The impact of the biostimulant Isobion and zinc interaction on the growth and concentration of elements in two cabbage hybrids

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Abstract

The Department of Horticulture and Landscape Engineering, College of Agriculture, University of Karbala, conducted a field experiment in the Al-Husseiniyah District of Karbala Governorate during the autumn season 2023-2024. The purpose of the experiment was to investigate the impact of two factors on the quality and yield indicators growth and concentration of elements in the Cabbage plant. One of the primary treatments is fertilization. The study had a total of eight treatments. Absence of distilled water spraying (Zn0S0), application of Isabion at a concentration of 3 L.ha-1 without zinc spraying (Zn0S1), application of Isabion at a concentration of 6 L.ha-1 without zinc spraying (Zn0S2), and application of Isabion at a concentration of 9 L.ha-1 without zinc spraying (Zn0S3). In the absence of Isabion and zinc spraying at a concentration of 1 gm.L-1 (Zn1S0), the application of Isabion at a concentration of 3 L.ha-1 and zinc spraying at a concentration of 1 g L-1 (Zn1S1), the application of Isabion at a concentration of 6 L.ha-1 and zinc spraying at a concentration of 1 g L-1 (Zn1S2), and the application of Isabion at a concentration of 9 L.ha-1 and zinc spraying at a concentration of 1 g L-1 (Zn1S3). Two hybrids, namely the red hybrid (C1) and the green hybrid (C2), were included in the second component. The study was conducted using a split plot method within a Randomized complete block design, with three replications. The main plot consisted of the variety, while the sub plots represented the different fertilization treatments. The findings can be succinctly summarized as follows :

-1The treatment combinations had a significant impact on all growth characteristics when compared to the control treatment. The Zn1S3 treatment, which included Isabion at a concentration of 9 L.ha-1 and zinc at a concentration of 1 gm.L-1, resulted in an average concentration of N, P, K, and Zn in scalar heads of 2.66, 0.48, and 2.18% and 191.34 mg/kg-1, respectively. The average number of botanical leaves was 18.72, the leaf space was 171.07 cm2, and the dry weight was 213.73 g per plant.

-2The green hybrid exhibits higher N content in the heads, leaf space, dry weight of the vegetable overall, and chlorophyll concentration in the leaves compared to the red dialect hybrid. The average differences are 12.44%, 164.79 cm2, 202.89 g.plant-1, and 2.84 mg, respectively. The concentration of P, K, and Zn in the leaf was found to be higher in the red hybrid , with average values of 0.36%, 1.73%, and 121.83 ppm, respectively..

-3The impact of the two-dimensional interference was observed to be positive, as indicated by the average N content in the head, leaf space, dry weight of the vegetable overall, and chlorophyll concentration in the leaves, which were measured to be 7.38%, 155.21 cm2, 175.03 g.plant-1, and 2.64 mg, respectively, using C2Zn1S3. The content of P, K, and Zn in the leafs was exceeded by the C1Zn1S3 treatment by an average of 0.21%, 1.24%, and 36.67 ppm, respectively.

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Introduction

The cabbage plant Brassica Oleraceae var. capitate, belonging to the Cruciferae family, is native to the Eastern Mediterranean Sea. In the year 2020, the total cultivated land area in Iraq amounted to 3690 dunums, with an average yield of 8789 tonnes per dunum(2). The composition of each 100 g of cabbage leaves is as follows: 92.18 g of water, 25 calories, 1.28 g of protein, 0.10 g of fat, 5.80 g of carbohydrates, 2.5 g, 3.20 g of sugars, 40 mg of calcium, 0.47 mg of iron, 12 mg of magnesium, 26 mg of phosphorous, 170 mg of potassium, 0.18 mg of zinc, and 36.6 mg of vitamin C (3). Research has indicated that the cabbage has a high concentration of bioactive chemical substances, including phenolic compounds, carotenoids, and glucosinolates. These compounds possess notable efficacy in disease prevention (4). Furthermore, it serves as a valuable reservoir of vitamin K, which plays a crucial role in the synthesis of blood clotting proteins, the regulation of blood pressure, and the mitigation of stroke risk (5.(
The cabbage provides a significant amount of glutamine and amino acids, both of which play a crucial role in maintaining intestinal health. The presence of multiple types of cabbage is due to the crucial function that the selection of the appropriate species plays in enhancing output and even holds the highest priority. The selection of an appropriate category also holds significant importance in augmenting productivity. It ranks as the foremost influential aspect in augmenting productivity(6.(

Recent studies have demonstrated that certain organic products have the potential to enhance essential biological processes. These products, commonly referred to as biostimulators, are organic substances that lack synthetic chemicals or growth-promoting agents. They have proven to be effective in promoting the growth and development of vegetable crops. The utilisation of these substances has witnessed a surge in recent times due to their ability to enhance plants' resilience against various stressors, including salt, drought, low temperature, insect infections, and diseases. This trend is indicative of both quantitative and qualitative advancements in crop yield(7.(
The plants cultivated in Iraqi soil experience a deficiency of micro-elements, particularly zinc, due to inadequate preparation and exposure to adsorption and deposition conditions. This hampers both the amount and quality of production (8) ،In Iraq, extensive research

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Table (1) Experimental field soil and irrigation water chemical and physical pro

Soil analysis			Melted ions (L1 mg)		
Title	Unit	Value	Ca^{2+}	439	195
(pH)	--------	7.46	Mg^{2+}	196	89
(EC)	ds m^{-1}	6.30	Na^{+}	517	223
N available	mg kg^{-1}	57	K^{+}	22	15
P available		7.0	HCO_3^{-}	431	416
K available		131	Cl^{-}	989	375
Zn available		0.682	$SO_4^{=}$	885	218
Article of membership	%	1.10	NO_3^{-}	19	23
$CO3^{-2}$		30.50	PO_4^{-}	0.54	0.49
clay		28.6	Water analysis		
silt		30.4	Title	Unit	Value
sand		41.0	(pH)	--------	7.39
Soil texture	Mixture		(EC)	ds m^{-1}	3.13

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Treatment and experimental design

The experiment used a split-plot design in a randomized complete block design with three replications, with the two cultivars Zeina F1 (red cabbage) and Wight Moon (green cabbage) as the main plots and eight combinations of The Isabion biostimulant and spraying with zinc in the sub plots. The results were compared using the LSD test at the 5% probability level. The experiment examined how two factors affected cabbage :

The first factor: two types of cabbage, the first type red (Zeina F1) and the second type green (white moon), which symbolized by C1 and C2.

The second factor: Adding the biostimulant Isabion, which consists of (10% nitrogen, organic materials, 62.5% amino acids, and 10.3% free amino acids) and is symbolized by the symbol (S) and is added at the following levels: (0, 3, 6, and 9) liters of ha-1. By combination with two levels of zinc sulphate (0, 1) g L-1, Which was added sprayed on the leaves.

The treatment for each of the two types of insults were 8 treatment, as follows:

.1 Without adding Isabion or spraying zinc, spraying with water only (Zn0S0.(

.2 Isabion at a concentration of 3 L.ha-1 and without spraying zinc (Zn0S1.(

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.3 Isabion at a concentration of 6 L.ha-1 without spraying zinc (Zn0S2.(

.4 Isabion at a concentration of 9 L.ha-1 and without spraying zinc (Zn0S3(

.5 Without adding Isabion and spraying zinc at a concentration of 1 g L-1 (Zn1S0.(

.6 Isabion at a concentration of 3 L.ha-1 and spraying zinc at a concentration of 1 g L-1 (Zn1S1.(

.7 Isabion at a concentration of 6 L.ha-1 and spraying zinc at a concentration of 1 g L-1 (Zn1S2.(

.8 Isabion at a concentration of 9 L.ha-1 and spraying Zinc at a concentration of 1 g L-1 (Zn1S3.(

Implementation of the experiment

Cabbage seedlings were procured from a privately-owned nursery located in Baghdad/Yusufiyah and subsequently sown in the field on October 7, 2023, when they reached a maturity of 45 days. In each treatment, a quantity of 15 tonnes ha-1 (11) of decomposed sheep dung fertilizer (Table 2) was applied below the planting line. Additionally, granulated NPK chemical fertilizer (15-15-15) was also utilised. A total of 200 kg ha-1 was applied to the seedlings both during the planting phase and during the growth period. The plant was irrigated with chemical fertilizers (NPK) dissolved in water using a drip irrigation system every 15 days throughout the growing season. The harvesting process took place from 1/11/2024 to 2/8/2024 when the plant reached the marketing stage. The soil for the experimental units was subjected to three applications of the Isabion biostimulant, occurring two weeks after transplantation, with a two-week delay between each watering

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Table 2. Some chemical characteristics of organic fertilizers

pH	EC (ds m^{-1})	% P	% N	% K	% C
7.67	8.17	0.671	3.38	0.91	43.76

Green growth indicators

Number of leaf external of head(leaf plant-1): The number of outer leaves that did not curl together was measured

Dry weight of Vegetative total (gm plant-1): The dry weight of the entire vegetable, including both the leg and leaves, was determined by cutting the plant into its soil contact area. Subsequently, the plant was shredded and washed with distilled water. The shredded material was then placed in pierced leaf bags and placed in an electric furnace set at a temperature of 70 m for a duration of 72 hours. The weight of the Vegetative was then measured multiple times using a delicate balance until it was determined .

The leaf area (cm2) was calculated according to (14) and in the following equation: leaf area on plant (cm2) =((g)dry-weight leaves × (cm2)squared area × plants × leaf number)/(Theweight of dry space piece(g)) *100

Total chlorophyll content of leaf (mg.100gm-1 Fresh weight) : The concentration of chlorophyll dye in plant leaves was

determined by randomly sampling 5 plants per test unit. The leaves were then washed with water. After that, 1 g of chlorophyll dye was extracted and 10 ml of acetone with a concentration of 80% was added. The chlorophyll dye was then crushed using a ceramic mortar. The resulting solution was then filtered using filter leaf. The aforementioned procedure was iterated in order to remove the residual dyes till the tissue colour attained a white hue. The entire volume of acetone leaching was reached 20 ml. The optical absorption of two wavelengths, specifically 645 and 663 nm, was measured using a spectrometer (15:(

Total Chlorophyll = [20.2×D (645)] + [8.02 × D (663)] (v/w× 1000) *100

(663)D = The measurement of photoabsorption at a wavelength of 663 nanometers .

(645)D = The observed light absorbency is measured at a wavelength of 645 nanometers.

V = Final volume of extract (20 ml(

W = Weight of leaf tissue (1 g(

Subsequently, it was transformed into a mg.100gm-1 Fresh weight

-3The leaves contain nutrients (N, P, K, Zn.(

The fourth and fifth leaf were chosen from the uppermost section of the plant and thereafter subjected to a drying process in an electric oven at a temperature of 70 m for a duration of 72 hours (16) ،Subsequently, the leaf samples were pulverised, and 0.2 g of the pulverised sample was subjected to wet digestion. This involved the addition of 4 ml of concentrated sulfuric acid and 2 ml of concentrated pyrochloric acid, following the procedure outlined in method(17). The estimation of the elements is as follows:

nitrogen % was determined using the Micro Kjeldahl equipment, following the procedure outlined in reference (18.(

phosphorus % has been conducted using the methodology outlined in reference. (19 (

potassium % was determined using the(Flame photometer) technique(20.(

concentration of zinc (mg kg-1) was determined using the Spectrophotometer Atomic Absorption technique (20 .(

Results and discussion

Number of leafs (leaf.plant-1(

The findings presented in Table 3 indicate a significant discrepancy among the hybrids in terms of leaf count. Specifically, the red cabbage exhibits a higher average of 15.67 leaves in plant, surpassing the counterpart the green cabbage a lower average of 12.33 leaves in plant .

The manure combinations have demonstrated a moral effect in this regard, as evidenced by an increase in the number of zinc spray leaves and an increase in the level of biostimulation addition. Zn1S3 exhibited the highest number of leaves, with an average of 18.72 leaves plant -1. This represents a moral advantage compared to the combination coefficients of Zn0S1, Zn0S2, Zn0S3, Zn1S1, Zn1S2, and Zn1S3, which had average values of 11.34, 13.72, 15.72, 11.72, 14.62, and 16.61, respectively. On the other hand, Zn0S0 had the lowest number of leaves, with an average of 9.56 leaf plant-1 .

The findings pertaining to the intersection of the treatments C1Zn1S3 shown moral superiority over C1Zn1S3 and yielded the highest leaf count, with an average of 21.22 leaves plant-1. In contrast, the comparative treatment of the green cabbage(C2Zn0S0) had the lowest average number of leafs, with 8.56 leaves plant-1

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Table 3. Biomotivation and zinc spray affect the amount of Number of leafs (leaf plant-1(

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	10.56	8.56	9.56
Zn_0S_1	12.45	10.22	11.34
Zn_0S_2	15.22	12.22	13.72
Zn_0S_3	17	14.44	15.72
Zn_1S_0	13.22	10.22	11.72
Zn_1S_1	16.56	12.67	14.62
Zn_1S_2	19.11	14.11	16.61
Zn_1S_3	21.22	16.22	18.72
Average	15.67	12.33	
L.S.D $_{0.05}$	**Hybrid**	**Treatment**	**Intersect**
	0.4991	**0.4648**	**0.6573**

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Leaf area(cm2(

The findings presented in Table 4 indicate that the hybrid had a moral impact on the leaf area. The data shown in the table indicates that the green cabbage had a higher moral superiority compared to its red counterpart, resulting in an average area of 164.79 cm2. In contrast, the red cabbage average leaf area of 159.93 cm2 .

The table demonstrates that there exist moral disparities in the mean values of the manure combinations addition level and zinc spray. Zn1S3 has the most leaf area, averaging 171.07 cm2, which surpasses the other manure combinations. Additionally, the treatment without the addition of a biomotivator and zinc spraying Zn0S0 exhibits the smallest leaf area, measuring 151.06 cm2

The combined effect of the treatment and the hybrid C2Zn1S3 treatment. The green cabbage has the highest leaf space of 1,474.11 cm1, which is morally superior to all treatment in this overlap. On the other hand, the red cabbage C1Zn1S3 has the lowest average leaf space, with an average of 146.0 cm2 per leaf

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Table 4. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on leaf area(cm^2).

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	146.90	155.21	151.06
Zn_0S_1	157.00	160.87	158.94
Zn_0S_2	161.87	164.47	163.17
Zn_0S_3	164.27	169.34	166.81
Zn_1S_0	155.98	159.61	157.8
Zn_1S_1	160.09	164.72	162.41
Zn_1S_2	165.29	170.02	167.66
Zn_1S_3	168.02	174.11	171.07
Average	159.93	164.79	
L.S.D $_{0.05}$	Hybrid	Treatment	Intersect
	1.0709	1.293	1.8285

Dry weight of the vegetative part (gm.plant-1(

According to the data presented in Table 5, there exist moral disparities in the dry weight of the overall vegetative when employing two cabbage hybrids. Specifically, the green cabbage exhibits the maximum dry weight rate of 202.89 gm plant-1, while the red cabbage amounts to 180.82 g of plant-1.

The highest dry weight rate of 213.73 g plant-1 was observed in the composterative combinations of biocenter and zinc spray at the Zn1S3 treatment. The moral variation of treatment (Zn0S1, Zn0S2, Zn0S3, Zn1S1, Zn1S2, and Zn1S3) was observed, with the lowest average dry weight rate of 165.18 g plant-1 in (Zn0S0S0.(

The fertilizer combinations and cabbage hybrid had a binary interaction that resulted in positive effects. Among the treatments, the C2Zn1S3 treatment had the highest average dry weight, measuring 224.83 gm.plant-1. This was significantly different from all other treatments in the interaction. On the other hand, the treatment of spraying with water only for the red cabbage had the lowest average dry weight, amounting to 155.33 g.Plant-1.

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Table 5. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on Dry weight of the vegetative part (gm.plant-1)

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	155.33	175.03	165.18
Zn_0S_1	170.27	191.88	181.08
Zn_0S_2	179.54	202.31	190.93
Zn_0S_3	186.04	210.35	198.2
Zn_1S_0	169.06	192.76	180.91
Zn_1S_1	188.61	207.09	197.85
Zn_1S_2	195.12	218.9	207.01
Zn_1S_3	202.62	224.83	213.73
Average	180.82	202.89	
L.S.D $_{0.05}$	**Hybrid**	**Treatment**	**Intersect**
	1.8955	**4.3177**	**6.1061**

Total chlorophyll (mg.100gm-1 wet weight(

The findings presented in Table 6 demonstrate that the hybrd a moral influence on the chlorophyll content of the leaf. Specifically, the green cabbage resulted in a chlorophyll content of 2.84 mg100 gm-1 ww, which is deemed superior compared to the red cabbage result of 2.77 mg.100gm-1 ww.

The addition of the Isubion in combination with zinc has given moral differences in the concentration of chlorophyll in the leaves, with Zn1S3 having the highest concentration of 2.98 mg100 gm-1 ww and a moral advantage in relation to the coefficients (Zn0S0, Zn0S1, Zn0S2, Zn0S3, Zn1S0, Zn1S1, Zn1S2 and Zn1S3) which have a concentration of 2.75, 2.91, 2.69, 2.78, 2.89 and 2.98 mg-1 respectively, while Zn0S0 was given a lower average of 2.60 mg.100gm-1 ww

The combination of manoeuvrable and hybrid elements has demonstrated a moral impact by resulting in a chlorophyll concentration of 3.04 mg100 gm-1 ww for C2Zn1S3, giving it an advantage over all other combinations in this overlap. In contrast, the treatment of red cabbage (C1Zn0S0) had the lowest average chlorophyll concentration of 2.55 mg100 gm-1 ww .

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Table 6. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on chlorophyll concentration

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	1.09	1.11	1.10
Zn_0S_1	1.43	1.51	1.47
Zn_0S_2	1.78	1.83	1.81
Zn_0S_3	2.17	2.24	2.21
Zn_1S_0	1.34	1.41	1.38
Zn_1S_1	1.82	1.9	1.86
Zn_1S_2	2.29	2.35	2.32
Zn_1S_3	2.63	2.69	2.66
Average	1.82	1.88	
L.S.D $_{0.05}$	**Hybrid**	**Treatment**	**Intersect**
	0.0474	**0.0387**	**0.0547**

The findings presented in tables(3, 4, 5, and 6) indicate that the hybrid's impact on the Vegetative growth indices is influenced by its distinct genetic composition. The expression of genes in each hybrid varies, and the interaction between genetic factors and the surrounding environment has influenced the hybrid's performance. This is due to the fact that the properties of the Vegetative influence a significant number of genes and have a secondary impact, rendering them highly susceptible to environmental influences. The hybrid's impact is a result of the convergence of the environment and genetics, leading to an augmented presence of the remaining genes that may be observed in a specific habitat known as the gene environment(21).The growth requirements of hybrids and their adaptation to environmental conditions increase the efficiency of photosynthesis as well as the accumulation of processed nutrients, and this gives an increase in vegetative indicators.(22) .These findings align with the findings of (23) Who confirmed that genetic makeup has a significant effect on vegetative growth indicators.

The findings from the aforementioned tables also indicate that the use of Isabion and zinc spraying in composting combinations has a significant impact on the attributes of the green growth of the humiliation. This can be attributed to:

Biological catalysts influence plant growth by Plant growth regulators similar to auxins, that absorb nutrients and enhance their concentration in vegetation (table 3, 4, 5, and 6). These nutrients are then transferred to leaves, leading to increased chlorophyll production and improved efficiency in the light-dependent growth process, promoting Vegetative growth(24.(

Zinc assumes a significant role in the synthesis of amino-treptophan acid, a precursor for auxinsproduction. This process contributes to enhanced cellular growth and division, as well as the development of plant tissues. Zinc's

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association with promoting cellulose growth and optimising photosynthetic efficiency is evident in the observed augmentation of vegetable growth in vegetation (25.(

The findings of this study align with previous research (26) that demonstrated a positive correlation between zinc spraying and the indicators of broccoli development. The findings were in line with (27), further confirming that the vegetable properties of the fat were enhanced with zinc spraying. The findings of this study align with previous research (28), which demonstrated that the application of zinc and amino acids by broccoli spraying resulted in enhanced vegetable markers in broccoli .

This study investigates the impact of including a biomotivator isabion and zinc spray on the dietary composition of two hybrids (N,P,K,Zn.(

Nitrogen concentration%

The findings from Table 7 demonstrate that the variety had a notable impact on the nitrogen concentration in the leaves. Specifically, the green cabbage exhibited a concentration of 1.88%, which was much higher than the average concentration of 1.82% observed in the red cabbage.

The incorporation of Isubion in conjunction with zinc resulted in significant variations in the augmentation of nitrogen content inside the leaves. The compound Zn1S3 exhibited the highest treatment rate of 2.66% and demonstrated moral superiority compared to the combination coefficients (Zn0S0, Zn0S1, Zn0S2, Zn0S3, Zn1S0, Zn1S1, Zn1S2, and Zn1S3). These combination coefficients recorded nitrogen concentrations of 1.10, 1.47, 1.81, 2.21, 1.38, 1.86, 2.32, and 2.66% respectively. This conclusion is based on the average nitrogen concentrations obtained from the fertilizer combinations, wherein the nitrogen concentration increased with increasing levels of addition and spraying to Isabion and zinc.

The relationship between fertilizer combinations and the cabbage hybrid exhibited a notable impact on this characteristic. Specifically, the intervention treatment C2Zn1S3 demonstrated the highest nitrogen percentage, reaching 2.69%, exhibiting a significant superiority over all other treatments in this interaction. Conversely, the comparison treatment for the red cabbage (C1Zn0S0) exhibited the lowest average nitrogen percentage in this interaction, amounting to 1.09%. The treatment of green bee (C2Zn0S0) did not exhibit a significant difference compared to the comparison treatment, which had an average of 1.11%.

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Table 7. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on Nitrogen concentrations

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	0.21	0.19	0.20
Zn_0S_1	0.29	0.27	0.28
Zn_0S_2	0.36	0.34	0.35
Zn_0S_3	0.41	0.40	0.41
Zn_1S_0	0.28	0.26	0.27
Zn_1S_1	0.38	0.33	0.36
Zn_1S_2	0.44	0.40	0.42
Zn_1S_3	0.51	0.45	0.48
Average	0.36	0.33	
L.S.D $_{0.05}$	**Hybrid**	**Treatment**	**Intersect**
	0.0179	**0.0353**	**0.050**

horous concentration%

The findings shown in Table 8 indicate that the hybrids exhibit a moral influence on the phosphorous component. The superiority of the red cabbage has been seen to yield an average score of 0.36%, whilst the green cabbage exhibits a lower average score of 0.33% .

The interaction between the Isibion biocenter and zinc resulted in favourable outcomes, leading to an augmentation in the phosphorous levels inside the leaves. Zn1S3 exhibited a moral superiority concentration of 0.48% compared to all other fertiliser combinations. The average concentrations of Zn0S0, Zn0S1, Zn0S2, Zn0S3, Zn1S1, Zn1S2, and Zn1S3 were 0.20, 0.28, 0.35, 0.41, 0.27, 0.36, 0.42, and 0.48%, respectively .

The bilateral interaction between the cabbage hybrid and the fertiliser combinations exhibited notable variations among the treatments. The interaction between the fertiliser combinations and the red cabbage hybrid demonstrated superiority, with the C1Zn1S3 intervention exhibiting the highest average interaction score of 0.51%. This score was significantly superior to all other treatments in this intervention. Following the C1Zn1S3 intervention, the green The bilateral interaction between the cabbage hybrid and the fertiliser combinations exhibited notable variations among the treatments. The interaction between the fertiliser combinations and the red cabbage hybrid demonstrated superiority, with the C1Zn1S3 intervention exhibiting the highest average interaction score of 0.51%. This score was significantly superior to all other treatments in this intervention. Following the C1Zn1S3 intervention, the green Hana treatment had an average interaction score of 0.45%. On the other hand, the comparison treatment for green cabbage (C2Zn0S0) had the lowest average interaction score of 0.19%, which was not

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significantly different from the average interaction rate of 0.21% observed in the comparison treatment for red cabbage (C1Zn0S0.(
comparison treatment for red cabbage (C1Zn0S0.(
treatment had an average interaction score of 0.45%. On the other hand, the comparison .(

treatment for green cabbage (C2Zn0S0) had the lowest average interaction score of 0.19%, which was not significantly different from the average interaction rate of 0.21% observed in the comparison treatment for red cabbage (C1Zn0S0

Table 8. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on phosphorous

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	1.24	1.21	1.23
Zn_0S_1	1.51	1.54	1.53
Zn_0S_2	1.77	1.80	1.79
Zn_0S_3	2.09	2.05	2.07
Zn_1S_0	1.27	1.31	1.29
Zn_1S_1	1.75	1.68	1.72
Zn_1S_2	2.03	1.93	1.98
Zn_1S_3	2.20	2.16	2.18
Average	1.73	1.71	
L.S.D $_{0.05}$	Hybrid	Treatment	Intersect
	0.0311	0.0403	0.057

Potassium concentration%

The findings shown in Table 9 demonstrate that there were no significant variations in the potassium concentration inside the inter-cabbage leaves. Specifically, the red-cabbage exhibited a potassium concentration of 1.73%, whereas the green-cabbage exhibited an average potassium concentration of 1.71% .

The addition of the biostimulant Isabion and foliar spraying with zinc had a significant impact on the potassium concentration. The 3Zn1S treatment had the highest potassium percentage of 2.18%, which was significantly higher than the potassium concentrations observed in the treatments Zn0S1, Zn0S2, Zn0S3, Zn1S0, Zn1S1, Zn1S2, and Zn1S3. The potassium concentrations for the seven treatments were 1.53%, 1.79%, 2.07%, 1.29%, 1.72%, 1.98%, 1.98%, and 2.18%, respectively. Additionally, the treatment of

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spraying with distilled water just Zn0S0 had the lowest potassium concentration in this interaction, measuring 1.23%.

Regarding the influence of the two overlaps among the study participants, C1Zn1S3 exhibited a higher percentage of potassium in the leaf compared to C1Zn1S3. This percentage was 2.20 percent higher than all treatment in this overlap, except for C2Zn1S3, which did not differ morally. On the other hand, C1Zn0S0 had a lower average potassium percentage of 1.21 percent in this overlap, which was not morally different from the control of the red cabbage (C2Zn0S0.(

Table 9. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on potassium concentration

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	36.67	34.33	35.50
Zn_0S_1	55.00	51.67	53.34
Zn_0S_2	79.33	72.67	76.00
Zn_0S_3	72.33	69.00	70.67
Zn_1S_0	166.00	157.67	161.84
Zn_1S_1	178.67	182.67	180.67
Zn_1S_2	199.00	188.67	193.84
Zn_1S_3	187.67	195.00	191.34
Average	121.83	118.96	
L.S.D $_{0.05}$	**Hybrid**	**Treatment**	**Intersect**
	0.5378	**2.0596**	**2.9126**

Zinc concentration in leaves (mg Zn.kg-1 dry weight(

The statistical analysis of table 10 reveals significant variations in zinc concentration in the leaves when two cabbage hybrids are introduced. The red cabbage exhibits a higher zinc content in the leaves (121.83 mg Zn.kg-1) and demonstrates moral superiority over the green cabbage , which had a concentration of 118.95 mg Zn.kg-1 .

The study observed variations in the concentration of zinc in the leaf as a result of the combination coefficients between the biostimulator and zinc spray. The compound Zn1S2 had a higher concentration of 193.84 mg Zn.kg-1 and demonstrated a stronger moral advantage compared to the other compounds in the transaction, namely Zn0S1, Zn0S2, Zn0S3, Zn1S0, Zn1S1, Zn1S2, and Zn1S3. Conversely, Zn0S0 displayed the lowest concentration of 193.84 mg Zn.kg-1.

The findings of the study indicate that there are moral disparities between the mean values of the manure combinations and the mean

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values of the individual hybrid. C1Zn1S2 exhibited the highest moral values of 199.00 mg Zn.kg-1 resulting from the therapy, hence demonstrating a moral benefit across all interactions. The green cabbage treatment had the lowest concentration in this overlap, measuring 34.33 mg Zn.kg-1. This quantity was not ethically distinct from the red cabbage treatment, which had an average of 36.67 mg Zn.kg-1

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Table 10. Effect of biomotivator isabion and zinc spray and two cabbage hybrid on zinc

hybrid / Treatment	C_1	C_2	Average
Zn_0S_0	36.67	34.33	35.50
Zn_0S_1	55.00	51.67	53.34
Zn_0S_2	79.33	72.67	76.00
Zn_0S_3	72.33	69.00	70.67
Zn_1S_0	166.00	157.67	161.84
Zn_1S_1	178.67	182.67	180.67
Zn_1S_2	199.00	188.67	193.84
Zn_1S_3	187.67	195.00	191.34
Average	121.83	118.96	
L.S.D $_{0.05}$	Hybrid	Treatment	Intersect
	0.5378	2.0596	2.9126

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The findings presented in Tables 7, 8, 9, and 10 indicate that there exist moral distinctions among the hybrids in terms of the concentrations of nitrogen (N), phosphorus (P), potassium (K), and zinc (Zn) in the leaves. These differences can be attributed to variations in genetic factors among the species, which in turn influence the leaf composition in terms of chemical elements. Consequently, this variation has led to enhanced absorption of these elements and subsequently increased their concentration within the plant(29), The results were in line with the (30) that you observed, indicating that the NPK concentration in the dialects differed among different species. This phenomenon can be attributed to the differential expression of quality among hybrids, which is influenced by the genes responsible for nutrient absorption. Furthermore, these qualities exhibited a positive correlation with the nutrient features within the vegetable population .

Also noted from the results of the above tables are the composting combinations between the Isabion and the zinc leaf spray which increased the concentration (N, P, K, Zn) in the cabbage due to:

Isibion is a nitrogen-containing substance that exhibits the ability to absorb nitrogen when applied to soil. This process encourages the growth of plant roots, leading to enhanced nitrogen absorption and a higher concentration of nitrogen in the leaves. Consequently, this phenomenon is evident in the assimilation of additional nutrients, such as phosphorous and calcium, leading to heightened levels of these elements within the foliage. Consequently, these elements enhance the efficacy of carbon sequestration, thereby augmenting the absorption and efficiency of the nutrients(31). One possible explanation for this phenomenon is that the introduction of the Isibion biostimulator has resulted in a rise in nitrogen levels at elevated concentrations, hence enhancing the production of internal growth catalysts that rely on nutrients. Conversely, the introduction of a biostimulator into the soil may result in a decrease in soil pH due to its acidic properties. This acidification leads to an enhanced release of nutrients into the soil solution, facilitating their absorption by roots and subsequently elevating their concentration in leaves(32.(

Zinc is known to have a significant impact on the stimulation of ion-borne cytochrome molecules, leading to improved plant efficiency in energy liberation, element absorption, and the synthesis of biological components within plants. Zinc is a crucial factor in the activation of the dolaz enzyme, which is responsible for the degradation of carbohydrates. This process leads to the release of energy in the form of ATP, which is necessary for active transport processes. Additionally, zinc aids in enhancing the absorption of elements that are reliant on the quality of energy. Zinc serves as a specialized agent in the activation of Carbon construction, which is present in Chloroplast. Its primary function is to facilitate the conversion of carbon dioxide gas into carbonic acid, hence functioning as a hydrogen source following acid degradation (27). The findings of this study (33) indicate that the application of zinc spray on broccoli resulted in an increase in nutritional concentration within the leaves. The findings of this study align with previous research conducted by (34), which demonstrated a positive correlation between the application of amino acids to broccoli leaves and an increase in nutrient content.

Conclusions

Applied Isobion and zinc with a concentration of 1 g l-1 using leaf spraying, which yielded the most favourable outcomes in terms of growth and concentration indicators.

The concentration of nitrogen in the heads, leaf space, dry weight of the vegetable total, and chlorophyll concentration in the leaves is higher in green cabbage hybrids compared to red cabbage The concentration of P, K, and Zn in the leaves of the plant, as well as the number of leafs, has been surpassed by the red cabbage.

In terms of nitrogen concentration in the head, leaf space, dry weight of the vegetable total, and chlorophyll concentration in the leaves, the binary interferometers demonstrated the most favourable outcomes when examining the interference between the manure combinations (Isabion, and zinc at 1 gm.L-1) and green cabbage.

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