The Pharma Innovation Journal 2022; 11(8): 218-221

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(8): 218-221

www.thepharmajournal.com
Received: 15-05-2022
Accepted: 18-06-2022

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Studies on effect of IBA and different environmental conditions on basal stem cuttings of fig (*Ficus carica* L.) in variety Deanna

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Abstract
Fig cultivation in India is having lot of potential and the demand for plants is increasing. Yet no or little work has been done so far on propagation of fig. Hence the present experiment entitled "Studies on effect of IBA and different environmental conditions on basal stem cuttings of fig (*Ficus carica* L.) in variety Deanna" was conducted. Two factors were used in the current experiment at unequal levels, and it was duplicated three times using a Factorial Randomized Block Design. Days to initial sprouting was recorded at 30 DAP and shoot length, the fresh weight and dry weight of the shoot were recorded at 90 DAP. The results showed that, the minimum days to initial sprouting, the maximum shoot length, the fresh weight of the shoot, and the dry weight of the shoot were recorded in IBA @ 2000 ppm under shade net conditions (G_2E_1). While control under open conditions (G_5E_3) took the greatest number of days to initiate sprouting, the shortest shoot length, and the lowest fresh and dry weight of shoot.

Keywords: Fig, days to initial sprouting, shoot length, fresh weight and dry weight of shoot

Introduction
The fruit crop fig belongs to the family Moraceae with chromosome number (2n = 26). Fig is a gynodioecious, deciduous and subtropical tree, originated in east Mediterranean region from where its cultivation expanded to the whole of the Mediterranean region, both for its fruit and as an ornamental plant. It is known as 'Anjeer' in Hindi.

In India, it is considered to be a minor fruit crop and the common (edible) figs are primarily grown for commercial purposes in western Maharashtra, Gujarat, Uttar Pradesh (Lucknow and Saharanpur districts), Karnataka (Bangalore, Mysore, Bellary, Chitradurga, and Srirangapatna districts), Tamil Nadu (Coimbatore district), and parts of Andhra Pradesh (Anantapur district) and Telangana (Rangareddy district).

Fig is propagated from seed, cutting, layering, grafts and by tissue culture techniques. It is most commonly propagated by cuttings to ensure true to type clonal planting material. As compared to other methods of propagation, fig is commercially propagated by stem cutting. Out of these methods, propagation through hard wood cutting is relatively easy and a cheap method of propagation.

The most common growth regulators, auxins, are required for rooting because they encourage the production of ethylene, which is advantageous to rooting. Indole Butyric Acid (IBA), as compared to NAA, IAA, and 2,4-D, is the most efficient rooting auxin (Hartman and Kester, 2015) [7]. The plant propagation medium's active component, IBA, is used to encourage adventitious roots in stem cuttings. These cuttings should be placed in the best growing conditions possible to provide a favorable environment for cutting rooting.

Material and Methods
The experiment was conducted at College of Horticulture, Dr. Y. S. R. Horticultural University, Venkataramannagudem, West Godavari District. It was conducted during 2021-2022. Experiment laid out in Factorial Randomized Block design (FRBD) with 2 factors. Growth Regulators concentrations (5 levels: G_1: IBA @ 1500 ppm, G_2: IBA @ 2000 ppm, G_3: IBA @ 2500 ppm, G_4: IBA @ 3000 ppm, G_5: Control) and Environmental conditions (3 levels: E_1: Shade net E_2: Mist chamber E_3: Open condition) with 15 treatment combinations replicated thrice. For experimental purpose cuttings were collected from the farmer's field. A slant cut was given at the basal end of the cuttings to expose maximum absorbing surface area for

induction of effective rooting. The basal parts (1-2 cm depth) of the cuttings were dipped in IBA solutions (at 1500, 2000, 2500,3000 ppm and control) for 5 seconds as per treatments, subsequently the cuttings were air dried for 5 minutes. The treated cuttings were planted in polybags containing rooting media i.e., red earth, farm yard manure and vermicompost in the ratio of 2:1:1. The rooting media was pressed gently around the base of the cutting to hold the cutting in right place, to eliminate air pockets and to make sure that the base of the cutting was in good contact with the moist rooting media. The terminal open ends of cuttings were smeared with blitox paste to avoid fungal infections. The polybags were kept under shade net, mist chamber and in open condition.

Results and Discussion

Days to initial sprouting

According to IBA concentrations, various environmental factors, and their interactions, there is a large difference in days to initial sprouting, as shown in table 1

Among the growth regulator treatments, significant differences were noticed for days taken to initial sprouting. The basal stem cuttings when treated with IBA @ 2000 ppm (G_2) showed minimum number of days to initial sprouting (10.57 days) compared to rest of the treatments and maximum number of days to initial sprouting (14.50 days) was recorded in control (G_5). Among environmental conditions, when compared to the cuttings in the mist chamber (E_2), (12.12 days), and open field conditions (E_3), (12.95 days), the basal stem cuttings under shade net conditions (E_1) recorded the shortest number of days to initial sprouting (11.52 days). Among the interaction effects, significantly minimum number of days to initial sprouting (9.36 days) was observed when the cuttings were treated with IBA @ 2000 ppm in shade net conditions (G_2E_1), while maximum number of days to initial sprouting (12.95 days) was noticed with control in open field conditions (G_5E_3) at 30 DAP.

Earliness in sprouting might be due to the fact that there was better utilization of stored carbohydrates and other factors with the help of growth regulators (Chandramouli, 2001) [3]. Ismail and Hussain (2007) [8] in fig, Sivaji *et al.* (2013) [15] in fig, Ajay *et al.* (2021) [1] in fig, and Amini *et al.* (2021) [2] in fig all noted similar results. Climate-friendly shade net conditions offer favourable circumstances for early sprouting. In comparison to mist and open conditions, Mahesh *et al.* (2019) [11] in ber, and Ajay *et al.* (2021) [1] in fig all saw identical outcomes when the plants were planted in shade net conditions.

Shoot length (cm)

The data pertaining to the shoot length as influenced by IBA concentrations, different environmental conditions and their interaction effect are depicted in Table 2.

There was significant effect of growth regulators on the shoot length. Maximum shoot length (39.34 cm) was found with IBA @ 2000 ppm (G_2), and minimum shoot length (34.57 cm) was observed with control (G_1). Different environmental conditions recorded significant effect on shoot length. Shade net (E_1), recorded highest length of shoot (40.49 cm), followed by mist chamber (E_2), (13.17) and the lowest (32.94 cm) was observed in open condition (E_3). The interaction of growth regulators and environmental conditions was significant on shoot length. Maximum shoot length (44.63 cm) was recorded with IBA @ 2000 ppm under shade net conditions (G_2E_1), whereas as lowest value of shoot length (31.23 cm) was noticed with control under open field conditions (G_5E_3).

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. Findings corroborates with the results obtained by Ismail and Hussain (2007) [8] in fig, Sivaji *et al.* (2013) [15] in fig and Singh *et al.* (2014) [14] in mulberry. An increase in the vegetative growth of the fig cuttings in shade house as compared to other growing conditions is supported by the results of Kuntagol (2017) [10] who reported that shade house condition recorded maximum shoot length which was superior over open conditions.

Fresh weight of the shoot (g)

Data enumerated in Table 3 with respect to fresh weight of shoot of fig cuttings after 90 DAP revealed that growth regulators, growing conditions and their interaction effect had significant effect on fresh weight of shoot.

Among the different concentrations of growth regulators, maximum fresh weight of shoot (46.66 g) was recorded with IBA @ 2000 ppm (G_2) and the minimum fresh weight (31.61 g) was recorded with control (G_1). Among the growing conditions, maximum fresh weight of shoot (49.80 g) was observed under shade net (E_1), while minimum fresh weight (33.35 g) was recorded under open condition (E_3), followed by mist chamber (E_2), (39.31 g). The interaction effect of growth regulators and environmental conditions revealed that maximum fresh weight (56.65 g) of shoot was found with IBA @ 2000 ppm under shade net (G_2E_1). However, lowest fresh weight of shoot (28.07 g) was noticed with control under open condition (G_5E_3).

The application of auxins increased the shoot diameter, shoot length and number of leaves resulting in higher fresh weight of shoots which might be due to the auxins which increased the permeability of cell for moisture, nutrients and resulted in the enlargement of cell causing more growth of plants parts (Kaur *et al.*, 2018) [9] in fig. More humidity, optimum light intensity and low evapotranspiration in shade house as compared to mist chamber and open condition helped in increasing the number of sprouts, number of leaves and vegetative parts which results in higher fresh weight of the shoot. The similar results were reported by Ratnamala *et al.* (2013) [12] in phalsa, Shiny *et al.* (2018) [13] in passion fruit Mahesh *et al.* (2019) [11] in ber and Ajay *et al.* (2021) [1] in fig.

Dry weight of the shoot (g)

Data related to the dry weight of shoot effected by IBA concentrations, environmental conditions and their interaction effect are presented in table 4.

Significant differences were noticed among treatments for the dry weight of shoot. The maximum dry weight of shoot (28.81 g) was found in the fig basal stem cuttings treated with IBA @ 2000 ppm (G_2) and the minimum dry weight (18.38 g) (G_5) was observed in control. Fig basal stem cuttings under shade net (E_1) showed significantly maximum dry weight of shoot (27.30 g), while the minimum dry weight (20.90 g) was observed in open conditions (E_3). The interaction between IBA concentrations and environmental conditions was found to be significant with respect to the dry weight of shoot.

Significantly maximum dry weight of shoot (32.49 g) was observed when fig basal cuttings were treated with IBA @ 2000 ppm under shade net conditions (G_2E_1), while minimum dry weight (15.93 g) was noticed in control under open condition (G_5E_3).

It is generally accepted that auxins have a certain role in the rooting initiation and therefore leads to control growth and development in plants, including lateral root initiation, root gravity response and other vegetative growth parameters such as vegetative dry weight (g). The similar results were reported by Harith *et al.* (2015) [6] in fig, Patel *et al.* (2017) in fig, Feraz *et al.* (2018) in fig, Ajay *et al.* (2021) [1] in fig. Significant difference among the growth regulator treatment and environmental conditions might be due to the favourable climate and increase in the production of the leaves and leaf area which ultimately increased the photosynthesis, relative growth rate and growth of lateral branching of shoots, which finally resulted in an increase in the dry biomass of the shoots (Deb *et al.*, 2009) [4].

Table 1: Effect of IBA and environmental conditions on days to initial sprouting in fig var. Deanna

Growth regulators(G)	**Environmental conditions (E)**			
	30 DAYS			
	E_1	**E_2**	**E_3**	**Mean (G)**
G_1	11.34	11.73	12.60	11.89
G_2	9.36	10.65	11.69	10.57
G_3	10.79	11.36	12.30	11.48
G_4	11.77	12.36	13.53	12.55
G_5	14.35	14.50	14.65	14.50
Mean (E)	11.52	12.12	12.95	
Factors	SE m±		CD @ 5%	
Growth regulators(G)	0.16		0.47	
Environment (E)	0.12		0.36	
G x E	0.28		0.81	

Table 2: Effect of IBA and environmental conditions on shoot length (cm) in fig var. Deanna

Growth regulators(G)	**Environmental conditions (E)**			
	90 DAYS			
	E_1	**E_2**	**E_3**	**Mean (G)**
G_1	52.37	43.78	35.75	43.96
G_2	56.65	45.02	38.32	46.66
G_3	49.43	45.94	33.89	43.09
G_4	52.92	32.67	30.74	38.77
G_5	37.62	29.15	28.07	31.61
Mean (E)	49.80	39.31	33.35	
Factors	SE m±		CD @ 5%	
Growth regulators(G)	0.51		1.50	
Environment (E)	0.39		1.16	
G x E	0.89		2.60	

G_1: IBA @ 1500 ppm	E_1: Shade net
G_2: IBA @ 2000 ppm	E_2: Mist chamber
G_3: IBA @ 2500 ppm	E_3: Open condition
G_4: IBA @ 3000 ppm	
G_5: Control	

Table 3: Effect of IBA and environmental conditions on fresh weight of shoot (g) in fig var. Deanna

Growth regulators(G)	**Environmental conditions (E)**			
	90 DAYS			
	E_1	**E_2**	**E_3**	**Mean (G)**
G_1	31.16	25.69	22.96	26.60
G_2	32.49	27.19	26.75	28.81
G_3	28.14	24.06	21.00	24.40
G_4	24.18	19.01	17.88	20.35
G_5	20.53	18.67	15.93	18.38
Mean (E)	27.30	22.93	20.90	
Factors	SE m±		CD @ 5%	
Growth regulators(G)	1.85		0.64	
Environment (E)	1.43		0.49	
G x E	3.21		1.10	

Table 4: Effect of IBA and environmental conditions on dry weight of shoot (g) in fig var. Deanna

Growth regulators(G)	Environmental conditions (E)			
	30 DAYS			
	E_1	E_2	E_3	Mean (G)
G_1	43.80	42.00	29.23	38.34
G_2	44.63	39.73	33.67	39.34
G_3	38.33	37.27	36.70	37.43
G_4	38.33	34.27	33.87	35.49
G_5	37.33	35.13	31.23	34.57
Mean (E)	40.49	37.68	32.94	
Factors	SE m±		CD @ 5%	
Growth regulators(G)	0.29		0.84	
Environment (E)	0.22		0.65	
G x E	0.50		1.45	

Conclusion

Experiment revealed that the cuttings treated with IBA @ 2000 ppm in shade net conditions (G_2E_1), recorded less number of days to initial sprouting (9.36 days), maximum shoot length (44.63 cm), maximum fresh weight (56.65 g) and dry weight of the shoot (32.49 g).

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