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EFFECT OF 6-BAP GROWTH REGULATOR ON SEED PRIMING OF SEVERAL BREAD WHEAT VARIETIES UNDER WATER IRRIGATION SALINITY STRESS

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Abstract: Two experiments were carried out under greenhouse conditions at the College of Agriculture - University of Anbar for the spring season 2018, using plastic seedlings containers on sandy soil to study the effect of 6-Benzylaminopurine growth regulator and used at a concentration of 250 mg l^{-1} on seedlings performance of six varieties of wheat, namely; IBA 99, Bohooth 10, Bohooth 22, Abu Ghraib, Bohooth 158 and Ezz under four levels of saline irrigation water 3.00, 4.50, 6.00 and 7.50 dS m^{-1} in addition to the comparison treatment distilled water 0 dS m^{-1}. The results of the experiment showed that the low concentrations of salts in the nutrient medium activate the radicle growth in the wheat plant. The seeds of wheat germinated in the irrigated medium were outperformed with salty water 3.00 dS m^{-1} with the highest averages of the studied traits. Ezz cultivar was the most toler-ant category of salinity of irrigation water compared to other cultivars. The results of the experiment also showed that soaking the seeds of wheat with a growth regulator solution 6-Benzylaminopurine contributed to reducing the negative effect resulting from the increase in saline stress in the germination medium which improved the seed germination and seed growth characteris-tics under saline stress. The research recommends using the Ezz variety in the event of high salinity in irrigation water, as well as treating the seeds with the 6-BAP growth regulator to increase the tolerance of seeds to the stress of irrigation water salinity.

Keywords: 6- Benzylaminopurine, Salinity Stress, Seed Priming, *Triticum Aestivum* L.

1. Introduction

Wheat crop considered as the first crop in the world in terms of total cultivating areas and global production. Wheat plants considered as one of semi tolerance crops to salinity so it is considered a desire crop under inappropriate conditions such as lack of irrigation or high salinity, but the germination stage is the most salinity when salinity causes a huge failing in seed germination and seedling development [1]. The harmful effect of salinity comes as chemical stress which effect of absorbing the available water in the radicle zone and causing unbalancing in nutrients uptake as a result of competing between cl- and Na+ from the side and the nutrients such as K+, Ca+ and No3 from the other side.

There are many things effect on crop efficiency to tolerance the salinity such as water irrigation crop management, irrigation water quality, weathering, and genotype. Plant hormones or called either as phytohormones are the secondary metabolites produced in plants in low concentrations involved in many aspects in plants including gene expression and transcription levels, cellular division, and growth. Recently, Plant Growth regulators (PGRs) considered as the most attractive technique to increase seed tolerance by decreasing the salinity stress caused by water irrigation as a type of Osmoprotectants agents [2].

Using PGRs improve the growth of radicle plant reflected on the increase in the absorption of nutrients as well as increasing the ability of radicle to absorb water and maintain the osmotic pressure of plant cells [3]. 6-Benzylaminopurine (BAP) growth regulator belong to cytokinins group which are responsible for stimulating cell division. BAP is the first generation of cytokinins and responsible for the growth of plant tissue through the stimulate cell division and inhibition of kinase enzyme which helps to increase the shelf life of fruits and keep the color green for vegetables [4]. Add citation to BAP using in seed priming The research aims to study the effect of different salt solutions on germination and seedling growth of several varieties of wheat bread by identifying the critical level of salinity in irrigation water and estimate the effect of growth regulator (BAP) to increase wheat seed performance to the salinity of the water irrigation.

2. Materials and Methods

Two experiments were carried out during the 2018-2019 season in the greenhouse of the College of Agriculture / Anbar University, using seedlings and sandy soil with electrical conductivity of 0.50 ds m^{-1}. The first and second experiments were applied using a completely randomized CRD design for global experiments with four replicates, and each experiment included a study of two factors. The first factor included irrigation water solutions prepared from mixed water that represents saline water from one of the wells in the study area (electrical conductivity 10 ds m^{-1}) With River water (its electrical conductivity is 1.2 ds m^{-1}) to obtain four concentrations of irrigation water solutions are 3.00, 4.50, 6.00 and 7.50 ds m^{-1} in addition to the comparison treatment (distilled water with an electrical connection 0 ds m^{-1}). The second factor involved the cultivation of six varieties of wheat: Aba 99, Abu Ghraib, Bohooth 10, Bohooth 22, Bohooth 158 and Ezz. As for the second experiment, it was carried out with the same concentrations of salinity of the aforementioned irrigation water for the purpose of knowing its effect on the seeds of the six varieties used after its treatment with the growth regulator 6-Benzylaminopurine (BAP) at a concentration of 250 mg l^{-1}.

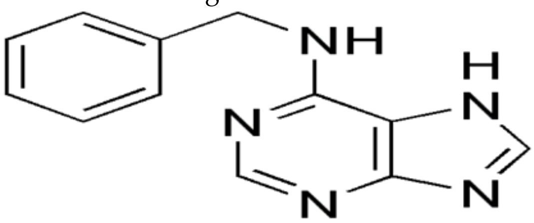

Figure 1. The chemical structure of the 6-BAP growth regulator.

I took a practical sample from the seeds of each of the six wheat varieties, then sterilized with 1% sodium hypochlorite solution for three minutes, then washed with distilled water and left on blotting paper to dry aerobically in the laboratory for 48 hours, after which the seed activation process was performed and Soak it for 12 hours with a 6-Benzylaminopurine growth regulator (BAP) solution. After the end of the soaking period, the seeds are dried aerially for 12 hours, after which they were planted with seedlings in a soft, sandy soil that was irrigated with the addition of 50 ml of pre-prepared local solutions as well as above as well as irrigation. With distilled water only, irrigation was carried out every three days. The first count was conducted five days after the date of planting to calculate the speed of germination by dividing the number of natural seedlings after five days by the total number of seeds, then the second count was taken by calculating the total number of natural seedlings after eight days from the date of planting to calculate the germination percentage by dividing the number Total of the natural seedlings at the end of the examination on the total number of seeds. After the end of the examination period, ten natural seedlings were taken randomly and measured the length of the radicle and the stalk (cm). Then the average was extracted for these two characteristics. The same pads used in the length of the radicle and stalk are taken for the purpose Procedure Examination of the dry weight of the seedlings (g), after insulating the seed envelope from the natural seedlings resulting from the standard laboratory germination test, Then the seedlings were placed in perforated bags and dried in an electric oven at a temperature of 60 CO degrees for 24 hours and after cooling them, then the samples were weighed with a sensitive balance and according to the average weight of the natural seedlings.

Irrigation water used in the experiment: S0 = distill water, S1 = 3.00 ds m^{-1}, S2 = 4.50 ds m^{-1}, S3 = 6.00 ds m^{-1}, S4 = 7.50 ds m^{-1}

growth regulator 6-Benzylaminopurine (BAP): T0 = 0.00 mg l^{-1}, T1 = 250 mg l^{-1}

The Seeding vigor was measured by the following equation.

Seed Vigor = Final germination ratio (%) × (radicle length cm + feather length cm).

3. Results and Discussion

Germination speed (seed day^{-1}): Increasing the concentration of salts significantly affected the gradual decrease in the average germination initiation speed, and the germination speed was not significantly affected in the concentration of 3.00 ds m^{-1} compared to the comparison treatment 0 ds m-1. The initiation of germination decreased significantly, with increased salt stress, until the number of germinated seeds reached 5.56 seeds per day $^{-1}$ and 4.47 seeds per day^{-1} in concentrations of 6.00 and 7.50 ds m^{-1} (Figure 2). This may be due to the increased level of saline stress in the germination medium, The result of an increase in the concentration of toxic ions, especially sodium ion, caused an imbalance in the water potential inside and outside the seed this reduced the seed water absorption rates and decreased cellular metabolism reactions during the germination stage, a hormonal imbalance represented by a lack of activity in gibberellin known to encourage germination of seeds and a negative impact on the speed of germination of seeds. This result is consistent with its finding [5] Those who confirmed the low speed of germination of wheat seed initiation by increasing the concentration of salts in the germination medium.

The cultivar Abu Ghraib achieved the lowest value with a significant decrease in germination speed of 7.30 seeds per day^{-1} compared to the rest of the varieties that differed significantly with each other. The Ezz variety recorded the highest germination rate of 35.37 seeds per day^{-1} followed by Bohooth 158, which recorded 22.90 seeds per day $^{-1}$. The reason for the difference in the performance of the varieties may be due to the difference in the origin of the genetic base, which in turn affects the overall physiological and biological processes of germination and is represented by the enzymatic activity, growth organizations and others according to the genetic mechanism that controls each species. As well as the difference in the degree of seed response to the growth regulator, which may be due to the difference in the chemical composition of the grain contents that affect the speed of impregnation and biochemical changes within the seed during germination affect the speed of impregnation and biochemical transformations within the seed during germination. The results were consistent with his findings [6].

The seed priming treatment with 6-Benzylaminopurine (BAP) achieved the highest mean germination speed of 45.78 seeds per day $^{-1}$ at the salt concentration S1 and with an increase of 40.39% compared to the non-seed priming treatment of the same local concentration S1. The seed priming treatment increased from the average germination speed of the two high concentrations (S3 and S4) to 8 and 12% after the germination speed ratio was zero and for both concentrations before stimulation. From these results, we note that the benzene growth regulator adenine precipitated in the germination of seeds irrigated with high salt concentrations compared to the non-use treatment, which reflected positively on the germination index regardless of the used varieties. The cultivar Abu Ghraib achieved the lowest value with a significant decrease in germination speed of 7.30 seeds day $^{-1}$ compared to the rest of the varieties that differed significantly with each other. The Ezz variety recorded the highest germination rate of 35.37 seeds day^{-1} followed by Bohooth 158, which recorded 22.90 seeds day^{-1}. The reason for the difference in the performance of the varieties may be due to the difference in the origin of the genetic base, which in turn affects the overall physiological and biological processes of germination and is represented by the enzymatic activity, growth.

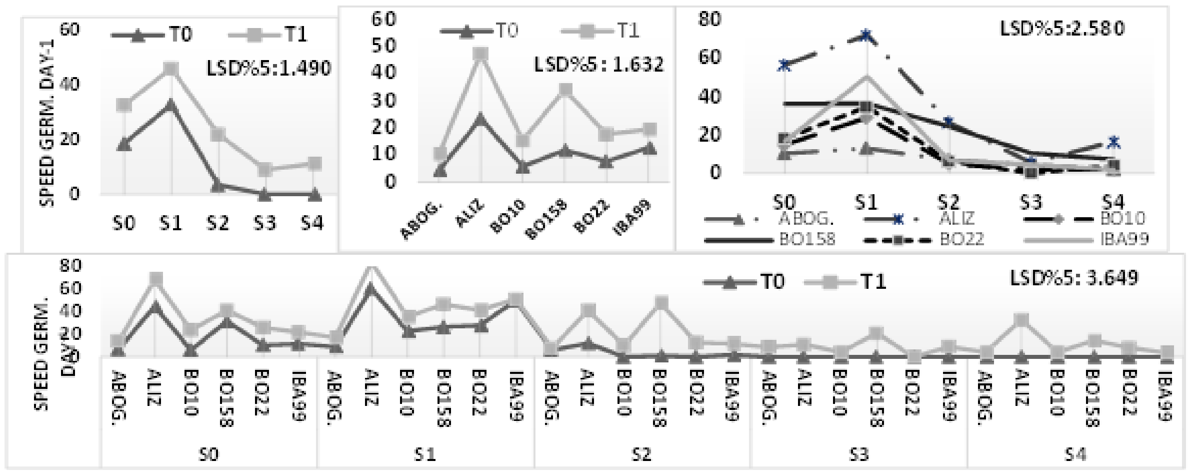

Figure 2. The effect of stimulating the seeds of six varieties of wheat under saline stress on the speed of germination.

organizations and others according to the genetic mechanism that controls each species. As well as the difference in the degree of seed response to the growth regulator, which may be due to the difference in the chemical composition of the grain contents that affect the speed of impregnation and biochemical changes within the seed during germination affect the speed of impregnation and biochemical transformations within the seed during germination. The results were consistent with his findings [6]. The seed priming treatment with 6-Benzylaminopurine (BAP) achieved the highest mean germination speed of 45.78 seeds day^{-1} at the salt concentration S1 and with an increase of 40.39% compared to the non- seed priming treatment of the same local concentration S1. The seed priming treatment increased from the average germination speed of the two high concentrations (S3 and S4) to 8 and 12% after the germination speed ratio was zero and for both concentrations before stimulation. From these results, we note that the benzene growth regulator adenine precipitated in the germination of seeds irrigated with high salt concentrations compared to the non-use treatment, which reflected positively on the germination index regardless of the used varieties.

Germination percentage %It appears from the results of Figure 3 that the germination percentage has been affected significantly by the factors of study and their interaction, We note that the high salt concentrations have significantly reduced the germination rate gradually and according to the salt concentration, as the concentration of 7.50 ds m^{-1} recorded the lowest average germination rate of 32.56% and a decrease of 58.54% compared to the percentage of germination of wheat seeds grown in the distilled water with an electrical conduction 0 dsm^{-1}.

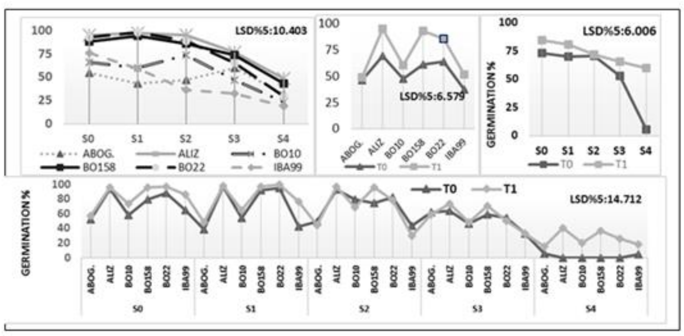

Figure 3. The effect of seed priming of six varieties of wheat under saline stress on germination %.

This result is consistent with the findings of [7] and [8] who indicated the increase in negative osmotic effects resulting from irrigation with salt water on seed germination, which reduced embryo activity and reduced germination. It is noted from the results that the germination percentage differed significantly between the varieties (Figure 2). The Ezz cultivar was distinguished by the highest germination percentage, and it did not differ from the Bohooth 158, while the cultivar differed significantly from Bohooth 22, Bohooth10, Abu Ghraib, and IBA 99. Figure 2 shows the effect of Salts concentrations on treatments treated with 6-Benzylaminopurine (BAP) and untreated ones in the average germination ratio of wheat cultivars, Low salt concentrations (S0, S1) did not significantly affect germination ratios, While the germination percentage was affected at higher concentrations (S2, S3),

The saline solution with a concentration of S4 inhibited the germination of the seeds of four varieties of wheat in this study, with the exception of the cultivar Abu Ghraib and IBA99, the reason for the different response to the genotypes when exposed to environmental stresses due to the genetic differences, the nature of growth and the periods necessary for their growth [9]. The failure of germination in salt soils is not often due to the sensitivity of the crop during the germination period, but rather to the high concentrations of salts in the medium in which the seeds are planted. It showed that the accumulation of high salt concentrations at the surface of the soil as a result of the movement of water upward and then evaporation, as well as the absence of other additions of water to the soil. When comparing the results of germination percentage for treated seeds with 6-Benzylaminopurine (BAP) regardless of the varieties used, the germination ratio improved at different salinity concentrations. As the salt concentration S4 recorded the highest difference in germination percentage when compared to the germination results of untreated seeds with 6-Benzylaminopurine (BAP) while its effect was slight and not significant at concentration S2 and slightly higher at concentrations (S0, S1, S3) that achieving seed priming treatments with 6-Benzylaminopurine (BAP) may be due to the regulator's effective role in increasing average enzymatic activity in seeds. The causes of inhibition of germination of seeds subject to salt stress is a difference in hormonal balance [10].

The hormone 6-Benzylaminopurine (BAP) increased the germination rate for all varieties without exception when compared to the case of not using it, but in different proportions, for example, the percentage of germination of the cultivar Abu Ghraib before seed priming is 45.8%, and after seed priming 48.67%, while the cultivar Bohooth158 before seed priming is 60.87%, and after seed priming 92.8%. The difference in the performance of the varieties may be due to the difference in the origin of the genetic base, which gives the varieties different capabilities regarding the vitality and activity of enzymes involved in biosynthesis, reproduction and cell division, as well as the different degree of response to seed priming with regulatory that are due to the difference in the grain contents of the chemical substance compounds that It occurs at the speed of impregnation and metabolism inside the seeds during germination. This is consistent with [11] study of five types of wheat when seed priming with growth regulators in different concentrations. The stimulating hormones for growth increase germination and reduce the effect of salinity, especially high concentrations.

Radicle length and Coleoptile length: Radicle length behavior is similar to coleoptile length by stimulating radicle growth in S0 and S1 concentrations, then there was a significant decrease in this characteristic at S2, S3, and S4 concentrations (Figures 4 and 5). With significantly superior seed priming compared to the effect of not seed priming wheat seed. The reason for short lengths with increasing salts is due to the increase in the concentration of ions in it and their direct negative effects such as inhibition of enzymatic activity in the seedling cells, which leads to the precipitation of proteins or inhibition of the effective sites of these enzymes and this is in line with what he indicated [12] that Irrigation with water that has a salinity of (4 - 12.5 ds m^{-1}) causes a decrease in the percentage of soluble protein in the leaves. The plant growth also decreases due to a decrease in the rate of expansion, division and distinction of leaves**.**

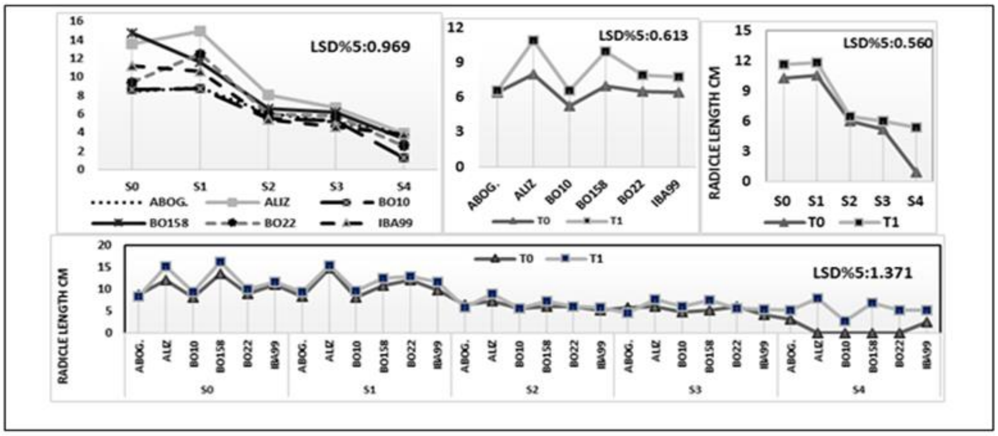

Figure 4. The effect of seed priming of six varieties of wheat under saline stress on radicle length.

Both cultivars Bohooth10 and Bohooth22 recorded a decrease in radicle and stem length (1.285 and 0.963) cm respectively, while Abu Ghraib cultivar recorded the highest length of radicle and coleoptile at the same salt concentration S4 was 4.07 cm and 3.10 cm, respectively. The reason for this may be that the varieties differ in their ability to block or bodice Salt ions in the feed solution from entering the seedling radicles. The lengths were influenced by the treatment of seeds with 6-Benzylaminopurine (BAP) regardless of the varieties. There were no significant differences between the saline concentrators S0 and S1 as well as the S2 and S3 concentrations, but they differed significantly with the higher S4 concentration.

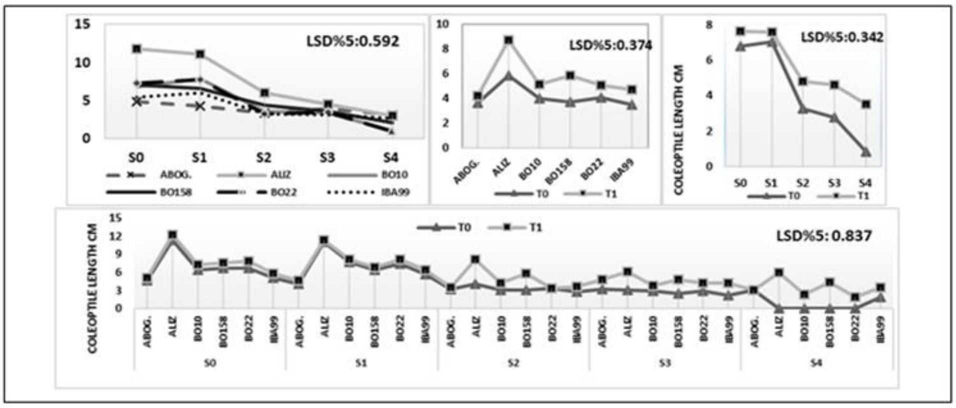

Figure 5. The effect of seed priming six varieties of wheat under saline stress on coleoptile length.

When comparing radicle lengths and coleoptile growing from the seeds of 6-Benzylaminopurine (BAP) treatment, regardless of salinity concentrations, it appears that the response of Ezz cultivar was higher than the other cultivars in both traits, followed by Bohooth 158, Whereas, Abu Ghraib cultivar response to seed priming was slight in improving the length of the radicle and coleoptile. The results of the triple interference showed that the high concentration of salinity S4 stopped the germination for both the Ezz variety and the Bohooth10, Bohooth22 and Bohooth158, but the seed priming of the seeds improved the germination percentage and thus its effect was reflected along both the radicle and the coleoptile (Figure 4 and 5).

Seedling vigor: Figure 6 shows that the effect of salinity was significant on the vigor of seedlings in all cultivars regardless of growth regulator as the vigor of seedlings gradually decreased with increasing saline concentrations. The reason for the low seedling vigor rate may be that the calculation of this trait depends on the length of the coleoptile and the radicle and germination percentage (Figures 2, 3, and 4) at high salt concentrations. The seed priming with 6-Benzylaminopurine (BAP) caused a significant increase in the seedlings vigor of all saline concentrations when compared to the non-seed priming treatment regardless of varieties. The seeds of cultivars treated with 6-Benzylaminopurine (BAP) showed a highly significant response to the seedlings vigor, except the Abu Ghraib variety, which responded slightly (which was not significant) to the treatment of seeds due to a decrease in both the radicle length,

coleoptile and germination percentage of the same variety. The results in Figure 6 showed the triple interaction between the salt concentrations, the wheat varieties, and the seed priming factors.

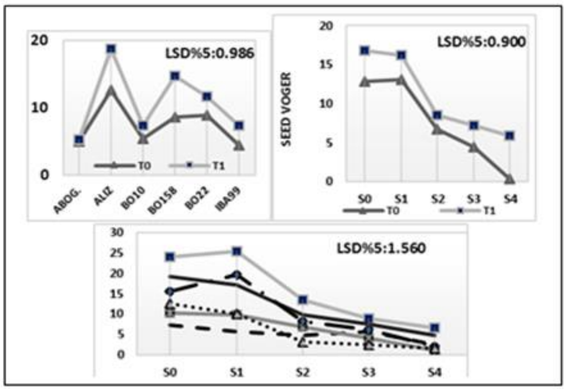

Figure 6. The effect of seed priming of six varieties of wheat under saline stress on the seedlings vigor.

The clear effect of the seed priming factor in both the salt concentrations and the wheat varieties, It seemed more important to treat stimulation at the high salt concentration S4 as it increased the ability of the cultivar to reduce the damage caused by salinity by improving the germination rate and the growth of plant cells and its positive effect in metabolic and physiological processes that take place in plant cells such as building carbohydrates, proteins and sugars, as it works 6- Benzylaminopurine (BAP) in improving the growth indices of plants under saline stress by its role in stimulating photosynthesis and maintaining coenzymes in this process, permeability of plasma membranes and increasing photosynthesis pigments [13].

Seedling dry weight: The results of Figure 7 showed that the effect of salinity was highly significant in dry weight in all varieties, regardless of the regulator used, and also the dry weight was inversely proportional to the salt concentration. Dry weights of wheat seedlings decreased significantly at S4 concentration of saline irrigation water, While the saline concentrations S0 and S1 did not affect the dry weight of the gesture. The increase in the dry weight is the result of the increase in the length of the radicle and the coleoptile that was reflected in the increase in the dry weight, which is due to seed priming with the 6-Benz-amin regulator. These results are consistent with the results of [14]. Dry weight decrease with increased salinity concentrations may be due to the role of sodium and chlorine in decreasing the rate of photosynthesis [15]. Most of the ions that make up salts that cause increased soil salinity have negative effects on plant growth. Increased salts ions concentrations inhibit the action of Glycolyse enzymes and cause a decrease in growth hormones such as Auxins, Gibberellins, and Cytokines, which leads to less growth of the vegetative system, as well as an increase in some growth inhibitors such as abscisic acid (ABA).

The results of Figure 6 indicate the significant effect of the varieties on the dry weight rates of the seedlings, cultivar Bohooth158 recorded the highest dry weight, followed by the Ezz cultivar with a non-significant difference, while the IBA 99 cultivar had the lowest dry weight of wheat seedlings. Varieties differ from each other in most germination standards and seedling characteristics, which have been indicated in the interpretations provided in the germination ratio, radicle length, and coleoptile (Figure 3, 4, and 5).

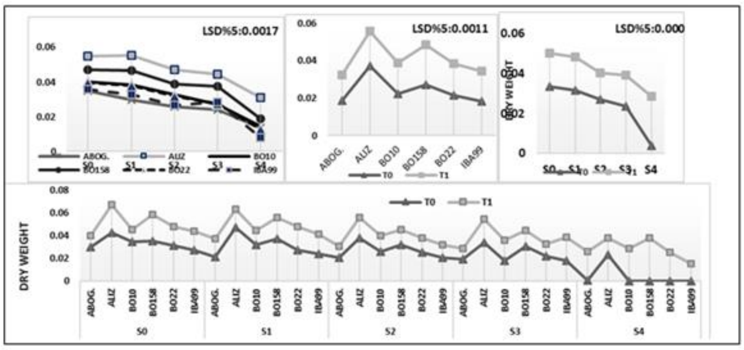

Figure 7. The effect of seed priming of six varieties of wheat under saline stress on the dry weight.

The results show the superiority of the two cultivars, Bohooth158, and the Ezz is due to their superiority in the aforementioned characteristics of the seedling, the similar behavior of each IBA 99 and Abu Ghraib of dry weight. Effect of dry weight increase with seed priming with 6-Benzylaminopurine (BAP) compared to non-seed priming with different weights regardless of saline concentrations and varieties. The seed priming of seeds reduces the harmful effect resulting from an increase in the concentration of salts in the medium of germination, this evidence proves that the general trend of the regulator 6-Benzylaminopurine (BAP) is to reduce the negative effects of saline stress in the seeds during the germination stage. It improved the seed performance relatively even when the Salts concentration increased in the germination medium**.**

4. Conclusion

The result confirmed the report of that high salinity levels leads to ion imbalance, osmotic regulation disorders and decrease in water absorption by seeds. Also data cleared that, speed germination index significantly affected, also salinity can affect germination of seeds by creating osmotic potentials which prevent water uptake ،that the major effect of salinity on germination may be attributed to a reduce hormone delivery throughout the seedling which inhibit the growth. Also the same effects for increasing salinity levels was observed on the other seed vigor traits such speed germination index and mean germination time. It can be concluded that the growth regulators effect large and important traits studied in this research, which caused the increase in speed of germination for plants extend and differently by the differences in plant species, and on that basis can we recommend the development of research at the level of the morphological characters and using salt affected soils.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

B. S. Alobaidy and M. N. Al-Falahi; methodology, writing—original draft preparation, A. A. Almarie and M. N. Al-Falahi; writing—review and editing, M. N. Al-Falahi; paraphrasing. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest:

The authors declare no conflict of interest.

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