HortScience 15(6):724–725. 1980.

Effects of Naphthaleneacetic Acid on Fruit Size, Quality, and Ripening of 'Zahdi' Datepalm[1]

Shafaat Mohammed and Hassan R. Shabana[2]
Palm and Date Research Center, Foundation of Scientific Research, Baghdad, Iraq

Additional index words. Phoenix dactylifera, growth regulator

Abstract. **Preharvest application of naphthaleneacetic acid (NAA) at 10, 20, 40, and 60 ppm concentrations to immature 'Zahdi' date palm (*Phoenix dactylifera* L.) fruit 15 to 16 weeks after pollination (late chimri stage) influenced fruit size, quality, and ripening. Compared with the controls, 40 and 60 ppm NAA treatments increased fruit size, weight, volume, pulp to seed ratio, and moisture content. At 60 ppm fruit weight was increased by 39%. Total soluble solids were not altered significantly. Fruit ripening was delayed at least one month by 40 and 60 ppm.**

Results of early attempts (4, 5, 8) to use growth regulators to improve size and quality of date fruits were discouraging. Failure to achieve encouraging results stimulated investigations (2, 6) to determine a physiological stage of fruit development responsive to the application of growth regulators. A physiologically active stage known as the "depressed period" during the early second sub-stage of chimri stage was found in 'Zahdi' and 'Sayer' date palm (3, 7). Chimri is the immature green-colored stage of dates which may be differentiated in 2 sub-stages. The first sub-stage is characterised by a rapid increase in fruit size and weight; the second sub-stage has a reduced rate of gain in fruit size and weight. Application of NAA and 2-(2,4,5-trichlorophenoxy) propionic acid at 50, 100, and 150 ppm concentrations during the depressed period caused an increase in fruit size and weight, and in some treatments (100 and 150) ppm) fruit never ripened (3, 7). The increase in fruit size after treatment with NAA at 50 or 100 ppm during the depressed period was mainly due to cell enlargement (1). These results indicated that the synthetic growth regulators, especially NAA might be used for the improvement of various important fruit characteristics (size, weight, ripening etc.) of date palm. This paper reports the effects of several concentrations of NAA on various fruit characteristics of 'Zahdi' date palm.

Twenty five 30-year-old 'Zahdi' date palm trees were selected for the experiment at the Azizia Date Experimental Orchard in southern Iraq. Fruit bunches on the selected trees were treated with NAA during the depressed period of fruit development approximately 15-16 weeks after full bloom and pollination. All bunches under treatment had been pollinated within a 1-week period during April.

NAA at 10, 20, 40, and 60 ppm was applied to the fruits in the morning with 1 liter plastic hand sprayers. A drop or 2 of Tween 20 was added to the NAA solutions as a wetting agent. The control fruit bunches were sprayed with distilled water and Tween 20. Treatments were arranged in a randomized block design with each treatment replicated five times. For each treatment a single fruit bunch per tree was used.

Fruits were sampled 3 times. The first sample was collected about 2 months after the NAA treatments when fruits reached the *khalal* stage (hard, yellow color, unripe) of maturity. The second sample was obtained about 3 months after treatment. At this time fruits were in the *rutab* stage (soft, yellow-brown color, half ripe). The third sample was harvested when the fruit attained the *tamar* stage (very soft, dark brown, full ripe). Length, diameter, weight, volume, pulp weight, seed weight, total soluble solids, and moisture content were determined for 20 fruits from each treatment at each sampling date. Pulp to seed ratio was calculated. Data were analysed statistically.

Treatment with 10 ppm of NAA did not increase length and diameter of fruits significantly except for an increase in fruit diameter during the khalal stage (Table 1). The 20 ppm treatment gave erratic increases in length and diameter of fruits. Treatments of 40 and 60 ppm NAA brought about an overall increase in length and diameter of fruits and improved the size of fruits significantly.

The 10 and 20 ppm treatments increased fruit volume significantly during the khalal and rutab stages (Table 1). Fruit weight was increased significantly by the 20 ppm treatment during the rutab stage. The best treatments were the 40 and 60 ppm NAA which produced fruits with significantly increased weight and volume. At 60 ppm a 39% increase in fruit weight was obtained during the tamar stage.

The effect of the 10 and 20 ppm treatments on pulp to seed ratio was poor compared to 40 and 60 ppm treatments (Table 1). The highest pulp to seed ratio (13.4) was obtained at 60 ppm and the lowest (8.1) in the control during the khalal stage. A slight drop in the pulp to seed ratio at 40 and 60 ppm treatments occurred during the rutab and khalal stages. An upward trend in pulp to seed ratio was noticed in the control and 10 and 20 ppm treatments during the rutab and tamar stages.

Fruits treated with NAA had more moisture than the control at all stages (Table 1). Fruits from the 40 ppm treatment had the highest moisture content at the tamar stage.

Total soluble solids content of the treated fruits was either similar to or lower than that of untreated fruits at all stages of fruit maturity (Table 1). A significant reduction in total soluble solids occurred at the khalal stage in fruits from the 40 ppm treatment.

The enhancement of fruit size and weight by NAA may be because cell size and/or cell numbers are increased (1). Our results further indicate that an increase in length of fruit is accompanied by a corresponding increase in diameter. This trend was noticeable in most of the treatments during all stages of fruit growth and maturity. Thus, fruit shape in general was not affected by NAA at 40 and 60 ppm in spite of significantly increased volume.

An increase in pulp to seed ratio in treated fruits, particularly during the rutab and tamar stages is useful because it may provide a larger edible portion. A decrease in the pulp to seed ratio at 40 and 60 ppm treatments during the rutab and tamar stages may be due to a high loss of moisture from the fruits. Although there is a high loss of moisture, NAA-treated fruits retained higher moisture than control fruits during the tamar stage. High moisture content of tamar fruit may be desirable if consumed in fresh form.

In general, NAA delayed fruit ripening at least by 1 month particularly at 40 and 60 ppm. Delay in fruit ripening of 'Zahdi' date palm due to application of NAA has been recorded in previous investigations (3,7). Disturbance in the hormonal balance of developing fruit may cause the delay. However, a delay in fruit ripening as recorded in the present experiment may be advantageous, because fruits in the rutab stage can be harvested late in the season for

[1]Received for publication December 8, 1979.
The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked *advertisement* solely to indicate this fact.

[2]Scientist and Assistant Professor of Research, respectively. Financial support from the Foundation of Scientific Research is thankfully acknowledged.

Table 1. Effect of NAA on fruit length, diameter, weight, volume, pulp to seed ratio, total soluble solids (TSS), and moisture content of 'Zahdi' date palm during *khalal*, *rutab*, and *tamar* stages.[z]

Stage NAA (ppm)	Length (cm)	Diam (cm)	Weight (g)	Volume (cc)	Pulp: seed ratio	Total soluble solids (%)	Moisture (%)
Khalal							
0	3.5	2.4	11.8	11.0	8.1	39.1	57.4
10	3.5	2.6	11.9	11.7	8.2	34.8	68.5
20	3.6	2.6	11.9	12.0	8.6	37.6	66.1
40	4.1	2.8	16.3	17.1	11.9	27.8	69.8
60	4.1	2.8	16.9	17.6	13.4	37.8	65.1
LSD 5%	0.1	0.1	0.5	0.5	1.7	10.4	9.2
Rutab							
0	3.3	2.2	8.9	9.2	8.2	77.6	30.2
10	3.4	2.3	9.5	9.7	8.7	75.1	43.1
20	3.4	2.3	11.1	10.5	9.3	70.8	38.6
40	3.6	2.5	12.3	14.1	10.6	72.4	40.8
60	3.6	2.5	12.4	14.7	11.5	71.9	38.4
LSD 5%	0.1	0.2	1.6	0.5	1.7	14.7	9.8
Tamar							
0	3.3	2.2	8.8	9.1	8.6	79.8	20.9
10	3.3	2.2	9.1	9.4	8.8	75.5	27.0
20	3.3	2.2	9.1	10.3	9.3	75.0	31.3
40	3.6	2.4	11.9	13.8	10.5	79.0	37.2
60	3.6	2.5	12.2	14.0	10.6	78.0	39.4
LSD 5%	0.1	0.1	1.1	1.5	1.7	5.8	4.9

[z]Mean of 5 replications, 20 fruits in each replicate.

local fresh consumption.

Fruit size, quality, and ripening of 'Zahdi' date palm may be improved by applying NAA at 40 and 60 ppm. Concentrations of 20 ppm or less are inadequate.

Literature Cited

1. Al-Ani, B.A., N.D. Benjamin, H.R. Shabana, and I.S. Saadawi. 1976. Effect of some growth regulators on cell number of fruit of date palm (*Phoenix dactylifera* L.) cv. Sayer (in Arabic). Baghdad Palm & Date Research Center Tech. Bul. 2/1976.
2. Benjamin, N.D., K.S. Jawad, H.R. Shabana, and H.D. Al-Agidi. 1973. Physico-chemical changes of ripening and determination of the depressed period of development in date fruit. II. Chemical changes in Zahdi and Sayer cultivars (in Arabic). *Baghdad Palm & Date Research Center Tech. Bul.* 10/1973.
3. _____, H.R. Shabana, B.A. Al-Ani, M.A. Clor, K.S. Jawad, and A.M.H. Shaibani. 1975. Effect of some growth regulators on the depressed period of development and physico-chemical changes during different stages of ripening of date fruit. I. Chemical changes (soluble solids, sugars) and moisture content in fruit of Zahdi and Sayer cultivars (in Arabic). *Baghdad Palm & Date Research Center Tech. Bul.* 1/1975.
4. Khosnaw, K.M., M.B. Al-Asead, H.R. Shabana, W.F. Al-Tai, and H.K. Al-Agidi. 1975. Some artificial auxins effects on the quality of date palm fruits. Third Intern. Palm & Date Conference, Baghdad.
5. Nixon, R.W. 1959. Effects of gibberellin on fruit stalks and fruit of date palm. Annu. Rpt. Date Growers Inst. 36:5-7.
6. Shabana, H.R., K.S. Jawad, N.D. Benjamin, and B.A. Al-Ani. 1974. Physico-chemical changes during different stages of ripening and determination of the depressed period of development in date fruit. I. Physical changes in Zahdi and Sayer cultivars (in Arabic). *Baghdad Palm & Date Research Center Tech. Bul.* 1/1974.
7. _____, _____, _____, and _____. 1976. Effect of some growth regulators at depressed period of development on the physical properties of Zahdi and Sayer cultivars (in Arabic). *Baghdad Palm & Date Research Center Tech. Bul.* 3/1976.
8. Sharples, G.C. and R.H. Hilgeman. 1950. Effect of hormone spray application upon the development and ripening of date fruit. Annu. Rpt. Date Growers Inst. 29: 14.

HortScience 15(6):725–727. 1980.

Respiration and Ethylene Production of the Developing 'Kerman' Pistachio Fruit[1]

Arazdordi Toumadje, Julian C. Crane, and Adel A. Kader
Department of Pomology, University of California, Davis, CA 95616

Additional index words. nuts, maturation

Abstract. **Respiration rate of whole 'Kerman' pistachio (*Pistacia vera* L.) fruit increased progressively during seed growth and development and gradually declined after the completion of seed growth. Blank (seedless) fruit, on the other hand, respired at a constant rate which was 5 to 6 times lower than that of fruit with seeds. There was no indication of a climacteric peak in respiration of fruit with seeds. Ethylene evolution from seeded fruit was not significantly different from that of blank fruit. Constant low levels of ethylene were maintained throughout the period of sheli and hull dehiscence, as well as fruit maturation, indicating that this hormone is probably not involved in those processes.**

A respiration and ethylene evolution study was started in 1978 as part of a research project to modify rate of maturation of the pistachio nut. Initial respiration measurements of immature fruit, using the method developed by Claypool and Keefer (4), showed large variations among replicate samples collected on the same date from the same tree. Both seed abortion (2) and to a minor extent parthenocarpy (5) contribute to a relatively high incidence of blank nuts (without kernels) in 'Kerman', although they do not abscise from the trees but remain until harvest. Fruit with no kernels developing in them are identical externally to those with kernels until shortly before maturity when the epidermis of seeded fruit assumes a milky appearance. Unequal numbers of blank fruit in the replications were eventually determined to be responsible for variation in rate of respiration from one replication to another (Fig. 1). The higher the percentage of blank nuts in a sample, the lower was the respiration rate. Fruit in which kernels were developing exhibited respiration rates 4 to 5 times higher than that of blank fruit. These data were derived from samples that were separated by floatation in water.

We found, in 1979, that the use of light was a more convenient, rapid, and accurate method of separating blank from seeded fruit. A cardboard box was used to enclose the light and reflector portion of a reading lamp. A hole slightly smaller than the size of a pistachio fruit was cut in the side of the box directly opposite the light source. By placing the fruit one at a time over the hole, blanks were identified as they transmitted more light than fruit with kernels. Accurate identification of blanks, however, was not attainable until the kernels had reached about 75% of their ultimate size.

[1]Received for publication May 9, 1980. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper must therefore be hereby marked *advertisement* solely to indicate this fact.