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Effect of Spraying with Glycine Betaine acid on the Growth and Yield of Sesame under Conditions of Salt Stress.

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ABSTRACT

The experiment was carried out in the agricultural season of 2023 at the site of the College of Agriculture, Anbar University. To study the effect of spraying with glycine betaine acid on the growth and yield of sesame under conditions of salt stress, a complete randomized block design was used. design was used R.C.B.D in the order of splinter plates and with three repeaters. The experiment included two factors, the first factor was the levels of salt stress with three salt concentrations of sodium chloride (NaCl): 1.5, 3 and 4.5 decisimens m-1, as well as the measurement treatment (distilled water) and a code for these coefficients in the codes s1, s2, s3 and s0 respectively, the main panels were switched on. The second factor was spraying with three concentrations of glycine betaine acid: 50, 100 and 150 mg l-1, as well as the metering treatment (distilled water) and its code gb1, gb2, gb3 and gb0 in succession, which occupied the secondary plates. The results showed the superiority of salt stress treatment (S0) in most of the studied attributes: plant height, leaf area, the number of capsules weighing 1000 seeds, seed yield, biological yield, and harvest index. The values were as follows: 96.42 cm, 1020.0 cm2, 122.39 plant capsules-1, 4.48 g, 76.41 g Pot^{-1}, 177.75 g Pot^{-1}, 41.73 %. On the relay The results also showed the superiority of the spray treatment with glycine betiane gb3 acid in all the studied qualities mentioned above. The results also recorded the presence of significant differences between the interference coefficients conclude from this study that irrigation of plants with high levels of salt stress has reduced the seed yield of the Sesame crop and the addition of high concentrations of glycine Betaine acid has somewhat mitigated the effect of salt stress, especially at low levels of salinity, and therefore it is possible to use water with low salt concentrations in the irrigation of Sesame crop and using Glycine irrigate it with low-salinity water.

***Keywords*:** Sesame yield, Salt Stress, Glycine Betiane acid, Seed yield, Biological yield.

INTRODUCTION

Sesame is an economically important oil crop, as its seeds are used in direct human nutrition and many food industries due to their high content of essential nutrients, as the percentage of oil in its seeds is 50-60%, the percentage of protein is 25%, the percentage of carbohydrates is 13.5% and the percentage of minerals is 1% [1]. The Sesame crop is also characterized by being a good source of vitamins, including pantothenic, vitamin E, A, B, and a source of minerals, including calcium, copper and phosphorus, which are necessary for human consumption,. Sesame seeds are rich in many antioxidants, including sesamin and sesamol. Despite the economic importance of the crop in Iraq, its productivity in Iraq is still low for many reasons, including the aggravation of the problem of salinity in most agricultural lands in central and southern Iraq [2]. As 75% of the cultivated lands in central and southern Iraq are affected by salinity to varying degrees, and therefore salinity has become an obstacle to agricultural development in the country. This problem began to emerge in the cities of Iraq with the progress of time, including Anbar province in particular, causing a noticeable decrease in the productivity of most field crops in Iraq, including Sesame crop.Soil salinity and salt stress are among the major problems facing agricultural expansion with the lack of water in Iraq, the Arab world and the world, as the impact of salinity intensifies with increasing temperature rates due to global heat.Salt stress is one of the most important abiotic stresses affecting crop growth and production in the world , a the high level of salts in the soil often causes a decrease in agricultural production as alinity affects more than 20% of the total cultivated area in the world, causing severe losses in crop yields[3]. In order to restore these lands to their former status, it is necessary to carry out integrated reclamation operations, starting with the implementation of irrigation and drainage networks, re-adjustment, leveling and washing, which are expensive works that require an agricultural policy adopted by the state and are difficult to carry out at the individual level, as well as the need for washing operations to large quantities of water, which is difficult to provide in light of the scarcity of irrigation water and its high salinity at the present time and the possibility of its aggravation in the future, which necessitates the adoption of other methods that are less expensive and achievable, including living with the problem of salinity as a reality and finding ways to achieve this using certain amino acids that will increase the tolerance of the Sesame crop to stress Being one of the crops sensitive to salinity, one of these acids is the use of Glycine betaine acid (GB), which is an important amino acid that protects crops from environmental stresses, it is one of the fast-soluble solutions in water and economically feasible in reducing the harmful effects of salinity on plant growth, and the accumulation of this acid inside the plant does not cause toxicity to the plant, except that high concentrations of it are an indicator of plant tolerance to salinity and drought, as many researchers have found that plants containing high concentrations of Glycine acid betaine has the ability to resist drought more than others and is a decisive factor with the tolerance of salinity [4]. pointed out that the average height of a plant decreases with increasing salinity and therefore the cell size decreases because the increase in salinity negatively affects the cell and its size, and elongation and expansion in plant cells decreases during development in high-salinity environments [5]. found an increase in the number of capsules per plant of sesame under medium levels of salinity and be low at high levels of salinity.A lot of studies have been conducted to treat salt stress using the amino acid glycine betaine (GB) as it helps in increasing the tolerance of plants to stress conditions, but there are no such kind of studies carried out in Iraq on the Sesame crop, so based on the above, this study was carried out to find out the effect of spraying with glycine betaine acid on the growth and yield of sesame under conditions of salt stress Claicin betaine is a compound consisting of the amino acid claicin paired with the compound betaine, and it carries a positive ketone charge of quaternary ammonium, and it works to methylate the amino acids associated with it. It was discovered in the sugar beet plant and is called tri-methyl glycine (Tri methyl glycine). Its molecular formula is (NH2CH2COOH) The mechanism of its action is due to the control of the osmosis of the cells. This acid is a sensor and a measure of the cells during the osmotic disorder, in addition, it has the ability to dissolve in water and fill the gaps with a high osmotic juice. An osmotic voltage is formed, which has the ability to dissolve in water and thus fills the gaps with a high osmotic juice and is found in copious quantities inside to respond to water stress, also an osmotic voltage to remove water molecules inside chloroplasts One of its most important roles is to protect the compounds present inside the plant, such as ATP synthase And the level of internal [6].

MATERIALS AND METHODS

Pots experiment was carried out in the agricultural season of 2023 at the site of the college of Agriculture - Anbar University, longitude and latitude (north 3699800 East 345150) to study the effect of spraying with Glycine Betaine acid on the growth and yield of sesame under conditions of salt stress, according to the design of complete random sectors. R.C.B.D in the order of Splinter plates and with three repeaters. The experiment included two factors, the first factor was the levels of salt stress with three salt concentrations of sodium chloride (NaCl): 1.5, 3 and 4.5 decisimens M-1, as well as the measurement treatment (distilled water) and a code for these coefficients in the codes S1, S2, S3 and S0 respectively, the main panels were switched on. The second factor was spraying with three concentrations of Glycine Betaine acid: 50, 100 and 150 mg L-1, as well as the metering treatment (distilled water) and its code GB1, GB2, GB3 and GB0 in succession, which occupied the secondary plates. In the experiment, 48 cylindrical anvils with a height of 40 cm, a diameter of 35 cm and a capacity of 35 kg were used.The surface area of one Anvil is 962.5 cm2. A small amount of gravel was placed at the bottom of the anvils and a light layer of glass wool was placed on top of the gravel and then filled with mixed soil taken from the experimental field at the first research station of the Faculty of Agriculture in the amount of 35 kg per anvil based on dry weight. The seeds were planted in the anvils on 17/6/2023. The salt stress coefficients were applied in the 4-leaf stage after the emergence of the plants in a homogeneous manner. The anivels were irrigated with salt concentrations after the humidity reached 50-60% of the field capacity. The washing requirements for the anvil soil were also carried out according to the recommendations. As for the spraying of glycine Betaine acid concentrates, it was in two batches, the first batch at the 4-leaf stage and the second batch at the beginning of the flowering stage. Five plants were taken from each anvil to study the following qualities: Plant height cm [7]. leaf area (cm^2), number of capsules per plant (plant capsule-1), Weight1000 gm harvest guide (%), biological yield (gm Pot^{-1}), seed yield (gm Pot^{-1}) (%)

RESULTS AND DISCUSSION

1. Plant height

The results in Table (1) showed the presence of significant differences between the coefficients of salt stress and the coefficients of glycine betaine acid (GB) and the overlap between them in the characteristic of plant height, where the comparison treatment(S0), which averaged (96.42) CM, was superior between the coefficients of salt stress. In contrast, the lowest average of these coefficients in the treatment (S3) reached an average of (58.8) CM, the reason for the decrease in plant height may be vegetative and otherwise there is an increase in the aging and abscess of the Leaf. [8]. Also, the rate of plant height decreases as the salinity increases. Therefore, the cell size decreases because the increase in salinity negatively affects the cell and its size. The elongation and expansion in plant cells decrease during development in high-salinity environments [9]and [10] .The results of the same table also showed that there are differences between the coefficients of glycine betaine acid (GB) for this trait, where the concentration exceeded (GB3) and averaged (89.42) CM, while the concentration (GB0) gave the lowest average of (69.17) CM, and this shows that high concentrations of glycine betaine acid increase the plant's height, and this was found by that addition of in addition, it is characterized by its rapid solubility in water and easy penetration of cellular membranes inside the plant and has a role in regulating the osmotic pressure in the cytoplasm, and this The whole is positively reflected on the growth indicators of the plant cm The results of the same table also showed that there are significant differences in the overlap, as the overlap between the transaction S0 and GB3 exceeded and gave the highest average of 106.00 CM, and this overlap does not differ significantly from the overlap between the transaction S1 and

GB3, giving an average of 104.67 CM, while the overlap between the transaction S3 and GB0, and the overlap S3 and GB1 gave the lowest averages, which amounted to 54.00 cm each[11].

Table 1: Effect of salt stress and spraying with glycine betaine acid and their overlap in plant height (cm).

Concentration of salt stress (dS/m)	Concentration of (Glycine Betiane acid g/L)				
	0	50	100	150	Average
0	85.33	95.33	99.00	106.00	96.42
1.5	74.33	75.33	82.33	104.67	84.17
3.0	62.00	68.67	75.33	81.67	71.92
4.5	54.00	54.00	59.00	65.33	58.8
LSD	3.090				1.951
Average Glycine	69.17	73.08	78.92	89.42	
LSD	1.529				

2- Paper Space

The results of Table 2 the presence of significant differences between the coefficients of salt stress and the coefficients of glycine betaine acid (GB) and the overlap between them in the quality of paper space, where the treatment exceeded (S0), which averaged 1020.0 CM2, while the lowest average of these transactions in the transaction (S3) reached an average of 875.3 CM2 [12].areas are affected even by moderate stress conditions, which leads to a decrease in expansion as well as a decrease in the filling pressure of the cell wall due to the deficit that occurs in water or in the rate of water flow to the cells in the plant due to lack of waterThe results of the same table also showed differences between the coefficients of glycine betaine acid (GB) for this trait, where the concentration exceeded (GB3) and averaged 951.8 CM2, while the concentration (GB0) gave the lowest average of 934.3 CM2 This acid does not harm the plant even if used in high concentrations [13]. The results of the same table indicated that there was a significant difference in the mean overlap between the salt stress coefficients and the concentration of glycine betaine acid (GB) for the paper area trait, where the overlap treatment S0 and GB3 recorded the highest average for this trait was 1030.0 CM2, while the overlap between S3 and GB0 gave the lowest average of 863.7 CM2.

Table (2) Effect of salt stress glycine betaine acid and the overlap between them in the quality of leaf area (cm2)

Concentration of salt stress (dS/m)	Concentration of glycine (mg/L)				
	0	50	100	150	Average
0	1008.3	1019.7	1022.0	1030.0	1020.0
1.5	985.0	989.7	983.0	993.3	987.8
3.0	880.3	884.7	883.3	896.0	886.1
4.5	863.7	872.7	877.0	887.7	875.3
LSD	5.4				4.6
Average Glycine	934.3	941.7	941.3	951.8	
LSD	2.1				

3- Number Capsules

The results of Table (3) showed the presence of significant differences between the coefficients of salt stress and the coefficients of glycine betaine acid (GB) and the overlap between them in the quality of the number of capsules, where the transaction (S0) was superior, which averaged 122.39 plant capsules-1, while the lowest average of these coefficients in the transaction (S3) reached an average of 77.33 plant capsules-1. These results agreed with what [14]. indicated that increasing the number of capsules per sesame plant under medium levels of salinity is low at high levels of salinity, When the water salinity level increased, it was noted that the number and weight of capsules decreased compared to the control with the highest percentages and the number of capsules, where 37.56 capsules per plant and 494 grams per plant were recorded for processing, respectively, and the lowest level was in the salinity level of the international system, which recorded (230) capsules per plant and(200) plants. The differences were obvious, as the effect of extreme salinity was noticeable and caused the death of plants (S3) and(S4) of local plants.the results of the interaction showed that the highest weight and number of capsules was recorded in the local type compared to the treated capsules(S2). the capsules were of great importance, while the plants (S3) and (S4) did not produce capsules in the Sumer and locale varieties [15]. The results of the same table also showed differences between the coefficients of glycine betaine acid (GB) for this trait, where the concentration exceeded (GB3) and averaged 113.91 plant capsules-1, while the concentration (GB0) gave the lowest average of 89.33 plant capsules-1. This acid does not harm the plant even if used in high concentrations [16]. There is no moral overlap between the two factors of the study as for the overlap, it was significant since the overlap between the transaction gave S0 and GB3 had the highest average of 133.57 plant capsules-1, and this did not differ significantly from the overlap between the treatment of S1 and GB3, which averaged 133.00 plant capsules^{-1} While the overlap between S3 and GB0 gave the lowest average of 67.00 plant capsules^{-1}.

Table 3: Effect of salt stress and spraying with Glycine Betaine acid and the overlap between them in the number capsules (plant capsule-1).

Concentration of salt stress (dS/m)	Concentration of Glycine Betiane acid (mg/L)				
	0	50	100	150	Average
0	112.00	119.00	125.00	133.57	122.39
1.5	96.33	102.00	108.66	133.00	110.00
3.0	82.00	89.33	97.66	102.66	92.91
4.5	67.00	74.33	81.00	87.00	77.33
LSD	0.943				0.235
Average Glycine	89.33	96.16	103.08	113.91	
LSD	0.534				

Weight 1000 Seeds- 4

The results of Table (4) showed that there were significant differences between the salt stress coefficients and the concentration of glycine betaine acid and the overlap between them in the weight class of 1000 seeds (G), where treatment (S0) exceeded the average of 4.48 G, while treatment (S3) gave the lowest average of 3.06 G. The results of the same table also showed significant differences between the concentrations of glycine betaine acid, where the concentration(G3) gave the highest average of 4.68 G, while the concentration(G0) gave the lowest average of 2.53 g. There is also an overlap between the two factors of the study, where the highest overlap was given between the S0 and G3 coefficients with an average of 5.50 G, while the lowest overlap was between the S3 and G0 coefficients and amounted to 1.53 G Genetic differences between plant varieties can play a role in these differences, as some varieties may be more responsive to glycine betaine acid or salt stress than others. Complex interactions between the coefficients and the concentration of cleisin-betaine acid can lead to mixed results, as some interferences may have a positive effect on seed weight. In contrast, others may have a negative effect. The increase in salinity led to a decrease in the weight of 100 seeds in sunflower varieties. Therefore, a decrease in the weight of 1000 seeds of a sesame crop is due to a decrease in roots, plant height and plant growth [17]. The seed yield decreases with high salinity levels, and there were differences between varieties in which salinity reduces the seed production of Sesame varieties, and they indicated a significant change in the tolerance of salinity levels between the varieties tested [18]. found that a decrease in the yield of sunflower and canola varieties' seeds is due to increased salinity levels [19].

Table (4): Effect of salt stress and spraying with glycine betaine acid and their interference in the weight of 1000 seeds (g).

Concentration of salt stress (dS/m)	Concentration of glycine (mg/L)				
	0	50	100	150	Average
0	3.50	4.13	4.77	5.50	4.48
1.5	2.80	3.40	4.33	4.87	3.85
3.0	2.27	2.90	3.30	3.77	3.06
4.5	1.53	2.53	3.60	4.57	3.06
LSD	0.47				0.25
Average Glycine	2.53	3.24	4.00	4.68	
LSD	0.25				

Seed quotient 5-

The results obtained in Table (5) indicate that there are significant differences between the salt stress coefficients and the concentrations of glycine betaine acid for the quality of the seed yield, which means that there is a noticeable effect of these factors on the productivity of seeds, where the treatment was superior 76.41 gm potted^{-1} and the lowest average for these transactions in the transaction was S3 51.50 gm potted^{-1} where it averaged S0 reported that all the fields of Root varieties were reduced by increasing the level of saliva in the field in the cannabis experiment, that the temperature of the leaves led to a decrease in the conductivity of transpiration nozzles and the osmotic potential was increased under salinity levels[20]. They showed a significant genetic variation between the varieties tested for sweetening and they responded differently to saliva. As they pointed out, there are many tolerance mechanisms and they worked in good varieties, and this decrease in seed yield is probably due to a decrease in plant height, the number of capsules, root growth and shoots [21]. The results of the same table also showed differences between the coefficients of glycine betaine acid (GB) for this trait, where the concentration exceeded (GB3) and averaged 76.00 gm potted^{-1}, while the concentration (GB0) gave the lowest average of 52.83 gm potted^{-}

[1] Claicin betaine acid works on the survival of plants and makes them resistant to stresses, and plants are predisposed not to get the metabolic imbalance caused by those stresses, as the accumulation of claicin betaine acid caused by salicylic acid under salt stress reduces ethylene(Ethylene) and stress and increases glutathione[22].The reason for the significant differences between the coefficients of salt stress and glycine betaine acid (GB), and between the concentrations of glycine betaine acid, and the influence of complex interactions between them on the quality of the seed yield can be caused by several factors:Direct and indirect effects: both salt stress and claicin-betaine acid may have a direct impact on plant growth and seed development, and this can change depending on their concentrations and exposure methods. In addition, there may be an indirect effect through their effects on such environmental factors as soil, water and nutrients available to the plant The table also indicates that there is an overlap between the study factors, where the highest overlap between S0 and G3 was 86.66 gm potted^{-1}, and this does not differ significantly from the overlap between S1 and G3, averaging 86.33 gm potted^{-1}, while the overlap between the coefficients S3 and G0 gave the lowest average of 41.00 gm potted^{-1}.

Table (5): Effect of salt stress and spraying with Glycine Betaine acid and the interference between them in the seed yield (gm potted-1)

Concentration of salt stress (dS/m)	Concentration of glycine (mg/L)				
	0	50	100	150	Average
0	67.00	73.00	79.00	86.66	76.41
1.5	57.66	64.00	70.00	86.33	69.50
3.0	45.66	53.00	61.66	69.00	57.33
4.5	41.00	48.00	55.00	62.00	51.50
LSD	0.867				0.570
Average Glycine	52.83	59.50	66.41	76.00	
LSD	0.421				

6- Biological Quotient

The results of Table (6) showed that there are significant differences between the salt stress coefficients and the concentrations of clysin betaine acid and the overlap between them in the biological quotient (gm potted^{-1}), where treatment (S0) gave the highest average of 177.75 gm potted^{-1}. In comparison, treatment (S3) gave the lowest average of 153.33 gm potted-1 The results of the same table also showed significant differences between the concentrations of glycine betaine acid (GB), where the concentration (G3) gave the highest average of 174.00 gm potted-1. In comparison, the concentration(G0) gave the lowest concentration of 157.41 gm potted^{-1}. As for the overlap, the results of the same table showed that there are significant differences in the overlap between the two factors of the study, where the overlap exceeded between S0 and G3 and averaged 183.66 gm potted^{-1}, And it was no different from the overlap between S1and g3 They averaged 183.00 gm potted^{-1} while the least overlap was between S3 and G0, which averaged 143.00 gm potted^{-1}. The reason for the presence of significant differences between the coefficients and the concentration of glycine betaine acid and the influence of the overlap between them on the character of the biological quotient can be multiple. The difference may be due to multiple influences, such as changes in soil, climatic conditions, plant reactions to the chemicals used. Differences in plant genes could also have a role in these divergent results. In addition, there may be complex interactions between various factors affecting the quality of the biological quotient, which leads to the differences observed in the results [19]. When cultivating different varieties of oats, the researcher found a decrease in the biological quotient, as this led to a gradual decrease in the quotient by increasing the salinity levels of irrigation water. This also led to a decrease in the number of deltoids, the number of cuttings, as well as a decrease in the number of deltoid grains. this happens because salt stress leads to an imbalance in the nutritional balance, resulting from a shortage in the availability of nutrients, competitive absorption, distribution and transportation within the plant. all this negatively affects the process of photosynthesis and its products. Through all this, the researcher concluded that the varieties differ among themselves in the effect of salt stress on their biological yield and other qualities results are in agreement with the findings [22].

Table (6): Effect of salt stress and spraying with Glycine Betaine acid and their interference in the biological quotient (gm potted-1).

Concentration of salt stress (dS/m)	Concentration of glycine (mg/L)				
	0	50	100	150	Average
0	171.66	175.66	180.00	183.66	177.75
1.5	163.00	168.00	173.00	183.00	171.75
3.0	152.00	158.00	163.00	167.33	160.08
4.5	143.00	151.33	157.00	162.00	153.33
LSD	1.012				0.681
Average Glycine	157.41	163.25	168.25	174.00	
LSD	0.486				

7- Harvest Guide

The results in Table (7) showed that there are significant differences between the coefficients of salt stress and the coefficients of glycine betaine acid (GB) and the overlap between them in the quality of harvest evidence (%), where the transaction (S0) excelled, averaging 41.73%, while the lowest average of these transactions in transaction (S3), averaging 33.02 %. The results of the same table also showed differences between the coefficients of glycine betaine acid (GB) for this trait, where the concentration exceeded (GB3) an. In comparison, ged 41.72%, while the concentration (GB0) gave the lowest average of 33.24%. The significant differences that appeared in the results between the coefficients and the concentration of glycine betaine acid and the influence of their overlap on the quality of the harvest guide can be caused by multiple factors. For example, there may be an effect from the composition of the soil and nutrition, as well as the direct effects of claicin-betaine acid on the growth of plants. The interplay of different factors may lead to complex interactions affecting the yield ratio, such as stimulation or mutual inhibition effects between the chemicals used. These factors can all contribute to the differences observed in the results. The reason for this decrease was the decrease in the grain yield due to the effect of the salinity of irrigation water on the number of buckets per unit area, grain weight, and the number of grains per bucket. (Vadaliya and Bhumika et al.,2019). The decrease in the yield, its components and the harvest guide, due to the effect of salt stress, which results in a decrease in the expansion of the biological yield, acceleration in the aging of tissues and cells, which leads to a decrease in the average photosynthesis, and the transfer of its products from photosynthetic sources to estuaries grains [23]. As for the overlap, it was significant, as the overlap between the transaction S0 and GB3 gave the highest average of 44.89%, and it did not differ significantly from the overlap between S1 and GB3, averaging 44.72%. While the overlap between S3 and GB0 gave the lowest average of 28.64%.

Table (7): Effect of salt stress and spraying with Glycine Betaine acid and the overlap between them in the harvest guide (%)

Concentration of salt stress (dS/m)	Concentration of glycine (mg/L)				
	0	50	100	150	Average
0	38.94	40.69	42.38	44.89	41.73
1.5	35.36	37.93	40.45	44.72	39.61
3.0	30.02	33.53	37.43	40.10	35.27
4.5	28.64	31.70	34.58	37.18	33.02
LSD	0.650				0.470
Average Glycine	33.24	35.96	38.71	41.72	
LSD	0.298				

Conclution

We conclude from this study that irrigation of plants with high levels of salt stress has reduced the seed yield of the Sesame crop and the addition of high concentrations of glycine Betaine acid has somewhat mitigated the effect of salt stress, especially at low levels of salinity, and therefore it is possible to use water with low salt concentrations in the irrigation of Sesame crop and using Glycine irrigate it with low-salinity water.

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تأثير الرش بحامض Glycine Betaine في نمو وحاصل السمسم تحت ظروف الإجهاد الملحي.

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الخلاصة

نفذت تجربة سنادين في الموسم الزراعي للعام ***2023*** في موقع كلية الزراعة ـ جامعة الانبار. لغرض دراسة تأثير الرش بحامض ***Glycine Betaine*** في نمو وحاصل السمسم تحت ظروف الإجهاد الملحي، وفق تصميم القطاعات العشوائية الكاملة ***R.C.B.D*** بترتيب الألواح المنشقة وبثلاث مكررات. وتضمنت التجربة عاملين هما العامل الأول مستويات من الإجهاد الملحي بثلاثة تراكيز ملحية من كلوريد الصوديوم (***NaCl***) هي: ***1.5*** و***3*** و***4.5*** ديسيسيمنز م$^{-1}$ فضلاً عن معاملة القياس (ماء مقطر) ورمز لهذه المعاملات بالرموز ***S1***، ***S2*** و***S3*** و***S0*** على التتابع، وقد شغلت الألواح الرئيسية. أما العامل الثاني هو الرش بثلاثة تراكيز من حامض ***Glycine Betaine*** وهي: ***50***، ***100*** و***150*** ملغم لتر$^{-1}$، فضلا عن معاملة القياس (ماء مقطر) ورمز لها ***GB1*** و***GB2*** و***GB3*** و***GB0*** على التتابع، والتي شغلت الألواح الثانوية. واظهرت النتائج تفوق معاملة الاجهاد الملحي (***S0***) في اغلب الصفات المدروسة وهي : ارتفاع النبات ، المساحة الورقية ، عدد الكبسولات ، وزن ***1000*** بذرة ، حاصل البذور، الحاصل البايولوجي ، دليل الحصاد وكانت القيم كالتالي ***96.42***سم ، ***1020.0*** سم2، ***122.39*** كبسولة نبات-1، ***4.48*** غم ، ***76.41*** غم اصيص-1 ، ***177.75***غم اصيص-1، ***41.73*** % على التتابع. كما أظهرت النتائج تفوق معاملة الرش بحامض ***GB3 Glycine Betiane*** في جميع الصفات المدروسة المذكورة في أعلاه. كما سجلت النتائج وجود فروق معنوية بين معاملات التداخل.

الكلمات المفتاحية: محصول السمسم ،الاجهاد الملحي ، حامض ***Glycine Betiane***، حاصل البذور، الحاصل البايولوجي.