Plant Archives Volume 20 No. 2, 2020 pp. 4648-4652 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EFFECT OF BIOFERTILIZERS AND ZINC NANO PARTICLES ON GROWTH, YIELD AND OIL PERCENTAGE OF SUNFLOWER (*HELIANTHUS ANNUUS* L.)

Abbas Ali Alamery* and Noor Abdulmunem Ahmed

College of Agriculture, University of Kerbala, Iraq.

Abstract

A field experiment was conducted at Ibn Al - Bitar Vocational Preparatory in Al-Husainean, Kerbala,during the spring season 2019. To study the effect of biofertilizers and foliar spray to the zinc nanoparticle and their interaction in the growth and yield of the sunflower (*Helianthus annuus L*)., Randomized Complete Block Design was used with three replications as factorial at two factors. The first factor biofertilizer coefficients (Control, Azotovit, Phosphatovit and Azotovit+ Phosphotavit). The second factor was Zn-nano particles (0, 50, 100 mg. L^{-1}). The results showed that Azotovit of biofertilizers treatment led to a significant increase in leaves area (0.705 m^2), head diameter (29.17 cm), number seeds per head (1224 seeds $head^{-1}$), weight of 1000 seeds (74.59 g), Fertility percentage (90.2%), total seeds yield (4.39 Mg h^{-1}) Whereas, the treatment of (Azotovit + Phosphotavit) biofertilizer in percentage of oil in seed was (44.2%) compared to the comparison treatment. Foliar fertilizer treatment of Zn-nano particles at 50 mg.L^{-1} concentration was superior to gave highest value in leaves area (0.694 m^2), head diameter (29.08 cm), weight of 1000 seeds (73.13g) total seeds yield (4.22 Mg. h^{-1}) and there was no significant difference between it and 100 mg.L^{-1} treatment in number seeds per, fertility percentage and percentage of oil in seed (%). We conclude from this that the integrated application of bio-fertilizer and nano-micronutrients is more effective in improving sunflower yield productivity.

Key words: biofertilizers, Zn-nano particles, oil yield, growth and Yield, sunflower.

Introduction

Sunflower (*Helianthus annuus* L.) plant is one of the important summer oil crops in the world it represents the third rank after *Glycine max* L. and *Brassica napus* L. in the amount of oil on the global level, Its importance comes from the fact that its seeds contain a high percentage of oil, amounting to more than 50%. Almost in the seeds of some of its improved varieties besides the high taste characteristics of the oil (NSA, 2019). It has been considered a promising alternative to traditional farming systems, Especially in semi-arid regions In the world, As its oil is one of the best healthy vegetable oils suitable for human nutrition because it contains Omega 3 fatty acid as well as a high percentage of unsaturated fatty acids (Oleic, Linoleic and Linolenic). Which ranges between (85% -91%) while saturated fatty acids (Palmitic and Stearic). That does not exceed (9%-12%), which plays an essential role in heart disease and atherosclerosis, as well as it contains vitamins A, B and E (Nasrallah *et al*., 2014). Vegetable parts are used in feeding livestock animals because they contain protein substances up to 36% and carbohydrates 22-20% and other nutrients. As a result of the negative effects and unguided use of chemical fertilizers, including the problem of soil pollution and increased soil salinity (Alamery *et al.*, 2019; Alafeea *et al*., 2019), therefore it was necessary to think about using modern fertilizers as a substitute for traditional fertilizers and use them to provide the nutrients necessary for plant growth and increase productivity and to maintain clean and good soil (Miransari, 2011). And among these fertilizers are very environmentally friendly and highly effective fertilizers so-called biofertilizers means only organic materials obtained from bacteria, fungi, microorganisms and amino acids (Lateef *et al*., 2019). Biofertilizers stimulate the plant's effectiveness in resisting environmental stresses and supplying adequate nutrients to crop plants through nitrogen fixation, dissolving phosphorous and potassium and producing plant growth hormones, ensuring optimal crop growth and development. Many researchers concluded that amino acids play an

***Author for correspondence :** E-mail: abas.hussian@uokerbala.edu.iq

important role in the germination process, root growth and the representation of nucleic acids and protein and they are included in organic compounds such as proteins, amines and enzymes (Ibrahim *et al.*, 2010; Abdel-Mawgoud *et al.*, 2011; Dwived *et al.*, 2016), Including nanotechnology is a modern technology that has the potential to bring about a new scientific revolution (Almosawy *et al.*, 2018b), nanotechnology can provide effective solutions to multiple agriculture problems (Prasad *et al.*, 2017; Lv, M. *et al.*, 2018; Alamery *et al.*, 2018). Nano-fertilizers are characterized by unique properties due to their small size and large surface area that leads to an increase in the absorption surface and thus an increase in photosynthesis and thus an increase in plant production (Singh *et al.*, 2016; Almosawy *et al.*, 2018). This study was conducted to find out the effect of bio-fertilizer and nanostatic fertilizer and their interaction on the growth and yield of sunflower.

Materials and Methods

A field experiment was conducted in soil (clay texture) to grow sunflower crop. In the spring agricultural season of 2019, In the fields belonging to Ibn Al-Bitar Professional Preparatory, Holy Karbala-Al-Husayniyah District. The experiment included two factors: the first factor was biofertilization with four levels (Control, Azotit, Phosphate and Azotovit + Phosphotavit). The second factor is zinc nano particles at three levels (0, 50 and 100 mg.L $^{-1}$). experiment was fertilized with recommended fertilizer quantities. It is added as a compound fertilizer that contains (N% 17, P% 12, K% 12). At a rate of 75 kg.H^{-1} in one batch after planting. As for nitrogen fertilizer, it used urea fertilizer (46% N). At a rate of 280 kg N.h^{-1} in two equal batches, potassium fertilizer was added at a rate of 120 kg K.h^{-1}, as potassium sulfate (50% K). It was added with nitrogen fertilizer. plants were harvested on 07/25/2019 when the emergence of full maturity signs, the following characteristics were measured and calculated :- leaves area (m ^{2}), head diameter (cm), Number of seeds per head (seed head^{-1}), Weight of 1000 seeds (g), Fertility Percentage (%), total seed yield (Mg h^{-1}) and percentage of oil in seed (%**)**.

Results and Discussion

Leaf area (m^2)

The results of the statistical analysis in table 1 showed that there were a significant differences between the treatments of biofertilizers and nano zinc particles and the interaction between them in leafs area, the treatment of bio fertilizers has a significant effect. Azotovit treatment was superior to gave highest value (0.705 m^2) compared to the non-addition treatment which recorded (0.579 m^2) with an increase of 21.76%. The results of the same table also indicate the effect of spraying with zinc nano particles, the second concentration 50 mg.L^{-1} superior by giving the highest rate (0.694 m^2), which did not a significant with the third concentration (100 mgL^{-1}) (0.649 m^2). The minimum value was recorded in control treatment(0.593 m^2). As for the effect of the interaction between biofertilizers and nanoscale, it was observed in Azotovit biofertilizer and the second concentration of zinc nano particles (50 mg.L^{-1}) by gave highest value (0.745 m^2). While the lowest value (0.482 m^2) was recorded at control treatment.

Head diameter (cm)

The table of statistical analysis (2) indicates a significant differences between the coefficients of biofertilizers and zinc nano particles and their interaction in the characteristic of the head diameter of sunflower plants, the addition of biofertilizers was a significant effect. Azotovit treatment was superior to gave highest value (29.17 cm), compared to the non-addition treatment (27.26 cm) with an increase (7.01%), which did not differ significantly from the two biofertilizers treatment (Phosphovit and Azotovit + Phosphovit), The same table also indicates the effect of zinc nano particles. The second concentration (50 mg.L^{-1}) superior by gave the highest rate in the head diameter (29.08 cm), which did not differ significantly from the third concentration (28.82 cm), the lowest value (27.30 cm) was recorded at control treatment. The interaction between biofertilizers and zinc nano particles, the treatment Azotovit and the second concentration of zinc nano particles (50 mg.L^{-1}) superior by gave the highest value (30.53 cm) compared with control treatment (not adding to both) (22.80 cm), with an increase (33.90%).

Number of seeds per head (seed head^{-1})

The results of the statistical analysis in table 3 indicate the effect of biofertilizers and zinc nano particles and the interaction between them, has a significant effect on the characteristic number of seeds per head. Azotovit treatment was superior by gave i the highest value (1224 seed head^{-1}) compared to the control treatment (without addition), which gave the lowest value (1133 seed head^{-1}), with an increase (8.03%). The concentrations (50 and 100 mg. Liter^{-1}) led to an increase in the number of seeds per head compared to the control treatment (15.22 and 8.12%), respectively. As for the interference between biofertilizers and zinc nano particles, the results of the table indicated that the highest number of seeds in the head recorded in Azotovit and the second concentration

Table 1: Effect of biofertilizers and zinc nano particles and their interaction in leaf area (m^2).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
0.579	0.614	0.640	0.482	0
0.705	0.743	0.745	0.627	Azotovit
0.632	0.580	0.702	0.614	Phosphotovit
0.666	0.660	0.688	0.649	Azotovit +Phosphotovit
LSD 0.05 for	0.073			LSD 0.05 for interaction
Bio fertilizers	0.649	0.694	0.593	Mean
0.042	0.037			LSD 0.05 for zinc nano particles

Table 2: Effect of biofertilizers and zinc nano particles and their interaction in head diameter (cm).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
27.26	29.70	29.27	22.80	0
29.19	28.23	30.93	28.40	Azotovit
28.73	28.27	29.07	28.87	Phosphotovit
28.44	28.73	27.47	29.13	Azotovit +Phosphotovit
LSD 0.05 for	2.49			LSD 0.05 for interaction
Bio fertilizers	28.73	29.18	27.30	Mean
1.44	1.24			LSD 0.05 for zinc nano particles

Table 3: Effect of biofertilizers and zinc nano particles and their interaction in Number of seeds per head (seed $head^{-1}$).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
1133	1301	1176	921	0
1224	1208	1356	1109	Azotovit
1171	1234	1107	1172	Phosphotovit
1145	1253	1050	1133	Azotovit +Phosphotovit
LSD 0.05 for	106.0			LSD 0.05 for interaction
Bio fertilizers	1249	1172	1084	Mean
61.2	53.0			LSD 0.05 for zinc nano particles

Table 4: Effect of biofertilizers and zinc nano particles and their interaction in Weight of 1000 seeds (g).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
63.04	67.26	66.91	54.96	0
74.59	75.23	79.91	68.62	Azotovit
68.87	70.24	71.59	64.80	Phosphotovit
74.24	74.03	74.10	74.58	Azotovit +Phosphotovit
LSD 0.05 for	2.60			LSD 0.05 for interaction
Bio fertilizers	71.69	73.13	65.74	Mean
1.50	1.30			LSD 0.05 for zinc nano particles

(50 mgL^{-1}) treatment (1356 seed $head^{-1}$), while the lowest value in interaction was recorded in the control (non-addition of both) treatment (921 seed $head^{-1}$).

Weight of 1000 seeds (g)

The results of the statistical analysis in table 4 showed a significant effect of biofertilizers and zinc nano particles and the interaction between them. Azotovit treatment was superior by gave the highest value (74.59 g), which did not differ significantly from the two biofertilizers treatments (Phosphovit and Azotovit + Phosphovit). Which gave (74.24 g), while the control treatment (without adding) was gave the least value (63.04 g).

The same table shows that the concentrations (50 and 100 $mg.L^{-1}$) led to an increase in the weight of 1000 seeds, compared to the non-addition treatment (11.24 and 9.05%) respectively. Interaction between biofertilizers and zinc nano particles, Azotovit biofertilizer treatment with second concentration (50 $mg.L^{-1}$) was superior by gave the highest value (79.91 g), while the lowest value (54.96 g) was recorded at control treatment.

Fertility Percentage %

The statistical analysis table 5 showed a significant effect of biofertilizers and zinc nano particles and the interaction between them. Azotovit treatment was superior by gave the highest value (90.2%). Control treatment (without adding) was gave the lowest value (82.9%). The same table also indicates the effect of zinc nano particles the third concentration 100 $mg.L^{-1}$ was superior by gave the highest value (89.4%), which did not differ significantly from the second concentration 50 $mg.L^{-1}$ which was recorded (89.2%), compared to the non-addition treatment, which recorded (83.3%), with an increase (7.32 and 7.08%) respectively. Interaction between biofertilizers and zinc nano particles, the first concentration of biofertilizer treatment with third concentration (100 $mg.L^{-1}$) was superior by gave the highest value (90.5%), while the lowest value (68.3%) was recorded at control treatment.

Total seed yield ($Mg.h^{-1}$)

The statistical analysis table 6 indicates a significant effect of biofertilizers and zinc nano particles and the

Table 5: Effect of biofertilizers and zinc nano particles and their interaction in Fertility Percentage (%).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
82.9	90.5	89.8	68.3	0
90.2	90.1	90.3	90.1	Azotovit
88.7	89.8	88.4	88.0	Phosphotovit
87.5	87.2	88.4	86.8	Azotovit +Phosphotovit
LSD 0.05 for	4.4			LSD 0.05 for interaction
Bio fertilizers	89.4	89.2	83.3	Mean
2.5	2.2			LSD 0.05 for zinc nano particles

Table 6: Effect of biofertilizers and zinc nano particles and their interaction in total seed yield (Mg.h^{-1}).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
3.83	4.46	4.27	2.75	0
4.39	4.14	4.56	4.47	Azotovit
3.92	4.09	3.95	3.73	Phosphotovit
3.92	3.83	4.08	3.83	Azotovit +Phosphotovit
LSD 0.05 for	0.26			LSD 0.05 for interaction
Bio fertilizers	4.13	4.22	3.70	Mean
0.15	0.13			LSD 0.05 for zinc nano particles

Table 7: Effect of biofertilizers and zinc nano particles and their interaction in percentage of oil in seeds (%).

Mean	Zinc nano particles (Mg. L^{-1})			Bio fertilizers
	100	50	0	
38.1	40.5	42.4	31.5	0
43.7	41.5	46.1	43.4	Azotovit
43.6	47.2	41.3	42.3	Phosphotovit
44.2	46.9	40.3	45.4	Azotovit +Phosphotovit
LSD 0.05 for	3.7			LSD 0.05 for interaction
Bio fertilizers	44.0	42.5	40.6	Mean
2.2	1.9			LSD 0.05 for zinc nano particles

interaction between them. Azotovit treatment was superior by gave the highest value (4.39 Mg.h^{-1}). Control treatment (without adding) was gave the lowest value (3.83 Mg.h^{-1}) an increase of (14.62%). The same table also indicates the effect of zinc nano particles, the second concentration 50 mg.L^{-1} superior by gave the highest value (4.22 Mg h^{-1}), which did not differ significantly from the third concentration 100 mg.L^{-1} which recorded (4.13 Mg h^{-1}), compared to the control treatment (3.70 Mg.h^{-1}). The interaction between biofertilizers and zinc nano particles, the second treatment of biofertilizer (azotovit) with second concentration (50 mg.L^{-1}) was superior by gave the highest value (4.56 Mg.h^{-1}), while the lowest value (2.75Mg.h^{-1}) was recorded at control treatment.

Percentage of oil in seed (%)

The results presented in the table of statistical analysis (7) indicate that there were a significant differences between biofertilizers treatments and zinc nano particles and their interaction, (Azotovit+ Phosphotovit) treatment was superior by gave highest value (44.2%), which did not differ significantly from the individual treatments (43.7% and 43.6%), the control treatment was given the lowest value (38.1%). The third concentration of zinc nano particles 100 mg.L^{-1} was superior by gave the highest value (44.0%) compared to the control (non-addition) treatment, which recorded (40.6%) with an increase (8.37%). The interaction between biofertilizers and zinc nano particles, the treatment of the interaction between Phosphotovit and the third concentration of zinc nano particles 100 mg.L^{-1} was superior by gave the highest value (47.2%), while The lowest value was recorded at control treatment (31.5%).

The results of our experiment revealed that biofertilizers generate positive effects on promoting plant growth by increasing the leafy area, head diameter, number of seeds per head, weight of 1000 seeds, total seeds yield, percentage of fertility and percentage of oil, It is attributed to the role of bacteria in improving soil fertility by fixing nitrogen from the atmosphere and dissolving phosphorous by launching special enzymes that dissolve phosphorous, which are phosphorous enzymes that convert phosphorous into a ready-made image of the soil and absorb it easily. This increases the production of hormones and thus increases plant growth (Govindappa *et al*., 2011; Raj and Adhikari, 2013) and this result is consistent with the findings of both (El-Refaey *et al*., 2015; Kumar *et al*., 2016; Shakya and Barwa, 2017; Al-Sudani and Al-Baldawi, 2018) which indicated a significant effect of adding fertilizer to the studied traits.

As for the zinc nano particles, the reason for the increase in some studied traits may be due to the unique behavior and properties of the nanoparticles due to their small size, making it possible to absorb them with better efficiency by the plant and also increasing their surface area, which enabled them to increase the speed of their absorption, Increased enzymatic activity and an increase in the speed of chemical reactions when they are at the nanoscale levels and their direct entry into plant cells

(Sabir *et al*., 2014; Almosawy *et al*., 2014). These results are consistent with the findings of Laware and Raskar, (2014) that the role of nanoparticles is manifested in encouraging and improving the characteristics of growth (Almosawy *et al*., 2019; Alamery *et al*., 2014). The overall results indicate that the integrated application of biofertilizers and micronutrients with nano-micronutrients is more effective in improving sunflower productivity.

References

Abdel-Mawgoud, A., A. El-Bassiouny, A. Ghoname and S. Abou Hussein (2011). Foliar application of amino acids and micronutrients enhance performance of green bean crop under newly reclaimed land conditions. *Aust. J. Basic Appl. Sci*., **5(6):** 51-55.

Alafeea, R.A.A., A.A. Alamery and I.T. Kalaf (2019). Effect of Bio Fertilizers on Increasing the Efficiency of Using Chemical Fertilizers on the Yield Component of Maize (*Zea Mays* L.). *Plant Archives*, **19(2):** 303-306.

Alamery, A.A. (2014). Response of Four Bread Wheat Caltivars (*Triticum Aestivum* L.) Under Abiotic Stress. Ii-in Some of Antioxidant Enzymes, Organic Acid and Active Iron. *Euphrates Journal of Agriculture Science*, **6(2):** 114-129.

Alamery, A.A., A.N. Almosawy, S.M. Al-Rubaei, H.M. Mohammed, L.Q. Al-Kinanai and H.G. Alkrati (2018). Effect of potassium and g power calcium nanoparticle spray on growth and yield of some broad bean cultivars (*Vicia faba* L.). *Biochem. Cell. Arch*., **18(2):** 2003-2007.

Alamery, A.A., S.M. Lateef, A.N. Almosawy, M.H. Alhassaany and M.M. Almosawy (2019). Effect of Phosphate Bio Fertilizers on Increasing the Efficiency of the Use of Phosphate Mineral Fertilizers and its Effect on some growth Properties of Broccoli. *Brassica oleracea var. italica*.

Almosawy, A.N., A.A. Alamery, F.S. Al-Kinany, H.M. Mohammed, N.A. Alyasiri and A.H. Alhusani (2018). Effect of proteck calbor nanoparticle on growth and yield of some wheat cultivars (*Triticum aestivum* L.). *Biochem. Cell. Arch*., **18(2):** 1773-1178.

Almosawy, A.N., A.A. Alamery, F.S. Al-Kinany, H.M. Mohammed, L.Q. Alkinani and N.N. Jawad (2018). Effect of optimus nanoparticles on growth and yield of some broad bean cultivars (*Vicia faba* L.). *Int. J. Agricult. Stat. Sci. Vol*., **14(2):** 2018.

Al-Mosawy, A.N., H.A. Al-Farttoosl, A.A. Al-Amery and R.L. Attiya (2014). Role of nutrient solution magnetizer of manganese sulphate in growth and yield in wheat which Grown in the fields of holy Karbala (*Triticum aestivum* L.). *KARBALÂ'HERITAGE Quarterly Authorized Journal Specialized in Karbalâ' Heritage*, **1(2):** 311-330.

Almosawy, A.N., N.N. Jawad and I.T. Kalaf (2019). Influence of Foliar Application of Boron and Times of Spraying on Yield of Maize (*Zea Mays* L.). *Plant Archives*, **19(2):** 307-309.

Al-Sudani and Al-Baldawi (2018). Effect of bio-fertilization on some traits of growth, yield, its component and oil yield for different cultivars of Flax. *Euphrates Journal of Agriculture Science*, **10(2):** 110-123.

Dwivedi, S., Q. Saquib, A.A. Al-Khedhairy and J. Musarrat (2016). Understanding the role of nanomaterials in agriculture. In Microbial Inoculants in Sustainable Agricultural Productivity; Singh, D.P., Singh, H.B., Prabha, R., Eds.; Springer: New Delhi, India, 271-288.

El-Refaey, R.A., E.H. El-Seidy, T.A. Abou-Zaied, U.A. Abd El-Razekand and E.A. Rashwan (2015). Effect of different mineral and biological nitrogenous fertilizers combinations on straw yield and fiber quality of some flax (*Linum usitatissimum* L.) genotypes. *Glob. J. Agric. Food Safety Sci*., **2:** 346-364.

Govindappa, M., R.V. Ravishankar and S. Lokesh (2011). Screening of Pseudomonas fluorescens Isolates for Biological Control of Macro phomina phaseolina Root-Rot of Safflower, *African Journal of Agricultural Research*, **6(29):** 6256-6266.

Ibrahim, S., L. Taha and M. Farahat (2010). Influence of foliar application of peptone on growth, flowering and chemical composition of *Helichrysum bracteatum* plants under different irrigation intervals. *Ozean J. Appl. Sci*., **3(1):** 143-155.

Kumar, S., J.K. Singh and A. Vishwakarma (2016). Effect of NPK level sand bio-fertilizers on quality parameters and seed yield of *Lin seed* (*Linum usitatissimum* L.) varieties under irrigated condition. *Intl. Quarterly J. of Life Sci*., **11(2):** 1339-1343.

Lateef, S.M., A.A. Alamery, M.H. Alhassaany, A.N. Almosawy and M.M. Almosawy (2019). Role of Bio Fertilizers and Phosphate levels on some growth and yield Properties of Broccoli (*Brassica oleracea* var. italica). *Plant Archives*, **19(2):** 1564-1568.

Lv, M., Y. Liu, J.H. Geng, X.H. Kou, Z.H. Xin and D.Y. Yang (2018). Engineering nanomaterials-based biosensors for food safety detection. *Biosens. Bioelectron*., **106:** 122-128.

Miransari, M. (2011). Soil microbes and plant fertilization. *Applied microbiology and biotechnology*, **92(5):** 875-885.

Nasrallah. Adel Bosef, Intisar Hadi Al-Halfi, Hadi Muhammad Al-Aboudi, Aws Ali Mohammed and Ahmed Mahdi Mahmoud (2014). The effect of spraying some plant extracts and antioxidants on the growth and yield of sunflower. *Journal of Agricultural Sciences*, **45(7):** 651-659.

NSA (2019). World Supply and Disappearance, National Sunflower Association, https://www.sunflower nsa.com.

Prasad, R., A. Bhattacharyya and Q.D. Nguyen (2017). Nanotechnology in sustainable agriculture: Recent developments, challenges and perspectives. *Front. Microbiol*., **8:** 1014, doi:10.3389/fmicb.2017.01014.

Raj, B.B. and P. Adhikari (2013). Effect of Azotobacter on growth and yield of maize. *S.A.A.R.C.J. Agri*., **11(2):** 141-147.

Sabir, S., M. Arshad and S.K Chaudhar (2014). Zinc oxide nanoparticles for revolutionizing agriculture: synthesis and applications. The Scientific World Journal, 1-8.

Shakya, L. and Sh. Barwa (2017). Effect of reduced doses of chemical fertilizers with dual inoculation of biofertilizers on linseed varieties. *Intl. J. Innovative Res.Sci., Engineering and Technol*, **6(7):** 14123-14129.

Singh, A., S. Singh and S.M. Prasad (2016). Scope of nanotechnology in crop science: Profit or Loss. stats/world-supply.