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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Effects of Adding Anti-saline and Humic Acid Foliar Spraying on Yield Parameters of Cauliflower (*Brassica oleracea* var. Botrytis)

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Abstract

Spraying humic acid on a growing plant cauliflower enhances chlorophyll and carotene levels in the leaves; its crucial role in protecting plants from salt stress, water stress, and heavy metals, and its many other advantages in saline soils. The research study was carried out in one of the agricultural fields in the Muqdadiyah area, Haruniyah area, 21km, using a randomized complete block design (RCBD) and a normal factorial experiment during the agricultural season 2019-2020. It was located 40 kilometers North-East of Diyala governorate, Baquba district. This study aimed to determine how adding anti-saline and spraying humic acid affects the yield parameters of Nahar cauliflower. The results demonstrated that the addition of anti-saline when treated with N_2 was superior in the majority of the studied traits, including: (head weight, head diameter, percentage of dry matter in the heads, total yield, and total plant weight without the heads). Sequentially, the results demonstrated (4349 g, 26.39 mm, 15.79 %, 13.39 mcg ha^{-1}, 1.971 kg $plant^{-1}$) superiority over the control treatment. The majority of the analyzed parameters, including (head weight, head diameter, percentage of dry matter in heads, total yield, and total plant weight without heads) (3584 g, 26.52 mm, 16.80 percent, 15.15 tons H^{-1}, 2.182 kg plant-1), were superior to the control treatment (3584 g, 26.52 mm, 16.80 percent, 15.15 tons H^{-1}, 2.182 kg $plant^{-1}$). The N_2H_2 treatment was found to be higher in most of the analyzed parameters, including (head weight, head diameter, percentage of dry matter in the heads, total yield, and total plant weight without the heads), which were (4684 g, 29.80 mm, 19.33 percent, 15.47 tons h^{-1}, 3.224 kg $plant^{-1}$) respectively compared to the control.

Keywords: Fertilization, Salt stress, Water stress, *Brassica oleracea* var. *Botrytis.*

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1. Introduction

Cauliflower (*Brassica oleracea* var *botrytis*) is a member of the *Brassicaceae* family and one of the essential winter vegetable crops, with over 350 genera and 4000 species spread across the globe, found in the Mediterranean region, and Cyprus is believed to be its original home (Jabbar et al., 2013). The cauliflower of vegetables is rich in many vitamins such as vitamin A and C as well as carotene, protein, phosphorus, potassium, iron, and calcium. It was shown that each 100 g of cauliflower contains 91.7% water, 25 calories, 2.4 g protein, 4.9 g carbohydrates, 72 mg phosphorus, 2.2 mg calcium, 1.1 mg iron, and many vitamins (Matlop et al., 1989). Anti-saline is a liquid fertilizer ready to be used to treat the phenomenon of salinity. It is added to soils with a salt concentration near the soil's surface to prevent it from moving to the top, leading to crop damage. It ends the problem of accumulated salt without forming layers. Impermeable and not added at temperatures below 5 degrees Celsius because this effect decreases when using low temperatures (Zodape, 2001). This substance reduces water evaporation in the soil and groundwater levels. They also found that it reduces the entry of salty seawater added by the wind into the soil by preserving the ready water (Ahmed and Salem, 2020).

Manymethodsexistfor adding nutrients to the plants. One of the most basic and effective techniques is foliar fertilization, which involves spraying nutrients directly into the leaves (Rajasekar, 2017; Rachid et al., 2020). Recent research shows that foliar feeding is more significant than soil fertilizer in terms of effectiveness and success. It's a compliment, not a replacement, for soil fertilization (Bader et al., 2020). Humic acid is a critical acid that plays essential roles in plant life. It works by increasing the production of chlorophyll and carotene pigments, the rate of carbon metabolism, and the activity of many essential enzymes, inhibiting ethylene synthesis and having the opposite effect to acid abscisic. Spraying humic acid on a developing plant under abiotic stress increases the concentration of nutrients and pigments chlorophyll and carotene in the leaves (Kaya et al., 2018). In addition to its excellent qualities and benefits and its essential function in protecting plants from salt, water, and heavy metal stress (Khoshbakht and Asgharei, 2015). Adding this acid improves the supply of nutrients to plants in salty soils. It causes an increase in oxygen activity, which is essential in promoting the plant's development and production (Sayfzadeh et al., 2011; Rahim and Mohammed, 2020). As a result, the research aims to study anti-saline and humic acid and their interactions in cauliflower development and yield. The study aimed to know the extent of the anti-salinity effect in protecting saline lands to increase agricultural production.

2. Materials and Methods

A field experiment was carried out within the randomized complete block design (RCBD) and with a normal factorial experiment in the agricultural season 2019-2020 in one of the agricultural fields in Muqdadiyah district, Al-Harouniya district, Kleu 21, 40 km north of Baquba district of Diyala governorate, to study the effect of adding anti-saline and spraying humic acid Assad On the characteristics of the Nahar cauliflower crop, where the field designated for the experiment was prepared by plowing horizontally, leveling and plowing again vertically, then leveling and smoothing.The field was divided into three sectors, and each sector contains 9 experimental units, meaning that a total of 27 experimental units with dimensions of 3*2 m for each experimental unit With a distance of 1 m between an experimental unit and another and a distance of 2 m between one sector and another, and Each trial unit contains 7 plants.Irrigation pipes were extended with dimensions of 1.30 m between one tube and another inside the experimental unit, and seedlings were planted on one side of the line with a distance of 40 cm between one plant and another.

The experiment included a study of two factors, the first factor is anti-salinity and is symbolized by the symbol ((N_2, N_1, N_0) and at concentrations (2, 1, 0) ml / liter sequentially, it was added to the soil until complete saturation and the second factor is humic acid lion and symbolized by the symbol (H_2, H_1,H_0) and at concentrations (4, 2, 0) ml / liter sequentially as it was sprayed as shown in *Table 2.*

On the vegetative total and seedlings were planted on 10/10/2019 and the crop was harvested on 12/25/2019 10 samples were randomly taken from the soil and extracted well A representative sample of the field was taken from it for the purpose of analysis before planting from a depth of 0-30 cm, air-dried, ground with a wooden hammer and sifted with a sieve with a diameter of (2 mm) and divided into several sections to ensure that the sample was not damaged or lost and kept in different and known places until the analysis and the following characteristics were studied (weight Disc (gm), disc diameter (mm), percentage of dry matter in pink discs (%), total yield (Mg H^{-1}), total plant weight without flower discs (kg $plant^{-1}$) and the soil of the study field was classified as alluvial mixture. The results were analyzedusing the statistical program (SAS), and the significant differences between the means were tested according to the (Duncan) multiplex test. Dodd at the 0.05 probability level (Al-Rawi and Khalaf Allah, 2000) as shown in *Table 1*.

Table 1. The soil's chemical and physical qualities before planting

Parameters	pH	CEC	CE	N	P	K	Sand	Silt	Clay	Texture
			Ds m^{-1}		(mg kg^{-1})			(%)		
Amount	7.5	24.9	1.92	45	12.24	192.9	38.8	8.8	52.4	Clay

***Table 2. The Chemical properties of humic acid and Anti*-saline**

Properties of humic acid				
Parameters	**Humic**	**K_2O**	**Humidity**	**solubility**
Amount	14%	2%	14%	99.8%
Properties ofAnti-saline				
Parameters	**Organicmatter**	**Alginate acid**	**amino acids**	**Mannitol**
Amount	50%	16%	2%	3%

3. Results and Discussion

3.1. Diameter weight of cauliflower (gm)

Table 3 revealed that adding anti-saline to the N_2 treatment, 4349 gm, significantly affected the comparison treatment N_0, 2389 gm. Adding humic acid outperformed the control treatment H_0, which totaled 3585 gm, while the treatment H_2 weighed 3041 gm. Regarding the interaction between the two variables, the treatment N_2H_2 had the highest value of 4684 g, compared to the comparison treatment N_0H_0, which had a value of 2357 g.

Table 3. Effect of adding anti-saline and spraying humic acid on the head weight (gm) of the Nahar cauliflower cultivar

Treatment	H_0	H_1	H_2	Mean±SEM
N_0	2357e	2414e	2396e	2389±16.82C
N_1	2731de	3400cd	3673bc	3268±297.88B
N_2	4035abc	4329ab	4684a	4349±187.62A
Mean±SEM	**3041±508.63B**	**3381±496.95AB**	**3584±661.97A**	

According to Duncan's polynomial testing, there is no significant difference in the coefficients with the same letter at the 0.05 probabilitylevel.

3.2. Cauliflower head diameter (mm)

Table 4 revealed that adding anti-saline to treatment N_2 resulted in a significant difference of 26.39 mm compared to comparison treatment N_0, which resulted in a difference of 20.16 mm. N_2H_2 had the most significant interaction value of 29.80 mm, compared to N_0H_0, which had a value of 16.64 mm.

Table 4: The effect of anti-saline and humic acid spraying on head diameter (cm) and yield parameters of the Nahar cultivar

Treatment	H_0	H_1	H_2	Mean±SEM
N_0	16.64e	19.92d	23.92bc	20.16±2.10C
N_1	18.91d	22.97c	25.84b	22.57±2.010B
N_2	23.40c	25.96b	29.80a	26.39±1.85A
Mean±SEM	**19.65±1.98C**	**22.95±1.78B**	**26.52±1.73A**	

The Duncan polynomial test indicates that at the 0.05 probability level, coefficients with the same letters do not differ substantially.

3.3. Cauliflower florets' dry matter content as a percentage (percent)

According to *Table 5*, adding anti-saline to treatment N_2 resulted in a significant increase of 15.79 % over comparison treatment N_0, which amounted to 12.25 %. Humic acid supplementation outperformed the H_0 control treatment by 16.80% and the H_0 control treatment by 12.27%. Treatment N_2H_2 exhibited the most significant interaction between the two variables, at 19.33 percent, compared to comparative treatment N_0H_0, which had 11.20 percent.

Table 5. The effect of anti-saline and humic acid spraying on the percentage of dry matter in head diameter (%) and yield parameters of the Nahar cauliflower cultivar

Treatment	H_0	H_1	H_2	Mean±SEM
N_0	11.20c	12.12bc	13.44bc	12.25±0.65B
N_1	12.19bc	12.86bc	17.63a	14.22±1.71A
N_2	13.42bc	14.61b	19.33a	15.79±1.80A
Mean±SEM	**12.27±0.64B**	**13.19±0.73B**	**16.80±1.75A**	

The Duncan polynomial test indicates that at the 0.05 probability level, coefficients with the same letters do not differ substantially.

3.4. Cauliflower head yield total (kg ha^{-1})

Table 6Table revealed that adding anti-saline to treatment N_2 resulted in a significant effect of 13.39 tons ha^{-1} compared to comparison treatment N_0, which resulted in 10.45 tons ha^{-1}. Adding marine algae to the H_2 treatment resulted in 15.15 tons ha^{-1}, outperforming the H_0 control treatment, which resulted in 11.68 tons ha^{-1}. Compared to N_0H_0, the treatment N2H2 had a higher value of 15.47 tons ha^{-1} in terms of the interaction between the two variables.

Table 6. The effect of adding anti-saline and humic acid on total head yield (kg ha^{-1}) of the Nahar cauliflower cultivar

Treatment	H_0	H_1	H_2	Mean±SEM
N_0	11.05d	12.24cd	14.99ab	10.45±1.16B
N_1	12.54bc	11.79cd	14.79ab	12.45±0.90B
N_2	11.45cd	13.25bc	15.47a	13.39±1.16A
Mean±SEM	**11.68±0.44B**	**12.42±0.43B**	**15.15±0.20A**	

The Duncan polynomial test indicates that at the 0.05 probability level, coefficients with the same letters do not differsubstantially.

3.5. Plant weight (kg plant^{-1}) without heads: (kg plant^{-1})

The maximum interaction value was 3.224 kg plant-1 in treatment N2H2, compared to 1.034 kg plant-1 in treatment N0H2. *The maximum* interaction value was 3.224 kg plant-1 in treatment N2H2, compared to 1.034 kg plant-1 in treatment N0H2.

Table 7 showed a significant impact of anti-saline addition to treatment N_2, 1.971 kg plant^{-1}, compared to control N0, 1.281 kg plant^{-1}. The H_2 treatment with added marine algae produced 2.182 kg plant^{-1}, which exceeded the control treatment H_0, which produced 1.269 kg plant^{-1}. The maximum interaction value was 3.224 kg plant^{-1} in treatment N_2H_2, compared to 1.034 kg plant^{-1} in treatment N_0H_2. *The maximum* interaction value was 3.224 kg plant^{-1} in treatment N_2H_2, compared to 1.034 kg plant^{-1} in treatment N_0H_2.

Table 7. The impact of anti-saline and humic acidtreatment on the Nahar cauliflower cultivar's total plant weight without heads (kg plant^{-1})

Treatment	H_0	H_1	H_2	Mean±SEM
N_0	1.034c	1.307bc	1.503bc	1.281±0.13C
N_1	1.491bc	1.506bc	1.818b	1.605±0.10B
N_2	1.280bc	1.409bc	3.224a	1.971±0.62A
Mean±SEM	**1.269±0.13B**	**1.407±0.05B**	**2.182±0.52A**	

The Duncan polynomial test indicates that at the 0.05 probability level, coefficients with the same letters do not differ substantially.

The study revealed that adding an anti-saline showed a significant difference due to the role of anti-saline in reducing salinity through practices or activities that represent the correct management of irrigation and water use with high efficiency, as well as reducing the added water to prevent waste, particularly in water-stressed areas. Three primary considerations must be considered to control the amount of water added in each irrigation: the consumption of crop water, the availability of water with which the irrigation process takes place, and the ability of soil to store water in the root zone. These findings agreed with those (Varma and Namara, 2006; Azooz, 2009; Rahim and Mohammed, 2020). It was presumed that anti-saline reduces crop water stress, maximizes yield, lowers the costs of delivering irrigation water to agricultural fields, increases soil moisture storage, and reduces fertilizer loss. Because it reduces surface and subsurface runoff and increases crop yields, the overall production is improved, the yield quality has improved, and excessive amounts of water have been reduced, reducing waterlogging issues. It helps control root zone salt accumulation by reducing the excess water that causes the groundwater level to rise.

Furthermore, irrigationwatercontains salts, and increasing irrigation implies adding salts to the soil, which results in increased returns by using the water stored in the soil for irrigation during the short periods when the crop is not irrigated, which is consistent with (Broner, 2005). Water stress has been linked to a decreased water supply in the soil due to continuous water loss via transpiration and evaporation.

Additionally, water stress results in several physiological and chemical changes in the plant, resulting in reduced growth, notably decreased leaf size, stem elongation, root growth, and water utilization efficiency (Farooq et al., 2009). Cell elongation and division have been used to promote plant growth and give the plant more opportunities to grow and expand. As the plant's hormone levels fluctuate, the stomata close. Increased abscisic acid levels in leaves and decreased cytokinin levels in roots lowered transpiration and water stress (Jaleel et al., 2009). Some hypotheses state how to overcome the problem of salinity and activate the anti-saline action in its explicit form, such as spraying with potassium sulfate fertilizer to reduce osmotic stress of the leaves or improve the host's nutrition by improving plant drought tolerance. Involvement in a wide range of physiological activities, such as transporting and storing numerous chemicals and water relations inside plants, regulated by soil salinity, indicates potassium's importance. This finding agreed with those (Yordanov et al., 2003; Zarghami et al., 2014; El-Taher et al., 2022).

It is conceivable that it influences ion entry, transfer, and transpiration processes, and the results support this theory (Khan et al., 2003; Mahdi et al. 2010). The reason could also be attributed to the synergistic effect of some phenolic compounds with other growth regulators, such as indole-3-acetic, which play an essential part in cell division and enlargement, resulting in increased plant height and thus increased vegetative growth and yield characteristics. These findings were agreed with (Al-sahaf et al., 2017; Abdul Kareem and Saeed, 2017). Humic acid is thought to have a role in forming plant hormones by activating enzymes in carbon metabolism.

As a result, the accumulation of processed nutrients in the plant rises, stimulating the plant to enhance its vegetative growth and production characteristics. These findings agreed with (Al-Abbasi et al., 2015). The role of humic acid has been attributed to increasing the effectiveness of carbon metabolism and element absorption, which leads to increased plant growth. As a result, vegetative growth and yield characteristics improve (Hegazi and El-Shraiy, 2007). These findings were consistent with those (Al-Qaisi, 2012; Al-Tamimi, 2015). Besides its role in increasing carbon dioxide absorption, which aids in carbon metabolism, it increases plant growth (Al-Obaidi, 2013). Spraying this acid boosts the ratio of nucleic and amino acids and the rate of carbon metabolism. It enhances carbohydrate content by oxidation, which improves the plant's characteristics and increases yield. These findings were consistent with those (Kumar et al., 2010; Gholamereza et al., 2011).

4. Conclusions

Adding anti-saline at a concentration of 2 mL L^{-1} enhanced most of the characteristics studied. When 4 mL L^{-1} humic acid was added, a large percentage of the characteristics studied performed better. Concentrations (4.2) ml L^{-1} produced better results in most of the traits studied for the anti-saline/humic acid interaction.

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References

Abdul Kareem A.J and M. Saeed (2017) Effect of Pinching Date and Foliar Spray of Salicylic Acid on Growth and Flowering of Marigold *(Tagetes erecta* L.) cv. Double Eagle. *Technical Journal*, 30(3): 22-31.

Ahmed, M. Y. and Salem S. A. R. (2020). Effect of growth regulators, salinity, and chitosan on vegetative triats for the shoots of rootstocks of Citrus (*Swingle citrumelo*) multiplied in vitro. *Euphrates Journal of Agricultural Sciences*, 12(2): 511-521.

Al-Abbasi, A. M., Abbas, J. A. and Al-Zurfi, M. T. (2015). Effect of spraying thiamin and salicylic acid on growth and flowering of *Zinnia elegans* L. *Advances in Agriculture & Botanics*, 7(1): 44-50.

Al-Qaisi, W. A. and Al-Muntafji, H. N. H. (2012). The effect of spraying with aspirin (acetylsalicylic acid) on the growth and yield of mung plants exposed to drought stress. *Al-Mustansiriya Science Journal*, 23(8): 67-82.

Al-Obaidi, Z. H. H. (2013). The Effect of Salicylic Acid and Growth-Stimulating Bacteria on The Activity of Enzymatic and Non-Enzymatic Antioxidants in The Growth and Yield of Maize Under Salt Stress. College of Agriculture, University of Baghdad.

Al-Rawi, K. M. and Khalaf Allah, A. M. (2000). Design and Analysis of Agricultural Experiments. Baghdad University. Ministry of Higher Education and Scientific Research. Iraq. pp, 561.

AL-Sahaf, F. H. R., AL-Zurfi, M. T. H., Saheb, A. R. and Saheb, T. H. (2017). Effect of spraying yeast extract and salicylic acid on growth and flowering of *Mathoila incaana* L. *Kufa Journal for Agricultural Sciences*, 9(1): 32-52.

Al-Tamimi, A. J. H. (2015). *The effect of salicylic acid and proline under saline stress conditions on the growth, yield, and quality of sunflowers*. (Ph.D. Thesis). Department of Soil Sciences and Water Resources. College of Agriculture, University of Baghdad.

Azooz, M. M. (2009). Salt stress mitigation by seed priming with salicylic acid in two faba bean genotypes differing in salt tolerance. *International Journal of Agriculture and Biology*, 11(4): 343-350.

Bader, B. R., Abood, M. A., Aldulaimy, S. E. H., Al-Mehmdya, S. M. H. and Hamdi, G. J. (2020). Effect of water deficit and foliar application of amino acids on growth and yield of eggplant irrigated by two drip systems under greenhouse conditions. *Journal of Agricultural Science*, 31(2): 131-138.

Broner, I. (2005). Irrigation: Irrigation Scheduling. Fact Sheet No. 4.708. Colorado State University Extension–USDA. 2 p.

El-Taher, A. M., El-Raouf, A., Hany, S., Osman, N. A., Azoz, S. N., Omar, M. A., ... and Mahmoud, A. M. (2022). Effect of salt stress and foliar application of salicylic acid on morphological, biochemical, anatomical, and productivity characteristics of cowpea (Vigna unguiculata L.) plants. *Plants*, 11(1): 115.

Farooq, M., Wahid, A., Kobayashi, N. S. M. A., Fujita, D. B. S. M. A. and Basra, S. M. A. (2009). Plant Drought Stress: Effects, Mechanisms and Management. In: Sustainable Agriculture, Eds: Lichtfouse, E., Navarrete, M., Debaeke, P., Véronique, S. and Alberola, C., pp 153–188, Springer, France.

Gholamreza, A. B. D. I., Mohammadi, M. and Hedayat, M. (2011). Effect of salicylic acid on Na^+ accumulation in shoot and roots of tomato in different K^+ status. *Journal of Biological and Environmental Sciences*, 5(13): 31-35.

Hegazi, A. M. and El-Shraiy, A. M. (2007). Impact of salicylic acid and paclobutrazol exogenous application on the growth, yield and nodule formation of common bean. *Australian Journal of Basic and Applied Sciences*, 1(4): 834-840.

Jabbar, A. H.; Iman, J. A. R. and Nasreen, K. A. A. (2013). Principles of Horticulture. Ministry of Higher Education and Scientific Research. Baghdad University. Faculty of Agriculture. University House for Printing Faculty of Agriculture. University House for Printing, Publishing, and Translation, 364.

Jaleel, C. A., Manivannan, P., Wahid, A., Farooq, M., Somasundaram R. and Panneerselvam, R. (2009). Drought stress in plants: a review on morphological characteristics and pigments composition. *International Journal of Agriculture & Biology*, 11(1): 100-105.

Kaya, C., Akram, N. A., Ashraf, M. and Sonmez, O. (2018). Exogenous application of humic acid mitigates salinity stress in maize (Zea mays L.) plants by improving some key physico-biochemical attributes. *Cereal Research Communications*, 46(1): 67-78.

Khan, W., Prithiviraj, B. and Smith, D. L. (2003). Photosynthetic responses of corn and soybean to foliar application of salicylates. *Journal of Plant Physiology*, 160(5): 485-492.

Khoshbakht, D. and Asgharei, M. R. (2015). Influence of foliar-applied salicylic acid on growth, gas-exchange characteristics, and chlorophyll fluorescence in citrus under saline conditions. *Photosynthetica*, 53: 410-418.

Kumar, S. P., Kumar, C. V. and Bandana, B. (2010). Effects of salicylic acid on seedling growth and nitrogen metabolism in cucumber (*Cucumis sativus* L.). *Journal of Stress Physiology & Biochemistry*, 6(3): 102-113.

Mahdi, S. S., Hassan, G. I., Samoon, S. A., Rather, H. A., Dar, S. A. and Zehra, B. (2010). Bio-fertilizers in organic agriculture. *Journal of Phytology*, 2(10): 42-54.

Matlop, A. N., Azzedine, S. M. and Karim, S. A. (1989). Vegetable Production Part I. The second revised edition. Directorate of the House of Books for Printing and Publishing University of Mosul. Ministry of Higher Education and Scientific Research Republic of Iraq, 680.

Rachid, A. F., Bader, B. R. and Al-Alawy, H. H. (2020). Effect of foliar application of humic acid and nanocalcium on some growth, production, and photosynthetic pigments of cauliflower (*Brassica oleracea* var. Botrytis) planted in calcareous soil. *Plant Archives*, 20(1): 32-37.

Rahim, O. M. A. and Mohammed, I. Q. (2020). Effect of organic fertilizer and foliar application of humic and salicylic acids on reducing salinity stress of irrigation water on vegetative growth characteristics of broccoli (*Brassica Oleracea*) plant. *Plant Archives*, 20(1): 2263-2268.

Rajasekar, M., Nandhini, D. U. and Suganthi, S. (2017). Supplementation of mineral nutrients through foliar spray-A review. International *Journal of Current Microbiology and Applied Sciences*, 6(3): 2504-2513.

Sayfzadeh, S., Habibi, D., Taleghani, D. F., Kashani, A., Vazan, S., Qaen, S. H. S., ... and Rashidi, M. (2011). Response of antioxidant enzyme activities and root yield in sugar beet to drought stress. *International Journal of Agriculture and Biology*, 13(3): 357–362.

Varma, S. and Namara, R. E. (2006). Promoting micro irrigation technologies that reduce poverty. *Water Policy Briefing*, 23: 1-6.

Yordanov, I., Velikova, V. and Tsonev, T. (2003). Plant to responses to drought and stress tolerance. *Bulgarian Journal Plant Physiology*, Special Issue: 187-206.

Zarghami Moghaddam, M., Shoor, M., Ganjeali, A., Moshtaghi, N. and Tehranifar, A. (2014). Effect of salicylic acid on morphological and ornamental characteristics of *Petunia hybrida* at drought stress. *Indian Journal of Fundamental and Applied Life Sciences*, 4(3): 523-532.

Zodape, S. T. (2001). Seaweed as a biofertilizer. *Journal of Scientific and Industrial Research*, 60(5): 378-382.