

**EFFECT OF SOME GROWTH REGULATORS ON SOME
FRUIT CHARACTERISTICS AND PRODUCTIVITY OF
DATE PALM TREES (*PHOENIX DACTYLIFERA* L.)
2- KHANIEZY CULTIVAR**

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ABSTRACT

Bioregulators have used for the improvement of quality and productivity of many fruit crops. Application of gibberellic acid (GA₃) naphthalene acetic acid (NAA), ethephon separately or in a mixture had significant effect on fruit set, fruit dry matter percentage, fruit soluble solid percentage, fruit ripening and yield of date palm trees. A study was conducted to assess relative effectiveness of GA₃, NAA, ethephon and a mixture of growth regulators on some fruit characteristics, and productivity of date palm trees, Khaniezy cultivar. Five selected female uniform date palm trees of Khaniezy cultivar were pollinated on March 5-15/94, 95 and 1996 by placing eight fresh male strands on female spadix center (flower clusters were subjected to one of the following treatments: control (water), 150 mg/l GA₃, 100 mg/l NAA, 1000 mg/l ethephon and a mixture of growth regulators. Then the fruit set (%), fruit flesh (%), dry matter (%), total soluble solid (°Bx), fruit ripening (%), fruit weight (kg)/bunch and per tree were measured. The data showed that the application of GA₃ or ethephon on flower clusters of Khaniezy date palm trees had no constant effect on fruit characteristics and productivity of trees. Naphthalene acetic acid or mixture of growth regulators application on Khaniezy flower clusters, reduced fruit dry matter percentage, fruit ripening percentage and increased fruit weight per bunch and per tree, therefore these treatments could be as a recommended treatments in this experiment.

Additional Index Words: Date Palm, NAA, GA₃, ethephon, growth regulators, Khaniezy, yield

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INTRODUCTION

Synthetic and natural plant bioregulators used extensively for the improvement of crop performance in citrus (Agusti et al., 1994, Elfving and Cline, 1993a, 1993b and Auto and Green, 1994), blackberry (Rom, 1999), sweet cherry (Facteau et al., 1992) and avocado (Garcia and Lovatt, 2000). Many scientists studied the effect of some growth regulators on yield and fruit quality of date fruit. Application of gibberellic acid in combination with hand pollination increased fruit set percentage, pulp/seed ratio, average fruit weight and size (Ibrahim and Simbel, 1991). Others found that the application of GA₃ decreased the seed weight, fruit weight, pulp weight, and total soluble solid (TSS) and delayed fruit maturation slightly (Benjamin et al., 1997) or significantly (El-Kassas, 1993; Moustafa and Seif, 1993 and Hussein et al., 1993).

Naphthalene acetic acid application on date palm trees reduced fruit yield per bunch, but increased fruit weight, dimensions, flesh weight percentage and total soluble solid percentage and reduced fruit ripening (%) (Moustafa, Seif and Abou-El-Azayem, 1993), but Benjamin et al., 1975, mentioned that the application of NAA on date palm trees had no effect on fruit TSS. Other auxin (2,4-DP) increased slightly satsuma mandarin yield, but had no effect on fruit soluble solid contents (SSCs) (Agusti, et al., 1994). Ethephon application reduced fruit set of apple trees (Elfving and Cline, 1993a, Autio and Greene, 1994; and Ansari et al., 1999), but increased fruit ripening, total soluble solid (TSS), fruit pulp weight. Ethephon had no effect on bunch weight, and yield of date palm trees (Benjamin et al., 1975; Hussein and El-Agamy, 1993; El-Hamady, et al., 1993).

The objectives of this study were to assess relative effectiveness of gibberellic acid, Naphthalene acetic acid, ethephon and mixture of growth regulators on fruit set (%), fruit flesh (%), fruit dry matter (%), total soluble solid (°Bx), fruit ripening (%), fruit weight and yield of Khaniezy date palm trees.

MATERIALS AND METHODS

The experiment was carried out during three successive growing seasons (94, 95 and 1996), five selected female uniform date palm trees (*Phoenix dactylifera* L.) of Khaniezy cultivar, grown in Kuawaytate Experiment and Research Station, Department of Agriculture and Live

Stock, Al Ain, the UAE were used. The trees were planted in sandy soil at 10 m apart. All the trees were of similar age (25 year old), uniform in growth, free from insects damage and diseases, and were subjected to the same management and cultural practices. Date palm trees were pollinated on March 5-15/94, 95 and 1996, by placing eight fresh male strands on female spadix (flower cluster) center. Ten flower clusters were used on each tree and every two flower clusters were subjected to one of the following treatments: Control (Water), 150 mg/l Gibberellic acid (GA_3), 100 mg/l Naphthalene acetic acid (NAA), 1000 mg/l Ethephon and Mixture of growth regulators (150 mg/l GA_3 + 100 mg/l NAA + 1000 mg/l Ethephon).

Two flower clusters were sprayed with a hand gun of the above treatments once 20 days after pollination (DAP) during three consecutive growing seasons (94-1996). Clusters were protected from contamination by polyethylene bags. The bags were removed after 10 days. Solution of growth regulators were prepared in a mixture of ethanol: water 8:92 v/v. A non ionic wetting agent (Tween 20 surfactant) at 0.01% was included in all treatments. The experiment was arranged in randomized complete block design with one tree plot of 5 replications each replicate with two clusters.

All fruit bunches were covered at the Khalal stage (mature stage) by permeable bags to avoid bird damage and fruit shattering. Ten strands were randomly selected per each replicate (5 strands for each bunch), from the 40-50 strands that composed a bunch, to determine percentage of fruit set at 45, 90 and 135 day after pollination (first, second and third stages of fruit development respectively). Each bunch was tagged and labeled and the respective percentage of fruit set per selected strand was determined by counting the number of fruit and dividing it by the total number of the twigs on the respective strands.

Fifty fruits were randomly selected per replication, to determine fruit flesh (pulp) percentage, fruit dry matter percentage and total soluble solid, ($^{\circ}Bx$) at 90, 135 and 180 day after pollination date (second, third and fourth stages of fruit development) (Aljuburi, 1995). Bunches were harvested 180 day after pollination. Each bunch was then weighed and all its respective fruits on all its strands were picked, and separated into ripening and non ripening fruits, the percentage of ripening fruit was determined by weighing of ripe fruit and divided by the total weight of each replicate (Aljuburi, 1995). Total yield per tree was determined by

harvesting the ten bunches from each tree, adding the value to the weight of fruit harvested for fruit flesh, fruit dry matter and total soluble solid samples. The data were subjected to Duncan's multiple range test (DMR) using a MASTAT Programme analysis.

RESULTS AND DISCUSSION

Application of GA₃, ethephon or mixture of growth regulators did not effect fruit set percentage of Khaniezy date palm trees at all three stages of fruit development (45, 90 and 135 DAP) during three successive growing seasons (94-96). Naphthalene acetic acid increased significantly fruit set % at the second or third stage of fruit development during first or first and second growing season respectively as compared with control (Table I). The fruit set (%) of Khaniezy date palm tended to be high in the first stage of fruit development, then progressively decreased with fruit age throughout the three growing successive seasons. The results are in agreement with Elfving and Cline, 1993a, 1993b who found that the application of ethephon had no effect on apple trees fruit set.

Application of GA₃ or ethephon on Khaniezy date palm flowers had no significant effect on fruit flesh percentage at second, third and fourth stages of fruit development during two or three successive growing seasons respectively, with exception that the application of GA₃ on flower clusters increased fruit flesh (%) at fourth stage during first growing season. Naphthalene acetic acid increased significantly fruit flesh percentage at the second or fourth stage of fruit development during second or first, second and third seasons respectively, whereas growth regulators mixture increased significantly fruit flesh (%) at fourth stage during second and third growing season compared with the control (table I). The results could conclude that the NAA treatment was more effective on fruit flesh percentage of Khaniezy date palm trees followed by the mixture of growth regulators than other treatment, as compared with the control. The results are in agreement with (Moustafa, seif and Abou-El-Azayem 1993; Shabana et al., 1993) who found that the NAA treatments increased fruit flesh weight % of date palm trees.

Fruit dry matter percentage of Khaniezy date palm trees was reduced significantly, when treated with GA₃, NAA, or mixture of growth regulators at the second stage of fruit development during first, third or first and second growing season respectively as compared with the control (table II). Ethephon treatment increased fruit dry matter percentage

significantly at the second stage of fruit development during the first and second growing season as compared with GA₃ or mixture treatments or during the first growing season as compared with NAA treatment but ethaphon treatment did not show significant differences at the second stage of fruit development during three consecutive seasons as compared with the control. Fruit dry matter percentage was decreased significantly when treated with GA₃ at fourth stage of fruit development during third growing season. Naphthalene acetic acid or growth regulators mixture reduced significantly fruit dry matter percentage at the third stage of fruit development during second or second and third growing seasons respectively relative to the control. At the fourth stage of fruit development, fruit dry matter percentage of Khaniezy date palm trees was decreased significantly with application of NAA or growth regulators mixture during three consecutive growing seasons as compared to the control (table II).

Table I. Effect of gibberellic acid (GA₃), naphthalene acetic acid (NAA), ethephon and mixture of growth regulators: on fruit set (%) (45, 90, 135 day after pollination) and fruit flesh (%) (90, 135 and 180 day after pollination) of Khaniezy date palm trees during 94, 95 and 1996.

Treatment	Fruit set (%)									Fruit flesh (%)								
	Days after pollination									Day after pollination								
	45			90			135			90			135			180		
	94	95	96	94	95	96	94	95	96	94	95	96	95	96	94	95	96	
Control	81.31a	74.61a	70.83a	55.1b	54.87ab	40.81a	38.14b	38.28b	34.50a	85.86a	86.99b	84.69a	91.43a	89.92a	90.11b	90.67c	90.79c	
150 mg/l GA ₃	87.09a	74.20a	75.34a	44.58b	48.33a	47.63a	28.75b	28.86b	25.55a	85.82a	87.71ab	85.55a	91.34a	91.56a	91.97a	90.57c	90.88c	
100 mg/l NAA	84.88a	77.74a	73.58a	70.56a	67.23a	47.34a	61.13a	61.90a	39.79a	86.96a	88.54a	85.83a	91.92a	88.56a	91.92a	93.19a	92.43a	
1000 mg/l Ethephon	83.72a	71.38a	75.32a	55.25b	53.26ab	47.09a	39.35b	41.95b	32.68a	85.73a	87.62b	84.81a	91.27a	91.86a	91.25ab	90.68c	91.03c	
Mixture (150mg/l GA ₃ + 100 mg/l NAA+1000 mg/l Ethephon)	81.29a	76.64a	73.59a	46.84b	54.03ab	31.71a	33.13b	45.30ab	26.30a	86.12a	87.75ab	85.35a	92.02a	93.04a	91.38ab	92.33b	91.77b	

Values are means of 5 replications (each replications represent 2 bunches).

Means within columns followed by the same letter do not differ significantly (P = 5%): Duncan's multiple range test.

The data concluded that the application of growth regulators mixture on Khaniezy date palm flower clusters reduced significantly dry matter %, followed by application of NAA, whereas GA₃ reduced fruit dry matter (%) once and ethephon increased it once during three growing seasons.

Total soluble solid (°Bx) of Khaniezy fruit increased significantly at the second stage of fruit development during the second growing season relative to the control with application of ethephon on date palm flower clusters. Gibberellic acid and mixture of growth regulators decreased significantly total soluble solid (°Bx) of Khaniezy fruit at the second stage of fruit development during third growing season (table II). Naphthalene acetic acid treatment had no significant effect on total soluble solid (°Bx) of Khaniezy fruit at second stage during three successive growing season as compared to the non treated trees.

Spraying GA₃ on flower clusters of Khaniezy trees decreased fruit total soluble solid (°Bx) at fourth stage of fruit development during third growing season compared with control. Naphthalene acetic acid or mixture of growth regulators treatments reduced significantly total soluble solid (°Bx) of Khaniezy fruit at the third or fourth stage of fruit development during second and third or first and third growing seasons respectively as compared to the control. Ethephon treatment had no significant effect on total soluble solid (°Bx) of Khaniezy fruit at the third or fourth stage of fruit development during second and third or three consecutive growing seasons relative to the control (Table 2).

The results concluded that the mixture and NAA reduced significantly total soluble solid (°Bx) of Khaniezy fruit relative to the

Table 2. Effect of gibberellic acid (GA₃), naphthalene acetic acid (NAA), ethephon and mixture of growth regulators: on fruit dry matter (%) and total soluble solid (°Bx) (90, 135 and 180 day after pollination) of Khaniezy date palm trees during 94, 95, 1996.

Treatment	Fruit dry matter (%)									Total soluble solid (°Bx)									
	Day after pollination									Day after pollination									
	90			135			180			90			135			180			
	94	95	96	95	96	94	95	96	94	95	96	94	95	96	95	96	94	95	96
Control	18.20ab	16.85ab	16.35a	42.54a	34.94b	67.70a	80.30a	84.22a	14.70a	13.83b	12.80ab	40.18a	45.03a	59.23a	77.86ab	85.87a			
150 mg/l GA ₃	16.21c	16.01bc	15.02ab	39.68a	35.30b	71.56a	80.34a	82.38b	12.27a	13.63b	11.70c	38.46ab	45.37a	58.66a	78.53a	80.93bc			
100 mg/l NAA	17.67b	16.47abc	14.11b	28.12b	32.61bc	43.40b	73.39c	80.31c	13.17a	14.27ab	12.30bc	28.53b	32.00b	43.13b	72.80b	80.53bc			
1000 mg/l Ethephon	18.25a	17.19a	16.10ab	39.57a	49.05a	67.87a	81.11a	84.41a	13.53a	15.77a	13.40a	43.00a	49.97a	68.67a	76.40ab	82.33ab			
Mixture (150mg/l GA ₃ + 100 mg/l NAA 1000mg/l Ethephon)	16.74c	15.57c	14.83ab	28.91b	25.68c	44.21b	75.41b	80.02c	12.28a	13.70b	11.60c	28.87b	31.43b	43.47b	72.79b	78.13c			

Values are means of 5 replications (each replications represent 2 bunches).

Means within columns followed by the same letter do not differ significantly (P = 5%): Duncan's multiple range test.

control, whereas ethephon increased it once and GA₃ decreased it twice at the three stages of fruit development during growing seasons.

The results were in partial agreement with Autio and Green, 1994, who found that ethephon treatment had no significant effect on fruit total soluble solid (%), and with Ansari, et al., 1999, who reported that the application of ethephon on three cultivars of apple trees increased SSC of Royal Gala and Ultra Gold, but had no influence on SSC of Blushing Golden apple. The results of GA₃ treatment are similar to that obtained by Rom, 1999; and Facticeau, 1992 who found that the GA₃ treatment decreased SSC accumulation in sweet cherry fruit in one of two years, or had no effect on SSC of Blackberry fruits.

Ethephon treatment had no significant effect on fruit ripening percentage of Khaniezy date palm trees during three successive growing seasons, whereas GA₃ treatment reduced significantly Khaniezy fruit ripening percentage during the first growing seasons as compared with control (Table 3).

Fruit ripening percentage was reduced significantly with application of NAA and mixture of growth regulators on Khaniezy date palm flower clusters during three consecutive growing seasons as compared to the control. The results were in agreement with Benjamin, et al. 1975; Aljuburi, Al-Masry and Al-Muhanna, 2000 who found that ethephon treatment had no significant effect on fruit ripening percentage. Similar results of GA₃ were obtained by Autio, Green, 1994; Moustafa and Seif, 1993; and Hussein et al., 1993a, 1993b), who found that the fruit ripening percentage decreased with application of GA₃ to date palm or apple trees, also the results of NAA are in agreement with Shabana, et al., 1998 who reported that the NAA application to date palm flower clusters delayed fruit ripening.

The results concluded that the spraying of NAA or mixture of growth regulators on Khaniezy flower clusters reduced the fruit ripening percentage. Similar conclusion was reported on Barhee date palm flower clusters by Aljuburi, Al-Masry and Al-Muhanna, 2000.

Application of GA₃ on Khaniezy date palm flower clusters decreased significantly fruit weight (kg/bunch) during first growing

season, whereas application of ethephon on flower clusters had no significant effect during three growing seasons. The results of ethephon application on Khaniezy date palm flower clusters are in agreement with Benjamin, et al., 1975; Ansari et al., 1999; Hussein et al., 1993; and El-Hamady et al., 1993, who demonstrated that the application of ethephon on date palm trees flower clusters had no significant effect on bunch weight and trees yield, and with Ibrahim and Simbel, 1991; and El-Kassas, 1993 who reported that the application of GA₃ increased bunch weight of date palm trees.

Naphthalene acetic acid treatment increased significantly fruit weight (kg/bunch) during first and second growing seasons relative to the control. The results of NAA application were in agreement with Agusti et al., 1994 who reported that the application of other kind of auxin (2,4-DP) on Satsuma mandarin caused slight increase in crop load and with Aljuburi, Al-Masry and Al-Muhanna, 2000 who found that spraying NAA on date palm flower clusters increased bunch weight of Barhee date palm trees. Application of mixture of growth regulators on flower clusters increased significantly fruit weight (kg/bunch) during the second growing season. Spraying GA₃ on Khaniezy flower clusters reduced significantly Table 3. Effect of gibberellic acid (GA₃), naphthalene acetic acid (NAA), ethephon and mixture of growth regulators on fruit ripening (%), fruit weight (kg)/bunch and yield (Kg)/tree of Khaniezy date palm trees during 94, 95 and 1996.

Treatment	Fruit ripening (%)			Fruit weight (kg)/bunch			Yield (kg)/tree		
	94	95	96	94	95	96	94	95	96
Control	87.78a	72.45a	76.96a	6.59b	3.88c	4.60ab	65.88b	38.77c	45.96ab
150 mg/l GA ₃	74.69b	67.57a	72.95a	3.14c	2.75c	4.00b	31.38c	27.51c	39.96b
100 mg/l NAA	23.07d	43.98b	60.68b	11.26a	9.00a	5.71a	112.6a	90.00a	57.06a
1000 mg/l Ethephon	85.96a	71.84a	78.33a	5.83b	3.86c	4.37b	58.32b	38.55c	43.74b
Mixture (150 mg/l GA ₃ + 100 mg/l NAA + 1000 mg/l Ethephon)	34.09c	42.02b	44.38c	6.19b	6.82b	4.79ab	61.94b	68.17b	47.88ab

Values are means of 5 replications (each replications represent 2 bunches).

Means within columns followed by the same letter do not differ significantly (P = 5%): Duncan's multiple range test.

trees yield by 52% during first growing season relative to the control, but ethephon treatment had no significant effect on yield (kg/tree) on Khaniezy date palm trees during three consecutive growing seasons.

Mixture of growth regulators treatment increased significantly fruit yield of Khaniezy trees by 76% only during the second growing season relative to the control. Naphthalene acetic acid treatment increased significantly fruit yield of Khaniezy trees by 71 or 132% during first or second growing season respectively as compared with the control. The results of NAA, treatments are similar to that obtained by Aluburi, Al-Masry and Al-Muhanna, 2000, who found that the NAA treatment increased significantly the average yield of Barhee date palm trees.

The results of NAA treatments are in contrast to the results obtained by Moustafa, Seif and Abou-El-Azayem, 1993, who reported that the NAA treatments reduced the average yield of date palm trees. These differences in results might be due to the differences in NAA concentrations, cultivar had been used and to environmental conditions, under which the experiment was done. The results also showed that the yield of Khaniezy date palm trees were higher for most treatments during the first growing season followed by third and second growing seasons, with exception of NAA and mixture treatments, which had higher yield/tree during first or second growing season respectively. The data suggest that NAA may be more effective in increasing Khaniezy date palm trees yield than other treatments under Al-Ain conditions of the United Arab Emirates.

CONCLUSIONS

The results concluded that the application of NAA or mixture of growth regulators once, twenty days after pollination on flower clusters of Khaniezy date palm trees during the growing season, reduced dry matter percentage of fruit, fruit ripening and increased fruit flesh percentage, fruit production per bunch and per tree, therefore these treatments could be as a recommended treatment in this research, under Al-Ain region, conditions, the United Arab Emirates.

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