Response of growth and yield of three varieties of bread wheat to spraying with glutathione.

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Abstract

Eexperiment was implemented during 2023-2024 in one of fields of Malta site of Agricultural Research Center (Dohuk Governorate) with design (RBCD) according to split-plot arrangement with 3 replicates to determine effect of foliar spraying with glutathione at four concentrations (conc.) where included (control treatment, soaking the seeds at a conc. 200 microgram L-1, plants spraying at a conc. 200 milligram L-1 and soaking the seeds at a conc. 200 microgram L-1 + plants spraying at a conc. 200 milligram L-1) on traits growth and yield of three varieties of bread wheat (Jihan 99, Tammuz 2 and Adana). It was observed that there were significant variants between varieties in all traits, as the Jihan 99 variety was significantly superior in plant height(87.79 cm), flag leaf area(40.65 cm2), chlorophyll content index(45.53 Spad), no. spike (380.04m2), no. grains spike-1(44.14), wt. 1000 grain(30.43 g) and grain yield(482.39g m-2,(

1000 .grain and grain yield, and Adana variety was significantly superior in harvest index. As for spraying with glutathione, it was superior to soaking the seeds at a conc. 200 microgram L-1 + plants spraying at a conc. 200 milligram L-1 in all the traits. Interaction between varieties and spraying with glutathione had a significant effect on all the traits, as interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1 + plants spraying at a conc. 200 milligram L-1 achieved highest significant rate in grain yield (528.300 g m-2.(

Keywords: varieties, glutathione, chlorophyll content.

Introduction

Soft wheat (Triticum aestivum L.) belongs to the Poaceae family and is considered the most important grain crop locally and globally in terms of cultivated areas and production. Its importance is due to its multiple uses, the most important of which is production of bread and achieving food security, in addition to being one of the important basic sources that provide humans with 20% protein, 55% carbohydrates, and 21% food calories consumed in all countries of the world [33].In Iraq, cultivated area for the wheat crop in the year 2020 reached (85.7) million hectare with an average yield of (73.615) kg/hectare [40]Compared to the global cultivated areas in 2022 (222.19) million hectares, with an average yield of (79.24) million tons. The world population is expected to increase from seven to nine billion during the year 2050 [18] As a result of the increasing population

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density, there is a need to achieve an increase in global production by an amount of (106%) annually to meet the growing needs for this crop [38]. This requires the use of different processes to serve the crop, including application of some modern technologies in order to improve growth of the crop, increase its productivity, and choose improved varieties that are appropriate to the conditions of the region. Despite the high productivity of the improved varieties of wheat that are suitable for the conditions of the agricultural area, they require the addition of some nutrients that increase the plant's ability to withstand drought as well as improving the growth and productivity of crops. Noticed [19] in their study of four varieties of soft wheat (Misr3, Sakha95, Sids14, Giza171) The Giza171 variety was superior in plant height, no. spike (m2), no. grains spike-1, wt. 1000 grains, grain yield and harvest index compared to the rest of the varieties. [25] noted that the pww variety was superior to the K-402 and K307 varieties in the no. spike (m2), no. grains spike-1, grain yield and harvest index, while no significant differences were recorded between the varieties in plant height and wt. 1000 grain. [5] indicated when they studied five varieties of wheat (Svevo, Sardar, Adnham, Grecate, Doma) The Doma variety was superior in plant height and 1000 grain weight, and the Svevo variety was superior in leaf area, no. grains spike-1, and harvest index, while no significant variants were observed in chlorophyll content index. Recently, there has been a move to use some compounds that are found naturally in plants, which may made to reduce the severity of the negative effects of drought, which reduce the osmotic potential of plant cell and thus increase the ability of plant cell to absorb water, which reduces the harmful effects of water stress [39] . Among these compounds is glutathione, which is a tripeptide that includes three amino acids (glutamic, cysteine, and glycine), which is responsible for protecting the plant from antioxidants, regulating cell function in terms of oxidation and reduction, and increasing plant's ability to withstand various stresses [32]. [34] showed in their experiment with six concentrations of glutathione (1200, 1000, 800, 600, 400,0 mg L-1) that spraying at a conc. 1000 mg L-1 It was superior in plant height, leaf area, no. spikes (m2), no. grains spike-1, and grain yield compared to the rest of the concentrations. [14] obtained significant differences between four concentrations of glutathione (300, 200, 100,0 mg L-1). The conc. 300 mg L-1 was superior in index of chlorophyll content in leaves, no. spikes (m2), grain yield and 1000 grain weight. The study aims to determine best variety for soft wheat and choose the best of concentration of glutathione compound and their effect on some growth, yield and its components.

Materials and methods

Experiment has been carried out in fields of Agriculture Research Center in the Malta site (Dohuk Governorate) during the 2023-2024,which included two factors, the first four concentrations of glutathione (control(no spots or spray) treatment, soaking the seeds at 200 microgram L-1, spraying the plants at 200 milligram L-1and soaking the seeds at 200 microgram L-1 + spraying the plants at 200 milligram L-1) ,the second is three varieties of soft wheat (Jihan 99, Tammuz 2 and Adana), he obtained it from the Seed Inspection and Certification Department/Dohuk Governorate. Before planting, the seeds were soaked with glutathione for 24 hours and then dried air-dried. The plants were sprayed with

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glutathione in two stages, the first at stage of complete emergence of the spike and the second before completion of flowering. The experiment was planted on 15/12/2023 using a design (RCBD) which had 3 replicates. Area of 1 plots was 2 m2 and contained five lines, each line 2 m long, With 20 cm between each line. Added N fertilizer with rate 5 kg hekter-1 in 2 doses, first at planting and the second after emergence of shoots. Also, DAP fertilizer (N20 P20) was added at a rate of 5 kg hekter-1 at planting and for all experimental units. The chemical and physical traits of the soil were estimated before sowing (Table 1). The rates of rainfall, maximum and minimum temperatures and Relative Humidity were recorded from the Meteorological Department in Dohuk Governorate (Table 2). The traits were studied {plant height, flag leaf area (cm2), chlorophyll content index, no. spikes (m2), no. grains spike-1, wt. 1000 grains, grain yield in grams m-2 and harvest index{%

Table (1) Chemical and physical traits of soil the experiment.

Chemistry Properties	**Malta Location**
PH	5.5
Ec ($ds.m^{-1}$)	0.9
Available P/$mg.kg^{-1}$	49.6
Organic matter ($g.kg^{-1}$)	1.98
Available K ($mg.kg^{-1}$)	110.0
Available N ($mg.kg^{-1}$)	54.2
Physical Properties	**Malta Location**
Clay ($g.kg^{-1}$)	434.7
Silt ($g.kg^{-1}$)	459.6
Sand ($g.kg^{-1}$)	106.2
Texture	Silty clay

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Table 2: Minimum and maximum monthly temperatures (C°), rainfall and relative humidity during season 2023/2024 for Malta site in Dohuk Governorate.

Months	Year	Min. Temperatures(c°)	Max. Temperatures(c°)	Rainfall (mm)	Relative Humidity %
December	**2023**	7.8	17.3	68.9	75
January	**2024**	6.3	13.0	126.6	77
February		6.0	15.8	67.5	68
March		7.9	18.1	226.68	62
April		15.9	28.7	36	46
May		17.9	29.9	64	47
Jun		25.8	40.4	0	26

*Weather station in Dohuk Governorate

Results and discussion

Plant Height(cm:(

Table (3) indicates that Jihan 99 variety recorded highest significant Mean of trait (87.792 cm) compared to Tammuz 2 variety, which recorded lowest Mean (84.504 cm). Increase in height of Jihan 99 variety may be due to genetic nature of the variety, which helped the seeds to grow and develop rapidly in a shorter time and thus form stronger and taller plants compared to plants of Tammuz 2 and Adana varieties. This result is consistent with [41] and [13]. As for glutathione compound, as soaking the seeds at a conc. 200 microgram L-1+ spraying the plants at a conc. 200 milligram L-1achieved highest significant rate for this trait (89.617 cm), while control treatment (without soaking and spraying) achieved lowest average for the trait is (82.739 cm). This is due to important glutathione in positive influence of plant growth and increasing bioprocesses as a result of it containing amino acids (glutamic, cysteine, and glycine), which increase plant's ability to divide and elongate plant cells, thus increasing elongation of the internode, which was reflected in increasing the plant's height [29]. Result is consistent with [16]. [26]. As for Interaction between the varieties and glutathione, as Jihan 99 variety with soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 recorded a significant superiority (91.683 cm) , while interaction between variety Tammuz 2 and control treatment recorded lowest rate (81.250 cm.(

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Table (3): Effect of varieties and glutathione on plant height (cm.(

Varieties	Glutathione				Mean of Varieties
	Control (0)	Seeds Soaking at 200 microgram L^{-1}	Plant Spraying at 200 milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	
Jihan99	84.033 eg	86.433 cd	89.017 b	91.683 a	87.792 a
Tammuz 2	81.250 g	83.100 f	85.433 de	88.233 b	84.504 c
Adana	82.933 fg	84.883 de	87.217 bc	88.933 b	85.992 b
Mean of Glutathione	82.739 d	84.806 c	87.222 b	89.617 a	

Different litters represent signification at the $p<0.05$ level

Flag leaf area(cm2:(

Table (4) indicates that Jihan 99 variety achieved highest significant rate for flag leaf area (40.650 cm2) compared to Tammuz 2 variety (38.171 cm2). This is mainly due to the difference in environmental and genetic factors between varieties. This result is consistent with [1] and [35]. As for glutathione compound, as soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 achieved highest rate (40.733 cm2) compared to control treatment (37.861 cm2). This is attributed to role of glutathione in the bioprocesses that take place inside the plant, which greatly affects division and elongation of plant cells, thus increasing the width of the leaf, in addition to its role in increasing chlorophyll pigment in leaves and thus increasing the efficiency of photosynthesis [29]. This is reflected in increase leaf area, including flag leaf. This is in line with [3] and [6]. Interaction between the varieties and glutathione compound showed that there was a significant superiority when interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 (41.967 cm2), while interaction between variety Tammuz 2 and control treatment gave lowest rate for the trait (36.833 cm2.(

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Table (4): Effect of varieties and glutathione on Flag leaf area (cm2.(

Varieties	Glutathione				Mean of Varieties
	Control (0)	Seeds Soaking at 200 microgram L^{-1}	Plant Spraying at 200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	
Jihan99	38.850 cd	41.133 ab	40.650 ab	41.967 a	40.650 a
Tammuz 2	36.833 e	38.600 cd	37.683 de	39.567 bc	38.171 c
Adana	37.900 de	39.600 bc	38.800 cd	40.667 ab	39.242 b
Mean of Glutathione	37.861 c	39.778 b	39.044 b	40.733 a	

Different litters represent signification at the $p<0.05$ level

chlorophyll content index (Spad.(

Table (5) indicates that Cihan 99 variety achieved highest significant Mean for chlorophyll content index (45.527 Spad), while Tammuz 2 variety achieved lowest Mean for the trait (42.836 Spad). This may be attributed to nature of growth of Cihan 99 variety, which was characterized by an increase in chlorophyll content and an increase in length of its vegetative growth period compared to two varieties Tammuz 2 and Adana. This result is consistent with [21] and [24]. Noted that soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 achieved a significant superiority (45.916 Spad). while control treatment achieved lowest rate for the trait (42.527 Spad). This is due to fact that glutathione helped accumulate large amounts of chlorophyll in the leaves as a result of it being a growth stimulant in the plant, in addition to its basic role in inhibiting the action of chlorophyll-degrading enzymes, as well as its basic role in delaying aging (extending the life of the plant) [31]. This is in line with [14] and [31]. As for interaction between the varieties and glutathione showed interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1, which gave highest rate (47.232 Spad), while interaction between variety Tammuz 2 and control treatment achieved the lowest rate (41.120 Spad.(

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Table (5): Effect of varieties and glutathione on chlorophyll content index (Spad).

ties	thione				of ties
	rol (0)	Seeds Soaking) ogram L^{-1}	Plant Spraying at200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	
99	7 cd	0 ab	0 c	2 a	7 a
nuz 2	0 g	0 d-e	3 fg	2 c	6 c
a	3 ef	0 c	3 d-e	5 b	5 b
of thione	7 c	0 b	6 c	6 a	

Different litters represent signification at the $p<0.05$ level

No. spikes (m2:(

Table (6) shows that Jihan 99 variety superior in No. spikes (m2), which recorded (380,042 spikes m2), compared to Tammuz 2 variety (362,458 spikes m2). The reason for this may be due to the genetic nature that excelled Jihan 99 variety from the rest of the varieties. This result is consistent with [7] and [23].As for the glutathione factor, soaking the seeds at a conc. 200 microgram L-1 and soaking the seeds at a conc. 200 Microgram L-1 + spraying the plants at a conc. 200 milligram L-1 recorded highest rate for the trait (374.445 and 378.667 spikes m2), respectively, compared to control treatment (362.944 spikes m2).This may be due to the positive role of the glutathione in biosynthesis pathways of many compounds, including protein and DNA, and the activation of hormones and enzymes, in addition to being an antioxidant compound, which is accompanied by a decrease in the conc. H2O2 in the leaves, Also, increasing the area of the flag leaf (Table 4) and then increase in transfer of photosynthesis products to plant, thus increasing number of shoots and thus increasing no. spikes.This finding is in line with [28] and [15].Interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1+ spraying the plants at a conc. 200 milligram L-1 had a significant effect on this trait and achieved highest rate for the trait (390.667 spikes m2), while the variety Tammuz 2 and control treatment (357.833 spikes m2).

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Table (6): Effect of varieties and glutathione on number of spikes (m2).

ties	thione				of ties
	ol (0)	Seeds Soaking at 200 gram L^{-1}	Plant Sp at200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	
99	00 d-e	00 ab	00 cd	67 a	42 a
nuz 2	33 h	67 e-g	00 hg	33 e-g	58 c
a	00 f-g	67 d-e	00 e-g	00 bc	42 b
of thione	44 c	45 a	33 b	67 a	

: Different litters represent signification at the p<0.05 level

N0. grains spike-1

Table (7) indicates that two varieties Jihan99 and Adana were significantly superior in No. grains spike - 1 (44,142 and 43,200 grains spike - 1), respectively, while the Tammuz 2 variety recorded lowest Mean for the trait (41,721 grains spike - 1). The reason for increase in no. spike grains for variety Jihan 99 and Adana may be attributed to increase in flag leaf area and chlorophyll content index (Table 4). And 5) which affected increase in photosynthesis process and thus increased dry matter accumulation in the grains, and then increase in no. grains spike -1. This is consistent with [28] and [2]. This trait was significantly affected by the concentrations of glutathione spraying, as highest significant rate was observed when soaking the seeds at a conc. 200 microgram L-1+ spraying the plants at a conc. 200 milligram L-1 (43,789 grains spike - 1), while lowest rate for the trait was observed when control treatment (42,350 grains spike-1. This due to increase in flag leaf area and chlorophyll content index (Table 4 and 5) Thus, increasing efficiency of photosynthesis process increases accumulation of dry matter through cell expansion and division, and this is reflected in an increase in no. flowers and more fruit set in the plant as a result of the role of glutathione in germination of the pollen tube and pollen grains during the process of pollination and fertilization. This result is consistent with [15] and [27]. Interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 showed a significant superiority in this trait (44,867 grains spike - 1), compared to variety Tammuz 2 and control treatment (40,750 grains spike - 1).

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Table (7): Effect of varieties and glutathione on no. grains spike-1

ties	thione				
	rol (0)	Seeds Soaking at 200 gram L $^{-1}$	Plant Spraying at 200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	of ties
99	0 ab	0 ab	0 ab	7 a	2 a
nuz 2	0 d	0 cd	3 cd	0 bc	1 b
a	0 bc	0 bc	0 bc	0 ab	0 a
of thione	0 b	0 b	4 b	9 a	

Different litters represent signification at the p<0.05 level

Wt. 1000 grain (g:(

Table (8) showed that Jihan 99 variety was significantly superior in wt. 1000 grain (30.425 g) compared to Tamuz 2 variety (28.275 g). The reason for increase in wt. 1000 grains in Jihan 99 variety is due to increase in area of flag leaf and chlorophyll content index (Table 4 and 5), and then an increase in process of photosynthesis and reflected in accumulation of dry matter products in the grains, and then increase in wt. grain. This is consistent with [20] and [9]. It was observed that there was a significant superiority of the glutathione compound when soaking the seeds at a conc. 200 microgram L-1 and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 (29.816 and 30.444 g), respectively, compared to control treatment (28.450 g).Increase in grain weight may be due to soaking the seeds and spraying the plants with glutathione has been linked to its role in delaying aging and prolonging plant life [29] Which led to an increase in effective period for grain filling, as well as providing an efficient source during the grain filling period by increasing the chlorophyll content index in the leaves (Table 5) and thus increasing accumulation of dry matter products in the grains, and then increase in grain weight. This is consistent with [30] and [8]. Record the interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 and the Adana variety and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 highest rate of the trait (31.417 and 30.900 g) respectively compared to the interaction of the Tammuz 2 variety with control treatment (27.450 g).

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Table (8): Effect of varieties and glutathione on wt. 1000 grain (g).

ties	thione				of ties
	rol (0)	Seeds Soaking at200 gram L $^{-1}$	Plant Sp at200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	
99	0 bc	0 ab	3 ab	7 a	5 a
nuz 2	0 e	3 d-e	0 de	7 cd	5 c
a	0 d-e	7 ab	0 cd	0 a	9 b
of thione	0 c	6 a	7 b	4 a	

Different litters represent signification at the p<0.05 level

Grain yield (g m-2(

Table (9) indicates that Jihan 99 variety achieved the highest significant mean for grain yield (482.388 g m-2), while the Tammuz 2 variety gave lowest mean for the traits (412.360 g m-2). The reason for this is that increase in grain yield in Jihan 99 variety was due to its superiority in no. spikes (m2), no. grains spike-1, and wt. 1000 grains (Table 6, 7, 8). The result is consistent with [11] and [17]. As for glutathione compound, as soaking the seeds at a conc. 200 microgram L-1+ spraying the plants at a conc. 200 milligram L-1 record highest rate for trait (487,000 g m-2), compare to control treatment (417,789 g m-2). This is due to increase in grain yield during the fourth treatment with glutathione compound and increase in the yield components, which are number Spikes (m2), no. grains spike-1, and wt. 1000 grain (Table 6, 7, 8). This is in line with [4] , [10], and [19]. Interaction between varieties and glutathione showed that there was a significant superiority between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1+ spraying the plants at a conc. 200 milligram L-1, which gave (528.300 gm L-1), while interaction between the variety Tammuz 2 and control treatment gave lowest rate for the trait (390.250 g m L-1.(

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Table (9): Effect of varieties and glutathione on grain yield (g m-2).

Varieties	Glutathione				Mean of Varieties
	Control (0)	Seeds Soaking at200 microgram L $^{-1}$	Plant Spraying at200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at200milligram	
Jihan99	445.850 d	477.167 c	478.233 c	528.300 a	482.388 a
Tammuz 2	390.250 f	417.258 e	402.083 f	439.850 d	412.360 c
Adana	417.267 e	466.583 c	438.867 d	492.850 b	453.892 b
Mean of Glutathione	417.789 d	453.669 b	439.728 c	487.000 a	

Different litters represent signification at the p<0.05 level

Harvest index:%

Table (10) indicates the moral superiority of Adana variety in the trait of harvest index (39.219%), while the variety Tammuz 2 recorded the lowest rate for the trait (35.794%). The reason for this may be due to the difference between varieties in grain yield and biological yield, as well as the genetic variation of varieties and experimental factors. This result is consistent with [37] and [5]. Regarding the glutathione compound, soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 achieved highest rate (42.485%) compared to spraying the plants at a conc. 200 milligram L-1 (32.918%). The increase in harvest index in this treatment is due to increase in grain yield (Table 9). This is agreed with [12] and [36].The interaction between varieties and glutathione showed that there was a significant superiority in interaction between Jihan 99 variety and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1 and variety Adana and soaking the seeds at a conc. 200 microgram L-1 + spraying the plants at a conc. 200 milligram L-1,as record highest rate of the trait (43.556 and 43.887%), compared to Tammuz 2 variety and spraying the plants at a conc.200 milligram L-1 (30.810%).

Table (10): Effect of varieties and glutathione on harvest index%.

Varieties	Glutathione				Mean of Varieties
	Control (0	Seeds Soaking at *200* microgram L $^{-1}$	Plant Spraying at 200milligram	Seeds Soaking at 200 micrograms + Plant Spraying at 200milligram	
Jihan99	39.466 b	36.214 cd	34.247 de	43.556 a	38.371 b
Tammuz 2	37.156 c	35.195 d-e	30.810 f	40.014 b	35.794 c
Adana	39.978 b	39.316 b	33.696 e	43.887 a	39.219 a
Mean of Glutathione	38.867 b	36.908 c	32.918 d	42.485 a	

Different litters represent signification at the p<0.05 level

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Conclusion

It was noted that the Jihan 99 variety was adapted to the conditions of the planting region compared to the Tammuz 2 and Adana varieties in all traits of wheat crop improved **The** except for harvest index. Also, soaking the seeds and spraying the plant with glutathione compound had a positive effect on the growth and yield of a plant.

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