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Response of fig (*Ficus carica* L.) hard wood cutting to IBA and bio-inoculants on rooting and survival

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Abstract
An experiment entitled ‘‘Response of Fig (Ficus Carica L.) Hard Wood Cutting to IBA and Bio-Inoculants on Rooting and Survival’’ was carried out at Fruit Research Station, Imaliya, Department of Horticulture, JNKVV, Jabalpur between the period January 2022 to April 2022 in a Factorial Completely Randomized Design with three replications. The experiment was comprised of two factors - Five levels of IBA i.e., (C_1) IBA 0 ppm (Control), (C_2) IBA 500 ppm, (C_3) IBA 1000 ppm, (C_4) IBA 1500 ppm, (C_5) IBA 2000 ppm and Four types of growing media i.e., (M_1) Normal soil, (M_2) Normal soil + PSB, (M_3) Normal soil + VAM and (M_4) Normal soil + PSB + VAM. The result revealed that among the various treatment combinations, the hard wood cuttings treated with 2000 ppm IBA and planted in growing media having Normal soil + PSB + VAM (C_5M_4) proved superior with respect to number of primary roots (4.30), diameter of root (1.49 mm), and length of longest root (23.97 cm), fresh weight of root (3.31 g) dry weight of the root (1.17 g) and percentage of cuttings that survive (78.44%) at 90 DAP followed by 1500 ppm IBA.

Keywords: Fig, IBA, PSB, VAM, hard wood cutting

Introduction

The fig tree, *Ficus carica* L., is a subtropical, deciduous fruit tree that is a member of the Moraceae family. It is a substantial shrub or small tree with a thin, twisted trunk and strongly lobed, three to five lobed leaves. There is an excessive amount of milky latex in there (Dahale *et al.*, 2018) [5]. It is believed to have originated in the East Mediterranean, from where its cultivation spread throughout the entire Mediterranean region. There are about 1000 species in the genus *ficus*, of which around 65 species are found in India. (Aghera and Makwana, 2018) [1]. The fig fruit's morphological name is "Syconium," and it is a vegetative, fleshy tissue with tiny fruits enclosed inside.

Asexual methods are used to propagate the fig, which is highly advantageous for clonal planting material replication, germplasm conservation, and the introduction of rapidly growing species. Compared to other asexual reproduction techniques in fig (Animove, 1972) [2], fig are commercially propagated by hardwood stem cuttings in India (Patel *et al*., 2017) [27]. Although figs can strike roots, there is little noticeable rooting. Its rooting capacity is being enhanced by the application of growth regulators. Numerous internal and external factors affect a branch cutting's capacity to germinate and establish roots. Seasons, the amount of endogenous and exogenous phytoharmones, the type of cuttings, the concentration of these, the physiological basis, and several other internal grounds are among them (Arya *et al*., 1994) [3]. The synthetic plant hormone is called indole-3-butyric acid. This is effective in promoting root initiation while decreasing auxiliary bud breaking on growing shoots. It promotes cell elongation, which contributed to the growth of the roots. It is a well-known plant hormone that is utilized in cutting-based plant cloning to generate new roots (Tanwar *et al.*, 2020) [15].

However, by making nutrients available to the growing roots, some bio-fertilizers help in the rooting of cuttings. Phosphorus Solublizing Bacteria (PSB) is responsible for increasing the availability of phosphorus to the root zones of the plants (Rathore *et al.*, 2020) [13]. Vasicular Arbuscular Mycorrhizae (VAM) is the most widely occurring endophyte in soil. The major advantage to plants by mycorrhizal symbiosis is improved phosphorus uptake chiefly under conditions of its low availability. Other benefits, which help plant growth mechanism, include better water and other nutrient uptake. A cutting establishment's suitable medium need to have enough moisture and appropriate aeration. Under shadow net conditions, using the right rooting medium and IBA concentration would speed increase the growth of fig cuttings.

Materials and Methods

The experiment was carried out at Fruit Research Station, Imaliya, Department of Horticulture, JNKVV, Jabalpur, (M.P.) between the period January 2022 to April 2022 in a Factorial Completely Randomized Design with three replications with 20 treatment and 03 replications.Hard wood cuttings having 5-6 nodes were taken from one year old shoot. The length of cuttings used for planting was 15-20 cm and pencil thickness in diameter. The leaves were removed from the cuttings and were trimmed to the required length. The bottom cut is made round just below the node and the upper cut is made in a slanting 1-2 cm above the upper node. The potting mixtures were prepared with soil, sand and farmyard manure (1:1:1) and these were enriched with bioinoculants as per treatment. Polythene bags of 15× 23 cm size of 200 gauge were used for filling potting mixture of soil, sand and farmyard manure in the ratio of 1:1:1, and mixed bio-inoculants (PSB and VAM) 5g/pot culture in potting mixture. The requisite quantity of Indol-3-butaric acid (IBA) 500, 1000, 1500 and 2000 mg was weighed separately and transferred to different volumetric flasks and then these weighed growth regulator samples were first dissolved in 10 ml of ethyl alcohol (90%) by thoroughly shaking, then measured quantity (990 ml) of distilled water was added into the flask. IBA solutions of 500, 1000, 1500 and 2000ppm was obtained. Treatment combination IBA 0 ppm (Control) + Normal soil (C_1M_1), IBA 0 ppm + Normal soil + PSB (C_1M_2), IBA 0 ppm + Normal soil + VAM (C_1M_3), IBA 0 ppm + Normal soil + PSB + VAM (C_1M_4), IBA 500 ppm + Normal soil (C_2M_1), IBA 500 ppm + Normal soil + PSB (C_2M_2), IBA 500 ppm + Normal soil + VAM (C_2M_2), IBA 500 ppm + Normal soil + PSB + VAM (C_2M_4), IBA 1000 ppm + Normal soil (C_3M_1), IBA 1000 ppm + Normal soil + PSB (C_3M_2), IBA 1000 ppm + Normal soil + VAM (C_3M_2), IBA 1000 ppm + Normal soil + PSB + VAM (C_3M_4), IBA 1500 ppm + Normal soil (C_4M_1), IBA 1500 ppm + Normal soil + PSB (C_4M_2), IBA 1500 ppm + Normal soil + VAM (C_4M_2), IBA 1500 ppm + Normal soil + PSB + VAM (C_4M_4), IBA 2000 ppm + Normal soil (C_5M_1), IBA 2000 ppm + Normal soil + PSB (C_5M_2), IBA 2000 ppm + Normal soil +VAM (C_5M_2) and IBA 2000 ppm + Normal soil+ PSB + VAM (C_5M_4). The fresh basal end of cuttings about 3 cm were dipped in hormonal solutions of 500 ppm, 1000 ppm, 1500 ppm and 2000 ppm for 10 minute. After treatment of cuttings with different concentration of IBA, the cuttings were planted in the polybags containing potting mixture. The cuttings were planted in polythene bags and kept under net house condition.

Results and Discussion

The impacts of different IBA levels and bio-inoculants on the results are presented in Table 01. There was a significant to effect of IBA levels and bio-inoculants on rooting and survival.

Effect of IBA levels and bio-inoculants on root parameters. The different IBA levels and growing media promote the root parameters *viz*., Number of primary roots, Diameter of root (mm), Length of longest root (cm), Fresh weight of root (g), dry weight of root (g) and survival at 90 DAP. Among the root parameters and survival the maximum significant results were noted in (C_5) IBA 2000 ppm, in growing media (M_4) Normal soil + PSB + VAM and its combination of IBA 2000 ppm + Normal soil + PSB + VAM (C_5M_4) over all the other treatments. Bio-fertilizers increased the level of growth promoting substances, available N_2, P_2O_5 and other nutrients with the application of PSB due to synergistic effect of bio-fertilizer in various ways (Damor *et al.*, 2014) [6], Tanwar *et al*., 2020) [15].

This has to do with the fact that auxins encouraged cell proliferation and that their elongation resulted in the differentiation of cambial initials into root primordia and in the mobilization of reserve food material to sites of root initiation, yielding a larger number of roots per cutting (Sharma, 1999) [20]. These results concur with Tripathi and Shukla's (2004) [17] pomegranate research and Reddy *et al*. (2008) [14] fig research. In this treatment, well rooting media and Auxin levels are maximized with increasing IBA concentrations when paired with endogenous auxins, which already present in the cuttings, thereby increasing the percentage of rooting in cuttings (Patidar, 2018) [11]. This trend of root elongation may be due to suitable environmental conditions like soil & atmospheric temperature, humidity and internal condition of cuttings *viz*., endogenous Auxin level and carbohydrate contents. The optimization of Auxin level due to external application consequently improves the rooting number & their length, diameter etc. It is well known that auxin affects vascular differentiation. In many woody species, auxin is known to stimulate both cambial activity and xylem development Zakrzewski, (1983) [18]. Fresh and dry weight of roots directly depends on number of roots, diameter and length of roots. Auxins, either naturally occurring or exogenously given, were thought to be responsible for the maximum fresh weight of roots and were used for root initiation and growth. The current results are consistent with the work by Chalfun *et al*., 2003 [4], shown in fig. Cv. Kaur (2016) [8] in Roxo de Valinhos in Pomegranate CV. Ganesh, shown in lemon cuttings (Deb *et al*., 2009) [26]. The increase in dry weight of roots may be the result of a higher accumulation of dry matter brought on by an increase in the number and length of roots. The current findings concur with those made by Deb *et al*. (2009) [26] in lemon cuttings and by Thota (2012) [16] in fig cv. Poona. These results are also line of findings of Rajkumar *et al*., (2017) [12], Ghani *et al*., (2019) [7], Rathore *et al*., (2020) [13].

Present result indicates that the different IBA levels and bio-inoculants promote the survival percentage of cutting. The significantly highest survival percentage of cutting were recorded in IBA level of 2000 ppm (C_5), in growing media (M_4) Normal soil + PSB + VAM, in treatment combination of IBA 2000 ppm + Normal soil + PSB + VAM (C_5M_4) over rest of the other treatments. The more and healthy root formation by the exogenous application of IBA with growing media is one of the possible reasons for enhancing the survival percentage of cuttings (Patidar, 2018) [11]. The other explanation for this is that higher shoot parameter development enables better growth of the rooted cuttings under field conditions after planting, which accounts for the best field survival (Sharma *et al*. 2009) [20]. Nair *et al.*, (2008) [19] reported maximum survival percentage of cuttings in *Pisticia* spp and *Stewartia pseudo camellia* at IBA. Thus, the roots absorb more water and nutrients and increase the survival rate. The results are also in agreement with the earlier findings of Haider *et al.* (2015) [24], Hakim *et al.* (2016) [25], Manila *et al.* (2017) [22], Rajkumar *et al.* (2017) [12], Seiar (2017) [21], Malaker *et al*. (2019) [23], Rathore *et al*. (2020) [13].

Table 1: The impacts of different IBA levels and bio-inoculants

Treatment	Number of primary roots	Diameter of roots (mm)	Length of Longest root (cm)	Fresh weight of root (g)	Dry weight of root (g)	Survival percentage of cutting At 90 DAP
IBA Levels (A)						
IBA 0 ppm (Control) + Normal soil	2.92	1.32	18.80	2.26	0.83	53.85
IBA 500 ppm	3.96	1.44	22.93	2.92	1.08	65.82
IBA 1000 ppm	4.04	1.45	22.98	3.12	1.09	69.57
IBA 1500 ppm	4.18	1.48	23.54	3.15	1.11	72.62
IBA 2000 ppm	4.30	1.49	23.97	3.31	1.17	76.23
S.Em ±	0.5	0.01	0.41	0.07	0.02	1.18
CD at 5%	0.16	0.03	1.17	0.19	0.05	3.36
Growing media (B)						
Normal soil	3.23	1.36	20.10	2.41	0.84	64.21
Normal soil + PSB	4.25	1.46	23.04	3.13	1.10	69.01
Normal soil + VAM	3.67	1.41	22.38	2.94	1.06	66.50
Normal soil + PSB + VAM	4.37	1.52	24.24	3.32	1.23	70.77
S.Em ±	0.05	0.01	0.37	0.06	0.02	1.05
CD at 5%	0.14	0.03	1.05	0.17	0.05	3.01
Interaction (A × B)						
IBA 0 ppm (Control) + Normal soil	2.57	1.30	17.24	2.17	0.75	43.41
IBA 0 ppm + Normal soil + PSB	3.27	1.33	19.16	2.27	0.78	59.33
IBA 0 ppm + Normal soil + VAM	2.78	1.32	19.33	2.31	0.76	50.00
IBA 0 ppm + Normal soil + PSB + VAM	3.07	1.34	19.45	2.28	1.05	62.67
IBA 500 ppm + Normal soil	3.26	1.36	20.39	2.43	0.84	63.67
IBA 500 ppm + Normal soil + PSB	4.35	1.45	23.60	3.33	1.15	67.11
IBA 500 ppm + Normal soil + VAM	3.57	1.41	23.28	2.56	1.12	64.85
IBA 500 ppm + Normal soil + PSB + VAM	4.64	1.53	24.46	3.36	1.20	67.67
IBA 1000 ppm + Normal soil	3.34	1.37	20.23	2.46	0.86	67.89
IBA 1000 ppm + Normal soil + PSB	4.42	1.47	23.82	3.35	1.17	70.00
IBA 1000 ppm + Normal soil + VAM	3.71	1.42	22.37	3.26	1.13	69.77
IBA 1000 ppm + Normal soil + PSB + VAM	4.67	1.55	25.50	3.40	1.21	70.63
IBA 1500 ppm + Normal soil	3.42	1.38	20.97	2.49	0.87	71.48
IBA 1500 ppm + Normal soil + PSB	4.56	1.51	24.17	3.34	1.18	72.30
IBA 1500 ppm + Normal soil + VAM	4.02	1.43	23.40	3.28	1.14	72.26
IBA 1500 ppm + Normal soil + PSB + VAM	4.71	1.58	25.59	3.51	1.25	74.44
IBA 2000 ppm + Normal soil	3.56	1.40	21.65	2.51	0.88	74.61
IBA 2000 ppm + Normal soil + PSB	4.64	1.52	24.47	3.37	1.21	76.29
IBA 2000 ppm + Normal soil + VAM	4.26	1.44	23.53	3.30	1.15	75.59
IBA 2000 ppm + Normal soil + PSB + VAM	4.74	1.60	26.21	4.05	1.45	78.44
S.Em ±	0.11	0.02	0.82	0.13	0.04	2.35
CD at 5%	0.31	0.6	2.35	0.37	0.11	6.72

Conclusions

Based on the findings of the present investigation, it is concluded that the IBA level IBA 2000 ppm (C_5) proved best over the other IBA levels which significantly superiority over rest of the treatment combinations with respect to rooting and survival. The hard wood cutting treated with 2000 ppm IBA recorded maximum number of primary roots, diameter of root and length of longest root, fresh weight of root dry weight of the root and survival at 90 DAP.

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