Research Article

EFFECT OF INDOLE ACETIC ACID (IAA) ON FRUIT DROP AND FRUIT QUALITY OF DATE PALM CULTIVARS

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Abstract

Effect of Indole-3-Acetic Acid (IAA) on fruit drop and fruit quality of date palm cultivars was assessed during 2011 at Agriculture Research Institute, Rata Kulachi D.I.Khan, Pakistan. The experiment was laid out in Randomized Complete Block (RCB) Design with two factors factorial arrangement and replicated three times. The concentrations of Indole Acetic Acid (IAA) were used as 50, 100, 150 and 200 ppm at Hababuke stage (immature green stage) and the cultivars used were Dhakki and Gulistan. The application of IAA significantly influenced the growth, yield components and reduced the fruit drop of date palm cultivars. Among cultivars, Dhakki cultivar showed more fruit length (4.97 cm), fruit diameter (3.03 cm), fruit weight (30.8 g) and pulp weight (29.16 g) when treated with 150 ppm Indole Acetic Acid, while the lower percent fruit drop (23.00%) and higher bunch weight (21.27 kg) was recorded in cultivar Gulistan with application of 150 ppm Indole Acetic Acid concentration. Cultivars effect was also significant for percent fruit drop, fruit length, fruit diameter, fruit weight, pulp weight and bunch weight. In case of interactions only length and pulp weight was found significant among all other parameter in both cultivars. Results revealed that application of Indole Acetic Acid as foliar spray @ 150 ppm showed good result to minimize the percent fruit drop of date palm cultivars and also affects other desirable parameters significantly. Therefore, the concentration of Indole Acetic Acid (IAA) @ 150 ppm should be applied as foliar spray at kimri stage (unripe stage) to minimize the fruit drop and to improve the fruit quality attributes of date palm cultivars.

Key words: Date Palm Cultivars, Indole Acetic Acid, Fruit Drop and Fruit Quality.

I. Introduction

Dates (*Phoenix dactylifera* L.) belong to family *Palmaceae*. In North Africa and Middle East it is important staple food having a vital role in their economy and social life. It is primarily cultivated for food and also for animal consumption [1, 2]. Out of thousands of worldwide existing cultivars, very few are present in Pakistan, which include Dhakki, Gulistan, Shakri, Zaidi and Hillawi. Dhakki is the most popular among all other cultivars and after Dhakki cultivar Gulistan is becoming popular. Gulistan is the second most popular cultivar in Dera Ismail Khan after Dhakki. Its origin is Panyala; a village of Dera Ismail Khan. It is famous due to delicious taste. The main problem faced by the local farmers now a day is its fruit drop due to which huge amount of fruit loss occur

during different stages as they drop down unhealthy. Nearly 60% fruit drop in cultivar Dhakki occurs from flowering to young developmental fruit stage. Effect of many auxins, hormones and growth regulators on various growth processes of plants has been studied. Growth regulating substances have also shown to prevent the fruit drop and accelerating the development process in date palm fruit. There are many growth regulators such as Indole Acetic Acid (IAA), Indole Butyric Acid (IBA), Naphthalene Acetic Acid (NAA), 2, 4-Dichlorophenoxyacetic Acid (2,4-D), 2,4,5-Trichlorophenoxy and Propionic Acid (2,4,5-TP) which have been used to prevent the fruit drop. The plant growth regulators act as a messenger and are needed in small amount at low concentration. In fact their site of action and biosynthesis are different [3]. IAA is predominantly

produced in cells of the apex (bud) and very young leaves of a plant. IAA is an auxin plant hormone and it is the most active auxin.

2. Objectives

- To study the response and to find the optimum concentration of Indole Acetic Acid to minimize the fruit drop and to enhance fruit quality of date palm cultivars (Dhakki and Gulistan).
- To study the response of date palm cultivars (Dhakki and Gulistan) to various concentrations of Indole Acetic Acid.

3. Materials and Methods

Experimental Design. The experiment was laid out in Randomized Complete Block (RCB) Design having two factors replicated three times. Six trees were selected i.e. three (3) of each cultivars (Dhakki and Gulistan) with total 30 treatments. Five bunches at each tree of Dhakki and Gulistan were randomly selected, tagged and sprayed with Indole Acetic Acid at kimri stage (unripe stage) of fruit development. A hand flit sprayer was used to spray the solution the tagged bunches of date palm cultivars in morning time. The experiment consists of the following two factors.

Factor A contains different concentrations of IAA i.e. I1 = 0 ppm (Distilled water), I2 = 50 ppm, I3 = 100 ppm, I4 = 150 ppm, I5 = 200 ppm and Factor B contains date cultivars i.e. Dhakki and Gulistan.

The data analysis for various parameter having results and discussion is as follows

4. Results and Discussion

Percent fruit drop (%). The mean values regarding percent fruit drop (%) are presented in Table 1, while their analysis of variance is mentioned in Table 1a. Data regarding percent fruit drop showed that IAA concentrations and cultivars highly significantly affected the percent fruit drop while their interactions were non-significant. The mean table for fruit drop indicated that the higher percentage of fruit drop (42.88%) was observed in cultivar Dhakki as compared to Gulistan (25.77%). The recorded data showed that fruit drop was significantly affected by various concentrations of Indole Acetic Acid (IAA). The higher percent fruit drop (39.54%) was noted in control treatment, while lower percent fruit drop (28.36%) observed in bunches treated with 150 ppm IAA. The maximum interaction for percent fruit drop (50.86%) was observed in control treatment in cultivar Dhakki whereas, minimum fruit drop (23.00%) was recorded in cultivar Gulistan which was sprayed with 150 ppm IAA. The fruit drop is a major problem in date palm and results in significant

economic losses every year. The preharvest fruit drop in date palm might be due to lower concentration of auxins and higher concentration of abscissic acid [4,5], as these hormones and their balance concentrations have a crucial role in the nutrients mobilization to the plant developing parts. So in date palm, plant growth regulators could be effective in controlling excessive fruit drop and the application of auxins can improve the fruit quality and also decreased the fruit drop effectively [6]. The present results showed that Indole Acetic Acid applied at the rate of 150 ppm resulted in a significant decrease of fruit drop as compared to control. These results are further strengthened by findings of El-Shewy (1999)[7], who observed the effectiveness of growth regulators @ 150 ppm in reducing fruit drop significantly and also documented that higher concentration of these growth regulators might be less effective in controlling fruit drop. Present results are also supported by the previous work of Azher *et al.* (2008), [8] who reported a significant reduction by using growth regulators in preharvest fruit drop as compared to control treatment in citrus.

Table 1. Effect of IAA on percent fruit drop (%) of date palm cultivars.

IAA concentrations (ppm)	Cultivars		Mean (%)
	Dhakki	Gulistan	
Control (Dist.H ₂ O)*	50.86	28.23	39.54 a
50	43.21	26.26	34.73 ab
100	38.88	26.67	32.78 bc
150	33.73	23.00	28.36 c
200	47.74	24.68	36.21 ab
Mean (%)	42.88 a	25.77 b	

Table 1a. Analysis of variance for percent fruit drop of date palm cultivars as affected by IAA.

Source of variation	Degree of freedom	Sum of square	Mean square	F-Calculated	Prob-value
Replication	2	38.73	19.36	0.88	
Cultivar (C)	1	2196.59	2196.59	99.32	0.000**
IAA (I)	4	413.45	103.36	4.67	0.009**
C × I	4	195.65	48.91	2.21	0.109 ^{NS}
Error	18	398.11	22.12		
Total	29	3242.54			

Coefficient of variation: 13.70 %

Fruit length (cm). The data regarding fruit length are given in Table 2, while their analysis of variance is mentioned in Table 2a. Mean values regarding fruit length showed that IAA concentrations, cultivars and their interaction significantly affected the fruit length of date palm cultivars. The mean value for fruit

length ranged from 3.65 cm for cultivar Gulistan to 4.93 cm for Cultivar Dhakki. The analysis of variance indicated a highly significant effect of Indole Acetic Acid concentrations on fruit length on both cultivars. More fruit length (4.63cm) was observed by the application of indole acetic acid (IAA) at the rate of 150 ppm which was statistically different from the rest of the treatments, whereas the minimum fruit length (4.03 cm) was noted in control treatment. A significant effect of Indole Acetic Acid (IAA) concentration on date palm cultivars was observed for fruit length. According to mean value for interaction, the higher fruit length (4.97 cm) was observed in cultivar Dhakki, treated with 150 ppm of Indole Acetic Acid, while the minimum fruit length (3.2 cm) was noted in cultivar Gulistan under control treatment. The increase in fruit size might be due to the optimize application of Indole Acetic Acid (IAA) at proper stage. The increased in fruit size of date palm provided by NAA application improved the potential of sink for carbohydrate [9]. The auxin (NAA and IAA) enhanced the cell size by increasing the carbohydrate mobility and uptake [10]. This increase in cell size made the fruit enlarged and promotes yield. The present results are supported by the previous work of Stern *et al.* (2007) [11] who stated that the mesocarp of the plum fruit was enlarged by the application of growth regulator, ultimately, increasing fruit size and final yield.

Fruit diameter (cm). The mean value of fruit diameter (cm) is presented in Table 3, while its analysis of variance mentioned in Table 3a. Data regarding fruit diameter (cm) showed that cultivars significantly affected the fruit diameter, while IAA concentrations and the interaction (IAA and cultivars) non-significantly affected the fruit diameter of date palm. The mean values for fruit diameter showed that highest fruit diameter (2.97 cm) was recorded in cultivar Dhakki while, the least fruit diameter (2.29 cm) observed in cultivar Gulistan. The mean values in respect to IAA were found to be non-significant, maximum fruit diameter (2.67 cm) was found in bunches sprayed with 150 ppm IAA while control treatment showed minimum fruit diameter (2.58 cm). The maximum interaction for fruit diameter (3.03 cm) was observed in cultivar Dhakki which was sprayed with 150 ppm IAA while, minimum fruit diameter (2.27 cm) was recorded in control treatment in cultivar Gulistan. The variation in fruit diameter might be due to genetic characteristic of different cultivars of date palm.

Table 2. Effect of IAA on fruit length (cm) of date palm cultivar

IAA concentrations (ppm)	Cultivars		Mean (cm)
	Dhakki	Gulistan	
Control (Dist.H ₂ O)*	4.87 a	3.20 d	4.03 b
50	4.93 a	3.57 cd	4.25 b
100	4.93 a	3.53 cd	4.23 b
150	4.97 a	4.30 b	4.63 a
200	4.93 a	3.67 c	4.30 b
Mean (cm)	4.93 a	3.65 b	

Table 2a. Analysis of variance for fruit length (cm) of date palm cultivars as affected by IAA.

Source of variation	Degree of freedom	Sum of square	Mean square	F-Calculated	Prob-value
Replication	2	0.014	0.007	0.11	
Cultivar (C)	1	12.16	12.16	206.62	0.000**
IAA (I)	4	1.132	0.283	4.80	0.008**
C × I	4	0.821	0.205	3.48	0.028*
Error	18	1.059	0.058		
Total	29	15.187			

Coefficient of variation = 5.66%

Fruit weight (g). The means value indicating fruit weight (g) is presented in Table 4, while its analysis of variance mentioned in Table 4a. The statistical analysis of data regarding fruit weight showed that IAA concentrations and cultivars significantly affected the fruit weight of date palm and the interaction was non significant. Mean values for fruit weight indicated that more fruit weight (29.79 g) was noted in cultivar Dhakki, on the other hand lesser fruit weight (17.24 g) observed in cultivar Gulistan. The analysis of variance indicated that fruit weight was significantly influenced by various concentrations of Indole Acetic Acid (IAA). The highest fruit weight (24.25 g) was obtained from bunches treated with 150 ppm which was statistically similar with 50, 100 and 200 ppm NAA, while lower fruit weight (22.45 g) was observed in control treatment. The maximum value of interaction for fruit weight (30.80 g) was observed in cultivar Dhakki sprayed with 150 ppm IAA whereas, minimum fruit weight (16.43 g) was recorded in cultivar Gulistan which was observed in control treatment.

Table 3. Effect of IAA on fruit diameter (cm) of date palm cultivar

IAA concentrations (ppm)	Cultivars		Mean (cm)
	Dhakki	Gulistan	
Control (Dist.H ₂ O)*	2.90	2.27	2.58
50	2.97	2.30	2.63
100	2.97	2.30	2.63
150	3.03	2.30	2.67
200	2.97	2.30	2.63
Mean (cm)	2.97 a	2.29 b	

Table 3a. Analysis of variance for fruit diameter (cm) of date palm cultivars as affected by IAA.

Source of variation	Degree of freedom	Sum of square	Mean square	F-Calculated	Prob-value
Replication	2	0.03	0.01	2.68	
Cultivar (C)	1	3.40	3.40	700.83	0.000**
IAA (I)	4	0.02	0.01	1.099	0.387 ^{NS}
C × I	4	0.008	0.002	0.41	0.798 ^{NS}
Error	18	0.09	0.005		
Total	29	3.54			

Coefficient of variance = 2.65%

Table 4. Effect of IAA on fruit weight (g) of date palm cultivars

IAA concentrations (ppm)	Cultivars		Mean (g)
	Dhakki	Gulistan	
Control (Dist.H ₂ O)*	28.45	16.43	22.45 b
50	29.60	17.20	23.40 a
100	30.33	16.87	23.60 a
150	30.80	17.70	24.25 a
200	29.73	18.00	23.87 a
Mean (g)	29.79 a	17.24 b	

Table 4a. Analysis of variance for fruit weight (g) of date palm cultivars as affected by IAA

Source of variation	Degree of freedom	Sum of square	Mean square	F-Calculated	Prob-value
Replication	2	0.82	0.41	0.76	
Cultivar (C)	1	1180.64	1180.64	2178.16	0.000**
IAA (I)	4	10.91	2.73	5.03	0.007**
C × I	4	3.15	0.79	1.45	0.258 ^{NS}
Error	18	9.76	0.55		
Total	29	1205.26			

Coefficient of variation = 3.13%

It was observed that the growth regulator (IAA) not only control the fruit drop but also improved the weight of the date fruit which was significantly varied from control treatment. The present results were in line with the previous work of Saraswathi *et*

al., (2003) [12] who observed a significant increase in fruit weight of citrus with the application of growth regulators. Moreover, Prasad and Pathak (1974) [13] also reported that that foliar application of NAA (50, 75, 100 and 150 ppm) significantly enhanced the fruit weight of mango. An increased fruit weight was also observed by applying different growth regulating substances on various fruit crops (Singh, 1980). [14]

Pulp weight (g). The means value regarding pulp weight (g) is presented in Table 5, while its analysis of variance mentioned in Table 5a. The statistical analysis of data regarding pulp weight showed that IAA concentrations, cultivars and their interaction significantly affected the pulp weight of date palm fruit. The mean data for pulp weight showed that the more pulp weight (28.29 g) was noted in cultivar Dhakki as compared to cultivar Gulistan (16.01 g). The mean data suggested that the pulp weight was significantly affected by various concentrations of Indole Acetic Acid (IAA). The highest pulp weight (22.67 g) was found in IAA treated with 150 ppm, while the lowest pulp weight (21.37 g) was observed in untreated bunches (control treatment). The interaction of IAA and date palm cultivars also significantly affected the pulp weight. However, the more pulp weight (29.17 g) was noted in Dhakki cultivar when treated with 150 ppm Indole Acetic Acid (IAA) concentration. While, the lowest pulp weight (15.67 g) was found in cultivar Gulistan in treated with 100 ppm IAA. The pulp represents the edible portion of the fruit therefore, the fruit possessing higher pulp are considered to be superior to the one having lower pulp. The present results are in line with the previous findings of Maximos *et al.*, (1980); El-Kassas (1983) and El-Hodairi *et al.*, (1991) [15,16,17] who reported that the application of various concentrations of GA₃ and IAA significantly influenced the pulp weight of date palm fruit.

Bunch weight (kg). The means value regarding bunch weight (kg) is presented in Table 6, while its analysis of variance mentioned in Table 6a.

The statistical analysis of data regarding bunch weight showed that IAA concentrations and cultivars significantly affected the bunch weight of date palm and the interaction between them was non-significant. The results for bunch weight (kg) indicated that the higher bunch weight (18.65 kg) was recorded in cultivar Gulistan, while lower bunch weight (12.69 kg) was noted in cultivar Dhakki.

Table 5. Effect of IAA on pulp weight (g) of date palm cultivars

IAA concentrations (ppm)	Cultivars		Mean (g)
	Dhakki	Gulistan	
Control (Dist.H ₂ O)*	26.97 b	15.77 c	21.37 b
50	28.07 ab	15.93 c	22.00 ab
100	29.03 a	15.67 c	22.35 a
150	29.17 a	16.17 c	22.67 a
200	28.20 a	16.53 c	22.37 a
Mean (g)	28.29 a	16.01 b	

Table 5a. Analysis of variance for pulp weight (g) of date palm cultivars as affected by IAA

Source of variation	Degree of freedom	Sum square	Mean square	F-Calculated	Prob-value
Replication	2	0.95	0.48	1.12	
Cultivar (C)	1	1129.76	1129.76	2658.26	0.000**
IAA (I)	4	5.94	1.49	3.49	0.028*
C × I	4	4.89	1.22	2.88	0.053*
Error	18	7.65	0.42		
Total	29	1149.11			

Coefficient of variation = 2.94%

Table 6. Effect of IAA on bunch weight (kg) of date palm cultivar as affected by IAA

IAA concentrations (ppm)	Cultivars		Mean (kg)
	Dhakki	Gulistan	
Control (Dist.H ₂ O)*	11.33	16.57	13.95 c
50	12.03	18.80	15.42 bc
100	12.59	19.01	15.80 b
150	15.67	21.27	18.45 a
200	11.82	17.63	14.73 bc
Mean (kg)	12.69 b	18.65 a	

Table 6a: Analysis of variance for bunch weight (g) of date palm cultivars as affected by IAA

Source of variation	Degree of freedom	Sum square	Mean square	F-Calculated	Prob-value
Replication	2	7.15	3.58	2.41	
Cultivar (C)	1	266.05	266.05	178.92	0.000**
IAA (I)	4	69.84	17.46	11.74	0.000**
C × I	4	2.35	0.59	0.39	0.809 ^{NS}
Error	18	26.77	1.49		
Total	29	372.17			

Coefficient of variation = 7.79%

The analysis of variance indicated that bunch weight was significantly influenced by various concentrations of Indole Acetic Acid (IAA). More

bunch weight (18.45 kg) was observed in the bunch treated with 150 ppm IAA which statistically varied from rest of treatment while lower bunch weight (13.95 kg) was observed in control treatment. The maximum value of interaction for bunch weight (21.27 kg) was observed in cultivar Gulistan sprayed with 150 ppm IAA whereas, minimum bunch weight (11.33 kg) was recorded in cultivar Dhakki in control treatment. The increase in bunch weight might be due an increase in fruit weight of date palm. The results are further supported by Shabana *et al.*, (1976); Shabana *et al.* (1998); Aljuburi *et al.*, (2001); Aljuburi *et al.*, (2003); Aboutalebi and Beharoznam, (2006) [18-22] who applied NAA at concentration of 150 and 200 ppm and found a significant increase in bunch weight of different date palm cultivars.

Conclusion. The following conclusions were drawn from the present research work that Indole Acetic Acid significantly influenced the percent fruit drop and fruit quality in both cultivars however, less fruit drop was recorded in cultivar Gulistan as compared to cultivar Dhakki. Furthermore, it was observed that the application of IAA at the rate of 150 ppm significantly increased the fruit weight, fruit diameter, fruit length, pulp weight and bunch weight with a reasonable reduction of percent fruit drop in both Dhakki and Gulistan cultivars.

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