# Enhancing Harvest Timing, Fruit Quality, and Yield of Barhee Date Palm through Exogenous CPPU and Putrescine Application

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## Abstract

The aim of this study was to assess the impact of CPPU preharvest spray and Putrescine on the shelf life, physicochemical features, and yield of 27 trees of date palm (*Phoenix dactylifera* L.)Cv. Barhee, with age 22 years old in a private grove affiliated to Al-Tarmia province, 55 km north of Baghdad. Two factors were used, the first factor included spray with CPPU with three concentrations C0(drizzling clusters with distilled water only ),C1(drizzling clusters with CPPU 5 mg $L^{-1}$) , and C2 (drizzling clusters with CPPU 10 mg $L^{-1}$), during Hababouk, and Kamri stage prior fruit color breaking . The other factor involved two levels of Put, P0 (drizzling clusters with distilled water only), and P1 (100 mg $L^{-1}$), drizzling was performed 6 weeks after the pollination process and the second drizzling when the fruits turned colored in the Khalal stage. The results showed that spraying with CPPU, especially (10 mg $L^{-1}$), improved fruit qualities, reduced fruit drop, increased bunch weight, yield per palm, delay fruit ripening and TSS, and increased titratable acidity. On the other hand, spray bunches with Put at concentration (100 mg $L^{-1}$) leads to enhancement of fruit traits and productivity, minimizing fruit drop and total sugars. The interaction between (CPPU 10 mg $L^{-1}$+ Put 100 mg $L^{-1}$) caused a significant effect of physical characteristics and productivity of date palm fruits, minimizing fruit drop, extend shelf life, decreasing total sugars, TSS, and increased fruit titratable acidity.

***Key words*:** Date palm, Shelf life, Cytokinin, CPPU, Polyamines, Putrescine

## Introduction

The date palm tree (*Phoenix dactylifera* L.) is one of Iraq's essential agricultural resources, this tree which has thrived in this region for thousands of years, is a symbol of adaptability and tenacity, there is proofs that date palms have been cultivated in Mesopotamia since 4000 B.C., when they were a vital part of the local economies, and diets, date palm cultivation is said to have originated in Iraq [16 , 26 ] In general, Iraq boasted over 33 million palm trees, making it the world's largest producer of dates prior the Gulf war, and the war between Iraq and Iran wars severely impacted the agricultural landscape [17]. The decline in productivity and spoilage in quality has emphasized the challenges this pivotal crop faces due to conflict, environmental degradation, and urban development [27].Barhee date palm is an important commercial cultivar, it is considered particularly valued for its sweet fruit, which is consumed at both the Khalal (early ripening) and Rutab (ripening) stages. Barhee date palm is primarily cultivated in hot, dry climates and thrives in areas such as Iran, Iraq, and the Arabian Gulf [22, 23]. Phenylurea CKs are a type of artificial PGRs that mimic natural CKs, which promote cell

ISSN 2072-3857

division and expansion[3.]Unlike natural adenine CKs *viz*., Kinetin and Zeatin, phenylurea CKs like Thidiazuron (TDZ) and N-(2-Chloro-4-Pyridyl)-N-Phenylurea,
which has several trade names such as CPPU, Forchlorofenuron, and Sitofex, are synthetic compounds that are not found naturally in plants. Diphenylurea (DPU), on the other hand, is primarily synthetic but can be found naturally at very low concentrations [2 , 36].Since CKs promote and improve cell division in the various growth stages of the developed fruits, and fruit-bearing tissues, regulate hormonal balance, inhibit ethylene production, and hinder the formation of the abscission zone, they have been shown in numerous studies to play a crucial role in reducing fruit drop when sprayed immediately after flowering or after fruit set, this in turn, increases the percentage of remaining fruits and yield [9, 19]. Polyamines (PAs) are low molecular weight nitrogenous compounds widely distributed in all living cells of plants and are essential for cell growth and differentiation, and the pathways biosynthetic have been identified in many [25, 37, 38], most frequent polyamines in vascular plants are putrescine (Put), spermidine (Spd), spermine (Spm), thermospermine (Tspm), and cadaverine (Cad), among these, Put is the main product of the PAs anabolic pathway and the most abundant in nature [15, 40].Put and ethylene are strongly related to fruit flourishing and maturation, Put generally inhibits ethylene production and delays ripening and senescence, this relationship is complex and may involve competition for bio-based raw materials and varies in accordance with the horticultural crops and stage of development [18, 21]. In addition, Put is effective in reducing fruit drop in date palms, mainly by reducing ethylene production and increasing the percentage of remaining fruit during the fruit growth and development stages, according to what was found by [8, 13]The aim of this experiment is intended to explore the impact of CPPU and Putrescine and their interaction on some fruit characteristics, yield and reducing fruits drop as well as possibility of extending shelf life.

**Materials and Methods**

The present study was conducted on 27 trees uniform in general growth as possible at age 22 years old of Barhee date palms for the season(2023-2024), in a private grove affiliated to Al-Tarmia province , which is far away 55 km north of Baghdad to explore the influence of drizzling CPPU and Put on productivity and fruit quality namely, TSS, total sugars , and ripening of fruits. Trees were planted at 10×10 m, and the trees were fertilized with organic manure (cattle waste) in November 2023, triple super phosphate (45%) at a rate 1.5 kg for each date palm was added in January 2024, nitrogen (46%) at a rate 4kg palm$^{-1}$ year$^{-1}$, which was added in four equal monthly doses starting from February until May 2024, a mixture of microelements (Fe, Cu, Zn and Mn at a rate 300 g palm$^{-1}$) was added in February 2024[7, 24]. All the trees were subjected to the same horticultural practices *viz*., pruning, pollination, pest management and disease monitoring. Experimental soil sample was taken at deepness (0-60 cm) to investigate the chemophysical features which were evaluated and displayed in Table 1.

ISSN 2072-3857

**Table 1.** Physical and chemical traits of the experimental soil`s.

| | | | | Soil texture | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| pH | EC(1:1) ds $m^{-1}$ | CEC C.mol $L^{-1}$ | Organic matter g $kg^{-1}$ | Sand g $kg^{-1}$ | Loam g $kg^{-1}$ | Clay g $kg^{-1}$ | N mg $kg^{-1}$ | P mg $kg^{-1}$ | K mg $kg^{-1}$ | Total CaCO3 g $kg^{-1}$ |
| 7.4 | 3.25 | 27.21 | 18.24 | 38.3 | 33.2 | 28.5 | 71.32 | 16.9 | 218.7 | 161.0 |

**Treatments and Experimental Design**

For the current research, (27) trees, as consistent in vigor and growth as much as possible were chosen and put via the following treatments, each of which consisting of three replicates and each treatment represented by one tree as an experimental unit containing 8 bunches within the randomized completely block design (RCBD) (i.e., nine treatments, three replicates, one tree per replicate = 27 tree). A small spraying motor was used to spray bunches until the run -off stage. Tween 20 used as surfactant agent. Two factors were applied in this study, the first was spraying CPPU (Assay 99.9%), in three concentrations: C0 (distilled water only ), C1 (spraying the bunches with CPPU at 5mg $L^{-1}$), and C2 (spraying the bunches with CPPU at 10 mg $L^{-1}$). Two times, on May 15, 2024, during the Hababok stage, and on July, 19,2024, at the Kamri stage prior to the fruit color changing and transitioning into the khalal stage, the bunches were sprayed with CPPU. The second factor was spraying Put at two concentrations: P0 ( spraying bunches with distilled water only), and P1(100 mg $L^{-1}$). Drizzling was performed 6 weeks after pollination process on 27/5/2024 and the second when the fruits turned colored in the Khalal stage on 5/8/2024.

**Measurements**

. **Fruits Physical parameters:** In order to assess the physical characteristics of the fruits in the khalal stage, 30fruits were selected from the pre-selected up strands ( 3 clusters were selected, and 10 strands were chosen from each cluster), as follow: **Fruit weight (g),pulp weight (g), and Seed (g) :** A random sample of fruits was taken and their weight was calculated, then the fruit weight was collected. After the seeds had been removed, the weight of the seed and fruit flesh was measured and then divided by the total number of the fruits. **Fruit drop (%):** Ten strands were chosen, and tagged from each bunch after five weeks of pollination. The dropping was calculated at the termination of khalal phase accordance to equation:

$$Dropping(\%) = \frac{\text{Number of dropped fruits per bunch}}{\text{Number of total fruits per bunch}} \times 100$$

**Weight of the Bunch (kg/bunch) and harvest per palm(kg/palm):** On September 19,2024, bunch weight and yield were taken after the fruits had reached the ripening stage, and 30% had reached the date stage [28]. **Fruit dry weight (%) and Fruit moisture (%):** According to Saker et al.,(2010), the fruits dry matter and moisture

ISSN 2072-3857

content has been determined by weighing 10 g of the sliced fruit flesh, and placing it in a vacuum oven adjusted at 70 C for hours until the weight kept constant., the following formula was used [37 , 38]

$$Moisture\ (\%) = \frac{\text{weight before drying} - \text{weight after drying}}{\text{weight before drying}} \times 100$$

$$Dry\ matter\ (\%) = \frac{\text{A verage dry weight (g)}}{\text{A verage fresh weight (g)}} \times 100$$

**Fruit ripening (%):** According to [5] the following equation, the percentage of ripe fruits was estimated after the fruit reached the ripening stage (fruits that displayed softness of a round 25% of the fruit area were considered ripe [33]

$$Ripening\ (\%) = \frac{\text{Number of ripening fruits}}{\text{Total number of fruits at bisir stage}} \times 100$$

**Fruits chemical parameters:** These indicators were measured after 30 uniform fruits were chosen from the labeled strands in rutab stage in September. Total and reducing sugars were calculated using [29] methodology, nonreducing sugars was estimated by the difference between total and reducing sugars. TSS (%): 10 g of fresh fruit flesh and 30 ml of distilled water were completely crushed together using an electric blender. A portable refractometer was utilized to estimate the fruits' TSS [1]. Titratable Acidity (%): It was determined in accordance with [1] by employing 0.1N sodium hydroxide and phenolphthalein indicator till the equivalence point was achieved. On the other hand, TSS/Acidity was utilized as ripening index. **Statistical Analysis** Experimental treatments were subjected and arranged into randomized complete block design (RCBD, according [6], the data were separate and analyzed using the statistical programs GenStat, and means were compared using (LSD) at probability ($P \leq 0.05$ )by two-way analysis of variance.

**Results**

**pulp weight (g), Seed (g), and Fruit weight(g):** Results presented in Table 2, shows that there is an effect of spraying with CPPU and Put in improving the fruit qualities represented by the weight of the fruit flesh and the weight of the fruit. CPPU spraying at concentration C2 (10 mg $L^{-1}$) achieved the highest values reaching (17.72 and 18.95 g), and spraying with Put at a concentration P1 (100 mg $L^{-1}$) gave values of (16.33 and 17.56 g) for the mentioned traits sequentially, comparison to C0 and P0, gave the minimum values. On the other hand, the interaction showed the same effect that appeared in the individual factors, so that the interaction treatment P1C2 gave the highest values (18.28 and 19.52 g) for the mentioned traits, sequentially, comparison to control. Moreover, no significant effect was shown for the individual factors and the interaction in their effect on seed weight.

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**Table 2.**Influence of spray application of CPPU and Putrescine and combination on pulp weight (g), Seed (g), and Fruit weight(g).

| Put (P) | CPPU (C) | | | Mean |
|---|---|---|---|---|
| | C0 = control | C1 =5 mg $L^{-1}$ | C2 =10mg $L^{-1}$ | |
| | pulp weight (g) | | | |
| P0 = control | 13.68 | 16.50 | 17.15 | 15.78 |
| P1 = 100 mg $L^{-1}$ | 14.88 | 15.82 | 18.28 | 16.33 |
| Mean | 14.28 | 16.16 | 17.72 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.17 | 0.14 | 0.24 | |
| | Seed (g) | | | |
| P0 = control | 1.22 | 1.22 | 1.22 | 1.22 |
| P1 = 100 mg $L^{-1}$ | 1.23 | 1.22 | 1.23 | 1.23 |
| Mean | 1.225 | 1.22 | 1.225 | |
| | C | P | C × P | |
| P ≤ 0.05 | n.s | n.s | n.s | |
| | Fruit weight (g) | | | |
| P0 = control | 14.90 | 17.72 | 18.38 | 17.00 |
| P1 = 100 mg $L^{-1}$ | 16.11 | 17.05 | 19.52 | 17.56 |
| Mean | 15.50 | 17.39 | 18.95 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.17 | 0.14 | 0.24 | |

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**Dropping(%),weight of the bunch (kg bunch$^{-1}$), and harvest / palm (kg / palm):** Statistical analysis outputs shown in (Table 3) revealed that the spraying with CPPU and Put resulted in a reduction in the fruit drop rate. The CPPU treatment with a concentration C2 and spraying with Put at a concentration P1 gave the lowest drop rate, reaching (5.06 and 5.43%) sequentially comparison to C0 as well as P0 recorded the highest drop rate, reaching (5.70 and 5.95%) respectively. In the same manner, the two-way interaction followed the same trend, with the interaction treatment P1C2 giving the lowest drop rate, reaching 4.76%, comparison to control ( 6.10 %). As for the bunch weight and yield weight, the C2 and P1 spraying treatment achieved the highest bunch weight and yield, reaching (25.01 kg bunch$^{-1}$ and 325.3 kg palm$^{-1}$) and (22.96 kg bunch$^{-1}$ and 298.6 kg palm$^{-1}$) for both treatments and the two mentioned traits, respectively, compared to the lowest values for treatments C0 and P0. With the same strength, the P1C2 interaction treatment showed significant superiority over the rest of the interaction treatments, giving bunch weight and yield of (25.94 kg bunch$^{-1}$ and 337.2 kg palm$^{-1}$), compared to control which gave (20.25 kg bunch$^{-1}$ and 263.3 kg palm$^{-1}$).

**Table 3.** Influence of spray application of CPPU and Putrescine and combination on Fruit drop (%), weight of the bunch (kg bunch$^{-1}$), and harvest per palm (kg palm$^{-1}$).

| Put (P) | CPPU (C) | | | Mean |
|---|---|---|---|---|
| | C0 = control | C1 =5 mg L$^{-1}$ | C2 = 10 mg L$^{-1}$ | |
| | | Fruit drop (%) | | |
| P0 = control | 6.10 | 5.67 | 5.35 | 5.70 |
| P1 = 100 mg L$^{-1}$ | 5.80 | 5.73 | 4.76 | 5.43 |
| Mean | 5.95 | 5.70 | 5.06 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.16 | 0.13 | 0.23 | |
| | | Weight of the bunch (kg bunch$^{-1}$), | | |
| P0 = control | 20.25 | 22.85 | 24.09 | 22.40 |
| P1 = 100 mg L$^{-1}$ | 21.37 | 21.58 | 25.94 | 22.96 |
| Mean | 20.81 | 22.22 | 25.01 | |

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| | C | P | C × P | |
|---|---|---|---|---|
| P ≤ 0.05 | 0.47 | 0.38 | 0.67 | |
| Harvest per palm (kg palm$^{-1}$) | | | | |
| P0 = control | 263.3 | 297.1 | 313.3 | 291.2 |
| P1 = 100 mg L$^{-1}$ | 277.9 | 280.6 | 337.2 | 298.6 |
| Mean | 270.6 | 288.9 | 325.3 | |
| | C | P | C × P | |
| P ≤ 0.05 | 6.20 | 5.06 | 8.77 | |

**Fruit dry weight (%), Fruit moisture (%), and Fruit ripening (%):** From the data shown in Table 4, it appears that the spraying treatment with CPPU at concentration C2 and Put at concentration P1 reduced the dry mass to give (51.51 and 55.23%) respectively, compared to C0 and P0 which recorded (59.74% and 56.21%) respectively. The two-way combination shows a superior effect, P0C0 achieved highest value reaching (62.64%) while P1C2 gave (50.90%). Regarding moisture content of the fruits, it is noted that the CPPU and Put spraying has taken a different approach, as they increased the moisture content of the fruits especially at concentration C2 and P1 giving (48.49 and 44.77%) comparison to C0 and P0 (40.26 and 43.79%). The two-way interaction shows a significant effect, P1C2 recorded the maximum percentage which reached (49.10) comparison with control which gave (37.36%). As for the percentage of fruit ripening, it appears from the results of Table 4 that the CPPU reduced the ripening of the fruits at concentration C2 which gave (41.17%) compared to C0 which gave the highest ripening percentage reached (51.64%),but Put did not show any effect on fruit ripening. Similarly, the interaction treatment P0C0 achieved the highest percentage of ripening, reaching (53.04%) compared to the lowest percentage of ripening in the treatment P1C2, giving a value of (41.07%).

**Table 4.** Influence of spray application of CPPU and Putrescine and combination on Fruit dry weight (%), moisture content (%) and Fruit ripening (%).

| Put (P) | CPPU (C) | | | Mean |
|---|---|---|---|---|
| | C0 = control | C1 =5 mg $L^{-1}$ | C2 = 10 mg $L^{-1}$ | |
| | | Dry weight (%) | | |
| P0 = control | 62.64 | 53.87 | 52.12 | 56.21 |
| P1 = 100 mg $L^{-1}$ | 56.84 | 57.95 | 50.90 | 55.23 |
| Mean | 59.74 | 55.91 | 51.51 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.67 | 0.55 | 0.95 | |
| | | Moisture (%) | | |
| P0 = control | 37.36 | 46.13 | 47.88 | 43.79 |
| P1 = 100 mg $L^{-1}$ | 43.16 | 42.05 | 49.10 | 44.77 |
| Mean | 40.26 | 44.09 | 48.49 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.67 | 0.55 | 0.95 | |
| | | Fruit ripening (%) | | |
| P0 = control | 53.04 | 44.95 | 41.27 | 46.42 |
| P1 = 100 mg $L^{-1}$ | 50.24 | 45.83 | 41.07 | 45.72 |
| Mean | 51.64 | 45.39 | 41.17 | |
| | C | P | C × P | |

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| | | | |
|---|---|---|---|
| P ≤ 0.05 | 0.90 | n.s | 1.27 |

**Fruit total sugars (%), Reducing sugars(%), and non-reducing sugars (%):**It is clear from the results of Table 5 that the CPPU and Put spray especially at C2 and P1 concentration reduced the percentage of total sugars to give ( 41.65 and 42.17%) respectively, compared to C0 and P0 which gave (43.33 and 44.43 % ). Similarly, the two-way interaction took the same direction, C2P1 gave the minimum percentage of total sugars reached (40.64%) compared to C0P0 which gave the highest percentage (45.96%). On the same context, as for the percentage of reducing sugars, spraying with CPPU reduced it to give the C2 concentration the lowest percentage of (27.18%) comparison to C0, which achieved ( 29.49%), while Put spray did not show a significant effect of reducing sugars content, the combination also took the same direction, C2P1 lead to reduced the percentage to give(27.11%), while the maximum percentage found in C0P0 which gave (30.76%).On the other hand, Put spray reduced the percentage of non-reducing sugars at P1 concentration reaching (14.15%) compared to P0 which gave (15.24%).

**Table 5**. Influence of spray application of CPPU and Putrescine and combination on Fruit total sugars (%), Reducing sugars(%) and non-reducing sugars (%).

| Put (P) | CPPU (C) | | | Mean |
|---|---|---|---|---|
| | C0 = control | C1 =5 mg $L^{-1}$ | C2 = 10 mg $L^{-1}$ | |
| | | Total sugars (%) | | |
| P0 = control | 45.96 | 41.37 | 42.66 | 43.33 |
| P1 = 100 mg $L^{-1}$ | 42.91 | 42.94 | 40.64 | 42.17 |
| Mean | 44.43 | 42.16 | 41.65 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.87 | 0.71 | 1.23 | |

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| Reducing sugars (%) | | | | |
|---|---|---|---|---|
| P0 = control | 30.76 | 26.24 | 27.25 | 28.08 |
| P1 = 100 mg $L^{-1}$ | 28.23 | 28.70 | 27.11 | 28.01 |
| Mean | 29.49 | 27.47 | 27.18 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.37 | n.s | 0.52 | |
| Non-reducing sugars (%) | | | | |
| P0 = control | 15.19 | 15.13 | 15.41 | 15.24 |
| P1 = 100 mg $L^{-1}$ | 14.68 | 14.24 | 13.53 | 14.15 |
| Mean | 14.93 | 14.68 | 14.47 | |
| | C | P | C × P | |
| P ≤ 0.05 | n.s | 0.70 | n.s | |

**TSS (%), Acidity(%), and TSS / Acidity:** Outputs observed in Table 6 shows that spraying CPPU at a concentration of C2 showed a reduction in the TSS percentage, an increase in the percentage of acidity, and a reduction in the percentage of TSS/Acidity, which reached (45.72 %, 0.270%, and 176.1) for the mentioned traits, respectively, in contrast to treatment C0, which gave values of (50.55%, 0.201%, and 264.1) for the mentioned traits, respectively, while no effect was observed as a result of Put. Similarly, effect was noted for the two-way combination which led to a reduction in the TSS content, an increase in the acidity, and a reduction in TSS/ Acidity which gave (46.31 %, 0.277%, and 168.7) respectively comparison with control which gave (51.50 %, 0.186 %, and 289.7 ).

ISSN 2072-3857

**Table 6.** Influence of spray application of CPPU and Putrescine and combination on TSS (%), Acidity(%) and TSS / Acidity

| Put (P) | CPPU (C) | | | |
|---|---|---|---|---|
| | C0 = control | C1 =5 mg $L^{-1}$ | C2 =10 $mgL^{-1}$ | Mean |
| | TSS (%) | | | |
| P0 = control | 51.50 | 45.72 | 47.42 | 48.22 |
| P1 = 100 mg $L^{-1}$ | 49.60 | 49.23 | 46.31 | 48.38 |
| Mean | 50.55 | 47.48 | 46.87 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.85 | n.s | 1.21 | |
| | Acidity(%) | | | |
| P0 = control | 0.186 | 0.234 | 0.262 | 0.227 |
| P1 = 100 mg $L^{-1}$ | 0.216 | 0.198 | 0.277 | 0.231 |
| Mean | 0.201 | 0.216 | 0.270 | |
| | C | P | C × P | |
| P ≤ 0.05 | 0.010 | n.s | 0.014 | |
| | TSS / Acidity | | | |
| P0 = control | 289.7 | 201.2 | 183.5 | 224.8 |
| P1 = 100 mg $L^{-1}$ | 238.5 | 266.0 | 168.7 | 224.4 |
| Mean | 264.1 | 233.6 | 176.1 | |
| | C | P | C × P | |
| P ≤ 0.05 | 14.15 | n.s | 20.01 | |

ISSN 2072-3857

**Discussion:** The enhancement in physical characteristics of the fruits due to CPPU spraying may be linked to several main mechanisms, including that it stimulates cell division and expansion, which contributes significantly to increasing the size and growth of the fruit. In addition, spraying the fruit makes it a place to attract and enhance the movement of carbohydrates by reducing its storage in the leaves and increasing the content of soluble sugars and starch in the fruit, which causes its accumulation and thus supports the progress development of the fruit besides its effect on the regulation and transfer of nutrients and hormonal regulation processes [14, 20]. Developed fruits are considered effective metabolic sinks, which leads to the cell wall responding to turgor pressure, which results in a large penetration of water into the cell due to the high negativity of the water potential and the high osmotic potential. As a result, the cells swell, which works to dilutes sugars and total soluble solids. The delay in fruit ripening resulting from spraying with CPPU may be attributed to its inhibition of the activity of enzymes such as invertase and cellulase, which stimulate the conversion of sucrose into reducing sugars (glucose and fructose), this leads to maintaining higher levels of sucrose in the fruit, which delays the structural changes of sugars associated with ripening [4, 32]. By observing the results shown in the above-mentioned tables, it is clear that spraying date palm bunches with Put 6 weeks after pollination and at the loss of green color, and alteration to yellow color at Khalal stage played a positive role in improving the physical characteristics of the fruits, represented by length of the fruit, diameter, shape of the fruit , pulp weight, and weight of the fruit. This is due to the role of Put as a growth regulator by promoting cell division proliferation and differentiation in the fruits, which directly supports the growth of fruit flesh, as Put works as important signaling molecules that activate other hormones and participate in interactions between hormonal pathways, which affects the fruits and the course of vital processes to regulate physiological responses [12, 30, 31]moreover, the pivotal role of Put in activating hormones mainly through multiple mechanisms that include biological regulation, mutual interaction of signals, and modification of gene expression that increases the production of auxins, gibberellins, cytokinins, and other plant hormones associated with cell division and expansion, which enhances the improvement of the physical characteristics of fruits [11, 15]. Reducing fruit drop resulted from using Put, may be is due to its effective role in protecting the plant from environmental stresses and stabilizing cell membranes and walls, in addition to its role as an antioxidant agent, thus increasing the levels of endogenous polyamines in the fruits, thus reducing oxidative damage and stress, which reduces fruit drop, as well as to its function inhibiting ethylene production and respiration rate and increasing the fruit internal moisture, all that contribute to reducing fruit drop and improving their stability, which leads to an increase in the weight of the bunch and thus the yield [13, 15,33,39].

**Conclusion** Based on findings, spraying CPPU and Put at both concentrations, but especially at high levels, successfully enhanced date palm fruits features, including the weight of the fruit, weight of bunch, harvest per palm, and minimize fruit drop. In addition to increasing fruit moisture content and decreasing fruit dry weight, putrescine at 100 mg $L^{-1}$ and CPPU spray at 10 mg $L^{-1}$ also delayed fruit ripening, reduced the maturity index (TSS/acidity), and decreased total sugars, reducing, and

ISSN 2072-3857

nonreducing sugar content. These results could be very helpful and important to farmers and producers who have a desire to enhance production and keeping quality of date palm fruits.

ISSN 2072-3857

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