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RESEARCH ARTICLE

ROLE OF IBA AND PHB ON SUCCESS OF CUTTINGS OF FIG CV. BROWN TURKEY

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ABSTRACT

In order to study the role of IBA and PHB on success of cuttings of fig cv. Brown Turkey an investigation was conducted at the nursery of Department of Horticulture, Khalsa College, Amritsar during 2016-2017. Ten treatments were used comprising of IBA (500, 750, 1000 ppm), PHB (500 ppm) by slow dip, IBA (2000, 3000, 4000 ppm) and PHB (750, 1000 ppm) by quick dip method along with control. The results of investigation indicated that IBA (3000 ppm) with quick dip proved to be the best in terms of minimum days to first sprouting (13.66), maximum sprouting percentage (77.77%), survival percentage (73.33%), rooting percentage (71.10%), number of roots per cutting (36.99), root length (28.12cm), fresh weight of roots (1.86g), dry weight of roots (0.70g), number of shoots per cutting (5.33), average shoot diameter (0.57cm), shoot length (16.2cm), fresh weight of shoots (52.39g), dry weight of shoots (20.35g), number of leaves (17.08) and total leaf area (299.61cm2).

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INTRODUCTION

The common Fig (*Ficus carica L.*) also known as Anjeer belongs to family Moraceae with over 1400 species classified into 40 genera (Watson and Dallwitz 2004). The important species are *Ficus benjamina*, *Ficus callosa*, *Ficus carica*, *Ficus religiosa*, *Ficus elastica*, *Ficus pumia* and *Ficus hawaii*. It is a classical fruit tree of antiquity associated with the beginning of horticulture in Mediterranean basin (Siddiqui and Hussain 2007). Fig is a syconus fruit originated from Western Asia and spread to Mediterranean by humans. Brown Turkey cv. of fig is well developed to warm climates and is cultivated in Punjab. Its fruit is richly flavoured and delicious with attractive purple brown skin, medium to large in size and pear shaped. The fruits are reasonably resistant to splitting (Rattanpal 2011). Due to its vigorous growing habit and hardy nature, it is used as a rootstock in India (Anonymous 2002). The fig fruit is sweet containing a large number of pits, often used dry. The dried figs have 29% water, 50% sugar, 4% protein, 5.5% nitrogen, 2% fatty material and a substance called Psoralen (Paknahad and Sharafi 2015). The Figs are consumed fresh, dried, preserved, candied and canned. About 90% of the fig, produced in world, are dried. A small portion is sun dried and large quantities are used for jam and alcoholic beverage production (Mars *et al* 2008). Fresh figs are delicious and used as dessert or for jam. Fig leaves serves as fodder in India. Figs are the richest source of calcium, manganese, magnesium, potassium, fibre and vitamin B_6, B_2, B_1, A and C which can improve physical strength, nerve capability and treatment of neurological diseases. Moreover it is rich in sugar next to dates.

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Fig is propagated from seeds, cuttings, layers, grafts and by tissue culture techniques. Out of these methods, propagation by means of cuttings is the easiest and cheapest (Singh 2005). In India, figs are commercially propagated by hardwood stem cuttings by which vigorous marketable plants can be produced in less than one year. Under north Indian conditions cuttings are made when plants have shed their leaves in winter season and become dormant. Higher success can be obtained by using the cuttings with short internodes, collected from basal portion of shoots located in lower parts of crown. Treatment of cuttings with different growth hormones promote rooting (Dhillon 2013). Growth hormones including Indole Butyric Acid, Para Hydroxy Benzoic Acid promote good rooting. Hardwood cuttings when planted with IBA 500 ppm, resulted in maximum number of leaves (Singh 2014). IBA and PHB (500-1500 ppm) when applied together generated highest rooting and survival percentage (Ram *et al* 2005).

MATERIALS AND METHODS

The present investigation "Role of IBA and PHB on success of cuttings of fig cv. Brown Turkey was carried out in the nursery of Department of Horticulture, Khalsa College, Amritsar during the year 2016-2017. The cuttings were taken from healthy uniform sized branches of fig cv. Brown Turkey, growing in the nursery of Department of Horticulture, Khalsa College, Amritsar. The cuttings were taken from hardwood cuttings arising on fig plants cv. Brown Turkey during the middle of January. The shoots selected for preparation of cuttings were healthy and disease free. The cuttings of 20 cm length having 3-6 buds were taken with preferably pencil thickness. A slanting cut was given at the upper side and a round cut was given at the lower end of the cutting. There were 10 treatment combinations comprising six concentrations of plant growth regulator IBA (500,750 and 1000 ppm) applied by slow dip method upto 24 hrs and IBA(1000, 2000 and 3000 ppm) applied by quick dip for 2 minutes. There were three concentrations of PHB(500 ppm) applied by slow dip and PHB(750 and 1000 ppm) as quick dip method with control with distilled water arranged in RBD with three replications and 20 cuttings per treatment. The lower portion of cuttings were treated with different concentrations of plant growth regulator by quick dip method for 5 seconds and allowed to dry for 5 minutes in partial shade and then planted on the beds prepared for this purpose by incorporating a mixture of sand, soil and farmyard manure. While planting about 2/3rd length of the cuttings were buried in the soil, leaving 1/3rd part exposed to the environment. The cuttings were planted 20 cm apart with row to row distance of 30 cm. Five sprouted cuttings were selected randomly from each treatment of each replication. All observations were recorded after 90 days of planting.

RESEARCH AND DEMONSTRATION FINDINGS

Days to first sprouting (days): IBA 3000 ppm recorded minimum number of days (13.66) for sprouting followed by IBA (4000 ppm and 2000 ppm) when applied as quick dip generating 14.66 and 18.33 days respectively. IBA when applied as slow dip also influenced the days for sprouting by taking more days (29.66, 29.00, 28.66) with IBA (500, 750 and 1000 ppm) as compared to quick dip. The cuttings when treated with PHB (500, 750 and 1000 ppm) took more days for sprouting (29.33, 28.66 and 29.00) when applied as slow and quick dip. Earliness in sprouting might be due to the fact that there was better utilization of stored carbohydrates, nitrogen and other factors with help of growth regulators (Chandramouli 2001). Similar findings were reported by Thota (2012) in Fig cv. Poona. Rafael (2005) and Adelson (2009) in olive also reported the same.

Sprouting percentage (%): The maximum percentage of sprouting (77.77 %) was observed in (IBA 3000 ppm) under quick dip treatment while the least (19.99%) was recorded under control. Under slow dip, (IBA 750 ppm) resulted in more sprouting (57.77%) as compared to other concentrations. The cuttings treated with PHB (750 ppm) when applied as quick dip resulted in maximum sprouting percentage (75.55%) while minimum was with PHB (500 ppm) when applied as slow dip. The success might be due to the increased level of auxins, resulting in earlier completion of physiological processes in rooting and sprouting of cuttings. The increase in number of sprouts might be due to the better utilization of stored carbohydrates, nitrogen and other factors with the help of growth regulators (Sinha *et al* 2014). Application of the auxin might have caused hydrolysis and translocation of carbohydrates and nitrogeneous substances at the base of cuttings and resulted in accelerated cell division and cell elongation (Singh *et al* 2015). It also has been found to enhance the histological features like formation of callus and tissue and differentiation of vascular tissue. The research findings of Kurd *et al* (2010) and Thota (2012) are also in line with the present findings.

Survival percentage (%): The establishment success varied with IBA and PHB levels. Maximum survival (73.33%) was recorded in IBA (3000 ppm).Minimum survival percentage (17.66%) was recorded from the cuttings under control. The superiority of treated cuttings regarding the survival can be attributed to better start and root growth. The better start might have facilitated absorption of nutrients and moisture from soil and better growth developed capacity to withstand for a longer period (Ram *et al* 2005). The present results are in line with the findings of Iqbal *et al* (1999), Kaur (2016) in Pomegranate cv. Ganesh, Thota (2012) and Kishorbhai (2014) in Fig.

Rooting percentage (%): Highest rooting (71.10%) was gained from IBA (3000 ppm) while the least (39.99) in control. The cuttings treated with PHB generated roots ranging from 48.88 per cent with PHB 500 ppm and maximum of 66.66 per cent with PHB 1000 ppm respectively. The superiority of IBA in producing the highest percentage compared with PHB and control might be due to their respective difference in initiating hydrolysis of nutrition in the region of root formation. The hydrolysis further increased the content of physiologically produced sugar, provided energy for meristematic tissues and thereby for roots formation as reported by Husen and Pal (2007) in *Tectona grandis* and Husen (2008) in *Dalbergia sissoo.* The results are in conformity with Kurd *et al* (2010), and Rafael (2005) in olive. Reddy *et al* (2008) also reported the same in the rooting of hardwood and semi hardwood cuttings of fig.

Number of roots per cutting: The highest number of primary roots (36.99) were recorded in IBA (3000 ppm) under quick dip followed by PHB (1000 ppm and 750 ppm) by quick dip with (34.55) and (34.44) roots respectively. It was observed that control had minimum number of roots (9.22) per cutting. This pertains to the fact that the auxins promoted cell division and their elongation led to differentiation of cambial initials into root primordia and in the mobilization of reserve food material to sites of root initiation there by giving higher number of roots per cutting (Sharma 1999).It also might have been due to the increased cell division and their differentiation under the influence of rooting chemicals, enhanced hydrolysis of nutritional reserves resulting into the increased root formation zone. These findings are in agreement with the research work of Tripathi and Shukla (2004) in pomegranate, Reddy *et al* (2008) in fig, Diwaker and Katiyar (2013) in kagzi lime, Shukla *et al* (2010) in peach, Kumar *et al* (2004) in lime and Ram *et al* (2005) in pomegranate cvs. Ganesh and Kandhari.

Root length (cm): Significantly maximum length of root (28.12 cm) was recorded with IBA (3000 ppm) followed by (23.16 cm) in IBA 4000 ppm when applied as quick dip. On the other hand slow dip treatment gave the highest length of 14.52 cm with IBA (1000 ppm). PHB remained at approximately 10-11cm generating the root length of 10.94 cm, 11.94 cm and 11.29 cm with 500 ppm applied as slow dip and 750 ppm ,1000 ppm applied as quick dip respectively while the least root length was of 11.18 cm was under the control. Evidence suggests that auxins might have increased rooting and ensured length of roots as the root elongation stage is very responsive to auxin concentration and it might be exhibited by the higher concentrations (Hartmann *et al* 2002).The findings are similar to Thota *et al*(2014) in fig and Rafael (2005) in olive. The research findings of Reddy *et al* (2008) are also in line with the present investigation.

Fresh weight of roots (g): The maximum fresh weight (1.86) was recorded in treatment of (3000 ppm IBA) and minimum (0.30g) with control.

Table 1. Effect of IBA and PHB on number of sprouting, survival and rooting parameters of fig cuttings cv. Brown Turkey

Treatments	Days to first sprouting	Sprouting (%)	Survival (%)	Rooting (%)	Number of roots per cutting	Root length (cm)	Fresh Weight of Roots (g)	Dry weight of roots (g)
T_1(IBA500 ppm) Slow dip	29.66	51.10%	48.88%	46.66%	12.99	7.85	0.69	0.09
T_2(IBA750 ppm) Slow dip	29.00	57.77%	53.33%	55.55%	15.55	12.74	0.88	0.12
T_3(IBA1000ppm) Slow dip	28.66	53.33%	51.10%	64.44%	18.77	14.52	0.97	0.68
T_4(IBA2000ppm) Quick dip	18.33	59.99%	57.77%	66.66%	31.10	20.75	1.16	0.36
T_5(IBA3000ppm) Quick dip	13.66	77.77%	73.33%	71.10%	36.99	28.12	1.86	0.70
T_6(IBA4000ppm) Quick dip	14.66	68.88%	64.44%	68.88%	33.44	23.16	1.65	0.54
T_7(PHB500 ppm) Slow dip	29.33	33.33%	30.33%	48.88%	32.33	10.94	0.39	0.24
T_8 (PHB 750 ppm) Quick dip	28.66	75.55%	62.22%	64.44%	34.44	11.94	0.61	0.31
T_9 (PHB 1000 ppm) Quick dip	29.00	60.00%	59.99%	66.66%	34.55	11.29	1.09	0.54
T_{10} Control	31.33	19.99%	17.66%	39.99%	9.22	11.18	0.30	0.15
MEAN	25.22	55.77	51.91	59.33	25.93	15.24	0.96	0.37
C.D. (0.05%)	2.78	7.56	9.18	12.7	3.06	2.14	0.26	0.08

Table 2. Effect of IBA and PHB on shoot and leaf parameters of fig cuttings cv. BrownTurkey

Treatments	Number of shoots per cutting	Average shoot diameter(cm)	Shoot length(cm)	Fresh weight of shoots(g)	Dry weight of shoots(g)	Number of leaves	Total leaf area(cm^2)
T_1(IBA500ppm) Slow dip	1.77	0.44	9.6	15.39	3.12	10.20	118.23
T_2(IBA750ppm) Slow dip	1.99	0.56	10.5	22.94	8.19	13.33	149.87
T_3(IBA1000ppm) Slow dip	2.33	0.53	11.0	18.58	5.17	11.53	136.06
T_4(IBA2000ppm) Quick dip	3.33	0.52	9.8	44.93	14.03	9.22	180.41
T_5(IBA3000ppm) Quick dip	5.33	0.57	16.2	52.39	20.35	17.08	299.61
T_6(IBA4000ppm) Quick dip	4.59	0.55	14.1	51.48	19.66	15.97	205.66
T_7(PHB500 ppm) Slow dip	1.44	0.39	8.2	14.68	2.45	8.09	108.23
T_8(PHB750 ppm) Quick dip	2.11	0.49	14.7	18.25	5.29	15.76	131.40
T_9(PHB1000ppm) Quick dip	2.21	0.56	12.2	20.84	6.55	13.44	161.57
T_{10} Control	1.77	0.43	9.1	14.52	2.32	8.43	081.44
MEAN	2.68	0.50	11.54	27.40	8.71	12.30	157.24
C.D. (0.05%)	0.70	0.04	1.57	2.77	1.40	1.96	65.36

PHB (500 ppm) applied as slow dip generated the fresh weight of 0.39g followed by 0.61 g and 1.09 g with PHB (750 ppm and 1000 ppm) respectively. Results of these findings are confirmed by Diwaker and Katiyar (2013) in Kagzi lime. Maximum fresh weight of roots was attributed to the fact that auxins naturally occurring or exogenously applied are for initiation and growth of roots. Low auxin activity and its slow degradation by auxin destroying enzyme led to the growth and vigour of roots. This might also be due to the reserved food in the cuttings (Singh *et al* 2013). The present findings are in line with the research study of Chalfun *et al* (2003) in fig cv. Roxo de valinhos, Kaur (2016) in pomegranate cv. Ganesh and Deb *et al* (2009) in lemon cuttings.

Dry weight of roots (g): The data indicated that the maximum dry weight (0.70g) was recorded in (3000 ppm IBA) followed by IBA (1000 ppm) applied as slow dip with (0.68 g). The increase in the concentration of PHB led to the increase in the dry weight of roots depicting 0.24g, 0.31g and 0.54g with PHB (500, 750 and 1000 ppm) respectively. The present results are in accordance with findings of Deb *et al* (2009) in lemon cuttings and Thota (2012) in fig cv. Poona. Increase in dry weight of roots might be due to the fact that the increase in the root number and length of roots resulted in higher accumulation of dry matter. Results are in agreement with the findings of Shukla and Bist (1994) in pear.

Number of shoots per cutting: Shoot number increased with an increase in the concentration of growth regulators up to a limit. The maximum number of shoots (5.33) were registered from the cuttings treated with IBA 3000 ppm followed by IBA 4000 ppm (4.55) under quick dip. On the other hand, maximum number of shoots 2.21 were reported with PHB (1000 ppm) followed by PHB 750 ppm and 500 ppm with 2.11 and 1.44 shoots respectively.

The more number of shoot formation with the growth regulators might be due to the vigorous root system which increased the nutrient uptake under the combined influence of IBA and PHB application. It affected the cell division in the vascular cambium, cell expansion and control of differentiation into different types of cambial resulting in increase in number of shoots (Devi *et al* 2016). The research findings of Khajehpour *et al* (2014) in olive, Thota (2012) in fig, Kurd *et al* (2010) in olive are in support with the present findings.

Average shoot diameter (cm): According to the data regarding shoot diameter maximum shoot diameter (0.57 cm) was recorded in the treatment of IBA (3000 ppm) while the least diameter (0.39 cm) was recorded in PHB (500 ppm). This might be attributed to more number of roots because auxins favoured cell division and their elongation and helped in better root development thereby resulting in better shoots with more shoot diameter. It was also due to the higher cell activity, more synthesized food material and photosynthates hence more shoots with more stem diameter (Devi *et al* 2016). The results are in line with the findings of Kaur (2016) in pomegranate cv. Ganesh and Thota (2012) in fig.

Shoot length (cm): The maximum shoot length (16.2 cm) observed in IBA (3000 ppm) applied by quick dip while minimum shoot length was observed under controlled conditions. This might be due to the fact that IBA led to best aerial growth .The emergence of longest shoots on cuttings may be attributed to the well developed root system in such cuttings which might have tended to promote shoot growth by ensuring adequate mobilization of water and nutrients from the soil or substrate to the growing apices. Consequently, there was a faster growth rate of the newly emerged shoots (Pratima and Rana 2011). These results are in line with the findings of

Kaur (2016) in pomegranate cv. Ganesh and Khajehpour *et al* (2014) in olive and Kishorbhai (2014) in fig.

Fresh weight of shoots (g): Maximum fresh weight (52.39g) was depicted by (IBA 3000 ppm) while the minimum fresh weight (14.52g) was recorded under control. This might be attributed to the fact that auxins increased the permeability of cell for moisture, nutrients and resulted in the enlargement of cell causing more growth of plant parts. They increased the number of shoots resulting in higher fresh and dry weight of shoots. Similar results are confirmed by Shukla and Bist (1994) in Pear. Kishorbhai (2014) also reported the same in fig .

Dry weight of shoots (g): The highest dry weight of shoots (20.35g) was found in IBA (3000 ppm) while the least (2.32g) was observed under control. This was in accordance with the number of shoots and fresh weight of shoots. These results may be attributed to the fact that auxins activated the shoot growth which might have resulted in the elongation of stems and leaves through cell division accounting for higher dry weight of shoots. The dry weight was related with number of sprouts, diameter and length of sprout per cutting. The findings of Shukla and Bist (1994) in Pear, Thota (2012) in lemon cuttings and Kishorbhai (2014) in fig are in support with the present investigation.

Number of leaves per cutting: It is evident from the results that the maximum number of leaves per plant (17.08) were observed under IBA (3000 ppm) with quick dip followed by (15.97) with IBA (4000 ppm) while the minimum were obtained in PHB (500 ppm) under slow dip. On the flip side, PHB treatment gave the best results in T_8 (750 ppm) with quick dip generating 15.76 leaves per plant. The least number of leaves (8.43) were reported under control. Increase in leaf number might be due to the vigorous rooting induced by the growth regulators enabling the cuttings to absorb more nutrients and thereby producing more leaves as reported by Stancato *et al* (2003). The research findings of Siddiqui and Hussain (2007) in *Ficus* and Kishorbhai (2014) in fig are in confirmation with the present study.

Total leaf area (cm^2): Different concentrations of IBA and PHB had significant effect on leaf area. The results of the study showed that the maximum leaf area (299.61 cm^2) had been achieved in IBA (3000 ppm) followed by (205.66 cm^2) with IBA 4000 ppm applied as quick dip while the least (81.44 cm^2) was noted under control. Under PHB treatment quick dip (1000 ppm) escalated over the other concentrations. The minimum leaf area 81.44 cm^2 was recorded under control.The increase in total leaf area is related with the growth. It might be due to the fact that the plants with the vigorous growth gave more leaf area and vice versa. Plants with more roots increased nutrient uptake and increased growth with more leaf area. The research study of Kishorbhai (2014) in fig, Devi *et al* (2016) in Phalsa and Kaur (2016) in Pomegranate cv. Ganesh are in support with the present findings.

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