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Effect of Planting Time, Rooting Hormone and different Rooting Media Combinations on Chlorophyll and Nutrient content of Leaves of Pomegranate Cuttings in Haryana conditions

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ABSTRACT: The experiment was conducted on the effect of time of planting, indole butyric acid (IBA) treatment and rooting media was carried out at Centre for Quality Planting Material, CCS Haryana Agricultural University, Hisar (Haryana) during the year 2017. Pomegranate can be propagated either sexually or vegetatively but the seedlings raised by seeds will have variations in progeny with respect to plant vigour, precocity and fruit quality, therefore, vegetative method of propagation is preferred for eliminating the high degree of variability and to ensure early bearing, transfer of good characters and genetic purity of a cultivar. Propagation through cuttings is simple, convenient, inexpensive and rapid. The pomegranate cuttings of Bhagwa variety were planted during February and March after treating half the cuttings with IBA at 2000 ppm and remaining half untreated in ten different combinations of rooting media. The chlorophyll content and Leaf nutrient content, *viz.* NPK was recorded maximum in leaves of pomegranate cuttings treated with IBA 2000 ppm and planted in cocopeat, perlite and vermicompost media (4:1:1) in February month.

Keywords: Pomegranate, IBA, Chlorophyll, Cocopeat, Perlite, Vermicompost.

INTRODUCTION

Pomegranate (*Punica granatum* L.) is a subtropical fruit belongs to the family Lythraceae and is known to be originated from Iran and grows well in arid conditions due its hardy nature. India is the leading country for pomegranate production in the world occupying an area of 0.193 million hectare and annual production of 2.198 million tonnes (Saxena and Gandhi 2015). Pomegranate is commonly propagated through hardwood cuttings because it is a simple, convenient, inexpensive and rapid method for (Upadhyay and Badyal 2007) obtaining well developed and stronger plants. However, the success of this method depends upon factors like time of planting, rooting hormone and media used. In order to reduce the high mortality of rooted cuttings under field conditions, it is highly desirable to build a healthy and well developed root system for enabling better field establishment of pomegranate trees by treating with suitable plant growth regulators (Tanwar *et al*., 2020). Exogenous application of auxin can induce early rooting and can prevent the failure of cuttings (Kasim and Rayya 2009).The success rate of cuttings as well as number and quality of roots in cuttings of various fruit plants can be increased by exogenous application of synthetic auxin indole butyric acid (IBA). To reduce the mortality rate of cuttings plant growing media other than soil is required with properties like chemical resistance, light weight, heat balance, physical stability, source of nutrients, free from insects-pests and pathogens (Ercisli *et al*., 2003) and it should also be sufficiently firm, dense to maintain the cuttings in place, porous to drain out excess water and permit aeration. In this way, the nutrients absorption, water consumption, oxygen maintenance and growth of plant can be improved using the different organic and inorganic substrates. Rooting medium plays an important role in rooting of cuttings and for further growth and development of cuttings. It also provides moisture and air to the base of cutting The different types of rooting media that can be used for growing pomegranate include sand, cocopeat, perlite, vermiculite, vermicompost, etc.

Sand is chemically inert medium with neutral pH and nutrients free (Alikhani *et al.*, 2011). Cocopeat, an organic material, which is porous in nature, has medium ion and high water absorption capacity (Schie, 1999), provides enough aeration to roots and maintains suitable pH and electrical conductivity. Cocopeat can store and provide nutrients to cuttings for longer period, and therefore, it may help to make the nutrients available to the cuttings of pomegranate (Raut *et al.*,

2015). Cocopeat and perlite have the capacity to interchange elements especially inside the substrate and proper moisture distribution, which help in rooting and plant growth (Nourizadeh, 2003). Perlite is considered as a substrate with excellent features in soilless cultivation since it has high water absorption capacity and increases water use efficiency (Djedidi *et al*., 1999), provides gas interchanges in media due to existence of porosity in it and improves aeration in the soil. Vermiculite improves soil aeration resulting in high moisture retention and more availability of nutrients to roots (Rajkumar *et al.*, 2016). Vermicompost consists of available forms of nutrition for plant uptake such as nitrates, exchangeable phosphorus, potassium, calcium and magnesium and increased water retention capacity (Khalighi and Padasht-Dehkaee 2000).

Besides, rooting hormone and plant growing media the time of operation also governs the survival of cuttings. The time of the year that shoot cuttings are being collected is so crucial for obtaining a high performance of sprouting in the cuttings (Kahramanoglu and Umar 2018). Successful cutting propagation has been associated with ideal planting time of cuttings. Higher rooting percentage was recorded in the cuttings planted at end of February than those planted at the beginning of October (Hambrick *et al.*, 1991). Hardwood cuttings of 20 cm length will root faster and easily if planted in February or March (Sheets, 2004). We report on effect of time of planting, IBA treatment and rooting media on rooting and root characters of pomegranate cuttings.

MATERIALS AND METHODS

Experimental site and details. The experiment was conducted at Centre for Quality Planting Material, CCS Haryana Agricultural University, Hisar (Haryana), India. The Hisar district in Haryana state of India is situated at 215.2 meter above sea level with coordinates of 29°10′ N latitude and 75°46′ E longitudes with typical semi-arid climate having hot and dry summer and extremely cold winters. The study was carried out under open field conditions during February and March of 2017 with different combinations of rooting media *viz.* T_1: S and, T_2: Cocopeat, T_3: Cocopeat + sand (1:3), T_4: Cocopeat + vermicompost (4:1), T_5: Cocopeat + perlite + vermicompost (4:1:1), T_6: Cocopeat + perlite + vermicompost (6:1:1), T_7: Cocopeat + perlite + vermicompost (8:1:1), T_8: Cocopeat + perlite + vermiculite (4:1:1), T_9: Cocopeat + perlite + vermiculite (6:1:1), T_{10}: Cocopeat + perlite + vermiculite (8:1:1).

Preparation of cuttings and IBA concentration. The hardwood cuttings of pomegranate cultivar Bhagwa were prepared from healthy and disease free one year old mature branches of 7.5-10 cm thickness. The cuttings of 20 cm in length with 5 to 6 buds were completely defoliated and a straight cut at basal end just below the bud and a slanting cut at the apical end above the bud was made. Indole butyric acid (IBA) of 2000 ppm concentration was prepared by dissolving 2 g IBA in small quantity of ethanol and final volume was made upto 1000 ml using distilled water.

Planting of cuttings. Poly bags of 7 × 9 inch were filled as per the treatment with rooting media on volume basis and kept replication wise for the planting of cuttings. The basal portion of half number of freshly prepared cuttings on the day of planting was treated with a solution of IBA 200 ppm for 2 minutes and remaining half of the freshly prepared cuttings was planted without IBA treatment in the polybags.

Chlorophyll content in leaves (mg/g of FW). A method developed by Hiscox and Israelstam (1979) was used for the estimation of chlorophyll. From each cutting, leaves were selected and the chlorophyll content of selected leaves was measured by using spectrophotometer. One hundred mg of leaf tissue was placed in a vial, then 5 ml dimethyl sulphoxide (DMSO) was added into it and kept overnight so that chlorophyll could be extracted into fluid and the tissue became chlorophyll free. A 3 ml aliquot of chlorophyll extract was transferred to a cuvette and the absorbance values were recorded at 645 and 665 nm against a blank (DMSO) by using a spectrophotometer. The chlorophyll contents were calculated by using the following equations:

Chlorophyll '*a*' =

$$\frac{(12.3\times A665) - (0.86 \times A645)}{a \times \text{weight of tissue} \times 1000} \times \text{ volume of DMSO}$$

Chlorophyll '*b*' =

$$\frac{(19.3\times A645) - (3.6 \times A665)}{a \times \text{weight of tissue} \times 1000} \times \text{ volume of DMSO}$$

Where,

a= path length

Total chlorophyll= chlorophyll '*a*'+ chlorophyll '*b*'

Nutrients content in leaves (N, P and K). Leaf samples were collected and oven dried. Thereafter, the dried leaves were ground by using the electric grinder and the powder formed was stored in clean polythene bags. These powdered leaf samples were used for digestion.

The powdered leaf samples of 0.2 g were taken in 50 ml conical flask. 10 ml of diacid mixture (H_2SO_4 and $HClO_4$ in ratio of 9:1) was added to it and kept overnight. Thereafter, it was kept on hot plate and heated gently at first. Then, it was heated vigorously until it became a clear colourless solution of about 3-4 ml and all the fumes ceased out. It was cooled down and transferred to 50 ml volumetric flask and volume was made to the mark using distilled water. It was then filtered using Whatman no. 1 filter paper and used for analysis.

Nitrogen content in leaves (%). Nessler's reagent method as given by Jackson (1967) was used for the determination of nitrogen content. 0.2 ml of digested plant material was taken in 25 ml volumetric flask and 5 ml of distilled water was added to it and about 1 ml of 10% NaOH was added to neutralize the acidity of

solution. Thereafter, 1 ml of 10% sodium silicate was added and the volume was made to about 20 ml, and then, 2 ml of Nessler's reagent was added, which gave orange colour complex. Volume was made to the mark. Intensity of colour was read on spectrophotometer by using blue filter at 440 nm wavelength. Nitrogen content was calculated by using standard curve.

Phosphorus content in leaves (%). Vanado-molybdate method proposed by Jackson (1967) was used for the determination of phosphorus in plant sample. 2 ml of aliquot was taken in 25 ml volumetric flask and 2-3 drops of 2,4-dinitrophenol indicator were added to it. Thereafter, ammonia solution was added until the yellow colour appeared and then 6 N HCl was added drop wise until it again became colourless. 5 ml of vanado-molybdate solution was added and the volume was made upto the mark. It was mixed well and the intensity of yellow colour was read on spectrophotometer by using blue filter at 440 nm wavelength and phosphorus content was calculated by using standard curve. A blank was also run simultaneously.

Potassium content in leaves (%). Flame photometer was used for the determination of potassium in acid digested plant samples. 5 ml of digested plant material was taken in a 25 ml volumetric flask and the volume was made to the mark using distilled water. Potassium concentration was measured by using flame photometer as explained by Piper (1966). Potassium content of the sample was calculated by using the standard curve.

Statistical analysis. The experiment was laid out in Factorial Complete Randomized Design. Each treatment was replicated six times. Statistical analysis of data collected during the study was done using OP STAT tool.

RESULTS

In the present study, the chlorophyll '*a*', chlorophyll '*b*' and total chlorophyll content in pomegranate leaves was significantly affected by the time of planting cuttings, IBA treatment and different rooting media when considered irrespective of each other as presented in Table 1 and 4.

Table 1: Effect of time of planting, IBA treatment and rooting media on chlorophyll 'a' content, chlorophyll 'b' content and total chlorophyll content (mg/g FW) in leaves of pomegranate.

Treatments	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll content
TIME OF PLANTING			
February (T_1)	1.13±	0.39±	1.53±
March (T_2)	1.04±	0.37±	1.41±
C.D. (P=0.05)	0.01	0.01	0.02
IBA TREATMENT			
IBA 2000 ppm (G_1)	1.19±	0.42±	1.62±
Without IBA (G_2)	0.98±	0.35±	1.33±
C.D. (P=0.05)	0.01	0.01	0.02
ROOTING MEDIA			
M_1: Sand	0.79±	0.26±	1.05±
M_2: Cocopeat	0.88±	0.31±	1.19±
M_3: Cocopeat + sand (1:3)	0.84±	0.29±	1.13±
M_4: Cocopeat + vermicompost (4:1)	0.93±	0.34±	1.27±
M_5: Cocopeat + perlite + vermicompost (4:1:1)	1.42±	0.51±	1.92±
M_6: Cocopeat + perlite + vermicompost (6:1:1)	1.26±	0.43±	1.69±
M_7: Cocopeat + perlite + vermicompost (8:1:1)	1.14±	0.44±	1.57±
M_8: Cocopeat + perlite + vermiculite (4:1:1)	1.38±	0.46±	1.84±
M_9: Cocopeat + perlite + vermiculite (6:1:1)	1.19±	0.43±	1.62±
M_{10}: Cocopeat + perlite + vermiculite (8:1:1)	1.05±	0.36±	1.41±
C.D. (0.05)	0.03	0.01	0.05

Effect of time of planting on chlorophyll and nutrient content of leaves. The content of chlorophyll '*a*' (1.13 mg/g of fresh weight), chlorophyll '*b*' (0.39 mg/g of fresh weight) and total chlorophyll content (1.53 mg/g of fresh weight) in pomegranate leaves was noted maximum in the cuttings planted during February as compared to those planted in March. Irrespective of IBA treatment and rooting media, the maximum nitrogen, phosphorus and potassium content in leaves (1.48%), (0.51%) and (2.38%) was observed in cuttings

planted during February as compared to those planted during March (1.39%), (0.33%) and (2.17%).

Effect of IBA treatment on chlorophyll and nutrient content of leaves. The cuttings treated with IBA 2000 ppm resulted in highest content of chlorophyll '*a*' (1.19 mg/g of fresh weight), chlorophyll '*b*' (0.42 mg/g of fresh weight) and total chlorophyll content (1.62 mg/g of fresh weight) in pomegranate leaves and the untreated cuttings showed the lowest content of chlorophyll '*a*' (0.98 mg/g of fresh weight), chlorophyll '*b*' (0.35 mg/g of fresh weight) and total chlorophyll (1.33 mg/g of fresh weight) in pomegranate leaves. The cuttings treated with IBA 2000 ppm showed maximum nitrogen (1.50%), phosphorus (0.53%) and potassium (2.41%) content in leaves and the minimum was recorded in untreated cuttings irrespective of time of planting cuttings and rooting media (1.36%), (0.39%) and (2.13%).

Table 2: Interaction effect of time of planting and rooting media (T × M) on chlorophyll 'a' content, chlorophyll 'b' content and total chlorophyll content (mg/g FW) in leaves of pomegranate.

Treatments	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll
T_1M_1	0.83	0.28	1.10
T_1M_2	0.92	0.32	1.24
T_1M_3	0.88	0.31	1.18
T_1M_4	0.96	0.36	1.32
T_1M_5	1.47	0.54	2.00
T_1M_6	1.31	0.45	1.76
T_1M_7	1.19	0.45	1.64
T_1M_8	1.42	0.48	1.91
T_1M_9	1.23	0.43	1.66
T_1M_{10}	1.11	0.37	1.48
T_2M_1	0.76	0.25	1.00
T_2M_2	0.84	0.29	1.14
T_2M_3	0.79	0.29	1.08
T_2M_4	0.89	0.33	1.22
T_2M_5	1.37	0.48	1.85
T_2M_6	1.22	0.42	1.63
T_2M_7	1.09	0.42	1.51
T_2M_8	1.34	0.44	1.78
T_2M_9	1.15	0.42	1.57
T_2M_{10}	1.00	0.35	1.35
C.D. (0.05)	NS	NS	NS

Table 3: Interaction effect of IBA treatment and rooting media (G × M) on chlorophyll 'a' content, chlorophyll 'b' content and total chlorophyll content (mg/g FW) in leaves of pomegranate.

Treatments	Chlorophyll 'a'	Chlorophyll 'b'	Total Chlorophyll
G_1M_1	0.88	0.30	1.18
G_1M_2	0.97	0.34	1.32
G_1M_3	0.94	0.33	1.27
G_1M_4	1.03	0.38	1.42
G_1M_5	1.55	0.55	2.09
G_1M_6	1.37	0.47	1.84
G_1M_7	1.24	0.47	1.71
G_1M_8	1.50	0.50	1.99
G_1M_9	1.29	0.47	1.77
G_1M_{10}	1.17	0.41	1.58
G_2M_1	0.70	0.23	0.93
G_2M_2	0.79	0.28	1.07
G_2M_3	0.73	0.27	0.99
G_2M_4	0.82	0.30	1.12
G_2M_5	1.29	0.47	1.75
G_2M_6	1.16	0.39	1.55
G_2M_7	1.04	0.39	1.44
G_2M_8	1.26	0.43	1.69
G_2M_9	1.08	0.38	1.46
G_2M_{10}	0.94	0.31	1.25
C.D. (0.05)	NS	NS	NS

Table 4: Effect of time of planting, IBA treatment and rooting media on nitrogen content (%), phosphorus content (%) and potassium content (%) in leaves of pomegranate cuttings.

Treatments	Nitrogen content (%)	Phosphorus content (%)	Potassium content (%)
TIME OF PLANTING			
February (T_1)	1.48±	0.51±	2.38±
March (T_2)	1.39±	0.41±	2.17±
C.D. (P=0.05)	0.02	0.01	0.03
IBA TREATMENT			
IBA 2000 ppm (G_1)	1.50±	0.53±	2.41±
Without IBA (G_2)	1.36±	0.39±	2.13±
C.D. (P=0.05)	0.02	0.01	0.03
ROOTING MEDIA			
M_1: Sand	0.82±	0.26±	1.88±
M_2: Cocopeat	1.03±	0.37±	2.02±
M_3: Cocopeat + sand (1:3)	0.95±	0.32±	1.91±
M_4: Cocopeat + vermicompost (4:1)	1.15±	0.44±	2.12±
M_5: Cocopeat + perlite + vermicompost (4:1:1)	2.19±	0.63±	2.69±
M_6: Cocopeat + perlite + vermicompost (6:1:1)	1.84±	0.57±	2.51±
M_7: Cocopeat + perlite + vermicompost (8:1:1)	1.45±	0.45±	2.34±
M_8: Cocopeat + perlite + vermiculite (4:1:1)	2.05±	0.59±	2.59±
M_9: Cocopeat + perlite + vermiculite (6:1:1)	1.61±	0.51±	2.42±
M_{10}: Cocopeat + perlite + vermiculite (8:1:1)	1.23±	0.45±	2.25±
C.D. (0.05)	0.04	0.01	0.07

Table 5: Interaction effect of time of planting and rooting media (T × M) on nitrogen, phosphorus and potassium content (%) in leaves of pomegranate cuttings.

Treatments	Nitrogen content (%)	Phosphorus content (%)	Potassium content (%)
T_1M_1	0.83	0.29	1.96
T_1M_2	1.07	0.43	2.12
T_1M_3	0.99	0.36	1.99
T_1M_4	1.19	0.49	2.20
T_1M_5	2.25	0.67	2.80
T_1M_6	1.88	0.63	2.62
T_1M_7	1.49	0.49	2.46
T_1M_8	2.11	0.65	2.70
T_1M_9	1.65	0.56	2.55
T_1M_{10}	1.28	0.51	2.36
T_2M_1	0.80	0.23	1.79
T_2M_2	0.99	0.32	1.92
T_2M_3	0.90	0.28	1.83
T_2M_4	1.10	0.39	2.03
T_2M_5	2.13	0.59	2.59
T_2M_6	1.80	0.51	2.40
T_2M_7	1.40	0.40	2.23
T_2M_8	1.99	0.53	2.47
T_2M_9	1.57	0.47	2.29
T_2M_{10}	1.17	0.39	2.14
C.D. (0.05)	NS	0.02	NS

Effect of rooting media on chlorophyll and nutrient content of leaves. The maximum content of chlorophyll '*a*' (1.42 mg/g of fresh weight), chlorophyll '*b*' (0.51 mg/g of fresh weight) and total cholorophyll (1.92 mg/g of fresh weight) was found in the cuttings planted in media combination of cocopeat, perlite and vermicompost of 4:1:1 ratio, while the minimum content of chlorophyll '*a*' (0.79 mg/g of fresh weight) and chlorophyll '*b*' (0.26 mg/g of fresh weight) and total cholorophyll (1.05 mg/g of fresh weight) content in pomegranate leaves was obtained in the cuttings planted in sand medium. Likewise, the cuttings planted in media combination of cocopeat, perlite and vermicompost in 4:1:1 ratio had the highest content of nitrogen (2.19%), phosphorus (0.63%) and potassium (2.69%) in leaves which was significantly higher than all other treatments when considered irrespective of time of planting cuttings and IBA treatment, however, the minimum content of nitrogen (0.82%), phosphorus (0.26%) and potassium (1.88%) was registered in leaves of cuttings planted in sand medium.

Combined effect of time of planting and rooting media on chlorophyll and nutrient content of leaves. The combined effect of time of planting and rooting media significantly enhanced the phosphorus content (0.67%) was obtained in leaves of cuttings planted in media combination of cocopeat, perlite and vermicompost (4:1:1) during the month of February, whereas, the minimum phosphorus content (0.23%) was recorded in leaves of cuttings planted in sand medium during March. However, chlorophyll, nitrogen and potassium content of leaves were not affected significantly by the interaction effect of time of planting and rooting media (Table 2 and 5).

Combined effect of IBA treatment and rooting media on chlorophyll and nutrient content of leaves. Interaction between IBA treatment and rooting media did not significantly influenced the chlorophyll and leaf nutrient content except phosphorus content (0.71%) which was found maximum in the cuttings planted in media combination of cocopeat, perlite and vermicompost in ratio of 4:1:1 after giving IBA 2000 ppm treatment and the minimum (0.22%) was observed in leaves of cuttings planted in sand medium without IBA treatment (Table 3 and 6).

Table 6: Interaction effect of IBA treatment and rooting media (G × M) on nitrogen, phosphorus and potassium content (%) in leaves of pomegranate cuttings.

Treatments	Nitrogen content (%)	Phosphorus content (%)	Potassium content (%)
G_1M_1	0.91	0.31	1.99
G_1M_2	1.09	0.44	2.13
G_1M_3	1.04	0.38	2.03
G_1M_4	1.22	0.52	2.26
G_1M_5	2.28	0.71	2.88
G_1M_6	1.89	0.65	2.67
G_1M_7	1.49	0.53	2.48
G_1M_8	2.12	0.67	2.76
G_1M_9	1.67	0.59	2.57
G_1M_{10}	1.29	0.51	2.40
G_2M_1	0.72	0.22	1.77
G_2M_2	0.97	0.31	1.91
G_2M_3	0.85	0.26	1.79
G_2M_4	1.08	0.36	1.98
G_2M_5	2.10	0.56	2.52
G_2M_6	1.79	0.49	2.36
G_2M_7	1.40	0.37	2.20
G_2M_8	1.99	0.51	2.42
G_2M_9	1.55	0.44	2.27
G_2M_{10}	1.16	0.39	2.09
C.D. (0.05)	NS	0.02	NS

Combined effect of time of planting and IBA treatment on chlorophyll and nutrient content of leaves. The cuttings planted in February after giving IBA treatment showed the maximum nitrogen (1.56%), phosphorus (0.56%) and potassium (2.52%) content in their leaves as compared to the leaves of cuttings planted in March without IBA treatment showed the minimum nitrogen (1.33%), phosphorus (0.33%) and potassium (2.03%) content. The chlorophyll content was not affected significantly by the interaction effect of time of planting and rooting media (Fig. 1 and 2).

Combined effect of time of planting, IBA treatment and rooting media on chlorophyll and nutrient content of leaves. The combined effect of time of

planting, IBA treatment and rooting media did not affected the Chlorophyll and leaf nutrient content except phosphorus content. The cuttings planted in media combination of cocopeat, perlite and vermicompost in ratio of 4:1:1 after giving IBA 2000 ppm treatment during February showed the maximum phosphorus content (0.72%), which was found statistically at par with the interaction effect of cuttings planted in media combination of cocopeat, perlite and vermiculite in ratio of 4:1:1 after giving IBA treatment during February, however, the minimum total phosphorus content (0.19%) was recorded in the leaves of untreated cuttings planted in sand medium during March.

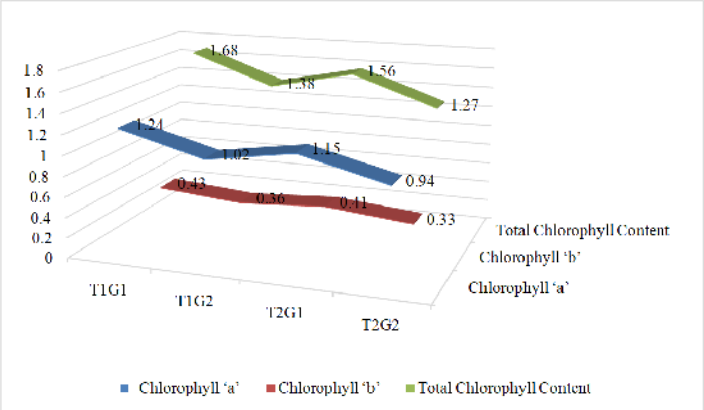

Fig. 1. Interaction effect of time of planting and IBA treatment (T × G) on chlorophyll 'a' content, chlorophyll 'b' and total chlorophyll content (mg/g FW) in leaves of pomegranate.

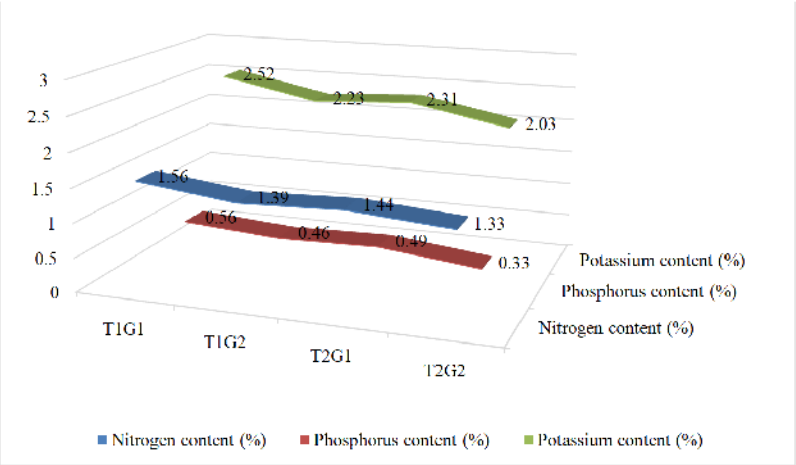

Fig. 2. Interaction effect of time of planting and IBA treatment (T × G) on nitrogen, phosphorus and potassium content (%) in leaves of pomegranate cuttings.

DISCUSSION

Chlorophyll Content. The increased concentration of chlorophyll in leaves might be due to the increased concentration of auxin, which increased the leaf area and photosynthesis. Shahab *et al.* (2013) observed that cuttings with more number of leaves absorbed more nutrients, thereby increased the assimilates production and provided sufficient food for the metabolism activities of the plants. Growth hormones have been shown to play an important role in regulating the amount and distribution of assimilates in plants (Galston and Davies 1969). The increase in chlorophyll content in leaves might be due to the supply of sufficient nutrients especially nitrogen, which is essential element for the synthesis of chlorophyll (Awasthi *et al.*, 1996). Similar results were reported by (Kaur *et al.*, 2002) who noticed that the chlorophyll content of leaves in grape vine stem cuttings enhanced after IBA treatment, Sivaci and Yalcin (2006) who reported that leaf chlorophyll content in stem cuttings of three apple cultivars (Golden Delicious, Starkrimson Delicious and Misket Delicious) was significantly increased by treatment of IBA 2000-3000 ppm and Rani (2017) who observed maximum leaf chlorophyll content in terminal cuttings of guava cv. Taiwan Pink planted in cocopeat medium with treatment of IBA 3000 ppm.

Leaf nutrient content (%). Leaf nutrient content *viz.*, N, P, K in leaves of pomegranate was found maximum

in cutting planted in February which might be due to the favorable ecological conditions for better growth of roots in February month, which was responsible for more absorption of nutrients. Likewise, the cuttings treated with IBA 2000 ppm had highest nitrogen, phosphorus and potassium content. It might be due to better development of root system, which increased the uptake of nutrients.

In case of rooting media, cocopeat along with perlite and vermicompost provided better aeration, moisture and nutrients to the cuttings, as cocopeat could store and release more nutrients to the cuttings of pomegranate for longer period (Raut *et al.*, 2015). Vermicompost consists of nutrients, *i.e.*, nitrates, phosphorus, potassium, calcium and magnesium in available forms for plant uptake and is good in water retention capacity (Khalighi and Padasht-Dehkaee, 2000). The use of different organic and inorganic substrates in appropriate proportion optimizes water and oxygen holding capacity and allows the plants to uptake nutrients better for sufficient growth and development (Bartczak *et al.*, 2007; Albaho *et al*., 2008; Ayesha *et al*., 2011; Hesami *et al*., 2012).

CONCLUSION

Based on the above findings it was concluded that the chlorophyll and leaf nutrient (N,P,K) content of leaves of pomegranate cuttings could be improved by planting the cuttings in media combination of cocopeat, perlite and vermicompost in ratio of 4:1:1 after treating with IBA at 2000 ppm during February. Thus, propagation of pomegranate through cuttings could be done more precisely by selecting right time for the operation, optimal rooting hormone concentration and appropriate rooting media combination.

FUTURE SCOPE

There is a problem of success rate of pomegranate propagation through cuttings. So, to overcome the losses of propagation material, different rooting media, IBA and proper time of planting of cuttings can be used to improve the success and survival rate of cuttings of pomegranate.

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