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Effect of G Power Ca + Nanocomposite and Bio-Fertilization on the Chemical and Yield Parameters of Sunflower

Q.TH. AL-ASADI [a*]

a College of Education for Pure Sciences, University of Kerbala, Kerbala, Iraq

P A P E R I N F O

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A b s t r a c t

A field experiment was conducted on the west side of AL-Jadwal Al-Garbi /Hindia/ Karbala, Iraq, during the spring agricultural season of 2023. The objective was to evaluate the effect of G power Ca + Nanocomposite spraying and Bio-Fertilization using *Pseudomonas* bacteria on sunflower yield and seed quality. Two factors were studied. First foliar spraying of G Power Ca+ Nanocomposite at four concentrations (0,2.5, 4 and 5 ml.L^{-1}). Second, Soil application of *Pseudomonas* bacteria at four levels (0, 10, 20 and 60 ml .L^{-1}) injected into Rhizosphere. The examined proceeded in accordance with the experiment design using the Gene stat program ,the arithmetic averages comparison employed the least significant difference (LSD0.05) test.

Measured parameters included Plant height, biological yield , seed content of oil, number of seeds per disc, and, protein in seed , and nitrogen in seed . The highest values were recorded at a concentration of 5 ml/L of G Power Ca+ nanoparticles and 60 ml/L of *Pseudomonas* bacteria for all studied traits, with observed (191.56 cm , 12.76 ton .ha^{-1}, 5.76 % , 1245 seed.$disk^{-1}$, 11.47 % , 2.99 %) showing statistically significant differences compared to the control treatments(122.87 cm , 6.56 ton .ha^{-1}, 1.87 % , 754 seed.$disk^{-1}$, 6.23%,1.04%)respectively . These results highlight the potential for improving sunflower productivity and nutritional quality in arid conditions by combining nanoparticle treatment with biofertilization.

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1. INTRODUCTION

Sunflower (*Helianthus annuus* L.) is a summer crop around that belongs to the Compositae (Asteraceae) family (Sharma *etal*.,2005) . Entering the oil industry for high-cost food, its seeds taste good and source in the high-quality oil industry, and its oil uses include soap and dye (Arshad *etal*.,2010). Its seeds are also essential nutrients for the human body, as they contain vitamins, basic fatty acids, minerals and unsaturated fatty acids, and its oil contains a high proportion of fatty acids, including linoleic acid and oleic acid, which are important medical substances in human diet and contain vitamin E(Baloglum *etal*.,2012)..

In recent times, the use of biosynthesis, which is one of the achievements of Biotechnology, has become widespread. It involves isolating, purifying, and characterizing microorganisms and using them as inoculations in the middle stages of plant growth, helping the plant to absorb nutrients. (Baha *etal*.,2012)

.The microbe content in the Rhizosphere has changed and its success depends on the efficiency of the organism, the compatibility of the micro-organism with the vegetarian family, the competitiveness of the organisms originally found in the soil, as well as the preparation of the living in the Rhizosphere and its viability (Al-Ibrahemi *etal*.,2024). The importance of this composting in providing part of the nutrients for plants, hormones, and some antibiotics can be used to reduce dependence

*Corresponding Author Institutional Email:
queod.theaban@uokerbala.edu.iq (Qioud TH. AL-ASADI)

on chemical fertilizers as a result of the provision of a large part of the nutrients to feed plants, reduce costs of agricultural production and reduce environmental pollution rates (Kumar *etal*.,2016) .Nano - fertilizer is critical to improving crop resilience for disease, and is a means of transporting compounds to target organs
be it root, leaf , fruit or other plant parts, and increasing the content of leaf from chlorophyll (He *etal*.,2018) .The nano-fertilizer (G power Ca +) is an important nano-accumulator used as an agricultural fertilizer produced by nanotechnology. It consists of several compounds, including nitrogen at 8% and calcium at 13% (Sekhon, 2014 and AL-Ibrahemi *etal*.,2020) , Some studies have suggested that nanomaterials have the potential to penetrate seed membranes, stimulate the ability to absorb plants into water, strengthen the enzyme system, and improve Plant
and growth (Al-Ghazal *etal*.,2023 ; Banerjee and Kole ,2016).The aim of study effect of G Power Ca + Nanocomposite and Bio-Fertilization on the Chemical and Yield Parameters of Sunflower

Material and method

The field experiment was carried out on the west side of Hindi Karbala, Iraq, for the spring agricultural season of 2023. The soil is sandy clay of the field was ploughed and blessed and then divided into experimental units, the size of the pilot unit 15 m and left 75 cm between the area and 25 cm between the groove and the other. The seeds were sown on 21/3/2023, and after germination and the emergence of plants, the land was watered regularly according to the plant's needs, and weeding was carried out manually and repeated as required. The experiment comprised a completely randomized block design (RCBD) performed with two factors. The first factor is G power Ca + Nanocomposite(8% Nitrogen , 13% water soluble CaO , Manufacturer Agri Sciences Ltd .Sti Izmir-Turkey), spray with three concentrations in addition to the control treatment (0, 2.5, 4, 5 ml.L^{-1}) in the early morning to avoid high temperatures. The spraying process was completed to reach full wetness and the 2-litre hand spray was used. The second factor involves ground composting with bacteria *Pseudomonas* with injection at concentrations (control, 10, 20, 60 ml .L^{-1}) in the Rhizosphere. Gram-negative *Pseudomonas flourescens* was used in the experiment. Twenty root zone soil samples were collected from different plant areas and placed in plastic bags to prevent drying. One gram of soil was taken from each sample, and each gram was added separately to 9 ml of sterile water to prepare an aqueous suspension. This suspension was placed in a shaker, and a series of dilutions were prepared,0.1 ml of each dilution was transferred to solid KingB agar. The samples were incubated at 25°C for 24–48 hours. The bacteria were then purified by re-culturing on Pseudomonas agar. Microscopic and biochemical tests were subsequently performed to identify the bacterial species. (Rosas *etal*., 2009).

The fertilizer added urea fertilizer and potassium fertilizer in the form of potassium sulfate and phosphate fertilizer in the recommended quantities. The first batch was added after 30 days of cultivation and the second batch after 60 days .

1- yield parameter: Plant height, number of seeds in the disc, biological yield.
2- chemical parameter: percentage of oil, percentage of protein in the Seeds , percentage of nitrogen in the Seeds.

Statistical analysis: Statistical analysis was performed according to the experimental design using Gene stat program. The arithmetic averages comparison employed the Least Significant Difference (LSD0.05) test.

Results and Discussion

Plant height

The results in Table (1) indicated a significant effect of G power Ca + Nanocomposite spraying and *Pseudomonas* on plant length. G power Ca + Nanocomposite showed the highest effect at a concentration of 5 m.L^{-1} (169.72 cm), while the lowest plant height was observed in the control (133.505cm). The increase in plant height may be attributed to calcium, a major nutrient that regulates metabolism, supports plant development and promotes cell expansion and division (Duan *etal*.,2022). Furthermore, nano-fertilizers possess unique properties; their small size and increased surface area allow for more efficient absorption by plants, leading to faster biochemical reactions and direct entry into plant cells (Sabir *etal*.,2014).
Similarly, *Pseudomonas* had a significant effect with the highest concentration (60 ml. L^{-1}) resulting in plant height of 173.375 cm, while the lowest concentration was recorded in the control (138.97cm). The role of bacteria in plant growth is linked to enhanced light absorption and efficient nutrient transfer to sink tissue (Al-Rawi,2010).

Biological yield

The results of Table (1) indicated a significant effect of G power Ca + Nanocomposite spraying and *Pseudomonas* on biological yield. The highest yield was observed at the highest concentration (5 ml.L^{-1}), reaching 10.856 tons ha^{-1}, while the lowest yield was recorded in the control (7.958 tons ha^{-1}). This effect is attributed to calcium's essential role in regulating and controlling plant metabolism, supporting growth, maintaining cell wall structure, and enhancing resistance biotic non-biotic stress (Waraich *etal*.,2011) Furthermore, calcium increases the availability of essential plant nutrients, particularly nitrogen, leading to increased efficiency in carbon metabolism and its products, thus positively impacting plant productivity (Sham *etal*., 2019).. *Pseudomonas* showed a significant effect on biological yield, with the highest yield observed at the 60 ml/bacteria treatment(11.573 tons ha^{-1}) and the lowest in the control group (7.958 tons ha^{-1}). This increase can be attributed to the bacteria role in enhancing dry matter production and accumulation during the grain-filling period, which subsequently increased in the number of grains per plant (El-Nagdy *etal*.,2010).

Percentage of oil in seeds

The results of Table (1) indicate a significant effect of G power Ca + Nanocomposite spraying and Pseudomonas on the percentage of oil in seeds. The highest oil percentage (4.205%) was recorded in treatment with G power Ca + Nanocomposite at the highest concentration (5 ml.L^{-1}), while the lowest percentage (2.56%) was observed in the control.

The increase in oil percentage in seeds may be due to higher of nitrogen and phosphorous concentration and the production of plant hormones. These factors promote meristem cells division, enhance the growth of radical and shoot, and stimulate nitrogen accumulation in plant tissues. This in turn improves the efficiency carbon assimilation and its translocation from source tissues its transition from the source to the sink ultimately, increasing the of oil content in seeds (Sekhon,2014). A significant effect of *Pseudomonas* was observed with the highest oil percentage (4.71%) recorded in the treatment with 60 ml .L^{-1} suspension, while the lowest percentage (2.37%) was found in the control . The increase in seed oil content is likely due to the role of bacteria in enhancing nutrient availability, uptake, and accumulation within the plant tissues (Kumar *etal*.,2016). The increase in seed oil content is likely due to the role of bacteria in enhancing nutrient availability, uptake, and accumulation within the plant tissues (Kumar *etal*.,2016).

Number of the seeds in the disc

The results of table (1) indicate a significant effect of G power Ca + Nanocomposite spraying and *Pseudomonas* on the number of seeds per disc. The G power Ca + Nanocomposite at the highest concentration (5 ml.L^{-1}) yielded the highest seed count (1034.75seed.disk-1), while the control treatment showed the lowest at the control (873.25 seed.disk-1). This increase may be due to enhanced vegetative growth, which is associated with higher dry matter accumulation. Increased humidity levels and nitrogen availability, promote carbon assimilation, to great plant expansion floral development(Singh *etal*.,2015). Calcium plays an important role in regulating and controlling plant metabolism and development, as well as maintaining cell wall structure.(Manjaiah *etal*.,2019) .

A significant effect of a *Pseudomonas* was observed, with the highest seed count (1105 seed.$disk^{-1}$) recorded in the 60 ml. L^{-1} treatment and the lowest (814.5 seed.$disk^{-1}$) in the control. The increase in seed number in the disc may attributed to the role of *Pseudomonas* in nutrient availability, which promotes early silk emergence through increased cell division and elongation. This synchronization with pollen production improves fertilization efficiency, leading to a higher seed account per disc (Shakya and Barwa , 2017), and may be due to the biological role of *Pseudomonas* in increasing the availability of nutrient elements and their absorption and transfer within the plant tissue and in appropriate concentrations. Which means increasing the efficiency of C4 Carbon fixation on the one hand and the transfer of metabolic compounds to the new locations of the reproductive stage of the plant on the other side(Gupta and Gupta,2005)

percentage of protein in the seeds

The results of Table (1) indicate a significant effect of G power Ca + Nanocomposite spraying and *Pseudomonas* on percentage of protein in the seeds. The highest protein content [1] (9.81%) was recorded in the treatment with G power Ca + Nanocomposite at the highest concentration (5 ml.L) while the lowest (7.243%) was observed in the control. The increase in seeds protein content may be attributed to increased calcium concentration In leaf tissues, which play a crucial role in nitrogen metabolism and prorien synthesis in Zea maize (Jampilek and

Kraeova ,2015).Similarly, *Pseudomonas* showed a significant effect, with the highest protein content (10.008%) recorded in the 60 ml .L^{-1}treatment and the lowest (7.173%) in the control.

Percentage of nitrogen in the seeds

The results of table (1) indicated a significant effect of G power Ca + Nanocomposite spraying and Pseudomonas in percentage of nitrogen in the seeds % , showing a significant effect of G power Ca + Nanocomposite with the highest concentration in treatment of 5 ml.L^{-1}
(2.24%) and the lowest concentration at the control (1.586%).
The study showed a significant effect of *Pseudomonas*, with the highest concentration(2.51%) recorded in the treated group (60 ml.L^{-1}), while the lowest concentration was recorded in the control group(1.34%) . These results are consistent with those of Al-Yassiri *etal.* (2024). This may be attributed to the effect of *Pseudomonas* on the absorption of mineral elements, which in turn affects cell division and mitochondrial formation. As a result, the leaf surface area and its nutrient supply increase , leading to increased carbohydrate and protein production.

Conclusion

The study highlights the potential of integrating nanocomposite fertilizers and bio-fertilization in improving sunflower yield and nutritional quality under arid conditions

Recommendations

1-recommend using nanofertilizers instead of chemical fertilizers.
2- recommend using biofertilizer as a foliar spray on the vegetative parts.

Table (1): The effect of G power Ca + Nanocomposite and Pseudomonas on Plant height, Biological yield, Oil in seeds, Seeds in the disc, Protein in the seed and Nitrogen in the seed.

G power Ca + Nanocomposite	*Pseudomonas* ($ml.L^{-1}$)	Plant Height (cm)	Biological yield ($ton.ha^{-1}$)	Oil in seeds %	Seed No. in disc ($seed.disk^{-1}$)	Protein in seeds%	Nitrogen in seed%
Control	Control	122.87	6.56	1.87	754	6.23	1.04
	10	129.76	7.67	2.26	848	6.75	1.56
	20	137.74	8.67	2.77	895	7.34	1.77
	60	143.65	9.97	3.34	996	8.65	1.97
2.5	Control	135.45	7.56	2.23	794	6.96	1.22
	10	146.56	8.64	2.79	899	7.23	1.68
	20	165.45	10.67	3.76	975	7.87	1.84
	60	175.84	11.63	4.76	1046	9.68	2.23
4	Control	147.91	8.75	2.45	865	7.56	1.34
	10	158.34	9.21	3.37	945	8.54	1.77
	20	162.63	10.94	3.99	998	9.56	1.99
	60	182.45	11.93	4.98	1123	10.23	2.83
5	Control	149.65	8.96	2.95	845	7.94	1.76
	10	164.76	9.94	3.76	995	9.85	1.87
	20	173.56	11.75	4.35	1054	9.98	2.34
	60	191.56	12.76	5.76	1245	11.47	2.99
L.S.D		1.76	1.84	1.34	1.45	1.74	1.84
Effect of G power Ca + Nanocomposite	Control	133.50	8.218	2.56	873.25	7.243	1.586
	2.5	162.33	9.625	3.385	928.5	7.935	1.743
	4	162.83	10.208	3.698	982.75	8.973	1.983
	5	169.72	10.856	4.205	1034.75	9.81	2.24
L.S.D		1.78	1.86	1.86	1.75	2.75	1.56
Effect of *Pseudomonas* (ml/bacteria)	Control	138.97	7.958	2.375	814.5	7.173	1.34
	10	149.855	8.82	3.038	921.75	8.093	1.72
	20	159.868	10.508	3.718	980.5	8.688	1.99
	60	173.375	11.573	4.71	1105	10.008	2.51
L.S.D.		1.63	1.02	1.13	1.70	1.02	1.32

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