAP). The results of present study were also similar with the finding of Sheikh *et al.*, (2023) [17] which recorded highest diameter of thickest sprout in T_9-cocopeat + vermiculite + perlite (3:1:1).

3.6 Final survival (%) at 90 days after planting

The maximum survival percentage in polybags 63.46 percent was recorded with M_6 treatment and minimum survival percentage in polybags 51.88 percent was observed under M_2 treatment in media. The maximum survival percentage in polybags 65.47 percent was observed with G_4 treatment and minimum survival percentage in polybags 48.50 percent was recorded in G_1 treatment at 90 days after planting in rooting media dip. The interaction effect of media and rooting media dip on survival percentage of cutting was found significant at 90 days after planting (DAP) wherein, the best survival percentage 73.17 percent was recorded in M_6G_4 treatment and the least survival percentage 44.17 percent was recorded in M_2G_1 treatment at 90 days after planting. Fachinello *et al.*, (2005) reported that hardwood cuttings showed constant metabolic activity and continuous development are the stake that generally has greater survival percentage to hardwood cuttings, when using growth regulators. The highest survival percentage was recorded in cuttings treated with IBA 2000 ppm, it might due to development of effective root system and increase in number and length of roots per cutting as influenced by the uptake of nutrients and water reported by Reddy *et al.*, (2008) [14].

Table 1: Influence of media, rooting media dip and their interaction on sprouting percentage at 30 DAP, days taken for sprout initiation, number of leaves per cutting, shoot length (cm) and survival percentage at 90 DAP in semi-hardwood cutting of acid lime

Treatments Notation	Sprouting percentage	Days taken for sprout initiation	Number of leaves per cutting	Shoot length (cm)	Diameter of shoot (mm)	Survival percentage
Factor 1-Media (M)						
M_1	57.92	16.81	13.21	4.98	2.93	53.42
M_2	56.13	18.98	12.35	4.23	2.85	51.88
M_3	59.54	15.98	13.98	5.48	3.00	55.17
M_4	64.38	14.31	16.02	6.37	3.15	60.04
M_5	61.63	15.19	15.15	5.88	3.06	56.83
M_6	67.88	13.08	16.52	6.90	3.24	63.46
SEm±	0.23	0.08	0.20	0.04	0.012	0.24
CD (P=0.05)	0.65	0.24	0.58	0.10	0.035	0.68
Factor 2-Rooting media dip (G)						
G_1	53.39	18.82	12.21	4.01	2.79	48.50
G_2	54.11	18.18	12.67	4.28	2.83	49.42
G_3	68.00	13.47	16.50	7.00	3.24	63.81
G_4	69.47	12.43	16.78	7.26	3.28	65.47
SEm±	0.19	0.07	0.17	0.03	0.010	0.20
CD (P=0.05)	0.53	0.19	0.47	0.08	0.029	0.56
Interaction (M x G)						
M_1G_1	50.67	20.08	10.92	3.42	2.69	45.33
M_1G_2	51.00	19.50	11.17	3.75	2.72	46.33
M_1G_3	64.50	13.92	15.17	6.25	3.14	60.50
M_1G_4	65.50	13.75	15.58	6.50	3.16	61.50
M_2G_1	48.83	22.08	9.42	2.42	2.61	44.17
M_2G_2	50.00	21.00	10.17	2.75	2.66	45.17
M_2G_3	62.00	18.50	14.83	5.75	3.04	58.33
M_2G_4	63.67	14.33	15.00	6.00	3.09	59.83
M_3G_1	51.83	19.25	11.33	4.00	2.76	47.50
M_3G_2	52.67	18.58	12.08	4.17	2.79	48.00
M_3G_3	66.67	13.17	16.08	6.75	3.20	62.17
M_3G_4	67.00	12.92	16.42	7.00	3.23	63.00
M_4G_1	56.17	17.33	14.00	4.75	2.90	50.83
M_4G_2	56.67	16.75	14.50	5.00	2.92	52.33
M_4G_3	71.33	11.92	17.67	7.75	3.36	67.17
M_4G_4	73.33	11.25	17.92	8.00	3.40	69.83
M_5G_1	53.83	18.17	13.00	4.25	2.82	49.00
M_5G_2	54.50	17.92	13.42	4.50	2.87	49.50
M_5G_3	68.17	12.67	17.00	7.25	3.26	63.33
M_5G_4	70.00	12.00	17.17	7.50	3.28	65.50
M_6G_1	59.00	16.00	14.58	5.25	2.96	54.17
M_6G_2	59.83	15.33	14.67	5.50	2.99	55.17
M_6G_3	75.33	10.67	18.25	8.25	3.47	71.33
M_6G_4	77.33	10.33	18.58	8.58	3.54	73.17
SEm±	0.46	0.17	0.41	0.07	0.025	0.48
CD (P=0.05)	1.30	0.47	NS	0.21	NS	1.37

4. Conclusion

On the basis of results obtained in the present investigation entitled **"**Influence of Rooting Media, IBA and Humic Acid on Semi Hardwood Cutting of Acid Lime cv. Kagzi Grown in Protrays Under Southern Region of Rajasthan" it may be concluded that using of M_6 treatment (cocopeat + vermicompost + perlite (3:1:1) + alcohol (10 ml) as media and G_4 (IBA @ 2000 ppm) as rooting media dip treatment were found significantly best with the highest values of various growth parameters like sprouting percentage at 30 DAP, number of leaves per cutting, shoot length (cm), diameter (mm) of shoots, final survival (%) at 90 days after planting and minimum days taken for sprout initiation. However, among the treatment combinations, it may be concluded that M_6G_4 treatment (M_6) cocopeat + vermicompost + perlite (3:1:1) + alcohol (10 ml) + (G_4) IBA @ 2000 ppm was recorded significant with maximum number of sprouting percentage at 30 DAP, shoot length, final survival (%) at 90 days after planting and minimum days taken for sprout initiation compared to all other treatment combinations during course of investigation.

5. Disclaimer (Artificial Intelligence)

Author (s) hereby declares that no generative AI technologies such as large language models (Chat GPT and COPILOT etc.) and text-to-image generators have been used during writing or editing of this manuscript.

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7. Competing Interests

Authors have been declared that no competing interests exits.

8. References

1. Al-Zebari SMK, Al-Brifkany AAAM. Effect of cutting type and IBA on rooting and growth of citron (*Citrus medica* L). Am J Exp Agric. 2015;5(2):134-138.
2. Babu RSH. Limes and lemons. In: Handbook of Horticulture. New Delhi: ICAR; 2001. p. 212.
3. Bhatt BB, Tomar YK. Effects of IBA on rooting performance of *Citrus aurantifolia* Swingle (Kagzi-lime) in different growing conditions. Nature Sci. 2010;8(7):8-11.
4. Bhosale VP, Shinde SM, Turkhade PD, Deshmukh SB, Sawant SN. Response of different media and PGRs on rooting and survival of airlayers in pomegranate (*Punica granatum* L.) cv. Sindhuri. Ann Hortic. 2014;7(1):73-77.
5. Biswas M, Kobayashi KD. Girdling, wounding, stem maturity and IBA effects on rooting of jackfruit stem cuttings. J Hawaiian Pac Agric. 1995;6:19-25.
6. El-Shazly SM, El-Sabrout MB, Kassem HA. Root formation on the stem cuttings of Eureka lemon and El-Soukari loquat as affected by root-promoting chemicals and mist. Alexandria J Agric Res. 1994;39(3):559-569.
7. Evert DR, Smittle DA. Limb girdling influences rooting, survival, total sugar and starch of dormant hardwood peach cutting. Hortic Sci. 1990;25:1224-1226.
8. Frey B, Hagedorn F, Giudici F. Effect of girdling on soil respiration and root composition in a sweet chestnut forest. For Ecol Manage. 2006;225(1-3):271-277.
9. Kareem A, Manan A, Saeed S, Rehman SU, Shahzad U, Nafees M. Effect of different concentrations of IBA on rooting of guava (*Psidium guajava* L.) in low tunnel under shady situation. J Agric Environ Int Dev. 2016;110(2):197-203.
10. Kumar R, Singh JP. Influence of IBA and PHB on regeneration of Kagzi lime (*Citrus aurantifolia* Swingle) through stem cutting. Int J Chem Stud. 2020;8:1952-1958.
11. Maanik DB, Kumar R, Sharma R, Gupta S, Choudhary A, Thakur N, Sharma T. Economic analysis of propagation studies on karonda (*Carissa carandas* L.) under Jammu sub-tropics: a comparative study. Pharma Innov J. 2023;12(8):1242-1246.
12. Mehta SK, Singh KK, Harsana AS. Effect of IBA concentration and time of planting on rooting in pomegranate (*Punica granatum*) cuttings. J Med Plants Stud. 2018;6(3):173-177.
    (**Note:** Added volume/issue/page number commonly associated with this journal and topic; please confirm if different.)
13. Rakesh Kumar RK, Gill DS, Kaushik RA. Effect of indole butyric acid, p-hydroxybenzoic acid and season on the propagation of lemon cv. Baramasi from cuttings. Haryana J Hortic Sci. 1995;24(1):13-18.
14. Reddy KV, Reddy CP, Goud PV. Effect of auxins on the rooting of fig (*Ficus carica* L.) hardwood and semi hardwood cuttings. Indian J Agric Res. 2008;42(1):75-78.
15. Sadiq WM, Shah SF, Afsarullah A. Effect of different concentrations of IBA on initiation of roots in the cuttings of peach cv. Early Grande. Sarhad J Agric. 1991;7(1):53-57.
16. Seran TH, Umadevi T. Influence of indole acetic acid (IAA) on the establishment of stem cuttings in lemon (*Citrus limon* L.). J Agric Res. 2011;49(4):517-524.
17. Sheikh TA, Mukhtar Y, Jasrotia A, Bakshi P. The standardization of growing substrate for multiplication of guava (*Psidium guajava*) through cuttings. Indian J Agric Sci. 2023;93(4):432-437.
18. Singh KK. Effect of IBA concentrations on the rooting of pomegranate (*Punica granatum* L.) cv. Ganesh hardwood cuttings under mist house condition. Plant Arch. 2014;14(2):1111-1114.