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EFFECT OF IBA AND NAA ON THE ROOTING AND VEGETATIVE GROWTH OF HARDWOOD CUTTINGS IN COMMON FIG (*FICUS CARICA* L.)

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ABSTRACT

The present investigation was carried out at Horticultural Nursery of Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi during the year 2021, in order to study the effect of different levels of IBA and NAA on the rooting and vegetative growth of hard wood cutting in common fig. The experiment was laid out in Completely Randomized Design in eleven treatments with three replications. The treatments comprised of IBA (500, 1000,1500, 2000, 2500 ppm) and NAA (500, 1000,1500, 2000, 2500 ppm) by quick dip method along with control. The result indicated that IBA (2500 ppm) was found to be best in terms of early sprouting (10.26 days), Sprouted cutting (88.84 %), survival percentage (87.29 %), number of roots cutting^{-1} (12.35 and 20.86), length of longest root cutting^{-1} (23.01 cm), length of shoot (12.37 cm and 26.19 cm), shoot diameter (1.59 cm), number of shoot cutting^{-1} (1.73 and 2.06) , fresh weight of roots cutting^{-1} (12.72 g), dry weight of roots cutting^{-1} (4.75 g) fresh weight of shoot cutting^{-1} (32.73 g), dry weight of shoot cutting^{-1} (9.19 g), number of leaves (8.77 and 11.40), leaf size *i.e.* length and width (14.20 cm and 13.56 cm), fresh weight of plant biomass (45.46 g) and dry weight of plant biomass (13.94 g).

Key words : Fig (*Ficus carica* L.), IBA, NAA, Hardwood cutting.

Introduction

Fig (*Ficus carica* L.) is one of the traditional Mediterranean fruit species. The common fig belongs to family *Moraceae* and is known as 'Anjeer' in hindi which has over 1400 species classified into 40 genera (Watson and Dallwitz, 2004). In 2018, world production of raw figs was about 1.14 million tons, led by Turkey (with 27% of the world total), Egypt, Morocco and Algeria as the largest producers collectively accounting for 64% of the total fig production (FAO, 2018). The area under fig cultivation in India is about 5600 hectares with a production of about 13,802 thousand tons and an average productivity of 12.32 t/ha (Anonymous, 2018). In India, fig cultivation is done in Maharashtra, Gujarat, Karnataka, Uttar Pradesh and Tamil Nadu. It is minor fruit crop in Northern India. Fig fruit represents an important constituent of the diet, because of its nutri-medico value. Its fruit is pear shaped and is botanically called as syconium (multiple fruit). The fruits can be consumed either in fresh or dried form. The fruitshave high calorie, protein, calcium, iron and fibre content. It has a nutritive index of 11, as against 9 for apple and 8 for raisin. The total sugar content of fresh fig is 16% and that of dried fig is 52% (Gani *et al.*, 2018). However, majority (about 80%) of the fruit is consumed in the dried form.

Fig is propagated from seed, cutting, layering, grafts and by tissue culture techniques. Out of these methods, propagation through hard wood cutting is relatively easy and a cheap method of propagation (Singh and Bahadur, 2015). Through hard wood cutting vigorous plants can be raised in less than a year. Under north Indian conditions cuttings are prepared when plants have shed their leaves in winter season and become dormant. The use different concentration of auxins on the cuttings has made it possible to improve the % and rate of success of the cuttings, reduction in time of initiation of cuttings and better rooting in fig (Siddiqui and Hussain, 2007). However, the success is also based on various other factors including the climatic conditions of the region. Though fig cultivation in Bundelkhand region is having lot of potential and the demand for plants is increasing, yet no or very little work has been done so far on propagation of fig under Bundelkhand region. The identification of auxins and their concentrations will help in enhancing the survival % even more and thus meeting demand of the fig growing farmers of Bundelkhand region. Keeping these points in view, the present research work was carried out to study the effectof IBA and NAA on the rooting and vegetative growth of hardwood cuttings in common fig under Bundelkhand region.

Materials and Methods

This experiment was conducted in the Horticultural Nursery, Rani Lakshmi Bai Central Agricultural University (RLBCAU) during March to June, 2021. The experiment was carried out by planting the hardwood cutting of fig in black polythene bags of size 25×15 cm. Polythene bags were filled with potting mixture prepared by mixing of one part of soil, vermicompost and neem cake each in 1:1:1 proportion. The cuttings of fig cv. Dinkar were selected from 4-year-old healthy, moderately vigorous grown mother plant, grown in the model orchard of Department of fruit science, RLBCAU, Jhansi.Hardwood cuttings were prepared from one year old shoot having 15-20 cm length and 1.5-2 cm diameter. The basal portion of mature stem was used as hardwood cutting. Each cutting had 4-5 nodes. Cuttings were prepared by giving straight cut at basal (bottom) usually just below a node and slant cut was given on the top 1.3 to 2.5 cm above the bud. The treatments consisted of different concentrations of IBA (500, 1000, 1500, 2000, 2500 ppm), NAA (500, 1000, 1500, 2000, 2500 ppm) and distilled water without growth regulator as control. The quick dip method (10 sec) was used to treat the cutting with auxin solution. In this method, the basal end of the prepared cuttings was kept standing in solution of auxin to a depth of 3 to 3.5 cm for 10 seconds and were allowed to dry for 20 minutes and then planted in polybags. Twenty one cuttings for each treatment were treated with auxin solution and repeated thrice in Completely Randomized Design. After 60 and 90 days of planting, the cuttings were uprooted carefully from the polybag without damaging the roots and washed under tap water. The survival % of cutting was recorded 90 days after planting.

Results and Discussion

On the perusal of data Table 1, it is evident that IBA and NAA significantly influenced the growth parameters. First sprout appearance with significantly earliest days for first sprouting of cutting minimum (10.26 days) in treatment 2500 ppm IBA, whereas maximum days required for initiation of sprouting (17.80 days) was Control. Significantly highest % of sprouted cutting (88.84%) was recorded with 2500 ppm IBA. Significantly maximum survival % (87.29%) was observed in the treatment 2500ppm IBA followed by 2000ppm IBA(81.10%) and 1500ppm IBA (80.90%), all of these treatments however, were at par to each other but superior over rest of the treatments including control which recorded minimum survival % (52.33%). Hardwood cutting may have contained more stored carbohydrate which in turn might have increased root number and root length with IBA treatment which in developed effective root system and increased the uptake of nutrients and 3water in cutting (Patel and Patel, 2018). This result in are in conformity with those reported by Mewar et al., (2018) in wild fig, Tanwar *et al*. (2020) in pomegranate and Gayathiri and Vijayaraj (2020) in guava. The number of roots cutting^{-1} increased significantly with increase in the concentration of auxin irrespective of the type of auxin. At 60 days after planting of cutting, highest number of roots cuttings^{-1} (12.35) was recorded with 2500 ppm IBA, which was significantly superior over all the other treatment whereas, at 90 days after planting of cutting, highest roots cutting^{-1} (20.86) was also observed in the treatment 2500 ppm IBA, which however, was at par with 2000 ppm IBA (19.80), but superior over all the other treatments. The maximum length of root was observed in 2500 ppm IBA (23.01 cm) which was at par with treatments 2000ppm IBA, 1500ppm IBA and 1000ppm IBA, but significantly superior to rest of the treatments. Increase in number of roots cuttings^{-1} might be due to the positive effect of auxin which may have induced an enhanced rate for root initiation and subsequent production of more number of roots (Hiral, 2017). The results are in conformity with those reported by Patel *et al*. (2017), Patel and Patel (2018) in fig and Ghosh *et al*. (2017) in Phalsa. The fresh weight of root recorded at 90 days revealed significant difference in fresh weight of root as influenced by different concentration of IBA and NAA treatment and increased with increasing concentration of auxin. Application of 2500 ppm IBA resulted in significantly maximum fresh weight of roots (12.72 g). Similarly, the dry weight of root was significantly influenced by different concentration of auxinat 90 days after planting. Maximum dry weight of root (4.75 g) was

Table 1: Effect of IBA and NAA on root parameter of fig cutting cv. Dinkar.

Treatment details	Number of days for sprouting	Percentage of sprouted cutting	Survival percentage (%)	Number of roots cutting^{-1}		Length of longest root cutting^{-1} (cm)	Fresh weight of root cutting^{-1} (g)	Dry weight of root cutting^{-1} (g)
				60DAP	90 DAP			
T_1 2500ppm IBA	10.26	88.84	87.29	12.35	20.86	23.01	12.72	4.75
T_2 2000ppm IBA	11.93	83.73	81.10	11.31	19.80	21.97	11.75	4.30
T_3 1500ppm IBA	12.80	79.89	77.70	10.91	17.73	21.78	11.34	4.69
T_4 1000ppm IBA	14.33	76.22	80.90	9.92	14.13	21.68	11.59	4.26
T_5 500ppm IBA	16.26	71.39	69.80	8.75	12.20	18.62	9.10	3.33
T_6 2500ppm NAA	12.80	80.19	74.53	9.41	14.13	17.95	8.70	3.66
T_7 2000ppm NAA	13.40	74.34	66.63	8.43	11.80	16.15	7.62	2.95
T_8 1500ppm NAA	14.20	70.02	61.86	8.05	11.93	14.75	6.66	2.45
T_9 1000ppm NAA	15.00	64.70	58.60	7.22	11.00	12.49	6.39	1.66
T_{10} 500ppm NAA	17.33	61.62	55.40	6.82	11.00	12.07	5.88	1.40
T_{11} Control	17.80	56.14	52.33	5.90	10.53	10.44	4.90	0.96
S.Ed	0.44	1.22	2.59	0.26	0.47	0.51	0.23	0.23
CD (P=0.05)	1.30	3.60	7.66	0.77	1.38	1.53	0.69	0.69

observed in the treatment 2500ppm IBA, followed by 2000ppm IBA (4.30 g), 1500ppm IBA (4.69) and 1000ppm IBA (4.26) all of which however, were at par but superior to other treatments. The dry weight depends upon the fresh weight also and therefore, a similar trend was observed for dry weight as in fresh weight. The results are in line with the finding of Khapare *et al.* (2012) and Sivaji *et al*. (2014) in fig.

The data related to the length of shoot of cutting at 30, 60 and 90 days after planting is presented in Table 2. The length of shoot increased with increase in level of auxin. At 30 days after planting, significantly maximum shoot length (6.06 cm) was observed with 2500 ppm IBA which however, was at par with 2000 ppm IBA (5.27 cm). Similar trend was observed at 60 and 90 days after planting. At 60 days after planting, significantly maximum length of shoot (12.37 cm) was recordedwith 2500 ppm IBA, which was statistically similar to application of 2000ppm IBA but superior to all the other treatments. Whereas, at 90 days after planting maximum length of shoot (26.19 cm) was found to be significantly superior with 2500 ppm IBA at par with 2000 ppm IBA (24.43cm). Maximum shoot diameter (1.59 mm) was observed in the treatment 2500 ppm IBA, which however, was at par with treatment 2000 ppm IBA followed by 1500 ppm IBA. Increment in shoot diameter might be due to maximum number of leaves in T_1 and vigorous root system, which might have resulted in more carbohydrate assimilation and also enhanced the absorption of minerals and water from the soil. Whereas, significantly maximum number of shoots (1.73) was observed in the treatment 2500 ppm IBA, which was superior to all the other treatments including control which recorded minimum number of shoots (0.667) at 60 days after planting of cutting. Similarly, at 90 days after planting of cutting, significantly, maximum number of shoots (2.06) was observed in the treatment T_1 (2500 ppm IBA). Maximum number of shoot formation with higher treatment of auxins might be due to the fact that auxins help in formation of vigorous root system which may have increased the nutrient uptake under the influence of IBA (Hiral *et al*., 2017). Variation in number of shoot due to different concentrations of IBA and can be caused by variation in mobilization of auxin within cuttings, their effect on hydrolysis of reserve food material into reducing and non-reducing sugars, phenolic compounds and metabolites (Patel *et al*., 2017). Highest fresh weight of shoots (32.73g) was found in the treatment 2500 ppm IBA which statistically similar with treatments 2000 ppm IBA (31.95 g) followed by 1500 ppm IBA(30.81g). However, lowest fresh weight of shoot (14.78 g) was observed in control.

Fig. 1 : Effect of IBA on rooting of cutting in fig (*Ficus carica* L.).

T_1 T_2 T_3 T_4 T_5

Fig. 2 : Effect of IBA on rooting of cutting in fig (*Ficus carica* L.) as compared to control.

T_6 T_7 T_8 T_9 T_{10} T_{11}

Fig. 3 : Effect of NAA on rooting of cutting in fig. (*Ficus carica* L.) as compared to control.

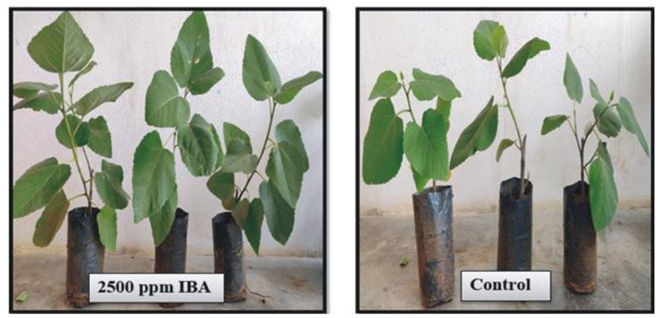

Fig. 4 : Effect of IBA on number of leaves in fig. (*Ficus carica* L.) as compared to control.

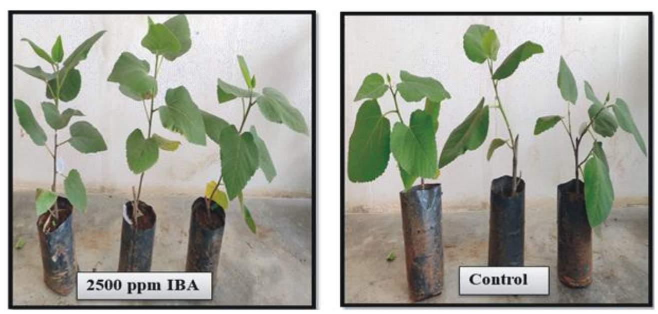

Fig. 5 : Effect of IBA on length of shoot in fig (*Ficus carica* L.) as compared to control.

On the perusal of data collected in respect of dry weight of shoot at 90 days after planting presented in Table 2, it is observed that, the dry weight of shoot was significantly influenced by different concentration of auxin and it consistently increased with increase in concentration of auxin. The maximum dry weight of shoot (9.19 g) was found to be significantly superior in the treatment 2500ppm IBA. However, the meandry weight of shoot ranged from 9.19to 5.65g. Similar observation have been made earlier by Kaur *et al*. (2017) in fig and Sujin *et al*. (2020) in guava.

At 30 days after planting, the maximum number of leaves cutting^{-1} (5.40) was noted best on application of 2500 IBA ppm having at par effect with 2000 IBA (5.26). Similar trend was observed at 60 days after planting wherein, the maximum number of leaves cutting^{-1} (8.77) was observed in the treatment 2500 IBA ppm, however, at par with treatment 2000 ppm IBA (7.46). Similarly, at 90 days after planting, maximum number of leaves cutting^{-1} (11.40) was observed in the treatment 2500 IBA ppm, which was also at par with treatment 2000 IBA (9.53). The data revealed that significant difference was observed for length and width of leaves at 90 days after planting of cutting due to the effect of different concentration of IBA and NAA. Maximum length (14.20 cm) and width of leaves (13.56 cm) was found in the

Table 2: Effect of IBA and NAA on shoot parameter of fig cutting cv. Dinkar.

Treatment details	Shoot length (cm)			Shoot diameter (cm)	Number of shoot cutting^{-1}		Fresh weight of shoot cutting^{-1}(g)	Dry weight of shoot cutting^{-1} (g)	Number of leaves cutting^{-1}			Leaf size (length and width in cm)		Fresh plant biomass (g)	Dry plant biomass (g)
	30 DAP	60 DAP	90 DAP		60 DAP	90 DAP			30 DAP	60 DAP	90 DAP	Length (cm)	Width (cm)		
T_1 2500ppm IBA	6.06	12.37	26.19	1.59	1.73	2.06	32.73	9.19	5.40	8.77	11.40	14.20	13.56	45.46	13.94
T_2 2000ppm IBA	5.27	11.88	24.43	1.50	1.40	1.86	31.95	8.39	5.26	7.98	9.53	13.90	13.32	43.70	12.70
T_3 1500ppm IBA	5.09	9.74	22.74	1.48	1.33	1.60	30.81	7.63	4.50	7.46	9.23	13.24	12.92	42.16	12.38
T_4 1000ppm IBA	4.85	8.74	21.31	1.22	1.13	1.46	28.36	7.38	3.87	6.73	8.99	13.24	12.66	39.95	11.64
T_5 500ppm IBA	3.78	7.95	21.20	1.10	1.06	1.20	25.31	7.04	3.36	5.96	8.46	12.34	11.93	34.41	10.37
T_6 2500ppm NAA	4.31	11.19	20.31	1.49	1.46	1.80	29.11	6.82	4.11	5.73	9.06	13.56	13.02	37.82	10.49
T_7 2000ppm NAA	3.61	10.82	18.34	1.13	1.13	1.53	22.27	6.70	3.86	5.00	8.80	13.03	12.60	29.90	9.66
T_8 1500ppm NAA	3.54	8.92	17.41	0.91	1.20	1.46	25.74	6.76	3.52	3.93	8.46	12.74	12.53	32.40	9.21
T_9 1000ppm NAA	3.22	8.03	16.36	0.83	1.06	1.40	21.02	6.61	2.94	2.96	7.86	12.04	11.74	27.42	8.27
T_{10} 500ppm NAA	3.09	7.30	16.22	0.76	0.80	1.40	21.08	6.34	2.74	2.90	8.73	12.06	11.84	26.96	7.74
T_{11} Control	3.10	6.21	14.30	0.62	0.66	1.13	14.78	5.65	2.57	2.98	6.93	11.32	10.91	19.68	6.61
S.Ed	0.27	0.36	0.78	0.81	0.08	0.08	1.07	0.21	0.24	0.21	0.40	0.31	0.35	0.70	0.33
CD (P = 0.05)	0.81	1.08	2.30	0.10	0.24	0.25	3.17	0.63	0.73	0.64	1.19	0.93	1.03	3.17	0.98

treatment T_1 (2500 ppm IBA) at 90 days after planting, which was found at par with treatment T_2 and T_3 for length of leaves while for width it was found at par with majority of the treatments but significantly superior over control. Increase in leaf number and size might be due to the vigorous rooting induced by the growth regulators which help cutting to absorb more water and nutrients and thereby producing more leaves. The result in are in conformity with those reported by Singh (2014) in pomegranate, Dahale *et al*. (2018) in fig and Ghosh *et al*. (2017) in Phalsa.

Plant biomass was significantly influenced due to the various treatment of different concentration of auxin like IBA and NAA. The highest fresh weight of plant biomass (45.46g) was found in the treatment 2500 ppm IBA followed by 2000 ppm IBA (43.70 g) which were at par with each other. The plant biomass (dry weight) at 90 days after planting presented in Table 2, shows significantly maximum dry weight of plant biomass (13.94 g) on application of 2500 ppm IBA whereas, the mean of fresh weight plant biomass varied from 13.94to 6.61g at 90 days after planting of cutting. Cuttings treated with IBA had also resulted in increased the number of shoots and roots which ultimately help in increase in fresh weight of shoots and roots (Hiral *et al*., 2017). The results are in close conformity with those reported by and in Patel *et al*. (2020) in Pomegranate.

Conclusion

On the overall assessment of the results of present investigation, it may be inferred that, the application of 2500 ppm IBA was found to be best for early and faster root and shoot growth in term of percentage of sprouted cuttings, survival %, number of shoots, shoot diameter, number of leaves per cutting, fresh and dry weight of shoot and root of cuttings in Fig under Bundelkhand conditions.

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