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Response of Cucumber Plants to the Combination of N-fertilization with Stimulants under Greenhouse Conditions

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Excessive use of nitrogen fertilizers on vegetable crops has negative effects on human health. There is need to rationalize and reduce nitrogen consumption in cultivated plants, especially after its high price. Two greenhouse experiment were executed through the two winter growing seasons of 2022/2023 and 2023/2024 under plastic greenhouses at the Vegetable Research Farm, Faculty of Agriculture, Benha University to study the effect of different rates of mineral and bio nitrogen fertilizer in addition foliar fertilization with some different growth stimulants, namely Clacium and boron, Potassium Phosphide, Seaweed Extract, MAP on vegetative growth, chemical content of leaves, yield and its quality of cucumber. The treatments were the interaction between three N-fertilizer , i.e., T_1- 100% RDN, T_2- 80% RDN + Bio fertilizer (Nitrobein), T_3- 60% RDN + Bio fertilizer (Nitrobein), and five sources of growth stimulants , i.e., Calium and boron at 2 ml / l, MAP at 2 g / l, Seaweed extract at 2 ml / l, Potassium phosphide at 2 g / l. and Control. Results showed that, adding all amount of nitrogen as 100% in mineral then spray the plants with Calium and boron at 2 ml/l exhibited the highest values in plant height and leaves area during the two seasons of study. In conclusion, the best treatment concerning increasing early yield, number of fruits per plant and total fruit yield per plant was 100% RDN and sprinklethe plants with "Calium and boron at 2 ml/l" followed by the best treatment concerning increasing total fruit yield per plant was "80% RDN +nitrobien" and spray the plants with the same stimulant "Calcium and boron at 2 ml/l" in both seasons.

Keywords: Cucumber, Nitrogen, Bio, Nitrobien, Calcium, Boron, Seaweed, MAP, Potassium.

1. Introduction

Cucumber (*Cucumissativus*L.) is considered one of the curcurbitaceae family's plants and is grown in the fields and greenhouses. Exaggeration applaying of mineral fertilization may have a negative effects on human health and on the economics of production due to their high prices. Cucumber, like any vegetable crop needs fertile soils rich in organic matter. Mineral nitrogen fertilization is considered one of the most substanial sources of nutrition for plants, including cucumbers, especially the unlimited-growing varieties that need a continuous amount of nitrogen throughout the growth period **(Singh and Ryan, 2015 and Abd-El-Shafy *et al*, 2024)**. Nitrogen plays a role in many vital processes inside the plant, with the production of biomass, the growth of leaves and roots, and helps absorb other nutrients, which in turn increase the size of the fruits **(Diaz *et al*., 2006 and El-Mehy *et al*., 2023)**.

Biofertilization such as nitrobein is considered one of the natural and environmentally friendly sources that reduce the negative impact resulting from excessive use of mineral fertilizers. It also has a role in reducing nitrates and nitrites in the soil and may have a role in encouraging the plant to form some hormones that help the plant to grow and develop (**Kumari *et al.*, 2018; Morais *et al.*, 2019 and Mohamed *et al.*, 2023)**.

Application of seaweed extracts is one of the type of organic agriculture because it consists of high levels of hormones and nutrients that have a major role in increasing the growth of the vegetative and root system of the plant **(Kocira *et al.*, 2018, Ghanaym *et al*., 2022 a&b and Lefi *et al.*, 2023).** Spraying plants with potassium improved dry weight (**Dawa *et al*., 2017; Shehata *et al*., 2018** on cucumber**)**, yield and its components (**Abd-Alkarim *et al*., 2017; Shehata *et al*., 2018 and Qassem *et al.*, 2022** on cucumber, and **Abd-Elaziz *et al*., 2019**

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and **Salama *et al*., 2019** on squash and **Mohamed *et al*., 2023** on common bean as well as **Halawa *et al*., 2024** on sweet corn). In addition, calcium may play a role in transport processes in the plant cell. It may also be involved in the formation of the cell wall, helping to preserve it. It is also considered one of the important elements that help in growth and development, as it is involved in regulating hormones**(Mumivand *et al*., 2010 and El-Shoura, 2020)**. Boron may play a role in transporting and storing carbohydrates, as well as in activating the early fruit setting process, reducing flower spalling, and thus increasing the total yield (**Halawa *et al*., 2024)**.

Therefore, this investigation was conducted into study the effect of mineral and bio-fertilizer such as nitrobein combination with sprinkle application by calcium and boron, potassium phosphide, seaweed extract, MAP on a-morphological parameters and chemical composition of plant foliage and yield of cucumber plant.

2. Materials and Methods.

A greenhouse experiment was conducted in two successiveseasons of 2022/2023 and 2023/2024 under plastic greenhouses at the Vegetable Research Farm, Faculty of Agriculture, Benha University to study the effect of different rates of mineral and bio nitrogen fertilizer in addition foliar fertilizationwith some different growth stimulants, namely Clacium boron, Potassium Phosphide, Seaweed Extract, MAP on Morphological parameters and chemical content of leaves. Plant material of this experiment was cucumber (*Cucumissativus cv.* Barracuda). The seeds of Barracuda F_1 were achieved from Agrotech for Modern Agriculture Company, Egypt. These seeds were sown in seedling trays (84 cells) on October 1$^{st.}$ and 15th for the first season and the second one, respectively. Before carrying out the experiment, a 30 cm depth sample was taken from the soil for mechanical and chemical analysis, as shown in Table 1.

Table 1. mechanical and chemical properties of plastic greenhouse soil.

Soil properties	Season	
	2022/2023	2023/2024
Particle size distribution		
Sand (%)	20.00	20.50
Silt (%)	23.50	22.50
Clay (%)	56.50	57.00
Soil texture	Clay	Clay
Chemical analysis		
pH (1:2.5 soil: water suspension)	7.98	8.11
EC (dS m^{-1})(soil past extract)	1.39	1.47
O.M (g kg^{-1})	2.91	2.83
Cations (mmolc L^{-1})		
Na+	6.6	6.9
Ca++	6.0	6.7
Mg++	1.2	0.9
K+	0.1	0.1
Anions (mmolc L^{-1})		
Cl^-	7.7	8.2
HCO_3	1.3	1.6
SO_4^{--}	4.9	4.8
Available elements (mg kg^{-1})		
N	27.35	28.33
P	8.00	9.00
K	198.00	195.00

The experimental design and treatments

The experimental treatments were prepared by applying the split plot design where, nitrogen fertilization treatments were added to the main plot, while spraying treatments were added to the split plots. All treatments were applied with four replicates. One experimental plot may consist of two redge, 6 meters long and 100 cm wide. Therefore, its area was 12 square metres. Seedlings were planted on both sides of the redge and at a distance of 30 cm from each other on the same line. A drip irrigation system had been used. This experiment contained from fifteen treatments which were the resulting from three mineral/bio nitrogen fertilizer and five sources of growth stimulants as follows:

A:- Mineral or bio nitrogen fertilizer treatments were N_1- 100% RDN as control treatment, N_2- 80% RDN + Bio fertilizer, N_3- 60% RDN + Bio fertilizer. Mineral N-fertilizer (NH_4NO_3, 33% N) was applayied at a rate of 250 kg N/fed. as recommended by Ministry of Agriculture. Because the soil content of available nitrogen was about

28 ppm, the actual and added amounts of mineral nitrogen become 222 kg, 172 and 122 kg N for N_1, N_2 and N_3, respectively. Since an feddan may contains 10 greenhouses, the quantity was converted to fit one greenhouse containing 1,000 plants. Total amount of the added N-Fertilization through the drip irrigation system for each fertilization regime were 22.2, 17.2 and 12.2 kg N/greenhouse/Season. Fertilizers were added weekly within the drip irrigation system starting from the second week until the thirteenth week.

Bio fertilizer (Nitrobein) containing active bacteria capable to N_2-fixing which was formed by the department of Microbiology, Agric. Res. Center, Giza. It was used at 1 l/greenhouse"containing1000 plants".

B:-growth stimulants treatments were S_0-Control (Without spraying), S_1- Calcium and boron (Caboron**)** at 2 ml / l, S_2- MAP at 2 g / l, S_3-Seaweed extract at 2 ml / l and S_4- Potassium phosphide at 2 g / l.

Measurements

- Plant growth characteristics: Three plantswere used to measure the phenotypic characters, i.e., plant height (cm), total number of leaves/ plant and total leaf area (cm^2/plant). Three leaves were picked up from each replicate and weighed to determine leaf fresh weight (g) then plant samples of leaves were dried at 70°C to calculate leaves dry weight.

- Chemical components: Nitrogenwas determined in leaves by distillation in a Micro-Kjeldahl method **(Piper, 1947).** Phosphoruswascalculated according to the method described by **King (1951).** Potassium and calcium were measuredaccording to the method described by **Jackson (1967).** While boron was determined as described by **Chapman and Paratt (1961).** Phosphorus, boron, nitrogen, calcium and potassium concentrations were determined in cucumber leaves. Chlorophyll reading (mg/100 g)wasdemenostrated with spectrophotometer according to **A.O.A.C.** (**2012).**

- Yield: Early yield (g/plant) was calculated as the sum of the first three pickings.Number of fruits and total yield per plant were counted as number of fruits and weighted / plot.

- Quality of fruits: Average fruit length (cm), diameter (cm) and weight (g) were determined. Total soluble solids (TSS) %: were determined by using a hand refractometer according to **A.O.A.C. (2012)**.

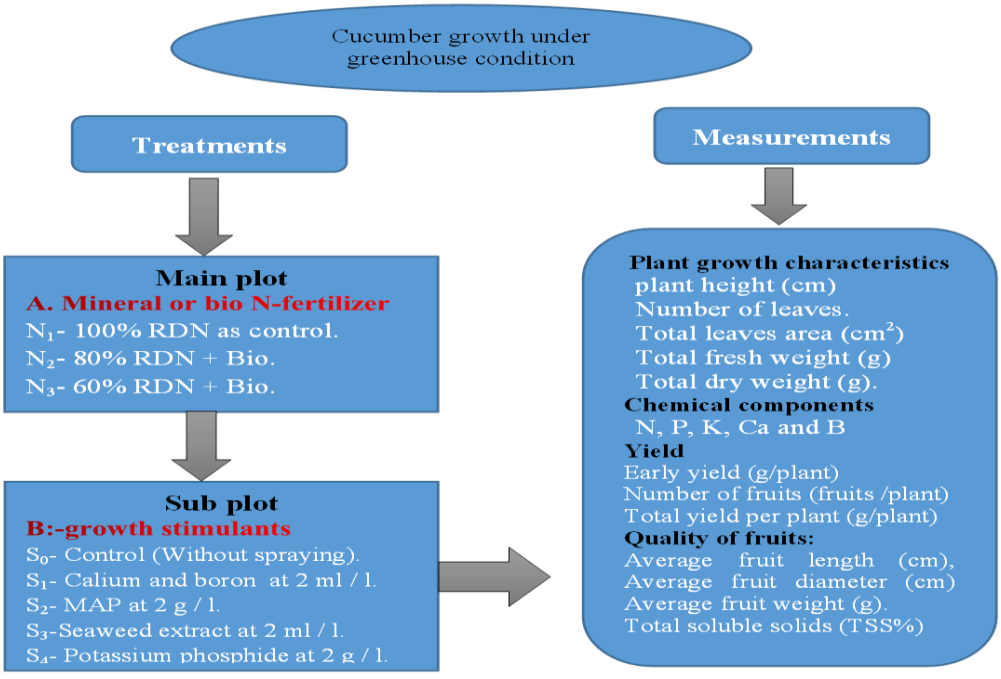

Fig. 1. Treatments used contain, the mineral or bio nitrogen fertilizer, growth stimulants and the measurementsin this study.

Statistical analyses

All obtained data from the experiments were recorded and statistically analysed according to a split plot design. Duncan's analysiswas used to differentiate means according to **Snedecor and Cochran (1991)**.

3. Results

1. plant growth characteristics

Data listed in Tables 2 and 3 exposure the effect of fertigation using three levels of mineral and bio nitrogen fertilizerand some growth stimulating as sprinkle on phenotypic characters of cucumber plant in winter seasons of 2022/2023 and 2023/2024.

a. Effect of mineral or bio nitrogen sources treatments

Results in Table 2 represent that application of different mineral and bio nitrogen fertilizer, i.e., "100% RDN", "80 or 60% + Bio fertilizer (Nitrobein) " significantly affected all the studied phenotypic characters, i.e., plant height, number of leaves per plant, leaves area, fresh and dry weights per plant in both seasons except dry weight in second season. This respect it, treatment of "80% RDN + Bio fertilizer (Nitrobein)" gave the greatest values of leaves number (31.4 and 30.5 leaves / plant) and total fresh (255 and 220 leaves /plant) weight in the two seasons of this experiment, respectively as shown in Table 2. These values were substantially greater than the values associated the treatment of "60% RDN + Bio fertilizer (Nitrobein.)" which recorded the leastvalues of plant height (162 and 169 cm/ plant), leaves number (27.3 and 27.5 leaves/ plant) and fresh weight (124 and 151 g /plant) in first and second season, respectively. This trend was true in both seasons.While adding all amount of mineralnitrogen as 100% also resulted the greatest values of plant height (189 and 202 cm / plant) in both season of study, respectively (Table 2).

Table 2. Effect of mineral nitrogen levels and nitrobein as fertigation as well as some growth stimulating compounds as sprinkle on plant growth characteristics of cucumber plant during 2022/2023 and 2023/2024 seasons.

Treatments	Plant height (cm)		No. of leaves /plant		Leaves area (cm^2/plant)		Total fresh weight (g/plant)		Total dry weight (g/plant)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Fertigation treatments										
100% N (Control)	189a	202a	27.7b	29.1ab	1021b	137ab	206b	215a	46.5b	54.4a
80%N+ Nitrobein	188a	194a	31.4a	30.5a	117a	120b	255a	220a	63.7a	63.1a
60%N+ Nitrobein	162 b	169b	27.3 b	27.5b	124a	151a	208b	197b	59.4a	63.6a
F-test	**	**	**	*	**	**	**	**	**	NS
Spraying treatments										
Control	147d	146c	22.33c	21.9c	89d	112b	115c	128d	33.6c	38.4d
Calcium and boron at 2 ml/l	207a	218a	33.6a	33.6a	149a	143a	320a	288a	76.3a	81.1a
MAP at 2 g / l	192b	208a	30.7ab	32.4a	119b	143a	234b	237b	60.8b	68.41 b
SWE at 2 ml/l	177c	190b	28.6b	28.8b	107c	141a	230b	2091bc	56.9b	59.8b c
Potassium phosphide at 2 g / l	175c	180b	28.9b	28.4b	106c	140a	216b	191c	55.0b	54.0c
F-test	**	**	**	**	**	*	**	**	**	**

Values labeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

b. Effect of sprinkle with growth stimulant.

Data in Table 2 clear that sprinkle with varience growth stimulating, i.e., calcium and boron at 2 ml/l, MAP at 2g/l , SWE at 2ml/l or potassium phosphide at 2g/l improved plant growth as plant height, leaves number and leaves area per plant , fresh and dry weights per plant compared with the control. In the during seasons of experiment (Table 2), sprinkle the plants with calcium and boron at 2 ml/l recorded the themaximum values regardingof plant height (207 and 218 cm),the leaves number(33.6 and 33.6 leaves / plant) and leaves area (149 and 143 cm^2 /plant), totalfresh weight (320 and 288 g /plant) and total dry weight (76.3 and 81.1 g/plant) followed by MAP at 2g/l, then SWE at 2ml/l in both seasons. Meanwhile, potassium phosphide at 2g/l came the lastrankas to their effects among the growth stimulants on plant height (175 and 180 cm), the leaves number (28.9 and 28.4 leaves / plant) and leaves area (106 and 140 cm^2 /plant), total fresh weight (216 and 191 g /plant) and total dry weight (55.0 and 54.0 g/plant) in both seasons. In addition, the values associated with control in the both season of study were significantly lower than the previously mention treatments, i.e., plant height (147 and 146 cm), the leaves number (22.3 and 21.9 leaves / plant) and leaves area (89 and 112 cm^2 / plant), total fresh weight (115 and 128 g /plant) and total dry weight (33.6 and 33.35 g/plant) (Table, 2).

c. Effect of the interaction.

Data presented in Table 3 clear that adding all amount of meniralnitrogen as 100% then sprinkle the plants with calcium and boron at 2 ml/l resulted the greatest values in plant height, i.e., 212 and 232 cm/ plant in both seasons of study, respectively. Also application the treatment of "80% N+ nitrobein" then spray the plants with calcium and boron at 2ml/l showed the highest values of number of leaves (37.7 and 36.0leaves/plant), total fresh (386 and 306 g/plant) and dry (94.2 and 90.0 g/ plant) weights in the both seasons. Meanwhile, the lowest values were concentrated with the tap water spray treatment on plants fertilized with the total amount of nitrogen 100% or 80% N+ nitrobein. Where, the lowest values of plant height (133 and 129 cm/ plant) were recorded on treatment of 60%+nitrobeinthen tap water spray(control) in both seasons. Meanwhile the lowest values of leaves number (20.7 and 19.7 leaves / plant) and total fresh weight (83 and 103 g / plant) were resulted from treatment of 100%N and 60%+nitrobein then tap water spray in first and second season, respectively.The lowest values of leaves area (70 and 98 cm^2) recorded with treatment of 100%N and 80%+nitrobein then tap water spraying in first and second season, respectively. Finally, the lowest values of dry weight (25.8 and 28.3 g/ plant) were resulted from treatment of 100%N then tap water spraying in both seasons.

Table 3. Effect of the interaction between mineral nitrogen and nitrobien levels as fertigationas well as some growth stimulating compounds as sprinkle on vegetative growth characteristics of cucumber plant during 2022/2023 and 2023/2024 seasons.

Treatments	Plant height (m)		No. of leaves /plant		Leaves area (cm^2/plant)		Total fresh weight (g/plant)		Total dry weight (g/plant)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
100% N (Control)										
T1-Control	144fg	148fg	20.7h	22.7fg	70f	124ce	83h	130fg	25.8e	28.3g
T2-Calcium and boron at 2 ml/l	212a	232a	30.3be	31.7ad	132ac	137ad	273bc	253ac	53.1bd	65.4bc
T3-MAP at 2 g / l	206a	220ab	33.0ac	36.3a	108ce	132be	239ce	300ab	57.8bc	76.3ab
T4-SWE at 2 ml/l	197ab	217ac	30.0be	31.7ad	96df	149ad	233ce	238cd	52.5bd	63.3bd
T5-Potassium phosphide at 2 g / l	186bc	195cd	24.7fh	23.0eg	101de	142ad	204df	155eg	43.2cd	38.3fg
80%N+ Nitrobein										
T6-Control	164de	162ef	24.7fh	23.3eg	112ce	98e	160fg	152eg	37.0de	40.8eg
T7-Calcium and boron at 2 ml/l	208a	214ac	37.7a	36.0a	154a	122ce	386a	306a	94.2a	90.0a
T8-MAP at 2 g / l	196ab	215ac	32.3ad	33.3ab	104ce	130be	243be	225ac	64.7b	66.7bc
T9-SWE at 2 ml/l	185bc	196bd	27.0dg	26.7df	104ce	120ce	230ce	213ce	60.8bc	60.0bd
T10-Potassium phosphide at 2 g / l	186bc	185de	35.3ab	33.0ac	108ce	130be	256bd	206ce	61.8b	57.6be
60%N+ Nitrobein										
T11-Control	133g	129g	21.7gh	19.7g	86ef	115de	103gh	103g	37.9de	45.9dg
T12-Calcium and boron at 2 ml/l	201ab	209ad	32.7ac	33.0ac	159a	171a	302b	305ab	81.7a	88.0a
T13-MAP at 2 g / l	173cd	189d	26.7eg	27.7df	144ab	167ab	220cf	187df	60.0bc	62.3bd
T14-SWE at 2 ml/l	150eF	156f	28.7cf	28.0ce	121bd	155ac	229ce	175df	57.3bc	56.0cf
T15-Potassium phosphide at 2 g / l	152ef	160f	26.7eg	29.3bd	108ce	148ad	187ef	213ce	60.0bc	66.0bc
F-test	**	**	**	**	**	*	**	**	**	**

Values labeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

In conclusion, the best treatment concerning increasing most of growth traits of cucumber plant, i.e., number of leaves per plant, fresh and dry weights per plant was "80% RDN with adding nitrobein bio fertilizer then sprinkle the plants with calcum and boron at 2 ml/l " as average between both seasons (Figs. 2, 3 and 4).

2. Chemical constituents of plant foliage

Data (Tables 4 and 5) indicate the effect of fertigation using different levels of mineral and bio nitrogen fertilizer and using some growth stimulating as sprinkle on chemical analysis on cucumber plant foliage in the winter seasons of 2022/2023 and 2023/2024.

a. Effect of nitrogen fertilizer treatments

Data (Table,4) display that all total assayed mineral contituents i.e., macro-elements (total nitrogen, phosphorus, potassium, calcium) and boron as micro-elements as well as total chlorophyll reading of plant foliage were considerably diverse due to various treatments of mineral and bio during winter seasons of 2022/2023 and 2023/2024. In the both season, addition of nitrogen fertilizers at "100% RND" represented the best values of N (1.93 and 1.88 %), P (0.21 and 0.21%) and K (1.52 ad 1.61%) contents and total chlorophyll reading (43.3 and 44.2mg/100g f.w) while, the best values of Ca (6.05 and 6.33 %) and B (28.7 and 34.0 ppm) contents were exhibited with application of 60%RDN + bio fertilizer (Table, 4). Meawhile , the lowest values of N (1.64 and 1.63%), P (0.20 and 0.20%) and K (1.37 and 1.34%) contents were recorded with application of "60% of RDN + bio fertilizer (nitrobein)" in the both season as well as Ca (5.71 and 5.90%), B (18.6 and 20.8 ppm) content and total chlorophyll reading (40.7 and 40.5mg/100g f.w) were recorded with application of 80%N + bio fertilizer (Table, 4).

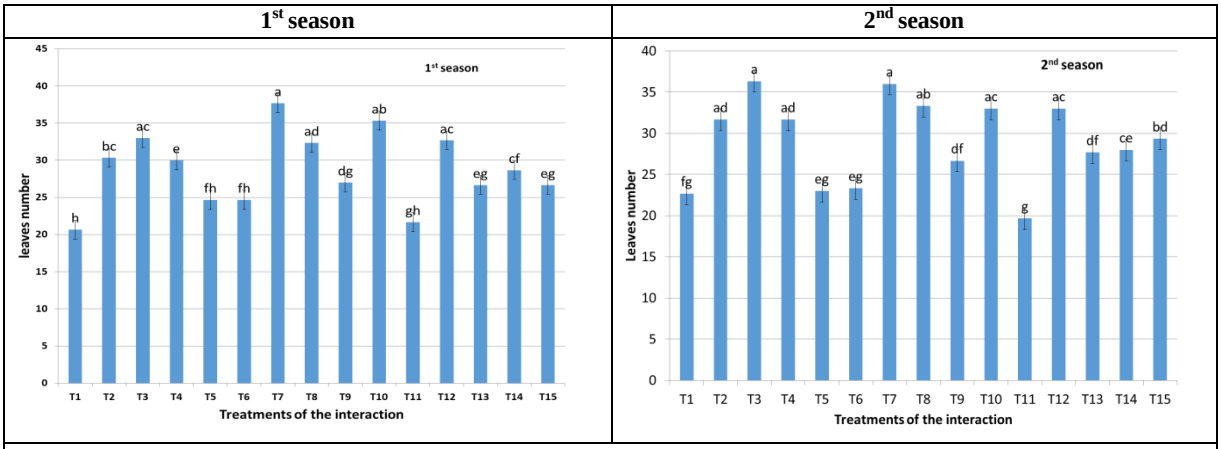

Fig. 2 Effect of treatments of the interaction between mineral nitrogen levels and nitrobien as fertigation as well as some growth stimulating compounds as sprinkle on leaves number of cucumber plant in both seasons.

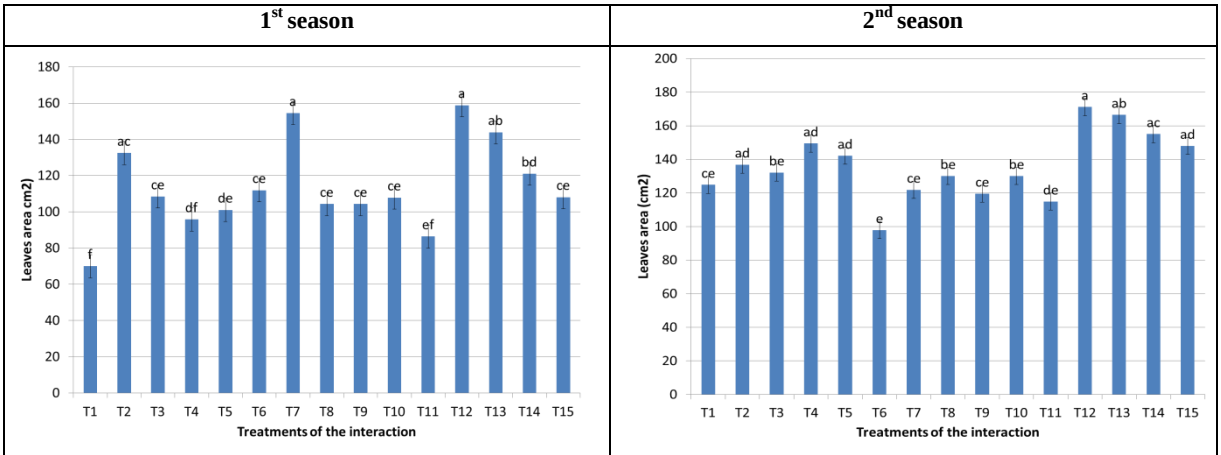

Fig. 3 Effect of treatments of the interaction between mineral nitrogen levels and nitrobien as fertigation as well as some growth stimulating compounds as sprinkle on leaves area of cucumber plant in both seasons.

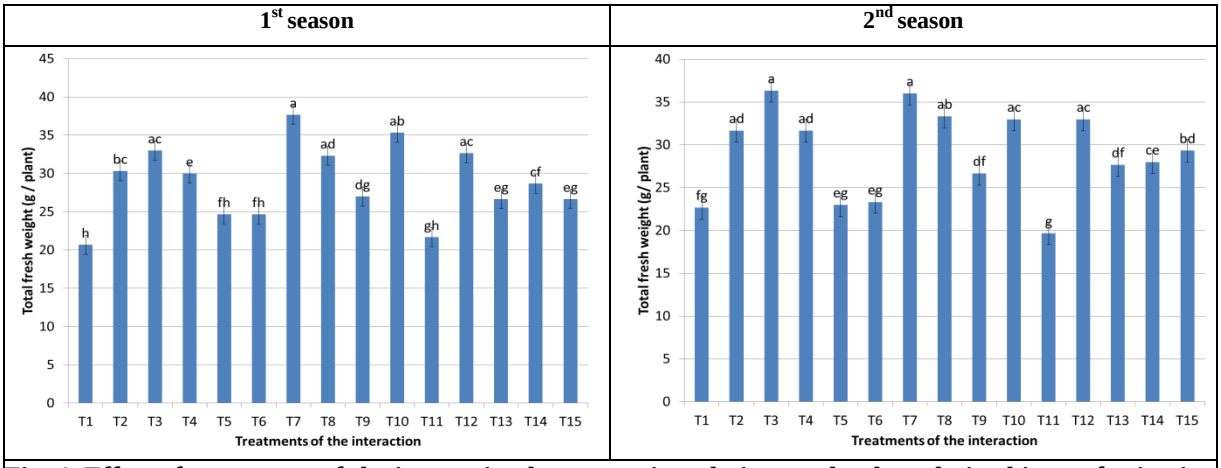

Fig. 4. Effect of treatments of the interaction between mineral nitrogen levels and nitrobien as fertigation as well as some growth stimulating compounds as sprinkle on total fresh weight of cucumber plant in both seasons.

b. Effect of sprinkleing with growth stimulant

From data in Table 4 it could be concluded that , sprinkle of cucumber plants with different growth stimulating, i.e., calcium and boron at 2ml/l, MAP at 2g/l, SWE at 2ml/l and potassium phosphide at 2 g / l as well as tab water (control) with significant increase in total nitrogen, phosphorus, nitrogen as well as total chlorophyll reading in plant leaves in both sesson. The highest values of total nitrogen (1.88 and1.86%)and phosphorus (0.24 and 0.23 %) were achieved by using calcium and boron at 2ml/l during first and second season, respectively compared with SWE at 2ml/l which recorded the lowest values of N (1.75 and 1.79%) and P (1.75 and 1.79%) in both seasons of study. The highest values of total potassium (1.62 an 1.55 %) contents were revealed with using Potassium phosphide at 2 g/l during first and second season respectively. The highest values of total calcium (6.20 and 6.29 %) and boron (27.5 and 34.9 ppm) were obtained by using calcium and boron at 2ml/l compared with control which registered the lowest values of Ca (5.70 and 19.3 %) and B (19.3 and 20.5 ppm) in both season. Some trends of results were true in both seasons. Meanwhile the highest value of chlorophyll reading (44.1 and 46.4mg/100g f.w) were recorded by using SWE at 2 ml/l at 2 g / l compared with control which recorded the lowest values (39.6 and 38.0 mg/100g f.w) in both seasons.

Table 4. Effect of mineral nitrogen levels and nitrobien as fertigationas well as some growth stimulating compounds as sprinkle on some chemical contents in leaves of cucumber plant during 2022/2023 and 2023/2024 seasons.

Treatments	N %		P %		K %		Ca %		B ppm		Chlorophyll (mg/100g f.w)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Fertigation treatments												
100% N (Control)	1.93a	1.88a	0.21a	0.21a	1.52a	1.61a	5.18c	4.67c	22.0b	24.1b	43.3a	44.2ab
80%N+ Nitrobein	1.72b	1.78b	0.20b	0.21a	1.41b	1.47ab	5.71b	5.90b	18.6c	20.8b	40.7b	40.5b
60%N+ Nitrobein	1.64c	1.63c	0.20b	0.20b	1.37c	1.34b	6.05a	6.33a	28.7a	34.0a	43.2a	41.4b
F-test	**	**	**	**	**	**	**	**	**	**	*	**
Spraying treatments												
Control	1.79bc	1.69d	0.20b	0.22b	1.34c	1.46ab	6.08b	5.70c	19.3e	20.5c	39.6b	38.0e
Calcium and boron at 2 ml/l	1.90a	1.86a	0.24a	0.23a	1.36c	1.47ab	6.20a	6.29a	27.5a	34.9a	43.0a	40.2d
MAP at 2 g / l	1.57d	1.64e	0.20c	0.21c	1.50b	1.37b	5.72d	5.83b	20.1d	23.0bc	41.4ab	43.7b
SWE at 2 ml/l	1.75c	1.79c	0.17d	0.19d	1.35c	1.51ab	4.46e	4.64d	25.2b	28.2b	44.1a	46.4a
Potassium phosphide at 2 g/l	1.83b	1.83b	0.21b	0.20c	1.62a	1.55a	5.77c	5.71c	23.4c	25.0bc	43.9a	41.9c
F-test	**	**	**	**	**	**	**	**	**	**	**	**

Values labeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

c. Effect of the interaction

As for the effect of the interaction, it is obvious from the data in Table 5 that there were a significant differences in all assayed mineral constituents i.e., macro-elements (total nitrogen, phosphorus, potassium ,calcium) and boron as micro-elements as well as total chlorophyll reading as a result of the interaction among the tested treatments during the two seasons of growth.

Table 5. Effect of the interaction between mineral nitrogen levels and nitrobien as fertigationas well as some growth stimulating compounds as sprinkle on some chemical contents in leaves of cucumber plant during 2022/2023 and 2023/2024 seasons.

Treatments	N %		P %		K %		Ca %		B ppm		Chlorophyll (mg/100g f.w)	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
100% N (Control)												
T1-Control	1.85cd	1.87bc	0.18i	0.21bc	1.44e	1.29df	4.65k	5.76g	15.2l	18.2e	47.9ab	48.4ab
T2-Calcium and boron at 2 ml/l	1.94b	1.84de	0.27a	0.23a	1.56c	1.77ab	5.52h	4.05k	28.5d	30.5bd	47.0ab	41.5c
T3-MAP at 2 g / l	1.84de	1.88b	0.19hi	0.21d	1.43e	1.54ad	4.46l	4.63j	15.3l	18.4e	34.6d	39.8cd
T4-SWE at 2 ml/l	2.12a	1.97a	0.19fh	0.22c	1.55cd	1.63ac	3.74m	3.57l	24.5f	27.8be	48.8a	50.5a
T5-Potassium phosphide at 2 g/l	1.89bd	1.83de	0.19gi	0.18f	1.65a	1.56ac	7.25b	5.36h	21.7h	25.6be	43.3bc	41.0c
80%N+ Nitrobein												
T6-Control	1.60fg	1.67f	0.18i	0.19e	1. 53cd	1.64ac	4.81j	5.03i	17.3k	20.5de	29.2e	28.0f
T7-Calcium and boron at 2 ml/l	1.85cd	1.89b	0.24b	0.21d	1.22i	1.16f	7.53a	7.84a	17.5k	20.4de	46.9ab	46.3b
T8-MAP at 2 g / l	1.54gh	1.62g	0.19hi	0.23ab	1.33f	1.39cf	6.26e	6.63c	20.3ij	18.2e	40.9c	41.1c
T9-SWE at 2 ml/l	1.85cd	1.88bc	0.17j	0.21d	1.27g	1.52bd	4.46l	4.63j	20.6i	23.3be	47.0ab	48.8ab
T10-Potassium phosphide at 2 g/l	1.76e	1.84de	0.20eg	0.23ab	1. 68a	1.79a	5.74g	5.35h	22.3g	21.6ce	39.6cd	38.4cd
60%N+ Nitrobein												
T11-Control	1.63f	1.53h	0.22cd	0.22bc	1.54cd	1.43ce	6.25e	6.31e	20.2ij	22.8be	41.6c	37.8d
T12-Calcium and boron at 2 ml/l	1.93bc	1.85cd	0.21de	0.22bc	1.25hi	1.64ac	6.34d	6.99b	36.7a	53.9a	35.2d	32.8e
T13-MAP at 2 g/l	1.34i	1.43i	0.21cd	0.22bc	1.26gh	1.24ef	6.43c	6.23f	29.9c	32.3bc	48.8a	50.2a
T14-SWE at 2 ml/l	1.47h	1.52h	0.13k	0.14g	1.28g	1.23ef	5.18i	5.72g	30.7b	33.4b	43.9ac	39.9cd
T15-Potassium phosphide at 2 g/l	1.83de	1.82e	0.22c	0.19e	1.53cd	1.22ef	6.05f	6.41d	26.1e	27.8be	41.5c	46.5b
F-test	**	**	**	**	**		**	**		**		**

Values labeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

In this regard, fertilizing cucumber plants with the highest levels of nitrogen fertilizer (100% RDN) without supplied bio fertilizer combined with treating the plants with each of calcium and boron reflected the highest values of N (2.12 and 1.97 %) content compared to the treatment of 60 N%+ bio with sparaying the plants by tap water which recorded the lowest values (1.63 and.53%) during the first and second seasons. Furthermore, supplying the same amount of nitrogen fertilizers (100% N) and spray the plants with calcium and boron exhibited the highest value of P (0.27 and 0.2 %) comparing with treatment of SWE at 2 ml/l which recorded the lowest values (0.13 and 0.14%) during the first and second seasons. Meanwhile, using levels of nitrogen fertilizer (80% +bio fertilizer) combined with treating the plants with potassium phosphide at 2g/l showed the most value of K (1. 68 and 1.79%) content compared with control treatment (100% RDN and tap water spraying) which recorded the lowest values (1.22 and 1.16%).The heighest values of Ca (7.53 and 7.84%) was recorded with treatment of calcium and boron at 2 ml/l comparing with the treatment of 100 % RDN and spraying with SWE at 2 ml/l (3.74 and 3.57 %). For B%, the heighest values (36.7 and53.9 ppm) were resulted from combaining treatment of 80% RDN +bio with treating plants by SWE at 2 ml/l compared to control treatment (100% RDN) and spraying by only water which recorded the lowest values (15.2 and 18.2 ppm). Regarding the heighest values of total Chlorophyll (48.8 and 50.5 mg/100g f.w) were recorded with treatment (100% RDN) and spraying by SWE at 2 ml/l compared with treatment of 80% RDN +bio with treating plants by only tap water (29.2 and28.0 mg/100g f.w) in both seasons.

3. Fruit yield

Data in Tables, 6 and 7 show the effect of fertigation using various levels of mineral and bio nitrogen fertilizer and sprinkle with some growth stimulating as well as their interaction on early yield (g/plant),total fruit number

(36.6 and 39.9 fruits / plant) and total fruit yield (g/plant) of cucumber during the two successive winter seasons of 2022/2023 and 2022/2023.

a. Effect of nitrogen treatments

Data in Table 6 show total early yield(g/plant), fruit number/plantand total fruit yield (g/plant) were significantly influenced by the supplyingwith different levels of mineral and bio nitrogen fertilizer in both seasons of study. In this respect, application of mineral nitrogen fertilizer at 100 % without bio fertilizerexhibited the highest values in two season for early yield (939 and 1014 g/ plant), total produced yield (2681 and 2917 g / plant) and fruits number (33.4 and 34.8 fruits / plant) in both seasons. The treatment of 80% RDN+ Bio was in the second ranke where it was recoded the mediest values ofearly yield (835 and 877 g/ plant), total produced yield (2422 and 2493 g / plant) and fruits number (36.6 and 39.9 fruits / plant) in both seasons. Meanwhile, treatment of "60% RDN+ bio" gave the lowest values of early yield (685 and 765 g/ plant), total produced yield (2092 and 2288 g / plant) and fruits number (28 and 30.7 fruits / plant) in both seasons(Table, 6). In this regard, the higher total produced yield when using the “100% RDN” or "80% RDN+ Nitrobein" were connected with the rise in vegetative growth plants (Tables 2 and 3).

b. Effect of sprinkle with growth stimulants

Data in Table 6 reveal that spraying cucumber plants with different growth stimulating, i.e., calcium and boron at 2 ml/l, MAP at 2g/l , SWE at 2ml/l or potassium phosphide at 2g/l significantly increased early plant (g/plant), total fruit number /plantand total fruit yield (g/plant) contrast with the control treatment (spraying with tap water).

Table 6. Effect of mineral nitrogen levels and nitrobien as fertigationas well as some growth stimulating compounds as sprinkle on fruit yield of cucumber plant during 2022/2023 and 2023 /2024 seasons.

Treatments	Early yield (g/plant)		Total fruit No. /plant)		Total fruit yield (g/plant)	
	1st	2nd	1st	2nd	1st	2nd
Fertigation treatments						
100% N (Control)	939a	1014a	36.6a	39.9a	2681a	2917a
80%N+ Nitrobein	835b	877b	33.4b	34.8b	2422b	2493b
60%N+ Nitrobein	685c	765c	28.0c	30.7c	2092c	2288c
F-test	**	**	**	**	**	**
Spraying treatments						
Control	531e	592d	21.4e	22.9e	1494d	1623d
Calcium and boron at 2 ml/l	991a	1021a	39.1a	41.3a	2957a	2957a
MAP at 2 g / l	913b	994a	36.6b	39.2b	2603b	2890a
SWE at 2 ml/l	860c	944b	34.4c	37.7c	2552b	2796b
Potassium phosphide at 2 g / l	803d	873c	31.7d	34.7d	2387c	2563c
F-test	**	**	**	**	**	**

Values labeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

In this regard, spraying the plants with calcium and boron at 2 ml/l gave the highest significant values of early yield (991 and 1021 g/ plant), total fruit number (39.1 and 41.3 fruits / plant)and total fruit yield (2957 and 2957 g/plant) in both seasons. Meanwhile, the values associated with control treatment (Which received tap water) in both season of study were significantly lower than the previously mention treatments, i.e., early yield (531 and 592 g/ plant), total fruit number (21.4 and 22.9 fruits / plant)and total fruit yield (1494 and1623 g / plant) (Table, 6).

c. Effect of the interaction

Regarding the effect of the interaction treatments between mineral and bio nitrogen fertilizer levels and sprinkle treatments on early yield, number of fruits and total fruit yield per plant, data in Table 7 reveal that "100% RDN" treatment and foliar spaying the plants with calcium and boron at 2 ml/l reflected the highest values for early yield (1144 and 1161 g/ plant), total fruit number (43.9 and47.0 fruits / plant) and total fruit yield (3402 and 3436 g/plant) in both seasons. Meanwhile, the treatment of "60% nitrogen + nitrobein" then spraying the plants withtap water in the same two season of study were significantly lower than the previously mention treatments, i.e., early yield (464 and 521 g/ plant), total fruit number (19.0 and 21.3 fruits / plant) and total fruit yield (1282 and1466 g/plant)(Table, 7).

Table 7. Effect of the interaction between mineral nitrogen levels and nitrobienas feratigationas well as some growth stimulating compounds as sprinkle treatments on fruit yield of cucumber plant during 2022/2023 and 2022/2023 seasons.

Treatments	Early yield (g/plant)		Total fruit No. /plant		Total fruit yield (g/plant)	
	1st	2nd	1st	2nd	1st	2nd
100% N (Control)						
T1-Control	615hi	671hi	23.0h	24.5i	1655g	1797f
T2-Calcium and boron at 2 ml/l	1144a	1161a	43.9a	47.0a	3402a	3436a
T3-MAP at 2 g / l	1030ab	1135a	41.2ab	45.1ab	2885bc	3319ab
T4-SWE at 2 ml/l	996bc	1110ab	39.8bc	43.6bc	2890bc	3200b
T5-Potassium phosphide at 2 g / l	909ce	990cd	35.0de	39.4de	2575cd	2833c
80%N+ Nitrobein						
T6-Control	514ij	584ij	22.2h	23.0ij	1545gh	1607fg
T7-Calcium and boron at 2 ml/l	1017bc	1008bc	40.7ac	41.4cd	2922b	2850c
T8-MAP at 2 g / l	960bd	985cd	37.8cd	39.2de	2685bd	2848c
T9-SWE at 2 ml/l	874de	959ce	34.8de	37.3ef	2519de	2753cd
T10-Potassium phosphide at 2 g / l	812ef	848fg	31.5fg	33.2gh	2441df	2408e
60%N+ Nitrobein						
T11-Control	464j	521j	19.0i	21.3j	1282h	1466g
T12-Calcium and boron at 2 ml/l	813ef	895df	32.8ef	35.4fg	2548de	2586de
T13-MAP at 2 g / l	750fg	863eg	30.9fg	33.3gh	2239ef	2504e
T14-SWE at 2 ml/l	711fh	763gh	28.8g	32.1h	2247ef	2435e
T15-Potassium phosphide at 2 g / l	689hg	782g	28.5g	31.5h	2144df	2448e
F-test	**	**	**	**	**	**

Values labeled with the same letters within a single column are not significantly different at the significance level 5%.

In conclusion, the best treatment concerning increasing early yield ,number of fruits per plant and total fruit yield per plant was 100% RDN and spray the plants with "calcium and boron at 2 ml/l" followed by the best treatment concerning increasing total fruit yield per plant was "80% RDN +nitrobien" and spray the plants with the same stimulant "calcium and boron at 2 ml/l" in both seasons (Figs. 5, 6 and 7).

4. Fruit quality

Data in Tables, 8 and 9 indicate the effect of fertigation using recommended dose of nitrogen and different levels of mineral with bio nitrogen fertilizer and some growth stimulating as sprinkle on physical fruit quality of cucumber plants like as average fruit weight (g), fruit length (cm), fruit diameter (cm) and T.S.S during the winter seasons of 2022/2023 and 2022/2023 seasons.

a. Effect of nitrogen fertilizer treatments

Data presented in Table 8 show that application of different treatments of mineral or bio nitrogen fertilizer, i.e., "100% RDN", "80% RDN + nitrobein" and "60%RDN + nitrobein" had no significant effect of the studied physical fruit quality traits, i.e., average fruit weight, length, diameter, and T.S.S% during both seasons of study except average fruit weight and diameter in the second seasons which recorde slowest defferances.

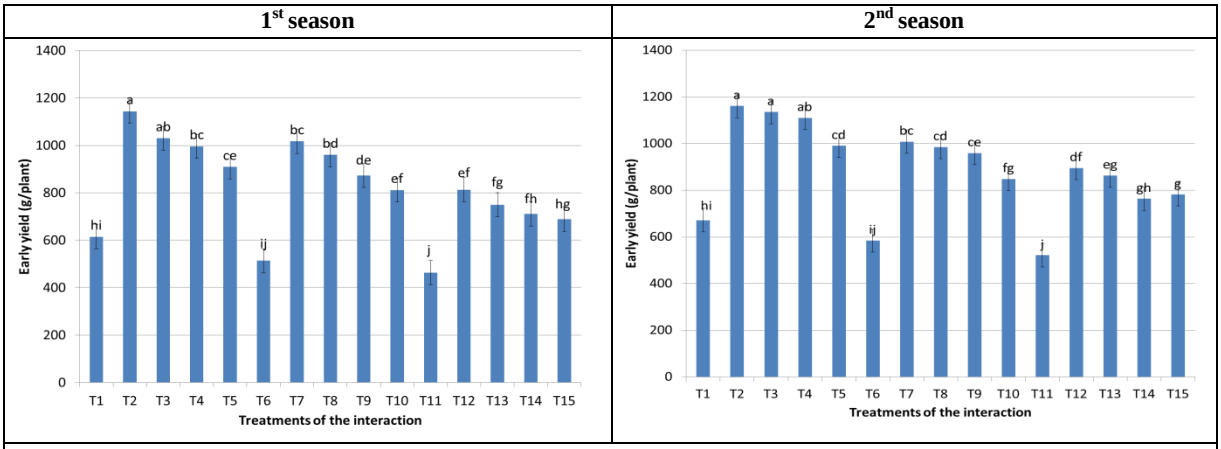

Fig. 5 Effect of treatments of the interaction between mineral nitrogen levels and nitrobien as fertigation as well as some growth stimulating compounds as sprinkle on early yield of cucumber plant in both seasons.

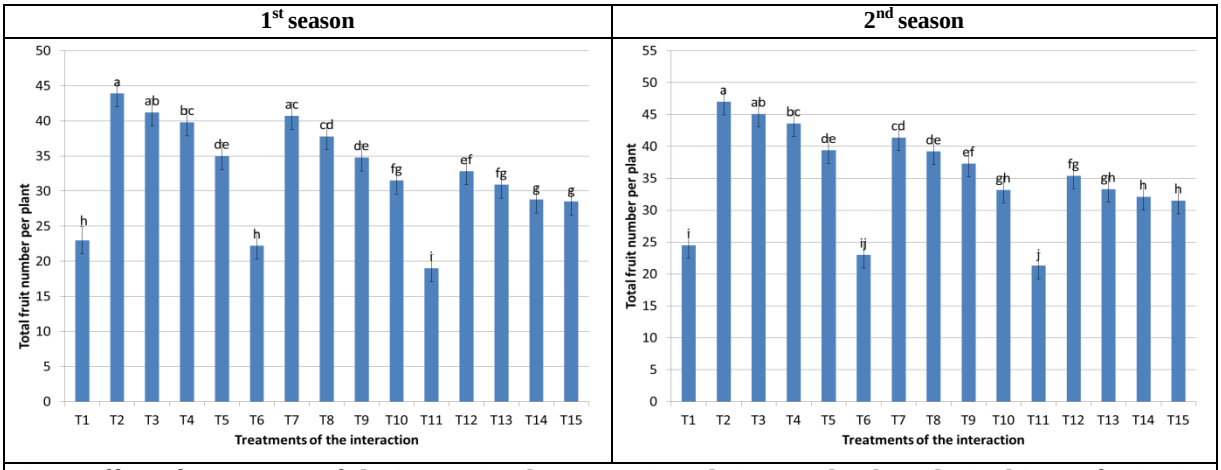

Fig. 6. Effect of treatments of the interaction between mineral nitrogen levels and nitrobien as fertigation as well as some growth stimulating compounds as sprinkle on total fruit number of cucumber plant in both seasons.

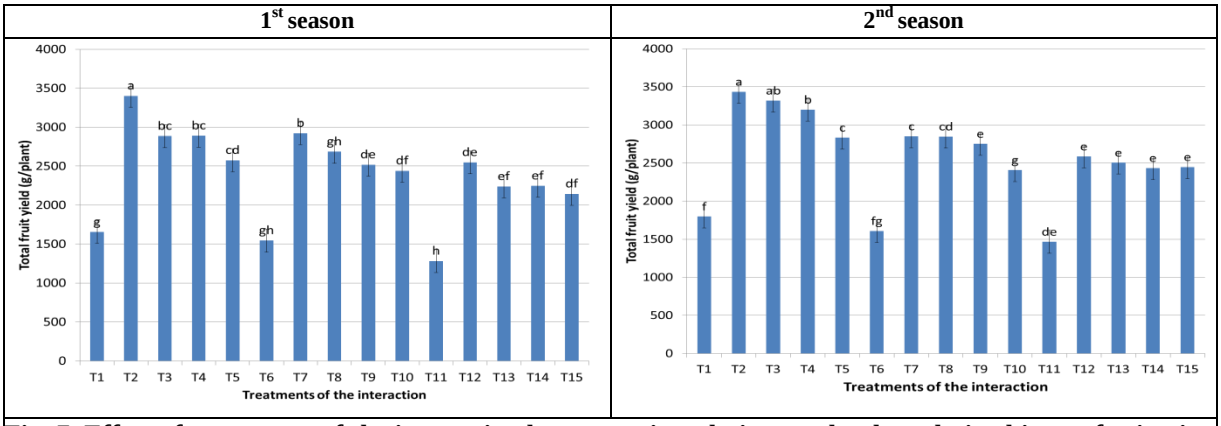

Fig. 7. Effect of treatments of the interaction between mineral nitrogen levels and nitrobien as fertigation as well as some growth stimulating compounds as sprinkle on total fruit yield of cucumber plant in both seasons.

b. Effect of sprinkle with growth stimulants

Regarding the effect of different spraying with different growth stimulating, i.e, calcium and boron at 2 ml/l, MAP at 2g/l , SWE at 2ml/l or potassium phosphide at 2g/l, the data in Table 8 reveal that averages fruit weight, length and diameter were significantly affected due to spraying the studied growth stimulating. Meanwhile the differences didn't reach to significance level (5%) in case of T.S.S%. Spraying the plants with calcium and boron at 2ml/l had the highest values of averages fruit weight (75.7 and 74.4 g), length (15.8 and 15.1 cm) and diameter (3.17 and 3.0 cm) during first and second season compared with control treatment which recorded the lowest values of averages fruit weight (69.8 and 70.8 g), length (13.6 and 13.8 cm) and diameter (2.5 and 2.6 cm) during both season.In the both season (Table, 8), treatment of spraying the plants with calcium and boron at 2 ml/l, was gave the highest values of fruit length and fruit diameter compared with control treatment which recorded the lowest values of fruit height and fruit during both season.

Table 8. Effect of mineral nitrogen levels and nitrobien as fertigationas well as some growth stimulating compounds as sprinkle on fruit yield characteristics of cucumber plant during 2022/2023 and 2022/2023 seasons.

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		T.S.S %	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Fertigation treatments								
100% N (Control)	74.2	73.1a	14.6	14.6	2.67	3.07	4.17	4.30
80% N+ Nitrobein	74.2	71.5b	14.6	14.7	2.67	2.93	4.20	4.27
60% N+ Nitrobein	74.2	74.1a	14.6	14.8	2.67	2.70	4.15	4.41
F-test	NS	*	NS	NS	NS	*	NS	NS
Spraying treatments								
Control	69.8c	70.8b	13.6c	13.8b	2.50c	2.67b	4.30	4.18
Calcium and boron at 2 ml/l	75.7a	74.4a	15.8a	15.1a	3.17a	3.00a	4.17	4.53
MAP at 2 g / l	71.2bc	73.9ab	15.1ab	14.6ab	2.89ab	2.89ab	4.15	4.30
SWE at 2 ml/l	74.9ab	71.7b	14.9b	15.1a	2.83ac	2.89ab	4.07	4.23
Potassium phosphide at 2 g / l	75.5a	74.0a	14.5b	14.8a	2.78bc	3.06a	4.18	4.38
F-test	**	**	**	**	**	**	NS	NS

Values abeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

c. Effect of the interaction.

Regarding the effect of the interaction between nitrogen fertilization and spraying of some plant stimulants, the average fruit weight, length and diameter were significantly affected, while the total dissolved solids (TSS) were not affected by these treatments resulting from the interaction (Table, 9). As fertilizing the plants with a rate of 80% nitrogen and compensating the rest by adding biofertilizer (Nitrobein) with spraying the plants with calcium and boron at a rate of 1 ml/liter gave the highest value for the average first fruit weight and fruit length in the second season, while adding the same soil fertilizer treatment (80% + nitropin) gave the highest value for the average fruit weight in the second season, especially when spraying with potassium phosphide. While when adding the entire recommended dose of mineral fertilizer 100% and then spraying the plants with calcium and boron at a rate of 2 g/liter, the highest value was achieved for the average length of the fruit in the first season and the diameter of the fruit in the second season, while when spraying with potassium phosphide at a rate of 2 g/liter on plants fertilized with a total amount of nitrogen 100%, the highest value for the diameter of the fruit was shown in the second season. Meanwhile, the treatment of "60% nitrogen + nitrobein" then spray the plants withtap water in the both season of study were significantly lower than the previously mention treatments, i.e., average fruit weight, fruit length and diameter (Table, 9).

Table 9. Effect of the interaction between mineral nitrogen levels and nitrobien as fertigationas well as some growth stimulating compounds as sprinkle treatments on fruit yield characteristics of cucumber plant during 2022/2023 and 2022/2023 seasons.

Treatments	Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		T.S.S	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
100% N (Control)								
T1-Control	72.1ad	73.6b	13.7e	15.0ab	2.33de	3.17ab	4.30ab	4.15ce
T2-Calcium and boron at 2 ml/l	77.4ab	73.2b	16.3a	15.0ab	3.50a	2.83ab	4.15ac	4.50ab
T3-MAP at 2 g / l	70.0cd	73. 7b	14.7be	14.0b	2.67be	3.00ab	4.05bc	4.15ce
T4-SWE at 2 ml/l	72.7ad	73.4b	14.0de	14.7ab	3.00ac	3.00ab	4.15ac	4.10de
T5-Potassium phosphide at 2 g / l	73.8ad	71.9bc	14.3ce	14.7ab	3.17ab	3.33a	4.20ab	4.60ab
80% N+ Nitrobein								
T5-Control	69.5cd	69.8b	15.0ae	14.3ab	3.00ac	2.67bc	4.40a	4.05e
T6-Calcium and boron at 2 ml/l	71.9ad	73.9b	15.0ae	14.7ab	2.83bd	3.17ab	4.15ac	4.70a
T7-MAP at 2 g / l	71.1bd	72.7b	15.7ac	15.0ab	3.17ab	2.83ab	4.25ab	4.35bd
T8-SWE at 2 ml/l	72.4ad	68.9b	15.0ae	15.0ab	3.00ac	3.00ab	3.90c	4.20ce
T9-Potassium phosphide at 2 g / l	77.5ab	72.6b	14.7be	14.7ab	2.50ce	3.00ab	4.30ab	4.05e
60% N+ Nitrobein								
T10-Control	67.7d	68.9c	12.0f	12.3c	2.17e	2.17c	4.20ab	4.35bd
T11-Calcium and boron at 2 ml/l	77.8ab	75.8ab	16.0ab	15.7a	3.17ab	3.00ab	4.20ab	4.40bc
T12-MAP at 2 g / l	72.4ad	75.4ab	15.0ae	15.0ab	2.83bd	2.83ab	4.15ac	4.40bc
T13-SWE at 2 ml/l	78.3a	73.0b	15.3ad	15.7a	2.50ce	2.67bc	4.15ac	4.40bc
T14-Potassium phosphide at 2 g / l	75.1ac	77.6a	14.7be	15.3ab	2.67be	2.83ab	4.05bc	4.50ab
F-test	**	**	**	**	**	*	*	**

Values labeled with the identical letters within a single column are not significantly distinct at the significance level 5%.

4. Discussion

It was noted that treatment of "80%N+ Nitrobein" was superior in vegetative growth characteristics. It may be due to mixing a large amount of free mineral N-fertilizer with the bio-fertilizer which fixed nitrogen and release some growth regulating around plants roots i.e, GA_3 and cytokines (**Kumari *et al.*, 2018; Morais *et al.*, 2019)**. Also,the rhizosphere of roots is enriched by biofertilizers, which also contain microorganisms, antibiotics, hormones like as auxins and cytokinins, and other nutrients including N, P, and K **(Abu Al-Saud *et al.* 2013 and Alfreeh *et al.*,2020)**. Microorganisms' stimulatory effects could be caused by Phytohormone production, increased mineral availability, phosphate and micronutrient release, nonsymbiotic nitrogen fixation, and the activation of disease-resistance mechanisms are examples of direct effects **(Youssef and Eissa, 2014 and Kudoyarova *et al.*, 2019)**. Indirect effects arise from (PGPR) altering the root environment and ecology. For example, acting as biocontrol agents and reducing diseases, liberation of antibiotic substances that kill noxious bacteria **(Jiao *et al.*, 2021)**. Superior "80%N+ Nitrobein may be due to increasing the ability to convert N2 to NH4 and thus make it available to plants. Bacteria (Nitrobein) may affect the reduction of soil pH by secreting organic acids such as acetic, propionic, fumaric and succinic acids, thus maintaining a suitable system of moisture, ventilation and a suitable environment for the absorption of other elements, which ultimately leads to improved vegetative growth, chemical components and increased yield (**Ewees and Osman, 2013)**. The full mineral N-fertilizer treatment (100% RDN) comes in second rink as, eutrophication is greatly influenced by the biogeochemical cycles of nutrients, especially N and P, which are influenced by the usage of mineral fertilizers

(Svanbäck *et al.* 2019; Abou ElFadl *et al.,* 2024, Hegab, 2024 and **Marey and Elmasry, 2024)**. Also, a large part may be lost during irrigation, and the plant will not benefit from it. These results are coincided with those mentioned by **Mukhtar *et al.* (2021) and Maheshwari *et al.* (2021)** on cucumber**, Al- Hmoud and Al-Momany (2017)** and **Dantas *et al.* (2020)** on squash aswell **as Gomes *et al.* (2020)** on melon, **Mousavi *et al.* (2021)** on pumpkin and **Farid *et al*., (2023)** on wheat who indicated bio-fertilizers are used to cut the amount of chemical fertilizers by at least 20-30% and contribute to sustainable agriculture.

The superiority of the calcium and boron compound is due to boron essential micronutrient which enhanced plant growth and calcium is assentialmacronutient enhance plant growth by playing a positive role on carbohydrates absorption through the photosynthetic process and increasing the new meristimic tissues **(Rafeii and Pakkish, 2021)**. The superiority may also be due to the integration between soil fertilization with nitrogen, which improves root growth and absorption, as well as soil acidity and the availability of many elements in the soil solution, with spraying with calcium and boron, which may improve the growth and development of leaves, which in turn carry out the process of photosynthesis **(Sas *et al*., 2003 ; Mohamed *et al* ., 2021**).

As for the positive effect of nitrogen on the chemical content of leaves, it may be due to nitrogen is macronutrient about 6% of plant dry matter, preseuce of N in adequate amount encourage the other nutrients in assimilation. This findings were hormony with thos obtained by **Hassan (2015**), **Mohamed *et al*., (2021) and Mohamed *et al*., (2024)**. As for the positive effect of spraying with calcium and boron, **Farid *et al*. (2020)** and **EL-Bauome *et al.,* (2023)** found that spraying may enhance plant growth because it is more efficient in providing the plant's requirements. The combined treatment of nitrogen fertilization with calcium and boron spraying was also found to be superior in terms of yield parameters. It may also be due to its positive effect on vegetative growth, which in turn stores a large amount of dry matter, which reflects the quantity and components of the crop. This may leads to an improve in its yield, and calcium and boron also reduces the rate of flower abscission which increases the percentage of fruit set and thus the number of fruits per plant (**Ziaeya and Rajaie, 2009; Fawy *et al*., 2016; Fouda, 2017** and **Sabri *et al*.,2021)**. These results of fruit yield are in the same rank with those told by **Al- Hmoud and Al- Momany (2017), Dash *et al*. (2020), Mahmood and Naile (2020), AlipourKafi *et al,* (2021), Silva *et al.* (2021), Najaf *et al.* (2021), Abdelrahman *et al*. (2021) Wang *et al*. (2021)** and **Mohamed *et al*., (2024)** all working on various cucurbitaceous vegetable crops and emphasized significant increments in growth and yield as a result of using bio fertilizers. This finding of effect of tested compounds agree with those reported by **Yusuf *et al*., (2019), Alkharpotly *et al*., (2024), Shareef *et al*., (2022)** and **Turki *et al* (2024)** on different vegetable crops.

The advantageous impact of nitrogen levels on physical fruit quality may be due to the effective impact of these treatments on vegetative growth and the storage of a large amount of dry matter, which is reflected in a high-quality yield (**El-Dissoky, 2019)**. These results are consistent with those obtained by **Dash*et al.* (2020).** Similar results concerning tested compounds were recorded by **Pal *et al*. (2016), Shehata *et al.,* (2018), Abd-Elaziz *et al*., (2019), Nada and Metwaly (2020), El-Shoura (2020)** and **Qassem *et al*. (2022).**

5. Conclusions

It was found that the 100% treatment is sometimes slightly superior to the rest of the soil fertilization treatments, but when reducing the amount of fertilizer given to the plant to 80% and compensating for the deficiency by adding the biofertilizerNitrobein, this treatment sometimes outperformed, especially when spraying the plants with calcium and boron at a rate of 2 g/liter, as sometimes there is no significant difference between 100% and 80%, but it may sometimes outperform, supported by adding biofertilizer through the soil or spraying the plants with calcium and boron at a rate of 2 g/liter. Therefore, this treatment may lead to saving about 20% of the mineral fertilizer, and thus the production inputs are reduced, with the stability of the crop quantity and its lack of significant effect by this deficiency of mineral fertilizer. It could be recommended that under such situation of this experiment using 80% RDN (200 kg ammonium nitrate / fed) + biofertilizer (20 L/fed nitrobein) then sprinkle the plants with calcium and boron at 2 ml/l for achieving vigor growth with ideal chemical contents in leaves which has reflected in growth and productivity.

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