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Study the effect of foliar spraying by Glutathione, Butyrecin and their interaction on some physical, chemical and productive characteristics of date palm *Phoenix dactylifera* L. CV. Hellawi

Aseel Ali Farhoud Al-Sharifi

Palm Research Center, Albasrah University, Iraq

Nada Abdel-Amir Obaid Al-Qatrani

Department of Horticulture and Landscape Engineering, College of Agriculture, Albasrah University, Iraq

Email: mbrwkmbrwk052@gmail.com

Abstract---This study was conducted on *Phoenix dactylifera* L. Hellawi date palm trees in one of the private orchards in Al-Haritha district in the north of Basra governorate during the growing season 2021 to know the effect of foliar spraying with the antioxidant Glutathione (0, 50, 100 mg. l⁻¹) and the butyrecin growth regulator at a concentration (0, 50, 100 mg. l⁻¹) by three sprays four weeks after contracting, between one spray and another one month, on some physical, chemical and physiological characteristics of fruits, leaves and components of the date palm yield of the cultivar Al-Hellawi. The results showed that the treatments of spraying with Glutathione at a concentration of 100 mg. l⁻¹ and spraying with butyrecin at a concentration of 100 mg. l⁻¹ were significantly superior, by giving them the highest increase in the physical characteristics of fruits (fruit weight, fruit flesh weight, fruit size) in the Kallal and wet stages compared to the control treatment. It outperformed in increasing the rate of fruit set and the rate of fruit ripening and increasing the rate of b and the amount of the total yield compared to the comparison treatment. The interaction treatment (Glutathione at a concentration of 100 mg. l⁻¹ + butyrecin at a concentration of 100 mg. l⁻¹) was superior in giving the highest significant increase in (fruit flesh weight, fruit ripening percentage) while the interaction treatment (Glutathione at a concentration of 100 mg. l⁻¹ + butyrecin at a concentration of 50 mg. l⁻¹) was superior by giving it the highest significant increase in the average size of the fruit, the percentage of fruit set, the average weight

of the bunch and the amount of the total yield compared to the comparison treatment.

Keywords---Phoenix dactylifera L, date palm, glutathione, butyrecin.

Introduction

The date palm, *Phoenix dactylifera* L., belongs to the order Palmae and the Arecaceae family according to the classification of the plant world Linnaeus. The palm family is one of the most important plant families, including about 220 genera and approximately 2,600 species. The date palm is one of the most cultivated types of fruits in the Islamic world in terms of area and production, and it has been honored by the divine scriptures called for its cultivation and care due to the fruits that this blessed tree gives of great nutritional and economic importance (Al-Bakr, 1972). The date palm represents an essential pillar in the agricultural environment of Iraq. Basra governorate is considered one of the most important areas for planting palm trees in Iraq, as palm trees are concentrated in the district of Abi-Al Khasib, Al-Harthia, Shatt Al-Arab, Qurna, and Al-Madinah (Ibrahim, 2013). Iraq is one of the oldest palm plantations in the world. The number of female trees is about 16514834 palm trees, and the fruit trees are about 10957930 palm trees (Central Statistics Organization, 2019). Al-Hellawi is considered one of the world-famous dates. It was previously considered one of the most important commercial varieties that Iraq exports to many world countries.

Phytohormones are organic non-nutritive compounds produced by plants in small quantities that regulate plant physiological processes as they move from where they are synthesized in the plant to their places of work (Shabana et al., 2006, Al-Hasany, et al,2020). Polyamine butrescine is one of the available and physiologically active amines, and it has many physiological effects, including its induction of cell division and membrane stabilization. Cell division, flowering, and increased plant tolerance to stress conditions and a role in the growth, development, and ripening of fruits (Kusano et al., 2008). The plant is exposed to several types of stresses during its life, including biological stresses, pathogens and insect infestations, and abiotic stresses, including salinity, drought, temperatures, high lighting and ultraviolet rays (Neto et al., 2017, Al-Hasany, et al,2021). Glutathione is the tripeptide compound GSH, which is the most it is abundant in plant tissues and is considered one of the antioxidants, and it plays multiple roles in cellular metabolism. It is a central compound in sulfur metabolism. It is one of the forms that are a significant transporter in sulfur reduction. The sulfur reduction pathway is linked to protein building, and it is a regulator of reduced sulfur. On the other hand, it is a strong reducer of sulfur species Reactive oxygen (Tausz, 2000, Noaema,et al, 2020).

Because of the lack of studies of these two compounds for date palm trees specifically in Basra Governorate and their impact on increasing the plant's ability to resist stress conditions, this study was proposed, which aims at the effect of foliar spraying with Glutathione and butyrecin and the interaction between them on some chemical properties of the leaves of physical, chemical, physiological and productive characteristics of date palm fruits of the Hellawi cultivar.

Materials and Methods

The study was conducted during the growing season of 2021 AD in one of the orchards in Al-Haritha district, north of Basra governorate. Twenty-seven date palms trees were selected from the Al-Hellawi cultivar, homogeneous in length, size, and vegetative growth as much as possible, free of disease infestations, about 20 years old. A soil sample (sub-samples) was taken randomly from different orchard locations at a depth of 0-30 cm to study the physical and chemical properties of the soil sample after removing the surface layer for laboratory analysis purposes. Then some physical and chemical properties of the soil sample were estimated, and river water samples were taken at the same time (Table1).

Table (1) Physical and chemical analysis of the soil of orchard in which date palm trees, cultivar Al-Hellawi, are planted during the season of 2021

Characteristic	Value	Unit
pH	7.93	1:1
E.C	12.23	Ds/m
Organic matter	1.34	%
Total N.	6.8	mg/g
Soil texture	Silty loam	
sand	12.03	%
silt	85.49	
clay	2.48	

Table (2) Physical and chemical analysis of irrigation water (river) in the orchard during the season 2021

Characteristic	Value	Unit
pH	6.86	1:1
Cl	108	Mg/1
Na	410	
Ca	280	
K	16.8	

The solutions (antioxidant and growth regulator) under study were prepared, and the foliage of palm trees was sprayed with the following concentrations:

1. Spraying with the antioxidant Glutathione at a concentration of (0, 50, 100) mg l⁻¹ and the control treatment (distilled water).
2. Spraying with the butyrecin growth regulator at a concentration of (0, 50,100) mg l⁻¹ as well as the control treatment

The solution of the antioxidant Glutathione and the butyrecin growth regulator was prepared by dissolving (50-100 mg. l⁻¹) of Glutathione and butyrecin each in a specific volume of distilled water, and the volume was completed to a liter, and the diffuser (0.1%) 20 was added to the prepared solution to reduce the surface tension and ensure complete wetness. Spraying during the early morning hours

and at the rate of the first three sprays four weeks after the contract and for one month between one spray and another. As for the untreated trees (control) were sprayed with distilled water with the spreader only. The spraying process continued until the leaves were completely wet, and a 20-liter hand pump was used.

Study indicators

Physical characteristics of date palm fruits in the khallal and rutab stages

Weight of the soft fruit and the fleshy part (g)

25 fruits were taken for each repeater, and their fresh weight was recorded using a sensitive digital scale, then the seeds were removed from the fruits and weighed on the same scale, and then the average weight of the fruit and the seed was extracted from dividing the total weight of the fruits by their number. The weight of the flesh of the fruit was extracted by subtracting the weight of the seed from the total weight of the fruit.

Fruit size (cm³)

25 fruits were taken randomly for each repeater, and the size was measured for them by calculating the amount of displaced water produced using the included cylinder; the displaced water represents the average fruit size and then extracted the average fruit size based on (cm³ / fruit). Fruit volume (cm³) = volume of displaced water/number of fruits in the sample

Production implications of the date palm

Fruit formation percentage (%)

The percentage of fruit knots was determined at the hababouk stage, then the number of fruits setting and the number of empty scars on the fruiting snout was calculated on 10 stalks, as they were randomly selected from each berry using the following equation:

Percentage of fruit set = number of fruits formation/ number of fruits formation+ number of existing fruits

Fruit ripening percentage (%)

10 fruiting shoots were randomly taken in the Kallal stages after 104 days and wet after 122 days of pollination. The number of ripe fruits and the total number of fruits in these shoots is calculated according to the following equation to calculate the ripening percentage.

Ripeness percentage (%) = number of ripe fruits / total number of fruits x 100

Total yield (kg)

After harvesting the yield on 20.08.2021, the amount of yield was calculated for each palm separately, and a field balance was weighed, and then the average weight of the total yield for each treatment (in kilograms) was extracted.

Bunch weight (kg)

The average bunch weight (kg) for each treatment was calculated by dividing the total yield of each treatment by the number of bunches.

Statistical analysis

According to the Randomized Complete Block Design (RCBD), the experiment was carried out as a factorial experiment with two factors. The first factor was Glutathione at three concentrations (0, 50, 100) mg. l⁻¹ and the second factor was butyrecin with three concentrations (0, 50, 100) mg. l⁻¹ and the interaction between them. At the rate of 3 palm trees for each treatment, one palm represents an experimental unit; thus, the number of palm trees is 27. The results in this study were statistically analyzed using the statistical program Gen Stat, and the averages were tested using the least significant difference test method R.LSD and at the test level of 5% (Al-Rawi and Khalaf, 1980).

Results and discussion

Physical characteristics of date palm fruits in the khallal and Rutab stages

Fruit Weight (g)

The results are shown in Table (3) indicate the effect of foliar spraying with the antioxidant Glutathione and the growth regulator butyrate and their interaction on the fruit weight rate in the khallal and wet stages. The treatments of spraying with Glutathione had a significant effect on the average weight of the fruit, as it was recorded concentration of 100 mg. l⁻¹ had the highest increase in the average weight of the fruit as it reached (8.336 g) in the Kallal stage, while the average weight of the fruit in the wet stage reached (6.942) g with a significant difference from the rest of the. The concentration of 50 mg followed the concentrations. l⁻¹ glutathione, compared to the control treatment that recorded less average amounted to (6.919, 5.857,) gm, for Kallal and the Rutab stages.

The results are shown in table (3); the spray treatment with butyrecin caused a significant increase in the average weight of the fruit, where the concentration of 100 mg. l⁻¹ had the highest rate of (8.187) g in the Khallal stage. In contrast, the same concentration in the Rutab stage recorded the highest rate of fruit weight, amounting to (6.892) g. Compared to the comparison treatment, it did not differ significantly from the concentration 50 mg. l⁻¹-butyrecin in the Khalla and Rutab stages, which recorded the lowest rate. It reached 6,610 (5.588) g for the Rutab and kallal stages. The results in the Table also indicate that the interaction between the two factors of the study was significant, and the interaction treatment (concentration 100 mg. l⁻¹) was superior.

Glutathione with 100 mg. l⁻¹butyrecine) of all interactions in the average fruit weight, as it reached (9.163) g in the Kallal stage, while the interaction (concentration 100 mg. l⁻¹ glutathione) was recorded with 50 mg. l⁻¹ butyrecin), the highest average fruit weight reached (7.560) gm in the wet stage. Compared to the comparison treatment, which recorded the lowest rate of (5.287, 6.267) g, respectively, during the Kallal and Rutab stages.

Glutathione is one of the antioxidants and behaves similarly to auxins, increasing cell division and size. As a result, antioxidants protect cells from senescence and increase the number of nutrients in various plant organs, thus improving the nutritional status of the tree, which is reflected positively in weight. The fruit results from increased cell division and expansion due to the availability of sufficient food, which leads to a lack of competition between fruits for nutrients and has a significant role in metabolic and physiological processes (Shaddad et al., 1990).

Table (3): Effect of spraying with Glutathione and butyrecin and the interaction between them on the average weight of the fresh fruit (g) of the date palm cultivar Al-Hellawi in the Kallal and Rutab stages

Glutathione concentration mg.l	kallal stage butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	6.267	6.987	7.497	6.917
50	6.557	8.130	7.900	7.529
100	7.007	8.837	9.163	8.336
Butyrecin average	6.610	7.984	8.187	
L SD (0.05)	Glutathione= 0.44 Butyrecin= 0.44 Interaction=0.76			
Glutathione concentration mg.l	Ratab stage butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	5.287	5.900	6.383	5.857
50	5.590	6.783	6.913	6.429
100	5.887	7.560	7.380	6.942
Butyrecin average	5.588	6.748	6.892	
LSD (0.05)	Glutathione= 0.41 Butyrecin= 0.41 Interaction=0.71			

Fruit fleshy layer weight

The results showed in Table (4) the effect of spraying date palm trees, cultivar Al-Hellawi, with the antioxidant Glutathione and the butyrecin growth regulator, and the interaction between them on the average weight of the flesh of the fruit, as shows The Table showed that the glutathione spray treatment had no significant differences between the treatments in effect on the average weight of the fruit flesh at the Kallal stage. It is also noted from the same Table that the spray treatment with butyrecin had a significant effect as the concentration of 50 mg. l⁻¹ exceeded, as the average weight of the fruit flesh reached (6.288 gm in the Kallal stage, compared to the comparison treatment, which recorded the lowest rate of (5.466 gm) in the same stage. The results of the Table also indicate that the

glutathione spray treatment had a significant effect, and the concentration of 100 mg. l⁻¹ significantly exceeded, reaching (5.590) g in the Rutab stages, followed by a concentration of 50 mg. l⁻¹, compared to the comparison treatment that recorded the lowest rate of (5.068) g in the Rutab stages. The Table also noted that the spray treatment with butyrecin has a significant effect on the average weight of the flesh of the fruit. The concentration of 100 mg. l⁻¹ significantly exceeded, reaching (5.668) g in the Rutab stages, compared to the comparison treatment that recorded the lowest rate of (4.676) g. The results of the Table also showed The interaction treatment had a significant effect as it was superior to (Glutathione at a concentration of 100 mg. l⁻¹ + Butyrecin at a concentration of 50 mg. l⁻¹) as it reached (6.093,6.663) gm during the Rutab stages and stages, respectively.

The comparison interaction recorded the lowest average weight of the fruit's flesh amounted to (4.470, 5.317) g during the khallal and Rutab stages, respectively. As for the changes in the soft weight of the fleshy layer, similar to the mentioned changes in the weight of the fruit, the weight of the fleshy layer is one of the important qualitative characteristics of the fruit, and from its quality measures, the higher the pulp Its market value has increased and is considered one of the desirable traits for the consumer. The increase in the average weight of the fleshy layer may be because Glutathione is a non-enzymatic antioxidant that accumulates in plant tissues (Vaidyanathan et al., 2003) (Table 4).

Table (3): Effect of spraying with Glutathione and butyrecin and the interaction between them on the average weight of the fruit fleshy (g) for date palm cultivar Al-Hellawi in the kallal and Rutab stages

Glutathione concentration mg.l	kallal stage butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	5.317	5.940	6.367	5.874
50	5.933	6.260	5.467	5.887
100	5.147	6.663	6.530	6.113
Butyrecin average	5.466	6.288	6.121	
L SD (0.05)	Glutathione= N.S Butyrecin= 0.44 Interaction=0.76			
Glutathione concentration mg.l	Ratab stage butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	4.470	5.097	5.637	5.068
50	4.613	5.670	5.633	5.306
100	4.943	6.093	5.733	5.590
Butyrecin average	4.676	5.620	5.668	
LSD (0.05)	Glutathione= 0.40 Butyrecin= 0.40 Interaction=0.69			

Fruit size

The results showed in Table (5) that the Glutathione spraying treatments with a concentration of 100 mg. l⁻¹ were significantly superior in the fruit size. The highest increase in the average fruit size was (7.490) cm³ compared to the

comparison treatment that recorded the lowest rate of (5.918) cm³ in the Khalla stage. It is also noted from the Table, the treatment of spraying with butyrecin at concentrations 50 and 100) mg. l⁻¹ showed significant superiority in the average fruit size and recorded the highest increase of (7.110,7.331) cm³, respectively, in the Kallal stage, compared to the comparison treatment that recorded the lowest rate of (6,294) cm³.

The Table results also show that the treatment of spraying with Glutathione recorded significant differences in the rest of the treatments at a concentration of 100 mg l⁻¹ significantly, and the highest increase in the average fruit size was (7.158) cm³ in the Rutab stage. The size of the fruit was (6.694) cm³, compared to the comparison treatment, which recorded the lowest rate of (5.928) cm³ in the Rutab stage. The interaction treatment had a significant effect, and the interaction of (Glutathione at a concentration of 100 mg. l⁻¹ + butyrecin at a concentration of 50 mg. l⁻¹) was significantly higher than the other interactions, and it scored higher an increase in the average fruit size amounted to (8.193) cm³ compared to the comparison treatment, which recorded the lowest rate of (5,763) cm³ in the Kallal stage. It is noted from the same Table that the interaction was significant. The interaction of (Glutathione at a concentration of 100 mg. l⁻¹ + butyrecin at 50 mg. l⁻¹) was significantly superior to the other interactions. The highest increase in the average fruit size was (7.777) cm³, compared to the comparison treatment, which recorded the lowest rate of (5.267) (cm³) in the Rutab stage. The increase in the average size of the fruit in the Kallal stage corresponds to the increase in its weight, and the reason may be due to the accumulation of nutrients in the cells of the fruit and its filling with water, while the decrease in the size of the fruit in the Rutab stage is due to the lack of water content of the fruit (Shabana and others, 2009) (Table 5).

Table (5): Effect of spraying with Glutathione and butyrecin and the interaction between them on the average fruit size (cm³) for date palm cultivar Al-Hellawi in the khallal and Rutab stages

Glutathione concentration mg.l	Kallal stage butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	5.763	5.910	6.347	5.918
50	6.753	7.497	7.763	7.328
100	6.387	8.193	7.913	7.490
Butyrecin average	6.294	7.110	7.331	
L SD (0.05)	Glutathione= 0.28 Butyrecin= 0.28 Interaction=0.49			
Glutathione concentration mg.l	Ratab stage butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	5.267	5.753	5.720	5.580
50	6.357	6.467	6.827	6.550
100	6.160	7.777	7.537	7.158
Butyrecin average	5.928	6.666	6.694	
LSD (0.05)	Glutathione= 0.25 Butyrecin= 0.25 Interaction=0.43			

Production indicators of the date palm

Fruits formation

The study results showed in Table (6) the effect of spraying date palm trees, cultivar Al-Hellawi, with the antioxidant Glutathione and the butyrecin growth regulator, and the interaction between them on the rate of fruit formation rate. The glutathione spraying treatment at a concentration of 100 mg. l⁻¹ was significantly superior and recorded the highest rate of (76,860)%, followed by the concentration of 50 mg. l⁻¹ in effect, which amounted to (73,730)% compared to the comparison treatment that recorded the lowest rate of (67,060)%. The results indicate that the spraying treatment with butyrecin at a concentration of 100 mg. l⁻¹ was significantly superior and recorded the highest rate in fruit formation, which amounted to (76,740)%, compared to the comparison treatment, which recorded the least significant difference of (66.160)%. As for the effect of the interaction between the two experimental factors, the results in the same Table show that the interaction treatment (Glutathione at a concentration of 100 mg. l⁻¹, butyrecin growth regulator at a concentration of 50 mg. l⁻¹) was significantly superior, and the highest rate in the fruit formation rate was (81.280) %, compared to the comparison treatment that recorded The lowest rate was (61.290) %.

The study results showed that the changes are taking place in the product characteristics, including an increase in the rate of ripening to the progression of fruits with growth and maturity in the Kallal stage to the stage of dates. This is due to the increase in the accumulation of processed food in the pulp of the fruits at the expense of the water content (Gold, 2010). The increase in the rate of the total yield of trees may be attributed to an increase in the weight and size of the fruits (Table 6).

Table (6): Effect of spraying with Glutathione and butyrecin and the interaction between them on the average percentage of fruit formation % of date palm trees, Hellawi cultivar

Glutathione concentration mg.l	butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	61.290	67.600	72.310	67.060
50	67.000	75.350	78.820	73.730
100	70.180	81.280	79.100	76.860
Butyrecin average	66.160	74.740	76.740	
L SD (0.05)	Glutathione= 1.39 Butyrecin= 1.39 Interaction=2.42			

Fruit ripening

The results of the study showed in Table (7) the effect of spraying Al-Hellawi date palm trees with the antioxidant Glutathione and the butyrecin growth regulator and the interaction between them on the rate of fruit ripening. The spraying

treatments had a significant effect on the rate of fruit ripening, as the glutathione spraying treatment at a concentration of 100 mg. l⁻¹ was significantly superior and recorded the highest rate of (76.800) %, followed by the treatment of concentration 50 mg. l⁻¹ Glutathione, which recorded an average of (70.550) % compared to the comparison treatment, which recorded the least significant difference of (64.820) %. It is also noted in the Table there are significant differences between the treatments of spraying with the growth regulator butyrecin in the percentage of maturity, as the treatment of spraying with butyrecin at a concentration of 100 mg.l⁻¹ recorded the highest rate in fruit ripening amounted to (76.430%) with a significant difference from the rest of the treatments, compared to the comparison treatment that recorded the lowest difference Significant amount reached (62.690) %. The interaction between Glutathione and butyrecin had an apparent effect on the maturity ratio, as the interaction treatment (the antioxidant Glutathione at a concentration of 100 mg. l⁻¹ with butyrecin growth regulator at a concentration of 50 mg. l⁻¹) recorded the highest rate of (80,020) %, with a significant difference from the rest of the interactions, except the interaction treatment (concentration 100 mg.l⁻¹ glutathione + concentration 100 mg. l⁻¹ butyrecin), recorded an average of (79.960) %, compared to the comparison treatment, which recorded the least significant difference of (56,590)% (Table 7).

Table (7): Effect of spraying with Glutathione and butyrecin and the interaction between them on the fruit ripening rate % of date palm trees, Hellawi cultivar

Glutathione concentration mg.l	butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	56.590	64.820	73.030	64.820
50	61.070	74.270	76.300	70.550
100	70.420	80.020	79.960	76.800
Butyrecin average	62.690	73.040	76.430	
L SD (0.05)	Glutathione= 0.99 Butyrecin= 0.99 Interaction=1.72			

Total yield

The results of the study showed in Table (8) the effect of spraying date palm trees, cultivar Al-Hellawi, with antioxidants Glutathione and butyrecin growth regulator and the interaction between them in the average amount of the total yield, as the Table shows the superiority of the Glutathione spraying treatment with a concentration of 100 mg.l⁻¹. The highest rate was recorded (26,979 kg, compared to the comparison treatment, which recorded the least significant difference of (24,492) kg. The Table also showed that the butyrecin spraying treatment at a concentration of 100 mg.l⁻¹ was significantly superior. The highest rate of the total yield amounted to (27,544) kg compared to the control treatment, which recorded the lowest rate of (23.291) kg. As for the interaction treatment, it had a clear effect on the average yield, as the interaction treatment (the antioxidant Glutathione at a concentration of 100 mg.l⁻¹ with the butyrecin growth regulator at a concentration of 50 mg.l⁻¹) recorded the highest average in the amount of the total

yield amounted to (29.363) kg with a significant difference. Compared to the treatment (concentration 50 mg.l⁻¹ glutathione + concentration 0 mg. l⁻¹ butyrecin), which recorded the lowest rate of (23.010 kg), which had no significant difference with the interaction (comparison) treatment. The reason for the increase in the amount of yield maybe was that the antioxidants work to protect plant cells from aging and increase the number of nutrients in the various plant organs and thus improve the nutritional status of the tree, which is positively reflected in the characteristics of the yield, including the increase in the weight of the fruit as a result of cell division and expansion due to the availability of sufficient food for it which leads to a lack of competition between the fruits for nutrients and this was positively reflected in the amount of the total yield of the tree (Mohamed, 1977; Cleland, 1986) (Table 8).

Table (8): Effect of spraying with Glutathione and butyrecin and the interaction between them on the average quantity of the total yield (kg) of date palm trees, cultivar Hellawi

Glutathione concentration mg.l	butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	23.337	24.333	25.807	24.492
50	23.010	26.467	28.780	26.086
100	23.527	29.363	28.047	26.979
Butyrecin average	23.291	26.721	27.544	
L SD (0.05)	Glutathione= 0.49 Butyrecin= 0.49 Interaction=0.85			

Bunch weight

The results of the study showed in Table (9) the effect of spraying date palm trees, cultivar Al-Hellawi, with antioxidants Glutathione and butyrecin growth regulator and the interaction between them in the rate of bunch weight, like the Table, shows that the treatment of spraying with Glutathione at a concentration of 100 mg. l⁻¹ significantly and recorded the highest rate of (4.072) kg, with a significant difference from the rest of the concentrations, compared to the comparison treatment, which recorded the least significant difference of (3.193) kg.

It is also noted in the Table the spraying treatment with butyrecin at a concentration of 100 mg. l⁻¹ had a significant effect and recorded the highest rate in the total weight of the grapes, which amounted to (4.238) kg, compared to the comparison treatment, which recorded the least significant difference of (2.819) kg. As for the interaction treatment between Glutathione and butyrecin in the weight of the seed, as the interaction treatment (Glutathione at a concentration of 100 mg. l⁻¹ + butyrecin at a concentration of 50 mg. l⁻¹) recorded the highest rate in the total weight of the seed was (4.877) kg, with a significant difference compared to the comparison treatment, which recorded the lowest rate of (2.307) kg. As for the increase in the weight of the bunch, Glutathione has a role in increasing the components of the yield and has an essential role in controlling

and maintaining the oxidative system inside cells; the reason may be due to its importance in the process of photosynthesis (Hell and Bergmann, 1990) (Table 9).

Table (9): Effect of spraying with Glutathione and butyrecin and the interaction between them on the average weight of the bunch (kg) for date palm trees of the Hellawi cultivar

Glutathione concentration mg.l	butyrecin concentration mg.l			Glutathione average
	0	50	100	
0	2.307	3.167	4.107	3.193
50	2.963	3.753	4.453	3.723
100	3.187	4.877	4.153	4.072
Butyrecin average	2.819	3.932	4.238	
L SD (0.05)	Glutathione= 0.29 Butyrecin= 0.29 Interaction=0.50			

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