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EFFECT OF SOWING DATE, BIO AND NANO FERTILIZERS ON VEGETATIVE GROWTH AND NUTRIENT CONTENTS OF CAULIFLOWER (BRASSICA *OLERACEA* VAR. BOTRYTIS L.) UNDER PLASTIC HOUSE CONDITIONS

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ABSTRACT

This experiment was carried out in the plastic house (500m^2) at protected cultivation department in Zakho technical institute/Dohuk polytechnic university., during growing seasons (2021-2022), to investigate the effect of sowing date (15 August, 1 September & 15 September), bio fertilizer (0, 2ml.L^{-1}) & nano fertilizer (0, 3, 6 & 9ml.L^{-1}) on Cauliflower (*Brassica* oleracea var. botrytis l.).,The appeared results demonstrated that both planting date on 15-Augustes and Nano fertilizer at concentration (9.ml L^{-1}) had significant differences in terms of vegetative growth characters, All studied parameters in the vegetative and macro nutrient contents were significantly increased by the first planting date during the study seasons. It was also observed that treating plant with Bio fertilizer at 2.ml L^{-1} significantly increased all investigated traits. The interactions between planting date at 15- August and Nano fertilizers (9 ml.L$^{-1)}$ were noticeable appeared by the improving of most detected traits. Significantly impacted most measures, whereas high concentration of Nano fertilizer and first planting date together produced the greatest overall result in all vegetative growth parameters (Number of leaf. leaf area (cm^2), and chlorophyll contents (SPAD). Re there was an increase grading nutrients contents, significant enhancement were showed.

***KEY WORDS*:** Planting date. Nano Zinc, Biofertilizers. Cauliflower

INTRODUCTION

Cauliflower (***brassica*** *oleracea* var. botrytis l.), is One of the most significant members of the Brassicaceae family, which has more than 350 genera and around 4000 species distributed across the world, is cauliflower (*Brassica oleracea* var. botrytis L). The Latin words "caulis" (stalk) and "Floris" (flower) were combined to create the English term "cauliflower." Cauliflower is a good source of vitamin A, which has a concentration of 40 IU, vitamin B1, of 0.13 mg, vitamin B2, and vitamin C, of 30 mg. It also provides 8.0 grams of carbohydrates and 2.3 grams of protein. Antioxidants, which shield cells from inflammation and damage brought on by free radicals, are abundant in cauliflower. These adversaries include. Sulfur-containing compounds known as glucosinolates, they give. Brassicaceae its bitter flavor.

Cauliflower is grown to obtain the crud (part that is eaten).The plant is the flower buds before they open with flower stands that are fleshy overgrown, In Iraq the area planted with cauliflower reached 3,408 dunums, with a productivity of 121 ton in 2015 year. The crop is highly thermo sensitive and variation in temperature significantly influences both vegetative and generative phases of the crop (Rahman *et al*., 2013).

The increase in food production is currently one of agriculture's biggest problems in meeting the needs of a rising population, and it will continue to be so in the future due to population pressure. The fertilization system is one of the primary variables affecting crop quality in the production of food. because one of the primary concerns limiting agricultural yield is soil fertility. The type and quantity of fertilizers applied have a significant impact on the development and output of vegetable crops (Chang *et al.,* 2010). Therefore, bio and nano fertilizers are frequently utilized to improve soil fertility and productivity.

Bio-fertilizers are naturally occurring substances that include living microorganisms and are produced by the roots of plants or cultivated soil. They have no negative effects on

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the health of the plant, the soil, or the environment. These are useful in activating plant growth hormones in addition to their roles in fixing atmospheric nitrogen and phosphorus solubilization (Singh and Singh 2019).

Nanomaterial called Nano fertilizers can include a carrier matrix of mineral elements. He, Deng, and Hwang (2019) claim that these compounds may be created either as a nanoparticulate nutrient or by nanoencapsulation other nutritious components. According to Husain Jaffrey et al. (2020), nutrients are necessary for a plant's full growth, and a plant's ability to absorb nutrients depends on how readily they are accessible in the soil. These nutrients' incomplete availability in sufficient amounts in the soil is another limiting issue (Asgari lajayer *et al*., 2019). In light of the aforementioned context, the current study was conducted to determine the ideal sowing date and evaluate the effects of planting date, bio and nano fertilizers on yield and certain nutritional content in cauliflower.

MATERIALS AND METHODS

The field experiment was carried out during growing seasons 2021—2022, to investigate the effect of planting date, Bio and Nano fertilizers on the growth and yield of cauliflower (*Brassica oleracea* var. botrytis L.) crop grown under protected condition at protected cultivation department in Zakho technical institute/Dohuk polytechnic university. The treatments were arranged in split- split plot in a randomized complete block design (RCBD). To investigate the response of Cauliflower to different concentration of Bio fertilizers (two concentrations) and four concentrations of Nano fertilizers and three sowing date grown in plastic house. The study determined vegetative growth, and nutrient content of the Cauliflower crop. The land was ploughed and the soil was softened, then it was divided into lines, drip irrigation system of the field was done after planting. Cauliflower seeds were sowed in three data at (15August, 1 September and 15 September under plastic house, two seed per pots seedlings transferred to the permanent place and planted at distance of 40 cm between the plant and 60 cm between rows. Other agricultural practices were similarly carried out to each experimental unit as followed by farmers in the area. The treatments were arranged in split-split plot. The main-plot (3 sowing date: 15 August, 1September and 15 September, and the sub-plots were four levels of Bio fertilizer's (with and without), and in sub-sub-plot were the four concentration of Nano fertilizers (0,3,6 and 9ml L^{-1}), in a Randomized Complete Block Design (RCBD), 24 treatments were involved in this trail (3×2×4=24) with three replication (72 experimental unit), every plot 4.0 meter long and 130 cm wide. Each unit is two lines, the distance between the plants on a line was 40 cm and between the lines was 65 cm. the unit area is (5.2 m^2). The number of plants in square meter was (4.82plants) and each plot content 14 plants, the results were analyzed statistically by (SAS,2007).

The experimental measurements were as follows:

1. Vegetative growth characters:

a) - Number of leaves (Leaf/$plant^{-1}$).
b) - leaf area (cm^2) per plant
C)-Chlorophyll content (SPAD)

2-Macronutrient and Micro nutrient content in the leaves

a)-Nitrogen percentage (N%)
b) -Phosphorus percentage (P %)
C)-Potassium percentage (K %)
d) - Concentration of Iron (Fe ppm)
e)-Concentration of Zinc (Zn ppm) by (Association of Official Analytical Chemists and Helrich, K .2000).

The research site's soil type was Sandy clay loam. To determined it some of the soil's physical and chemical characteristics, random samples of the field soil were collected from various locations at a depth of 30 cm, air dried, and then passed through a 2.0 mm sieve. The results are displayed in Table (1). And the available nutrient in the soil was showed in the table (2).

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Table (1):- Some physical and chemical characteristics of the soil in the land experiment.

Characteristics	Measuring units	Result
Volumetric distribution of soil separate		
Sand	(%)	50.8
Silt	(%)	21.6
Clay	(%)	27.8
Texture	---	Sandy clay loam

Table (2):- Some available nutrient content of the soil in the land experiment**.**

Available nutrient content		
Total –N	**(%)**	**1.852**
Available phosphorus	**(%)**	**0.351**
Available potassium	**Ppm**	**1.493**
Organic matter	**(%)**	**1.872**
PH	**1:1 in peste**	**7.09**
Electrical conductivity	**(ds.m^{-1})**	**0.209**

The analysis was carried out at soil and water science laboratory, College of Agricultural engineering Sciences University of Duhok.

RESULTS AND DISSCATION

Data in Tables (3): Showed the effect of sowing date, Bio and Nano fertilizers on vegetative parameters (Number of leaf per plant (leaf.plant^{-1}), Leaf area and chlorophyll SPAD) on of cauliflower grown under plastic house conditions. Concerning number of leaf per plant, it was showed that there were significant effects between the date of planting, Nano and bio fertilizers on leaf number per plant. While where it was observed that treating plant with bio 2ml.L^{-1} and first planting date 15 August recorded higher number of leaf per plant (25.833 leaf.plant^{-1})as compared with other treatments, treating plant with first planting date 15 Augusts and Nano

Zn 9ml.L^{-1} gave a higher number per plant (25.645 leaf.plant^{-1}). Regarding triple interaction treatments among three factors (Nano fertilizer, Bio fertilizer and planting date in this study it were appeared significant effect among them. , a significant effect was seen among them planting date 15-September.* Bio 2 ml/L, fertilizer*Nano Zn 9 ml.L^{-1}) recorded higher number of leaf.plant^{-1} (27.790 leaf.plant^{-1}) as compared with interaction among planting date 15-September*zero Bio fertilizer *zero Nano fertilizer) which were gave lowest leaf number per plant (13.072 plant^{-1}).

Table (3):- Effect of Sowing Date, Bio and Nano Fertilizers on number of leaves (leaf.plant^{-1})

Planting Dates	Biofrtilizers ml/L	Nano Zn ml/L				Planting dates * Biofertilizer	Planting dates
		0	**3**	**6**	**9**		
15-Aug	0	21.370b-d	22.433 a-d	23.213 a-d	23.500a-d	22.629ab	23.544a
	2	22.133 a-d	23.583 a-d	24.327a-c	27.790a	24.458a	
01-Sep	0	13.072f	20.223b-e	14.729ef	21.290 b-d	17.329d	19.789b
	2	19.923b-e	21.373 b-d	22.117 a-d	25.580ab	22.248ab	
15-Sep	0	17.577d-f	18.867c-f	19.619b-e	20.076b-e	19.035cd	20.003b
	2	18.610c-f	20.200b-e	20.944 b-d	24.130a-c	20.971bc	
Nano Zn		18.781c	21.113b	20.825bc	23.728a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	21.752a-c	23.008ab	23.770ab	25.645a		
	01-Sep	16.498d	20.798bc	18.423	23.435ab		
	15-Sep	18.094cd	19.534cd	20.281b-d	22.103a-c		
Bio fertilizer * Nano Zn	0	17.340c	20.508bc	19.187bc	21.622b	0	19.664b
	2	20.222bc	21.719b	22.462b	25.833a	2	22.559a

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level.

Regarding the results in table (4 and 5), they show the effect of sowing date, Bio and Nano fertilizers on Leaf area (cm^2) and Chlorophyll SPAD) on of cauliflower grown under plastic house conditions. Concerning leaf .area per plant, it was noticed where the results showed that there are no significant effects between the dates of planting on leaf area per plant. While treating plant with bio fertilizer 2ml.L^{-1} shows showed a significant effect compared with to untreated plant (9914.876, 8743.306(cm^2) respectively. Regarding double interaction among treatments it they were showed a significant effects, interaction among planting date 15- August and Bio fertilizers 2ml.$L^{-1)}$ recorded higher leaf area per plant (9920.125..plant^{-1}) as compared with to other treatments, treating plants with all plant first all dates 15 Augusts, 01-September and 15-September and Nano Zn 9ml.L^{-1} gave a higher leaf area per plant as compared with interaction. Regarding triple interaction treatments among three factors (Nano fertilizer, Bio fertilizer and planting date in this study it revealed a significant effect among them. it were the results revealed that interaction among planting date 15-September.* Bio fertilizer 2 ml/L, *Nano Zn 9m ml.L^{-1}) recorded higher leaf area per.plant^{-1} (10832.333 cm^2) as compared with interaction among planting date 1st-September*zero Bio fertilizer *zero Nano fertilizer) that gave lowest leaf area per plant (7628.667 cm^2).

Table (4): -Effect of Sowing Date, Bio and Nano Fertilizers on leaf area (cm^2) of tested plant.

Planting Dates	Bio fertilizer ml/L	Nano Zn ml/L				Planting dates * Bio fertilizer	Planting dates
		0	**3**	**6**	**9**		
15-Aug	0	7634.667c	8038.000c	9419.000b	9849.333b	8735.250b	9327.688a
	2	7942.500c	10410.333a	10495.333a	10832.333a	9920.125a	
01-Sep	0	7628.667cd	8032.000c	9604.667b	9843.333b	8777.167b	9345.625a
	2	7936.333c	10404.333a	10489.333a	10826.333a	9914.083a	
15-Sep	0	7404.625d	8031.917c	9597.252b	9836.210b	8717.501b	9313.960a
	2	7971.250c	10403.585a	10469.920a	10796.920a	9910.419a	
Nano Zn		7753.007d	9220.028c	10012.584b	10330.744a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	7788.583d	9224.167c	9957.167b	10340.833a		
	01-Sep	7782.500d	9218.167c	10047.000ab	10334.833a		
	15-Sep	7687.938d	9217.751c	10033.586ab	10316.565a		
Bio fertilizer * Nano Zn	0	7555.986f	8033.972e	9540.306d	9842.959c	0	8743.306b
	2	7950.028e	10406.084b	10484.862b	10818.529a	2	9914.876a

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level.

The results in table (5) Showed the effect of sowing date, Bio and Nano fertilizers on chlorophyll SPAD on of cauliflower grown under plastic house conditions., significant effects between the date of planting on chlorophyll planting date on 15-AguAugust planting date., appeared effect on chlorophyll SPAD as compared with planting date that gave highest chlorophyll (55.587SPAD) as compared with planting date on 15-September. While treating plant with biofertilizer 2ml.L^{-1} showed a significant effect compared with untreated plant (56.691S and 50.396 SPAD) respectively. Double interaction among treatment showed significant effects, interaction among between planting date 15- August and Bio fertilizers 2ml.L^{-1}) recorded higher chlorophyll 58.760 SPAD) as compared with other treatments, treating plant with plant first date in on 15 Augusts, with Nano Zn 9ml.L^{-1}) gave a higher higher chlorophyll compared with interaction. Regarding triple interaction treatments among three factors (Nano fertilizer, Bio fertilizer and planting date significant effect among them was detected. it revealed that interaction among planting date 15-September. Biofertilizer 2 ml/L, fertilizer*Nano Zn 9m.L) recorded higher chlorophyll SPAD per (65.710) as compared with interaction among planting date 15st-September*zero Biofertilizer*zero Nano fertilizer) that gave lowest leaf area per plant (42.830 SPAD).

Table (5):-Effect of Sowing Date, Bio and Nano Fertilizers on chlorophyll SPAD **in tested plant.**

Planting Dates	Biofrtilizers ml/L	Nano Zn ml/L				Planting dates * Biofertilizer	Planting dates
		0	**3**	**6**	**9**		
15-Aug	0	46.760k	52.027gh	54.323ef	56.543d	52.413d	55.587a
	2	51.990gh	56.927d	60.413c	65.710a	58.760a	
01-Sep	0	44.510l	49.777ij	52.073gh	54.363	50.181e	53.352b
	2	49.790ij	54.677e	58.163d	63.460b	56.523b	
15-Sep	0	42.830m	48.213jk	50.532hi	52.796fg	48.593f	51.691c
	2	48.249jk	52.739fg	56.553d	61.616c	54.789c	
Nano Zn		47.355d	52.393c	55.343b	59.081a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	49.375g	54.477de	57.368c	61.127a		
	01-Sep	47.150h	52.227f	55.118d	58.912b		
	15-Sep	45.539i	50.476g	53.542e	57.206c		
Bio fertilizer * Nano Zn	0	44.700f	50.005e	52.310d	54.568c	0	50.396b
	2	50.010e	54.781c	58.376b	63.595a	2	56.691a

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level

From the above results in tables (3, 4 and 5) was seen, this a significant increase in vegetative growth parameters was may been due to the effect of Nano and Bio fertilizers, that influencing on vegetative growth significantly that considered important for plant, The planting date is the most important factor among the factors affecting the growth and yield characteristics of different crops, as it determines the chance of success or failure of the crop, (Matloob *et al* 1989).

A study on broccoli in India, found that the most appropriate planting date was 12/10, as a significant increase was achieved in plant height 43.13 cm, stem diameter 48.10 mm, number of leaves 27.50 leaves, main heads weight 834 66 g and total plant yield 37.04 ton ha-1, compared to 20/1 date plants that showed the lowest results for the mentioned characteristics as they were 36.64 cm, 44.45 mm, 24.06 leaves, 626.22 g and 27.48 ton ha-1 each, respectively. In an experiment carried out by (Suthar et al 2018). (Note: These should be transferred to the place of the phrase mentioned above in the study)

The positive effect of the application of zinc oxide nanoparticles on tomato plants opens an avenue for its potential use as a future Nano fertilizer. It has been observed that NPs in low concentrations have not displayed any harmful effect to plants but instead are capable of activating specific physiological and molecular responses. For example, TiO2 nanoparticles (0.25–4 %) are able to promote photosynthesis and nitrogen metabolism in spinach and, therefore, improve the growth of the plants (Zheng *et al.* 2005; Klaine *et al.* 2008

The enhancement in vegetative growth in tables (3,4 and5) is attributable to the fact that that it was shown that there are significant effects between the date of planting on percentage of Nitrogen, planting date on 15-August., there was a significant effect that recorded high percent of nitrogen (2.018 %) as compared with other planting date. While treating plant**s** with biofertilizer 2ml.L^{-1} shows significant effect compared with untreated plant (2.288). Regarding double treble interactions among treatments it were showed a significant effects, interaction among planting date 15-August and

Bio fertilizers 2ml.L^{-1}) recorded higher percentage of nitrogen 2.483b as compared with other treatments, treating plant with planting on the first date 15 Augusts, Nano Zn 9ml.L^{-1} gave a higher

percentage of nitrogen (2.730%)as compared with other interaction. Regarding triple interaction treatment among by the interaction o three factors (Nanofertilizer, Bio fertilizer and planting date in this study it were appeared significant effect among them., it were revealed that interaction among planting date 15-

September.* Bio fertilizer 2 ml/L, fertilizer*Nano Zn 9m ml.L^{-1}) recorded higher percentage of nitrogen (3.340%) as compared with interaction among planting date 01-September *zero Bio fertilizer *zero Nano fertilizer) that gave lowest percent of nitrogen per plant (1.070%) Table(6).

Table (6):- Effect of Sowing Date, Bio and Nano Fertilizers on Nitrogen percentage in tested plant.

Planting Dates	Biofrtilizers ml/L	Nano Zn ml/L				Planting dates * Biofertilizer	Planting dates
		0	**3**	**6**	**9**		
15-Aug	0	1.130ij	1.253h-j	1.703f	2.120e	1.552c	**2.018 a**
	2	1.443g	2.480d	2.670c	3.340a	2.483b	
01-Sep	0	1.070j	1.220 h-j	1.520g	1.870f	1.420d	**1.806b**
	2	1.263hi	2.230e	2.420d	2.853b	2.192a	
15-Sep	0	1.073j	1.247 h-j	1.384gh	1.813f	1.379d	**1.784b**
	2	1.223 h-j	2.185e	2.414d	2.933b	2.189b	
Nano Zn		1.200d	1.769c	2.019b	2.488a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	1.287f	1.867d	2.187c	2.730a		
	01-Sep	1.167g	1.725e	1.970d	2.362b		
	15-Sep	1.148g	1.716e	1.899d	2.373b		
Bio fertilizer * Nano Zn	0	1.091g	1.240f	1.536e	1.934d	0	**1.450b**
	2	1.310f	2.298c	2.501b	3.042a	2	**2.288a**

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level.

The results in Concerning Table (7 and 8) it was revealed that there are significant effects between the dates of planting on percentage of phosphorus and potassium, planting date on 15-August., appeared significant effect that recorded high percent of phosphorus (0.447%) as compared with other planting dates. While treating plant with biofertilizer 2ml.L^{-1} shows significant effect compared with untreated plant (0.471, 0.394) respectively. Nano fertilizers appeared significant effect treating plant with high concentration of Nano zinc 9ml.L^{-1}) recorded high percent of phosphorus (0.510). Regarding double interaction among treatments it were showed significant effects, interaction among planting date 15- August and Bio fertilizers 2ml.L^{-1} recorded higher percentage of phosphorus 0.486% as compared with other treatments, treating plant with planting on the first date 15 August. Nano Zn 9ml.L^{-1} gave a higher percentage of phosphorus 0.525%) as compared with other interactions. Regarding triple interaction treatment among three factors (Nanofertilizer, there was a significant Bio fertilizer and planting dates in this study it were appeared significant effect among them., it was revealed that interaction among planting date 15-September.* Bio 2 ml/L, fertilizer*Nano Zn 9m.L) recorded higher percentage of phosphorus (0.573%) as compared with interaction among planting date 01-September *zero Bio fertilizer *zero Nano fertilizer) that gave lowest percent of phosphorus per plant (0.290%).

Table (7): -Effect of Sowing Date, Bio and Nano Fertilizers on Phosphorus percentage in tested plant.

Planting Dates	Biofrtilizers ml/L	Nano Zn ml/L				Planting dates * Biofertilizer	Planting dates
		0	3	6	9		
15-Aug	0	0.310i	0.413ef	0.432e	0.478cd	0.408c	0.447a
	2	0.403fg	0.476cd	0.493c	0.573a	0.486a	
01-Sep	0	0.290ij	0.393f-h	0.412ef	0.458d	0.388d	0.427b
	2	0.383gh	0.456d	0.473cd	0.553ab	0.466b	
15-Sep	0	0.287j	0.389f-h	0.410ef	0.455d	0.385d	0.423b
	2	0.375h	0.454d	0.471cd	0.543b	0.461b	
Nano Zn		0.341d	0.430c	0.449b	0.510a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	0.356f	0.444d	0.463c	0.525a		
	01-Sep	0.336g	0.424e	0.443d	0.505b		
	15-Sep	0.331g	0.422e	0.440d	0.499b		
Bio fertilizer * Nano Zn	0	0.296f	0.398e	0.418d	0.464c	0	0.394b
	2	0.387e	0.462c	0.479b	0.556a	2	0.471a

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level.

Regarding the percent of potassium table (8) showed that planting date on 15-August., had a significant effect it recorded high percent of Potassium percentage (5.033%) as compared with other planting dates. While treating plant with biofertilizer 2ml.L^{-1} shows significant effect compared with untreated plant (5.401%) respectively Nano fertilizers appeared significant effect treating plant with high concentration of Nano zinc 9ml.L^{-1}) recorded high percent of Potassium percentage (6.483%). Regarding double interaction among treatment there was a significant effect, interaction among planting date 15-August and Bio fertilizers 2ml.L^{-1} recorded higher percentage of Potassium 6.483% as compared with other treatments, treating plant with planting on the first date 15 Augusts, and Nano Zn 9ml.L^{-1} gave a higher percentage of potassium 5.908%)as compared with other interactions. Regarding triple interaction treatments among three factors (Nano fertilizer, Bio fertilizer and planting date in this study there was a significant effect among them., it were revealed that interaction among planting date 15-September.* Bio fertilizer 2 ml/L, fertilizer*Nano Zn 9m.L^{-1}) recorded higher percentage of potassium (7.523%) as compared with interaction among planting date 01-September *zero Bio fertilizer *zero Nano fertilizer) that gave lowest percent of potassium per plant (1.833l %).

Table (8):-Effect of Sowing Date, Bio and Nano Fertilizers on Potassium percentage **in tested plant.**

Planting Dates	Biofertilizers ml/L	Nano Zn ml/L				Planting dates * Biofertilizer	Planting dates
		0	3	6	9		
15-Aug	0	2.757k	3.453j	4.703gh	5.443d	4.089c	5.033a
	2	4.390h	5.827c	6.163c	7.523a	5.976a	
01-Sep	0	1.957l	2.653k	3.903i	4.643gh	3.289d	4.233b
	2	3.590ij	5.027e-g	5.363de	6.723b	5.176b	
15-Sep	0	1.833l	2.701k	3.780ij	4.491h	3.201d	4.126b
	2	3.467j	4.904fg	5.213d-f	6.621b	5.051b	
Nano Zn		2.999d	4.094c	4.855b	5.908a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	3.573d	4.640c	5.433b	6.483a		
	01-Sep	2.773e	3.840d	4.633c	5.683b		
	15-Sep	2.650e	3.802d	4.497c	5.556b		
Bio fertilizer * Nano Zn	0	2.182h	2.936g	4.129e	4.859d	0	3.527b
	2	3.816f	5.252c	5.580b	6.956a	2	5.401a

mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level.

The results in Table (9) It was revealed that there are significant effects between the dates of planting on concentration of micronutrient content(Fe Mg ppm), planting date on 15-August .,appeared significant effect that recorded high concentration of iron (118.318ppm) as compared with other planting dates. While treating plant with biofertilizer 2ml.L-1 showed significant effect compared with untreated plant (124.050ppm) respectively Nano fertilizers appeared significant effect treating plants with high concentration of Nano zinc 9ml.L^{-1}) recorded high concentration of iron (125.683ppm). Concerning double interaction among treatments it were showed significant effects, interaction among planting date 15-August and Bio fertilizers 2ml.L^{-1} recorded higher concentration of iron (126.151ppm) as compared with other treatments, treating plants with planting on the first date 15 Augusts, Nano Zn 9ml.L^{-1} gave a higher concentration of iron (127.190 ppm) as compared with other interactions. Regarding triple interaction treatment among three factors (Nanofertilizer, Bio fertilize and planting date in this study it revealed significant effect among them., it were revealed that interaction among planting date 15-September.* Bio 2 ml/L, fertilizer*Nano Zn 9m.L) recorded higher concentratration of Iron (138.583ppm) as compared with interaction among planting date 01-September *zero Bio fertilize *zero Nano fertilize) that gave lowest concentration of iron (103.158 ppm).

Table (9): Effect of Sowing Date, Bio and Nano Fertilizers on concentration of Iron (ppm) in tested plant.

Planting Dates	Biofrtilizers ml/L	Nano Zn ml/L				Planting dates * Biofertilizer	Planting dates
		0	**3**	**6**	**9**		
15-Aug	0	104.520l-n	107.290kl	114.333gh	115.797gh	110.485c	118.318a
	2	106.950k-m	126.683de	132.387c	138.583a	126.151a	
01-Sep	0	103.158n	107.303kl	111.262ij	116.258g	109.495c	116.550b
	2	104.138mn	125.107ef	129.317d	135.857b	123.605b	
15-Sep	0	97.561 o	104.645l-n	109.138jk	113.108hi	106.113d	114.253c
	2	103.178n	123.715f	128.188d	134.494bc	122.394b	
Nano Zn		103.251d	115.791c	120.771b	125.683a	Bio fertilizer	
Planting	15-Aug	105.735g	116.987de	123.360b	127.190a		

Dates * Nano Zn	01-Sep	103.648h	116.205e	120.289c	126.058a		
	15-Sep	100.369i	114.180f	118.663cd	123.801b		
Bio fertilizer * Nano Zn	0	101.746h	106.413f	111.578e	115.054d	0	108.698b
	2	104.755g	125.168c	129.964b	136.311a	2	124.050a

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level

The results in table (10) revealed that planting date on 15-August., appeared significant effect that recorded high concentration of magnesium (59.857ppm) as compared with other planting dates. While treating plant with bio fertilizer 2ml.L^{-1} shows significant effect compared with untreated plant (59.628ppm) respectively Nano fertilizers appeared significant effect treating plant with high concentration of Nano zinc 9ml.L^{-1}) recorded high concentration of magnesium (61.603ppm). Regarding double interaction among treatment it were showed significant effects, interaction among planting date 15-August and Bio fertilizers 2ml.L^{-1} recorded higher concentration of magnesium 61.699ppm as compared with other treatments, treating plants with planting on the first date 15 Augusts, Nano Zn 9ml.L^{-1} gave a higher concentration of magnesium (61.603ppm) as compared with other interactions. Regarding triple interaction treatment among three factors (Nano fertilizer, Bio fertilizer and planting dates in this study it were appeared significant effect among them., it were revealed that interaction among planting date 15-September.* Bio fertilizer 2 ml/L, fertilizer*Nano Zn 9m.L^{-1}) recorded higher concentration of magnesium (62.400ppm) as compared with interaction among planting date 01-September *zero Bio fertilizer *zero Nano fertilizer) that gave lowest concentration of magnesium (53.357 ppm). (Table 8) .

Table (10):-Effect of Sowing Date, Bio and Nano Fertilizers on concentration of magnesium (ppm) in tested plant.

Planting Dates	Biofrtilizers ml/L	Nano Zn ml/L				Planting dates * Bio fertilizer	Planting dates
		0	3	6	9		
15-Aug	0	54.943k-n	57.827f-i	58.617fg	60.670d	58.014c	59.857a
	2	56.897h-j	60.417de	62.893c	66.590a	61.699a	
01-Sep	0	53.357no	55.827j-l	57.027g-i	58.947ef	56.289d	57.967b
	2	55.027k-m	58.417f-h	60.543de	64.590b	59.644b	
15-Sep	0	51.383p	53.482m-o	54.682l-n	56.422i-k	53.992e	55.767c
	2	52.697op	56.072j-l	58.997ef	62.400c	57.541c	
Nano Zn		54.051d	57.007c	58.793b	61.603a	Bio fertilizer	
Planting Dates * Nano Zn	15-Aug	55.920e	59.122c	60.755b	63.630a		
	01-Sep	54.192f	57.122d	58.785c	61.768b		
	15-Sep	52.040g	54.777f	56.839de	59.411c		
Bio fertilizer * Nano Zn	0	53.228f	55.712e	56.775d	58.679c	0	56.098b
	2	54.873e	58.302c	60.811b	64.527a	2	59.628a

The mean with a column, row, and their interaction following with the same latter are not statistically different, according to Duncan multiple at the 0.05 level.

Data from the above table**s** (6,7,8,9 and 10) showed that the enhancements in the macro and micro nutrient content in the leave may be go back to the influence of the date of planting, the early planting date appeared significant in all macro and micro nutrient as compared with other planting dates., or may be due to the effect of the bio fertilizers and Nano zinc that enhance the rate of nutrient in the plant.

The spinach plants were sprayed with different concentrations (0, 100, 500, and 1000 ppm) of ZnO NPs after 14 days of sowing. At

the time of maturity (45–50 days), the leaf physical parameters such as leaf length, leaf width, and leaf surface area were noted and nutritional parameters such as protein, carbohydrate, fat, and dietary fiber contents in leaf samples were determined. When 500 and 1000 ppm concentration of ZnO NPs were sprayed, there was an increase in leaf length, width, surface area, and color of spinach leaves were recorded with concentration of 500 and 1000 ppm in comparison with control leaf samples of spinach.

Furthermore Zinc is an essential micronutrient and absorbed in the form of divalent cations, and it is important for plant growth and production. It is important in different vital physiological processes as synthesis of protein, maintenance of membrane integrity, and production of energy (Hansch and Mendel 2009). In addition, zinc is important for leaf cells for chlorophyll formation (leaf green pigment) and in regulation of starch biosynthesis and root development (Wassel et al. 2007)

Zinc is an essential element for plants and animals and plays an important role in plants metabolic Nearly 200 enzymes and transcription elements of zinc need it as one of the most essential components. Zinc plays an important role in protein and carbohydrates syntheses. It also has effects,on growth of stem and root (Kabata-Pendias, 1999).

CONCLUSION

Concerning the concluded search it is concluded that planting in the first date and using organic material such Bio Nano fertilizer may enhanced the growth and nutrient content of plant rather than chemical fertilizers that make the environment polluted with toxic remained of it and using nano and bio will make the quality of plant better and the biochemical characteristic of the soil were be better., and from the above results I recommended to far from chemical fertilizer and follow the natural and bio fertilizers for getting the best qualities and healthy of crops.

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كارتێكرنا دەمێت چاندنێ و زبلێ سروشتی و نانو ل سەر ساخلەتێن شینكاتیێ وە كانزاییێت خارنێ ژ رووەكێ قەرنەبیت د بن خانیێ نالیونیڤە

(Brassica oleracea var. Botrytis l.)

مەرەم ژ ڤێ ڤەكولینە حسێب كرنا دەمێت چاندنێ یە (15 تەباخێ) وە زبلێ نانو(0,3,6 وە 9 مل) وە زبلێ سروشتی (د گەل و بێ) د دەمێ شینكاتیێ وە كانزاییێت خارنێ ژ رووەكێ قەرنەبیت د بن خانیێ نالیونیڤە. رووەك هاتنە چاڤدێری كرن د ناف زەڤیا ڤەكولینادا. بەرهە د هاتنە چاڤدێری كرن د بن چاڤدیرییەكا چر ل بەشێ چاندنا پاراستی زانكویا پولیتكنیك زاخو دوەرزێ چاندنێ 2021- 2022

ئەنجام هوسا دیاركرن كو هەدو دەمێت چاندنێ 15 تەباخێ زبلێ نانو 9 مل-1 بوویە ئەگەرێ زێدەبوونەكا بەرچاڤ دهەمی ساخلەتین شینكاتی. هەمی ساخلەتێن شینكاتی و خارنێت ماكرو بووینە ئەگەرێ زێدەبوونەكا بەرچاڤ د وەرزێ ڤەكولینێ دا. هەر وەسا دییار كو زیێدە كرنا زبلێ سروشتی ب قەبارێ 2 مل بوویە ئەگەرێ زێدەبوونەكا بەرچاڤ دهەمی ساخلەتین هاتینە وەرگرتن د هەمی دەمێت چاندنێ دا. تێكەل كرنا كارتێكەرا دناڤبەرا دەمێت چاندنێ 15 تەباخێ زبلێ نانو 9 مل یا بەرچاڤ بو ب پێش ئیخستنا ساخلەتین هاتینە وەرگرتن. نالیونێ رەشێ پاراستی ب شیێوەكێ بەرچاڤ كارتیكرنەكا باش هەبو ل سەر كاریێن هاتینە كرن. ل دەمێ قەبارێ زیێدە یێ زبلێ نانو وە روژا ئێكێ ژ چاندنێ د گەلك باشترین ئەنجامەكێ ل سەرهەمی ساخلەتێن شینكاتیێ (هەژمارا بەلگان , رووبەرێ بەلگان 2م , وە رێژا كلوروفیلی. دەربارێ بكارئینانا مادێن خارنی كارتێكرنا بەرچاڤ هەبو.