

EFFECTS OF IBA AND NAA ON INTEGRATED ROOT DEVELOPMENT IN AERIAL OFFSHOOTS OF *PHOENIX DACTYLIFERA* L.

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Abstract

Experiment was conducted to develop rooting ability in aerial offshoots of Aseel and Karbalain cultivars of date palm during two successive years (2014-2015) using roots promoting hormones. The results revealed that significantly higher (35.90 cm) offshoot base diameter was in the Aseel variety treated with NAA @ 1000 mg/l. However the maximum (21.33) number of roots per offshoot and higher (9.20) number of lateral roots per root were recorded in the Karbalain variety treated with IBA @ 2000 mg/l as compared to the rest of treatments. The significant results for maximum (1.53 cm) root diameter, fresh weight (10.57 g) and dry weight (2.43 g) were obtained by Aseel variety treated with IBA @ 2000 mg/l. The higher water content percentage (89.17) was observed in Karbalain variety treated with NAA @ 1000 ppm, whereas the control produced least water content percentage (28.23) in the same variety. To sum up the rooting characters using IBA @ 2000 mg/l by injection in the aerial offshoots of Aseel and Karbalain varieties of Date palm was proved as significantly better in comparison with rest of the treatments.

Introduction

Date palm (*Phoenix dactylifera* L.), a dioecious and monocotyledon species belonging to Arecaceae is a dominant fruit crop in arid and semi-arid regions of the world. It possesses critical economic and ecological importance in many countries of the Middle East and North Africa (Al-Khayri 2001, Asemota *et al.* 2007). It has multipurpose importance such as food, medicine and ornamental plant. Pakistan is one of the leading dates' producers in the world. The dates are third most important fruit in Pakistan.

There are three techniques to propagate date palm such as seed propagation, offshoot propagation (traditional methods) and recently developed tissue culture techniques. Date palm is propagated sexually through seeds and asexually through offshoots (Alkhateeb and Ali-Dinar 2002). Owing to heterozygosity and dioecious nature of the date palm, seed propagation is not suitable because it may produce off type plants. Offshoots are normally used in propagation due to their ability of root regeneration (Chao and Krueger 2007 and Rahmana and Rakhodaei 2013). Generally two types of offshoots occur on a date palm tree: the lower and the upper. It is believed that lower offshoots are more physiologically active than the upper. In fact, the upper offshoots have fewer carbohydrates than the lower offshoots. Therefore, they may result in low root production. Development of the root structure plays critical role in survival and growth of the date palm. Most of the palm species produce adventitious roots that originate from the root initials present on trunk (Day *et al.* 2009). The transport capacity of root is linked with root aging and associated with radial growth resulting in the increase of xylem vessels and diameter of largest vessels (Kumar *et al.* 2007, Martinez *et al.* 2002). Since application of root promoting substances

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helps to get profuse roots within a short time (Bose *et al.* 1997), synthetic hormones like IBA and NAA are commonly used to promote root development in asexual propagation. In order to promote rooting, base of the offshoot should be in contact with moist soil for at least 12 months before removal. For this purpose high offshoots, boxes or plastic bags/Hessian material could be fastened around the base of the offshoot.

The soil compaction affects physical properties which in turn can affect distribution and growth of the palm roots (Yahya *et al.* 2010). Hati *et al.* (2006) reported that the medium containing mixture of sand, silt and FYM (1 : 1 : 1) by volume, improve soil physical conditions such as moisture retention capacity and aggregate soil stability, crop water use efficiency. That type of medium was reported to improve soil fertility, crop performance and yield (Kaur *et al.* 2005, Bokhtiar and Sakurai 2005).

It is a common practice in Pakistan that aerial offshoots of date palm are thrown and wasted. The most serious impediment in the expansion of this crop is unavailability of good quality planting materials to increase area under crop. Realizing the scarce research work conducted on the rooting of aerial (rootless) offshoots, the present study was, therefore, designed to stimulate and improve the rooting efficiency of aerial offshoots of commercial date palm varieties through the application of synthetic hormones like IBA and NAA.

Materials and Methods

Date palm aerial offshoots (attached with mother plant) of cv. Aseel and Karbalain approximately 3 years old, were selected. The mother plants (7 years old) of each cultivar were of the equal in age and uniform in vigour. They were 7 years old at the start of this study. They were free of insects' damage and diseases. The hormone IBA and NAA were applied by injection in root zone of aerial offshoots attached in mother plant under field conditions at Date palm research station Kot Diji, Khairpur, Sindh, Pakistan. The treatments were as follows: Control, IBA @ 1000 mg/l, IBA @ 2000 mg/l, IBA @ 3000 mg/l, NAA @ 1000 mg/l, NAA @ 2000 mg/l, NAA @ 3000 mg/l (prepared according to the formulae as described by Hartman and Kester, 1975). Next the offshoot bases were covered with prepared media and gunny bags which were securely fastened with plastic rope.

All other cultural practices like irrigation, weeding, insect/pest and disease control were done regularly to all experimental plants. The data were recorded as per schedule and after 12 months, offshoots were opened and data were obtained. The dry weight of root was recorded after drying it around 80°C for 24 hrs in drying vacuum oven (Model: No: Mino 3055 Gen lab Thermal eng). The percentage of water content for roots was calculated by using following formula:

$$\text{Water content \%} = \frac{\text{Fresh weight} - \text{dry weight}}{\text{Fresh weight}} \times 100$$

The growing medium prepared by mixing sand, farmyard manure and garden soil in the ratio of (1 : 1 : 1) by volume was analyzed for soil texture by Bouyoucos Hydrometer method, pH of 1 : 5 soil-water extract by pH meter, EC of 1:5 soil-water extract by EC meter and organic matter by Walkley-Black method (Walkley and Black 1934). The growing medium was sandy loam in texture with 75% sand, 16% clay and 7.5% silt content. The soil was non-saline with EC 1.98 dS/m and alkaline in nature with pH 7.8, the organic matter content of the growing medium was 0.75%. This experiment included six treatments. Each treatment was replicated three times. Experiment was laid out following completely randomized block design. The following observations were recorded during both years: offshoot base diameter (cm), number of roots per

offshoot, number of lateral roots per root, root length (cm), root diameter (cm), fresh weight (g), dry weight (g) and root water content %. Thereafter, the data were tabulated and subjected to the proper statistical analysis of variance using LSD test. Recognizing the significant differences among the various treatment means, according to the method outlined by Gomez and Gomez (1985) and Steel and Torrie (1980) was applied.

Results and Discussion

It is revealed from the results presented in Table 1 that there were great differences in rooting response by offshoots of date palm. Highly significant results were observed among mean values of different parameters. The maximum 35.90 cm offshoot base diameter was recorded in Aseel cultivar. However, the Karbalain cultivar was recorded minimum (31.77) cm offshoot base diameter. The highest value (21.33) was recorded in number of roots per offshoot under the IBA @ 2000 mg/l by Karbalain cultivar. However, 19.00 number of roots were produced by same cultivar under the concentration of NAA @ 2000 mg/l. The offshoots kept under control, reflected poor rooting ability. IBA application @ 2000 mg/l produced 9.20 number of lateral roots per offshoot followed by 7.96 using NAA @ 2000 mg/l in the same Karbalain cultivar.

Differences among the root length also remained highly significant. In this case, Aseel cultivar produced highest (17.60) cm root length where IBA @ 2000 mg/l was applied. Whereas the lowest (2.10) root length was recorded by Karbalain cultivar with control. The root diameter of Aseel and Karbalain cultivar was nearly same (1.53) cm with the use IBA @ 2000 mg/l. and 1.51 cm. The minimum (0.20) root diameter was recorded in Karbalain cultivar in control.

Results on fresh weight of root also showed considerable variation between the performances of cultivars. The highest (10.57 g) fresh weight of root was observed with application of IBA @ 2000 mg/l followed by 9.26 g with NAA @ 2000 mg/l by Aseel cultivar. Lower (0.53 g) fresh weight was noted by Karbalain cultivar under control. The highest (2.43 g) dry weight was recorded by Aseel with IBA @ 2000 mg/l and the lowest (0.06) g was observed by Karbalain in control. Only medium level of IBA gave higher root length, root diameter, fresh weight and dry weight of roots. These results corroborate with the previous work of Qaddoury and Amssa (2004) who had mentioned that medium dose of IBA resulted in highest rank. Therefore, it might be due to the influence of some internal biochemical factors.

Data regarding the root length and number of root, the medium concentration of IBA performed better. This observations were supported by the results obtained by Sun and Bassuk (1991) who had reported that IBA @ 500-2000 ppm increased rooting per cent and number of root in apple rootstock. Al-Jabary (2010) had reported that, IBA application through injection in the aerial offshoots of date palm cultivar Hillawi increased rooting per cent, root length, number of roots and root diameter.

The increase in water content (%) seems to be associated with same concentrations @ (1000 mg/l) of both NAA and IBA. The water content (%) in newly induced roots of Karbalain cultivar was observed highest per cent (89.17). But in case of Aseel cultivar it was noted as 88.80 per cent which is a slightly lower than that of the former. The lowest (28.23%) water content was recorded by Karbalain cultivar under control. This indicates that the use of IBA and NAA not only promote root formation but also promote root functioning effectively. More or similar results were reported by other scientists that the stimulation and development of roots in plants is closely related to hormonal (Afzal *et al.* 2011, Yamada and Sawa 2013) and nutritional (Lima *et al.* 2010) mechanisms.

Table 1. Effect of IBA and NAA on root development in aerial offshoots of Aseel and Karbalain cultivars of date palm.

Cultivars	Treatments	Offshoot base diameter (cm)	Number of roots per offshoot	Number of lateral roots per root	Root length (cm)	Root diameter (cm)	Fresh weight (g)	Dry weight (g)	Water content % in root
Aseel	Control	33.00b	0.00h	0.00h	0.00i	0.00g	0.00k	0.00g	0.00c
	IBA 1000 mg/l	32.40c	3.66g	3.46ef	12.93cd	0.56de	5.50g	0.60e	88.80a
	IBA 2000 "	32.40c	14.00c	7.20c	17.60a	1.53a	10.57a	2.43a	77.00a
	IBA 3000 "	32.23cd	6.33def	3.70ef	14.43bc	0.80cd	8.50c	1.76b	79.57a
	NAA 1000 "	35.90a	4.66fg	3.36f	12.13de	0.63de	6.16f	1.20c	80.03a
	NAA 2000 "	33.13b	7.33de	5.66d	15.80b	1.16b	9.26b	1.70b	81.47a
Karbalain	NAA 3000 "	32.17cd	5.66ef	3.80ef	14.40bc	0.76cd	8.36c	1.70b	79.50a
	Control	33.00b	0.33h	0.70g	2.10h	0.20fg	0.53j	0.06g	28.23b
	IBA 1000 mg/l	31.87cd	4.66fg	3.60ef	7.76g	0.60de	2.33i	0.33f	86.10a
	IBA 2000 "	31.77d	21.33a	9.20a	10.80ef	1.53a	7.36d	1.16c	83.57a
	IBA 3000 "	32.30cd	7.66d	3.70ef	8.10g	0.80cd	6.20f	1.00d	83.40a
	NAA 1000 "	32.20cd	5.66ef	3.23f	8.23g	0.43ef	3.26h	0.36f	89.17a
LSD	NAA 2000 "	32.93b	19.00b	7.96b	9.20fg	0.90c	6.80e	1.30c	80.60a
	NAA 3000 "	31.90cd	15.00c	4.16e	7.66g	0.30f	5.83fg	0.96d	83.83a
		0.47	1.79	0.68	1.63	0.23	0.46	0.15	21.44

In each row, means followed by a common letter are not significantly different at 5% probability level.

Considering the above mentioned results it may be concluded that the different concentrations of both the hormones (NAA and IBA) remained effective except control treatment. Over all the application of IBA @ 2000 mg/l in the aerial offshoots of Aseel and Karbalain varieties of date palm by injection proved significantly better in comparison with rest of treatments. Therefore, the aerial offshoot may be better used in the subsequent cultivation of true-to-type plant material over the year. Hence, it may increase the area under date palm cultivation and ultimate increase in yield and sufficient employment opportunities.

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