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Response of number of air layers per shoot in pomegranate cv. Bhagwa

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Abstract
The experiment entitled with Response of number of air layers per shoot in pomegranate cv. Bhagwa. With the objectives to study the effect of number of air layers per shoot and to find out the retention of appropriate number of layers per shoot for higher success in pomegranate The data obtained were analyzed using FRBD model with four treatment i.e. number of air layers per shoot *viz.*, L_1 two layer per shoot, L_2 four layer per shoot, L_3 six layer per shoot and L_4 eight layer per shoot with four replication.
The pomegranate propagation significantly influenced by number of air layers per shoot in treatment L_1 i.e. two layer per shoot significantly showed better response for early root initiation (22.54 days), rooting percentage (70.44%), length of primary root (12.00cm), length of secondary root (2.36cm), fresh weight of root (2.04g), dry weight of root (0.59g) and number of leaves (42.00). However, number of primary roots (22.32), number of secondary roots (37.79), root volume (4.04cm^3), heights of rooted air layered (27.41cm) and survival percentage (77.13%) was maximum in treatment L_2 i.e four layer per shoot. Whereas, the results regarding fresh and dry weight of shoot were found to be non- significant.

Keywords: Sphagnum moss, air layering, IBA, Pomegranate

Introduction

The Pomegranate (*Punica granatum* L.) is one of the ancient and highly praised favorite fruit. It is commercially grown, apart from India, in a number of countries for its sweet acidic fruits, which provide cool refreshing juice, and is valued from its medicinal properties. To highlight its importance, it was chosen as a symbol of the 18th international horticultural congress held during 1970, showing it in a basket (Sheikh, 2006) [11]. India is the world's leading producing country of pomegranate with an area 131 thousand hectares under cultivation and production 1345.7 thousand Mt. with an average productivity of 10.3 tons per hectare (Anon 2014) [1]. In India, Maharashtra leads in pomegranate production 945.2 thousand Mt from an area of 90 thousand hectare with an average productivity of 10.6 tons per hectare (Anon 2014) [1]. Next to Maharashtra maximum pomegranate cultivation takes place in Karnataka, Gujarat, Andhra Pradesh and Rajasthan. The area under pomegranate is increasing day by day due to its export potential in international market as well as demand in domestic market. Propagation of pomegranate by seed is easy but it takes more time for flowering and fruiting and it brings genetic variability and leads to low yield and poor quality fruits. Propagation through hard wood cuttings is also the best and less expensive method (Upadhyay and Badyal, 2007) [17] but commercially air-layering is one of the most successful method in pomegranate propagation and has the advantage of being able to reproduce plants with better rooting than cuttings. Air layering can be advantageously useful in pomegranate propagation to minimize the time for fruiting earlier than cutting planting to increase the success percentage (Tomar, 2011) [13]. Hence farmer prefer quality planting material which is developed by layering or hard wood cutting. The exogenous application of IBA and NAA induces rooting stem cutting and air layering due to their ability to activate in cambium regeneration, cell division and cell multiplication (Bhosale, 2009) [4]. There is a heavy demand for planting materials so there is need to produce large planting material in shortest possible time so there is need to do multiple air layers per shoot so one can get maximum number of air layers per shoot per tree. At present there is no standard available with pomegranate growers to perform air layers per shoot and it's retention per shoot for correct and precise advice to pomegranate growers of Maharashtra state.

Material and Methods
The present investigation was carried out during the year 2015-16 at CFN unit, College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola (MS). The materials used and methodologies adopted in the investigation given below:

A. Selection of Plants and Branches
The uniformed sized, healthy and vigorous growth of 5 year old trees of *Punica granatum* cv. Bhagwa grown at CFN Unit, were selected. On these plants, well-matured and healthy branches of pencil size shoot thick were selected from one year old mature shoots of pomegranate for air layering.

B. Preparation of Plant Growth Regulators (IBA) in Lanolin Paste
For preparation of 5000 ppm lanolin paste of IBA 500 mg of IBA was weighed on a chemical balance and was transferred in a beaker. Thereafter, 5 ml of ethyl alcohol (95 %) was added to it and shaked thoroughly to dissolve properly. Then 100 g lanolin was taken in petri dish and heated. The dissolved growth regulator was transferred into the melted lanolin paste and stirred firmly with clean glass rod until evaporation alcohol. In this way, harmonious mixture of growth regulator and lanolin paste was prepared.

C. Preparation of Layers
A strip of bark of 4.0 cm width was completely removed around the stem. The exposed surface was scraped to ensure complete removal of cambium layer to retard healing. Then cut portion was treated with growth regulator paste by brush. Later on slightly moistened sphagnum moss was placed to enclose the cut surfaces. A piece of polythene film was wrapped and tied with string.

Results and Discussion
The result obtained from the present investigation as well as relevant discussion have been summarized under following sub heads and given in Table. 1 and 2

1. Days required for root initiation
The data presented in Table 1 indicated that, short period required for root initiation significantly influenced by number of air layers per shoot on minimum days required for rooting (22.54 days) was observed in L_1 treatment i.e. two layer per shoot, which was at par with in treatment L_2 i.e. four layer per shoot (23.83 days) and followed by treatment in L_3 i.e. six layer per shoot (25.14 days) However, treatment L_4 i.e. eight layer per shoot took maximum days required (26.48 days) for rooting as compare to other treatment. Initiation of early rooting is dependent on weather conditions prevailing during the period. Growth regulators also play vital role in initiation of early rooting. It might be due to the difference in presence of food material (substrate) in shoots. These result are in agreement of Owais (2010) [9], Bankar and Prasad (1992) [3] and Singh (1994) in pomegranate.

2. Rooted air layers (%)
Data presented in Table 1 indicates that maximum percentage of rooted air layers (70.44%) was recorded in treatment L_1 i.e. two layer per shoot which was at par (67.38%) with in treatment L_2 i.e. four layer per shoot and (64.83%) in treatment L_3 i.e. six layer per shoot. However, minimum percentage of rooted air layers (59.88%) was recorded in treatment L_4 i.e. eight layer per shoot. This is might be due to IBA had better effect on the rooting and greatest rooting percentage was found in higher concentration. Auxin application enhanced the Auxin concentration in the cell and increased the cell division which resulted quick callus formation (Hartman *et al.* 1989) [6]. Similar results are also reported by Misra and Singh (1988) [7] in Karonda.

3. Number of primary roots
Data presented in Table 1 indicated that maximum number primary roots per layer was observed in treatment L_2 i.e. four layer per shoot (22.32) which was at par with in treatment L_1 i.e. two layer per shoot (20.94) and followed by treatment in L_3 i.e. six layer per shoot (19.53). However, minimum number of primary roots per layer was observed in treatment L_4 i.e. eight layer per shoot (18.34). This might be due to accelerated rooting in the layering with the increased IBA concentration increases cell wall elasticity which further may have accelerated cell division and in turn increased number of roots up to a certain level. (Bora *et al.* 2006) [5]. These result are in agreement of Bhosale *et al.* (2009) [4] in pomegranate.

4. Number of secondary roots
Data presented in Table 1 indicated that maximum number of secondary roots per layer was observed in treatment L_2 i.e. four layer per shoot (37.79) which was at par with in treatment L_1 i.e. two layer per shoot (36.25) and followed by treatment in L_3 i.e. six layer per shoot (35.31). However, minimum number of secondary roots per layer was observed in treatment L_4 i.e. eight layer per shoot (34.87). Use of sphagnum moss and adequate level of IBA would have be advantageous for emergence of more number of secondary roots. These result are in agreement of Owais (2010) [9] in pomegranate and Tyagi and Patel (2004) [15] in guava.

5. Length of primary roots (cm)
Data presented in Table 1 indicated that maximum length of primary roots per layer was observed in L_1 i.e. two layer per shoot (12.00cm) which was at par with in treatment L_2 i.e. four layer per shoot (11.00) and followed by treatment in L_4 i.e. eight layer per shoot (10.31.), However, minimum length of primary roots per layer was observed in L_3 i.e. six layer per shoot (9.46 cm). This might be attributed due to the action of auxin activity which might be caused hydrolysis and translocation of carbohydrates and nitrogenous substances in the cellular level and resulted in accelerated cell elongation and cell division under favourable environmental condition. These results are in conformity with Ulemale and Shelke (1987) [16], Singh (2001) [12] in guava and Bhosale *et al.* (2014) in pomegranate.

6. Length of secondary roots (cm)
Data presented in Table 1 indicated that maximum length of secondary roots per layer was observed in treatment L_1 i.e. two layer per shoot (2.36 cm), which was at par with in treatment L_2 and L_3 (2.13 and 2.6 cm respectively), However, minimum length of secondary roots per layer was observed in treatment L_4 i.e. eight layer per shoot (1.88cm). This might be due to maximum rainfall and increased humidity in atmosphere which was best for layering. These results are in conformity with Tryambake and Patil (2002) [14] in pomegranate, Baghel (2015) [2] in guava and Tomar (2011) [13] in pomegranate.

7. Fresh weight of roots (g)
Data presented in Table 1 indicated that, in respect of fresh

weight of the root was found to be maximum in treatment L_1 i.e. two layer per shoot (2.04 g) followed by in treatment L_2 and L_3 (1.74 and 1.52g respectively), However, minimum fresh weight of root was recorded in treatment L_4 i.e. eight layer per shoot (1.43 g). Natural and synthetic auxin when applied exogenously increases the development of pre-existing root primordial. The increase in number, length and diameter of root per air layers might have directly influenced the fresh weight of the roots. (Hartman *et al.*1989) [6]. These results are in conformity with Bhosale *et al.* (2009) [4], Patel *et al.* (2012) [10] in pomegranate.

8. Dry weight of roots (g)

Data presented in Table 1 indicated that in respect of dry weight of the roots was found to be maximum in treatment L_1 i.e. two layer per shoot (0.59 g) followed by in treatment L_2 and L_3 (0.42 and 0.29 g respectively), However, minimum dry weight of the root was recorded in treatment L_4 i.e. eight layer per shoot (0.24 g).This is might be due to auxin are known to to be helpful in rooting and auxin to adenine high ratio to promotes the rooting. These results are in conformity with Bhosale (2009) [4] in air layers of pomegranate.

Table 1: Effect of response of number of air layers per shoot in pomegranate cv. bhagwa

Treatment	Days required for root initiation	Percentage of rooted air layer (%)	No of primary roots 90 DAL	No of secondary roots 90 DAL	Length of primary roots (cm) 90 DAL	Length of secondary roots (cm) 90 DAL	Fresh weight of roots (g) 90 DAL	Dry weight of roots (g) 90 DAL
L_1 - Two layer/shoot	22.54	70.44 (57.06)	20.94	36.25	12.00	2.36	2.04	0.59
L_2 – Four layer /shoot	23.83	67.83 (55.17)	22.32	37.79	11.00	2.13	1.74	0.42
L_3 - Six layer/shoot	25.14	63.59 (52.89)	19.53	35.31	9.46	2.06	1.52	0.29
L_4 - Eight layer /shoot	26.48	59.88 (50.70)	18.34	34.87	10.31	1.88	1.43	0.24
F Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.54	1.31	0.95	0.88	0.48	0.14	0.10	0.6
CD at 5%	1.33	3.23	2.34	2.17	1.19	0.34	0.23	0.15

Note-Figures in parenthesis denote the arc sign transformations value.
DAL- Days after layering.
DAT- Days after transplanting

9. Root volume (cm^3)

Data presented in Table 2 indicated that in respect of root volume was found to be maximum in treatment L_2 i.e. four layer per shoot (4.04 cm^3) which was at par with treatment L_1 i.e. two layer per shoot (3.69 cm^3), and followed by treatment in L_3 i.e. six layer per shoot (2.95cm^3),However, minimum root volume was recorded in treatment L_4 i.e. eight layer per shoot (2.83 cm^3), This is probably because of the fact that higher concentration of IBA promoted the cell division which increased the root volume. These results are in conformity with Noor Elahi Jan *et al.* (2002) [8] in litchi and Bhosale *et al.* (2009) [4] in pomegranate.

10. Heights of rooted air layer (cm)

Data presented in Table 2 indicated that significantly maximum height of rooted layer was observed in treatment L_2 i.e. four layer per shoot (27.41cm) which was at par with in treatment L_1 i.e. two layer per shoot (25.84cm), and L_3 i.e. six layer per shoot (25.13cm), Whereas, minimum height of rooted layer was observed in L_4 i.e. eight layer per shoot (23.84cm). This might be due to reduced transpiration rate which in turn increases the cell turgidity and enhances the cell division. Thus the greater portion of available photosynthesis used in root growth resulted in maximum height of rooted air layered. These results are in conformity with Noor Elahi Jan *et al.* (2002) [8] in litchi and Bhosale *et al.* (2009) [4] in pomegranate.

11. Number of leaves per layer at final survival

Data presented in Table 2 indicated that maximum number of leaves per layer was observed in treatment L_1 i.e. two layer per shoot (42.00) at final survival which was at par with in treatment L_2 and L_3 (40.69 and 38.38 respectively), and minimum number of leaves at final survival was registered in treatment L_4 i.e. eight layer per shoot (37.44). This might be due to the relative humidity and optimum light intensity which were the important factors in the development of leaf coupled with auxin content activated the synthesis of more carbohydrates in the leaves which might have resulted in elongation of leaves through cell elongation and cell division that resulted in more leaf area per plant. These results are in conformity with Patel *et al.* (2012) [2], Bhosale *et al.* (2009) [4] in pomegranate.

12. Fresh and Dry weight of shoot (g)

Data presented in Table 2 indicated that in respect different treatments of number of air layer per shoot of fresh and dry weights of shoot showed non significant results.

13. Survival percentage (%)

Data presented in Table 1 indicated that treatment L_2 i.e. four layers per shoot had recorded significantly higher survival percentage (61.43 %), which was at par with in treatment L_1 i.e. two layer per shoot (60.21 %), and followed by treatment L_3 i.e. six layer per shoot (56.87cm^3), and minimum survival percentage was recorded in treatment L_4 i.e. eight layers per shoot (55.48 %). This might be due to better survival of rooted layers is obviously due to profuse rooting with longer roots having increased accumulation of dry matter. These results are in conformity with Tomar (2011) [13] in pomegranate and Baghel (2015) [2] in guava.

Table 2: Effect of response of number of air layers per shoot in pomegranate cv. Bhagwa

Treatment	Root volume (cm^3) 90 DAL	Height of rooted air layered (cm) 60 DAT	No of leaves per layer 60 DAT	Fresh weight of shoot (g) 60 DAT	Dry weight of shoot (g) 60 DAT	Survival percentage (%)
L_1 - Two layer/shoot	3.69	25.84	42.00	10.14	3.93	75.31 (60.21)
L_2 – Four layer /shoot	4.04	27.41	40.69	10.57	4.66	77.13 (61.43)
L_3 - Six layer/shoot	2.95	25.13	38.33	9.53	3.92	70.13 (56.87)
L_4 - Eight layer /shoot	2.83	23.84	37.44	9.24	3.66	67.88 (55.48)
F Test	Sig	Sig	Sig	NS	NS	Sig
SE (m)±	0.34	0.84	1.34	0.63	0.42	1.20
CD at 5%	0.84	2.06	3.30	-	-	2.94

Note-Figures in parenthesis denote the arc sign transformations value.
DAL- Days after layering.
DAT- Days after transplanting.

Conclusions

The pomegranate propagation was significantly influenced by number of air layers per shoot. The number air layers per shoot L_1 *i.e* two air layers per shoots significantly shows better response for root initiation, rooting percentage, length of root, fresh weight of root, dry weight of roots and number of leaves while number of roots, root volume, height of rooted air layered, and survival percentage is maximum in L_2 *i.e* four layer per shoot.

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