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The Effect of Fertilizing with Cerealine and Spraying with Micronutrients on the Productivity and Quality of Onion

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Abstract: Two field experiments were carried out during the two successive winter seasons of 2021/2022 and 2022/2023 in in the El-Gemmeiza Agricultural Research Station in the Gharbeya Governorate, Egypt, to study the effect of mineral, bio nitrogen and spraying with some microelements individually or in the mixture on plant growth, yield and its components and nitrogen use efficiency (NUE) as well as storability of onion (*cv*. Giza 20). The interaction treatment between 75 % RRN with cerealine as biofertilzer and foliar spray with mixture micronutrients (Fe+Cu+Zn) at 50 ppm of each was the best treatments for enhancing plant height, number of leaves/plant, bulbing ratio, fresh weight and dry weight/plant at 90 and 120 days after transplanting (DAT), marketable yield and total yield /fed. macro and microelements in bulbs (N, P ,K, Fe, Cu and Zn) in both seasons. In this concern, this treatment produced relative increases in total yield/fed. were about 21.31 and 22.76 % over 100 % RRN only in the 1st and 2nd seasons, respectively as well as gave the highest gross return, net return and beneficial cost ratio. While, the interaction between cerealine biofertilzer only and Zn at 50 ppm as foliar application increased TSS and DM in bulbs and reduced the weight loss percentage in bulbs after five month from storage in both seasons. As for NUE, the interaction between 50 %RRN (45 kg N/fed.) + cerealine biofertilzer and spraying with the mixture of Fe+Cu+Zn at 50 ppm gave the highest values in both seasons.

Key words: Onion, nitrogen, cerealine, iron, copper, zinc, yield and storability.

1. Introduction

One of Egypt's most popular vegetable crops for processing and exporting is the onion (*Allium cepa* L.). This is among the most valuable sources of hard currency. A widely prized therapeutic herb is the onion (cut, kipped, or hazelnut). Several active compounds found in onions seem to prevent heart disease. (**El-Hadidi *et al*., 2016**). The total area devoted in Egypt for production in 2022/2023 was 250 thousand fed. which produced 3.4 million tons with average 13.6 ton/fed. (**FAO, 2024**).

Nitrogen play a significant role in improving productivity and quality of vegetable crops. Onions are the most susceptible crop plants in extracting nutrients, especially the immobile types, because of their shallow and unbranched root system; hence they require and often respond well to addition of fertilizers (**Rizk *et al*., 2012**). Therefore, optimum fertilizer application with appropriate agronomic practices in specific environment are necessary for obtaining good yield of onion. Excessive amounts of nitrogen fertilizer are applied to vegetables in order to achieve a higher yield. However, chemical nitrogen fertilizer alone generate several deleterious effects to the environment and human health and also should be replenished in every cultivation season since, the synthetic N fertilizer are rapidly lost by either evaporation or by leaching in drainage water causing dangerous environmental pollution (**Aisha *et al*., 2007**).

In order to offset some of the mineral nitrogen fertilizer and so lower agricultural expenses and soil contamination, Azospirillum (functioning bacterium of cerealine) is utilized (**Yasari and Patwardhan 2007**). According to **Singh and Dutta (2006**), Azospirillum is an N-fixing bacterium that increases the supply of nitrogen and improves the uptake of minerals and water, which in turn boosts crop productivity.

Plant growth, yield, and bulb quality of onion were significantly affected by the combination between mineral and bio nitrogen (**Dikshit 2015, El-Hadidi *et al*. 2016, Hafez and Geries, 2018, Imani and Arshad 2019, Novello *et al*., 2021, Tilahun *et al*., 2021, Geisseler *et al*., 2022, Ashenafi and Tenaye 2023, Gupta *et al*., 2023, Singh *et al*., 2023, Vojnovi´c *et al*., 2023,Arunachalam *et al*., 2024, Attaya *et al*., 2024, Hanna *et al*., 2024 and Tariful *et al*., 2024**).

Foliar sprays are frequently used to apply micronutrients, especially iron and manganese, to a variety of crops. In foliar sprays, soluble inorganic salts typically work just as well as synthetic chelates; however, inorganic salts are typically preferred due to their lower cost. One or more micronutrients in foliar spray tests may indicate purported deficits in micronutrients. The advantages of foliar sprays are therefore: (1) application levels are much lower than for soil application; (2) simple standardized application; and (3) reaction to the nutrient used is almost immediate in order to correct deficiencies during the growing season. (**Mortvedt *et al*., 1991**). Although micronutrients like iron, copper, and zinc are present in plant tissue in parts per million and are needed by plants in small levels, they are essential for a wide range of cellular and metabolic processes. They also play an essential role in improving yield and quality, and are highly needed for improved plant growth and yield of many crops **(Hansch and Mendel, 2009**).

Spraying plants with iron, copper or zinc individually or in the mixture produced the best plant growth, productivity and bulb quality **(Abd El-Samad *et al*., 2011**, **Ali, *et al*., 2016 ,El-Hadidi *et al.* 2016** ,**Manna and Maity 2016 , Goyal *et al.* 2017**, **Mohamed *et al*., 2018 Ahmed *et al*. 2019, Feteh, 2020, El-Sherbeny *et al*., 2024) on onion.**

Therefore, the aim of this study is 1- Reducing the use of nitrogen fertilizer by using the bio-fertilizer cerealine and spraying with some microelements such as iron, copper and zinc, 2- Obtaining the highest productivity with the best quality of onion bulbs under the similar conditions to this study.

2. Materials and Methods

Two field experiments were carried out during the two successive winter seasons of 2021/2022 and 2022/2023 in El-Gemmeiza Agricultural Research Station in the Gharbeya Governorate, Egypt, to study the effect of different nitrogen treatments and some microelements individually or in the mixture on plant growth , bulb yield and its components as well as storability of onion (*cv*. Giza 20). The physical and chemical properties of the experimental soil are presented in Table 1.

Table (1). shows some of the physical and chemical properties of the experimental soil (according to Balck *et al*., 1981)

Parameter	Value	
1. **physical properties**	**2021/2022**	**2022/2023**
Corse sand (%)	3.96	4.50
Fine sand (%)	14.34	15.51
Silt (%)	40.40	38.90
Clay (%)	41.30	41.09
Textural class	**clayey loam**	**clayey loam**
2. **Chemical properties**		
EC dSm^{-1} (soil past extract)	2.39	2.31
pH (1: 2.5 soil : water suspension)	8.09	7.97
$CaCO_3$ (%)	2.54	2.49
Organic matter (%)	1.81	1.79
Available nitrogen (ppm)	35	34
Available phosphorus (ppm)	7.9	8.3
Available potassium (ppm)	322	328
DTPA- extractable		
Fe ppm	3.55	3.70
Cu ppm	0.88	0.75
Zn ppm	0.99	1.10

Table (2). Data of whether conditions at Gharbeya Governorate during 2021/2022 and 2022/2023

Seasons	Months	Air temperature (C)		Relative humidity (%)	Rain Fall Mm/day
		Maximum	Minimum		
2021/2022	**December**	23	12	58	3.0
	January	19	8	63	5.3
	February	19	8	72	6.2
	March	23	10	64	5.2
	April	25	14	52	1.6
	May	36	17	44	0.8
	June	37	22	48	0.1
2022/2023	**December**	21	13	62	3.1
	January	18	12	60	5.5
	February	28	13	59	6.2
	March	20	12	55	5.5
	April	24	16	48	1.4
	May	33	22	47	0.7
	June	35	23	55	0.1

This experiment includes 20 were the combination between four nitrogen fertilization , i.e., cerealine, 50 % of the recommended rate (RR) of nitrogen (45 kg N/fed.+ cerealine), 75 % RR (67.5 kg N/fed.+ cerealine) and 100% RR only (90 kg N/fed.) and five treatments for microelements as foliar spray (Fe, Cu , Zn at 50 ppm of each and Fe+Cu+Zn at 50 ppm of each, beside unsprayed treatment.

These treatments were arranged in a spilt plot design with three replications. Nitrogen treatments were arranged in the main plots, while the treatments of microelements as foliar spray were arranged in the sub plot.

The amounts of biofertilizer (cerealine) at 5 liter/feddan was divided into two portions, one half being applied one month after transplanting time before the first irrigation and the remaining portion was applied before the second irrigation , 60 days from transplanting . the biofertilizer cerealine, which containing active bio-nitrogen fixation bacteria was obtained from Bacterilization Unit, Microbiology Dept., soils water Res. Inst. , ARC, Giza. The different rates of nitrogen were added in two equal portions at 30 and 60 days after transplanting in the form of ammonium nitrate (33.5%N).

Foliar application of microelements i.e., iron, copper, and zinc were added in the form of $FeSO_4$20 % , $CuSO_4.5H_2O$ 25.45 %, and $ZnSO_4.7H_2O$ 23 % by hand sprayer until saturation of leaves three times after 45, 60 and 75 days from transplanting applied at 200 liter/feddan.

Seeds of onion were sown in nursery on October 15th in 2021/2022 and 2022/2023. Onion transplants were transplanted at 10 cm apart on both sides of the ridge in 15th December in both seasons. All experimental units area was 10.5 m^2 (i.e., 1/400 feddan) and it contained six ridges with 3.5 m length and 50 cm in width. One row was used for the samples to measure vegetative growth and the other two rows were used for yield determination.

Phosphorus in the form of superphophate calcium (15.5% P_2O_5) at the rate of 300 kg/fad. was added before ridging, and 100 kg /feddan potassium sulphate (48% K_2O) was added in the second irrigation.

The normal agricultural practices in both experiments were carried out as commonly followed in the district.

2.1. Data Recorded

A. Plant growth measurements

A random sample of 10 plants from each experimental unit was taken at 90 and 120 days after transplanting in both seasons of study, and the following measurements were recorded:

1. Plant height (cm)
2. Number of leaves/plant.
3. Bulbing ratio = $\frac{\text{Maximum bulb diameter}}{\text{Maximum neck diameter}}$
4. Total fresh weight (g)
5. Dry weight (g): The plant without roots was oven dried at 70^{o}C till constant of the weight

B. Yield and its components

Onion plants were harvest when 50% of plant tops were down, left in the field to cure for two week , then tops and roots were removed and bulbs were weighted and the following data were recorded:

1. Marketable yield (ton /fed.): Bulbs with diameter more than3.5 cm.
2. Callus yield (ton/fed.): Bulbs was diameter less than 3.5 cm.
3. Total yield (ton/fed.) = marketable + culls yield
4. Average bulb weight = $\frac{\text{Yield of bulbs/plot}}{\text{Total number of bulbs/plot}}$

5. Nitrogen use efficiency (NUE)**:** NUE was calculated according to **Delogu *et al.* (1998)** by the following equation:

$$NUE = \frac{\text{Bulb yield at N treatment} - \text{Bulb yield at zero N}}{\text{Applied N rate at N treatment}}$$

C. Bulb Quality at Harvesting Date

At harvest time, five bulbs were randomly taken from each treatment and oven dried at 70^0C till constant weight and the chemical constituents of onion bulbs in both seasons were determined nitrogen, phosphorus and potassium according to the methods advocated by **Bremner and Mulvaney (1982), Olsen and Sommers (1982) and Jackson (1970).** Fe, Cu and Zn concentration (ppm) was determined in bulb and analyzed by the Atomic Absorption Spectrometry - Graphite Furnace (Shimadzu 6800), according to **Westerman [1990**].

1. Total soluble solids (T.S.S.%): to determine by Carl Zeis Refract meter.

2. Dry matter content in bulb: One hundred gram of fresh bulbs was oven dried at 105°C till constant weight and DM% was calculated.

D. Storability

Marketable bulbs of each plot were weighted, and placed in common burlap bags and then kept in room temperature. The total weight loss% was recorded at fifth month after harvesting. To calculate the percentage of weight loss in both seasons, the storage zero time was June 1st and the finish date was November 1st. The differences between the initial weight and successive weights gave the rate of total weight losses as described by **Abubaker *et al.* (2019**).

$$\text{Weight loss \%} = \frac{W0-W1}{W0} \times 100$$

W0= initial weight

W1= weight after fifth month

2.2. Statistical analysis:

According to **Snedecor and Cochran (1980**), the collected data were properly statistically analyzed of variance. Duncan's multiple range test (**Duncan, 1958**) was used to compare the differences between treatments; means that had the same letter were statistically insignificant, while means that had a different letter were statistically significant.

2.3. Economic analysis

Economic analysis was done to calculate net return and the beneficial cost ratio with each treatment:

1. Cost of cultivation: Cost of cultivation from each treatment was calculated in Egyptian pounds (L.E.). Data cost of inputs, rental cost, land preparation, seedling planting, irrigation, fertilizers, and weeding, harvesting, and other expenses.
2. Gross return: Onion total yield was converted into gross return (L.E.)/fed.) on the basis of local market price.
3. Net return: It was calculated by subtracting the cost of cultivation from the gross return
4. Beneficial cost ratio: It was calculated by the formula, beneficial cost ratio= gross return/ cost of cultivation.

3. Results and Discussion

3.1. Plant growth

3.1.1. Effect of nitrogen levels and cerealine biofertilzer

Data in Tables 3 and 4 show that fertilizing onion plants with nitrogen at 50 % and 75 % of recommended rate (RRN) and cerealine as biofertilzer (*Azospirillum sp*.) had significant effect on plant height, number of leaves/ plant, bulbing ratio , fresh weight and dry weight / plant at 90 and 120 days after transplanting (DAT) in both seasons. Fertilizing with 75 %RRN with cerealine gave the highest values of plant height , number of leaves/ plant, bulbing ratio , fresh weight and dry weight / plant with no significant differences with 100% RRN with respect to bulbing ratio , fresh weight and dry weight / plant at 90 DAT in both seasons . Cerealine as biofertilzer gave the lowest values of plant growth parameters at 90 and 120 DAT in both seasons.

The increase in fresh weight by treated plants with 75 %RRN+ cerealine could be attributed to its involvement as building blocks in the synthesis of amino acids, as they link together and form proteins and make up metabolic processes required for plant growth (**Abdissa *et al*., 2011**). The stimulative effect of N at 75 %RR+ cerealine on total dry weight/plant may be due to that the same treatment increased number of leaves/ plant, bulbing ratio and total fresh weight (Tables 3 and 4).

The increases in total dry weight/ plant due to fertilizing with75 %RRN + cerealine at 120 DAT were about 6.66 and 6.13 % over fertilizing with 100 % RRN and were about 21.14 and 17.92% over fertilizing with cerealine only in the 1st and 2nd seasons, respectively.

The availability of more nutrients, which support the onion plant's maximum vegetative development, and the influence of nitrogen (N) contributing to the faster rates of vegetative growth and stem elongation may be the cause of the growth increase that occurs when nitrogen levels reach to a specific optimal level (**Amare *et al*., 2020**).

These results agreed with those found by **Manna *et al.* (2014)**, **Mohamed *et al*. (2018)**, **El-Shaikh *et al*. (2021)**, **Gupta *et al*., 2023 and Singh *et al*., 2023** indicated that fertilizing onion plants with N at 75 %RR plus bio nitrogen fertilizer such as Azospirillum, nitrobein or biogein scored the maximum values of all plant growth parameters as compared to fertilizing with 100 % RR of nitrogen.

Table (3). Effect of nitrogen levels + Cerealine biofertilizer on vegetative growth of onion during 2021/2022 and 2022/2023 seasons

Treatments	Plant height (cm)		Number of leaves / plant		Bulbing ratio	
	Days after transplanting					
	90	120	90	120	90	120
	2021/2022 season					
Cerealine only	53.86 d	59.60 c	6.91 c	7.20 c	1.74 c	1.89 d
50 %RRN + Cerealine	61.33 b	67.80 b	7.06 bc	7.36 bc	1.79 b	2.09 c
75 %RRN + Cerealine	66.46 a	73.06 a	8.26 a	8.31 a	1.88 a	2.97 a
100%RRN only	57.80 c	66.13 b	7.50 b	7.80 b	1.86 a	2.87 b
LSD at 0.05 level	**1.32**	**3.01**	**0.46**	**0.48**	**0.02**	**0.09**
	2022/2023 season					
Cerealine only	52.93 d	58.86 c	6.73 c	6.95 c	1.72 c	1.87 d
50 %RRN + Cerealine	60.26 b	65.66 b	6.90 b	7.24 bc	1.77 b	2.07 c
75 %RRN + Cerealine	65.26 a	71.86 a	7.77 a	8.11 a	1.86 a	2.99 a
100%RRN only	56.46 c	64.53 b	6.89 b	7.64 b	1.85 a	2.84 b
LSD at 0.05 level	**1.40**	**3.82**	**0.09**	**0.44**	**0.03**	**0.11**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

Table (4). Effect of nitrogen levels + Cerealine biofertilzer on fresh and dry weight / plant of onion during 2021/2022 and 2022/2023 seasons

Treatments	Fresh weight / plant (g)		Dry weight / plant (g)	
	Days after transplanting			
	90	120	90	120
	2021/2022 season			
Cerealine only	58.33 c	150.73 d	11.25 c	17.97 c
50 %RRN + Cerealine	61.40 b	166.47 c	11.90 b	20.41 b
75 %RRN + Cerealine	69.20 a	192.13 a	12.73 a	21.77 a
100%RRN only	68.06 a	180.87 b	13.05 a	20.41 b
LSD at 0.05 level	**2.43**	**2.99**	**0.57**	**0.61**
	2022/2023 season			
Cerealine only	58.13 b	152.27 d	11.04 c	17.91 c
50 %RRN + Cerealine	60.33 b	168.33 c	11.59 b	19.79 b
75 %RRN + Cerealine	68.53 a	199.20 a	12.20 a	21.12 a
100%RRN only	66.40 a	193.93 b	12.38 a	19.90 b
LSD at 0.05 level	**2.53**	**2.90**	**0.47**	**0.54**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.1.2 Effect of some microelements

Foliar spray with some microelements as Fe, Cu and Zn increased plant growth of onion compared to control (without microelements) at 90 and 120 DAT in both seasons. and foliar spray with Fe+Cu+Zn at 50 ppm of each increased plant height, number of leaves/ plant, bulbing ratio , fresh weight and dry weight / plant (Tables 5 and 6).

Table (5). Effect of foliar spray with some microelements on vegetative growth of onion during 2021/2022 and 2022/2023 seasons

Treatments	Plant height (cm)		Number of leaves / plant		Bulbing ratio	
	Days after transplanting					
	90	120	90	120	90	120
	2021/2022 season					
Fe at 50 ppm	59.41 c	66.50 b	7.33 c	7.43 c	1.77 c	2.25 d
Cu at 50 ppm	61.33 b	70.83 a	8.22 a	8.40 a	1.86 b	2.67 b
Zn at 50 ppm	61.66 b	69.50 a	7.52 bc	7.91 b	1.84 b	2.51 c
Fe+Cu+Zn at 50 ppm of each	65.66 a	70.33 a	7.97 ab	8.08 ab	1.94 a	2.90 a
Control (without)	51.25 d	56.08 c	6.14 d	6.51 d	1.67 d	1.95 e
LSD at 0.05 level	**1.67**	**2.88**	**0.45**	**0.44**	**0.02**	**0.11**
	2022/2023 season					
Fe at 50 ppm	58.33 c	65.08 b	6.93 c	7.24 c	1.75 c	2.23 c
Cu at 50 ppm	60.25 b	68.41 ab	7.57 a	8.19 a	1.85 b	2.63 b
Zn at 50 ppm	61.00 b	68.16 ab	7.29 b	7.70 b	1.82 b	2.54 b
Fe+Cu+Zn at 50 ppm of each	64.66 a	69.25 a	7.56 a	7.97 ab	1.93 a	2.89 a
Control (without)	49.41 d	55.25 c	6.00 d	6.33 d	1.66 d	1.93 d
LSD at 0.05 level	**1.63**	**3.35**	**0.08**	**0.43**	**0.02**	**0.15**

The increases in total dry weight / plant at 120 DAT due to spraying with the mixture of Fe+Cu+Zn at 50 ppm of each were about 22.24 and 19.50 % over control treatment (spraying with water in the 1st and 2nd seasons, respectively.

Micronutrients like iron and copper are necessary for plants and are found in trace amounts in plant tissue (parts per million), yet they play a role in a wide range of cellular and metabolic activities. Additionally, they are crucial for increasing the dry weight of onions (**Hansch and Mendel, 2009**).

These results are in coincide with those obtained by **Ballabh *et al*. (2013), Rizk *et al*. (2014)**, **Shukla *et al*. (2015)**, **El-Hadidi *et al.* (2016), Goyal *et al.* (2017)** , **Ahmed *et al*. (2019) and Feteh (2020)**. They indicated that spraying onion plants with different micronutrients such as Fe, Cu, or Zn singly or in combinations gave the best results for increasing plant growth parameters as compared to unsprayed plants.

Table (6). Effect of foliar spray with some microelements on fresh and dry weight / plant of onion during 2021/2022 and 2022/2023 seasons

Treatments	fresh weight / plant (g)		dry weight / plant (g)	
	Days after transplanting			
	90	120	90	120
	2021/2022 season			
Fe at 50 ppm	60.91 c	158.00 d	11.65 c	20.70 ab
Cu at 50 ppm	65.16 b	163.33 c	12.64 b	20.50 b
Zn at 50 ppm	60.58 c	184.00 b	12.04 c	20.24 b
Fe+Cu+Zn at 50 ppm of each	79.33 a	199.50 a	14.25 a	21.60 a
Control (without)	55.25 d	157.91 d	10.56 d	17.67 c
LSD at 0.05 level	**1.57**	**2.78**	**0.41**	**0.92**
	2022/2023 season			
Fe at 50 ppm	60.50 c	175.75 c	11.26 c	20.08 b
Cu at 50 ppm	64.50 b	180.50 b	12.21 b	19.89 b
Zn at 50 ppm	59.58 c	178.42 bc	11.82 b	19.61 b
Fe+Cu+Zn at 50 ppm of each	77.75a	196.67 a	13.66 a	21.14 a
Control (without)	54.41 d	160.83 d	10.07 d	17.69 c
LSD at 0.05 level	**2.68**	**4.36**	**0.44**	**0.75**

3.1.3. Effect of the interaction

The obtained results in Tables 7 and 8 indicate that the interaction between 75 %RRN equal 67.5 kg /fed. nitrogen with cerealine and foliar spray with the mixture of Fe+Cu+Zn at 50 ppm of each significantly increased plant growth of onion with no significant effect with 100 %RRN only (90 kg N/fed.) and Fe+Cu+Zn at 50 ppm of each with respect fresh weight / plant at 90 and 120 DAT and dry weight at 90 DAT in both seasons. The interaction between 75 %RRN with cerealine as biofertilzer and foliar spray with mixture micronutrients (Fe+Cu+Zn at 50 ppm of each) was the best treatments for

enhancing plant height, number of leaves / plant , bulbing ratio, fresh weight / plant and dry weight / plant at 90 and 120DAT in both seasons.

The increases in total dry weight/plant at 120 DAT due to the interaction between 75 %RRN + cerealine and spraying with the mixture of Fe+Cu+Zn at 50 ppm of each were about 25.25 and 23.65 % over 100 %RRN only in the 1st and 2nd seasons, respectively.

Similar results were in coincidence with those stated by **El-Hadidi (2016)**. Who showed that fertilizing onion plants with nitrogen at 150 kg /fed. and spraying with copper at 50 ppm gave the maximum results for plant height , neck and bulb diameter, fresh and dry weight .

3.2. Yield and its components

3.2.1 Effect of nitrogen levels and cerealine biofertilizer

Data in Table 9 indicate that 75 % RRN with cerealine gave the highest values of average bulb weight (131.30 and 129.66 g) and marketable yield (18.351 and 18.158 ton/fed.), whereas 100% RRN only gave the values of culls yield (2.128 and 2.032 ton/fed.) in both seasons. As for total yield, fertilizing with 75 %RRN and cerealine as biofertilizer (20.380 and 20.190 ton/fed.) and 100 % RRN only (19.980 and 19.579 ton/fed.) increased total yield without significant differences between them in the both seasons.

This means that fertilizing with 75 %RRN and cerealine as biofertilzer treatment was the best treatment for enhancing bulb weight, marketable and total yield. On the other hand, treated onion plants with cerealine only appeared the lowest values of all yield and its components in both seasons.

Respecting nitrogen use efficiency (NUE) data in Table 9 show that fertilizing with 50 %RRN and cerealine as biofertilzer significantly increased NUE (147.12 and 148.68 kg bulb /kg N), followed by 100%RRN only (122.19 and 123.60 kg bulbs/kg N) in both seasons.

The increase in onion yield may be due to the use of biofertilizer such as cerealine and its direct role in fixing nitrogen, producing substances such as plant hormones, which help in increasing the availability of minerals and their forms in the composted material and increase the levels of ex-tractable N or Fe, Zn, Mn **(El-Kramany *et al.*, 2000).**

These results are in harmony with those mentioned by **Imani and Arshad 2019, Novello *et al*., 2021, Tilahun *et al*., 2021, Geisseler *et al*., 2022, Ashenafi and Tenaye 2023, Arunachalam *et al*., 2024, Attaya *et al*., 2024 and Hanna *et al*., 2024.** They reported that the mixtures between 75 %N RR + biofertilizer produced the highest bulb weight and total yield of onion.

Table (7). Effect of the interaction between nitrogen levels + Cerealine biofertilizer and foliar spray with some microelements on vegetative growth of onion during 2021/2022 and 2022/2023 seasons

Treatments		Plant height (cm)		Number of leaves / plant		Bulbing ratio	
		Days after transplanting					
N +Bio	Microelements	90	120	90	120	90	120
		2021/2022 season					
Cerealine only	Fe	53.66 g	60.00 hi	6.33 fgh	6.62 gh	1.69 i	1.88 kl
	Cu	55.33 fg	59.00 hij	7.66 cde	8.07 b-e	1.78 gh	1.96 ijk
	Zn	57.33 ef	64.00 fgh	6.77 efg	7.19 efg	1.74 h	1.88 kl
	Fe+Cu+Zn	56.66 efg	62.66 ghi	8.11 bcd	8.03 b-e	1.88 cde	2.04 h-k
	Control	46.33 i	52.33 k	5.66 h	6.12 h	1.59 j	1.70 l
50 %RRN + Cerealine	Fe	59.66 de	68.00 efg	7.11 ef	7.22 efg	1.77 gh	1.90 jkl
	Cu	63.33 c	70.00 cde	8.11 bcd	8.24 bcd	1.84 def	2.17 ghi
	Zn	63.66 c	67.66 efg	7.11 ef	7.68 def	1.82 fg	2.12 hij
	Fe+Cu+Zn	70.00 b	75.33 bc	6.99 ef	7.22 efg	1.92 bc	2.40 fg
	Control	50.00 h	58.00 ijk	6.00 gh	6.47 gh	1.62 j	1.86 kl
75 %RRN + Cerealine	Fe	63.66 c	69.66 c-f	8.22 bcd	8.10 b-e	1.83 efg	2.75 e
	Cu	72.00 ab	79.00 ab	8.66 ab	8.73 abc	1.92 bc	3.24 bc
	Zn	69.00 b	74.00 bcd	8.77 ab	8.92 ab	1.90 bcd	2.99 d
	Fe+Cu+Zn	73.66 a	82.33 a	9.22 a	9.20 a	2.03 a	3.87 a
	Control	54.00 g	60.33 hi	6.45 fgh	6.60 gh	1.73 hi	2.03 h-k
100 %RRN only	Fe	60.66 cd	68.33 d-g	7.66 cde	7.80 cde	1.82 fg	2.46 f
	Cu	54.66 fg	75.33 bc	8.44 abc	8.56 a-d	1.91 bc	3.33 b
	Zn	56.66 efg	72.33 cde	7.44 de	7.88 cde	1.89 cd	3.04 cd
	Fe+Cu+Zn	62.33 cd	61.00 hi	7.55 cde	7.89 cde	1.95 b	3.29 b
	Control	54.66 fg	53.667 jk	6.44 fgh	6.88 fgh	1.76 h	2.23 gh
LSD at 0.05 level		3.34	5.76	0.91	0.89	0.05	0.22
		2022/2023 season					
Cerealine only	Fe	52.66 ij	58.66 j-m	6.05 ij	6.44 hi	1.65 h	1.85 fg
	Cu	54.00 hij	57.33 klm	7.22 e	7.74 b-f	1.78 efg	1.94 efg
	Zn	57.00 fgh	63.00g-k	6.72 h	6.86 gh	1.73 g	1.86 fg
	Fe+Cu+Zn	55.66ghi	61.33 g-k	7.83 cd	7.93 b-e	1.86 bcd	2.01 ef
	Control	45.33 l	54.00 lm	5.85 k	5.81 i	1.58 i	1.68 g
50 %RRN + Cerealine	Fe	58.66 efg	66.33 e-h	6.78 gh	6.94 fgh	1.76 fg	1.89 efg
	Cu	62.00 cd	64.66 f-j	7.97 c	8.10 bcd	1.83 cde	2.11 ef
	Zn	62.66 c	66.00e-i	6.97 f	7.55 d-g	1.80 def	2.07 ef
	Fe+Cu+Zn	69.00 b	75.00 abc	6.73 h	7.18 e-h	1.88 bc	2.45 cd
	Control	49.00 k	56.33klm	6.05 ij	6.47 hi	1.59 hi	1.84 fg
75 %RRN + Cerealine	Fe	62.66 c	68.33 c-g	7.67 d	7.97 b-e	1.81 def	2.71 c
	Cu	71.00 ab	78.00 ab	8.19 b	8.50 abc	1.88 bc	3.19 b
	Zn	68.33 b	73.00 b-e	8.47 a	8.61 ab	1.89 bc	3.19 b
	Fe+Cu+Zn	72.66 a	81.00 a	8.62 a	9.03 a	2.02 a	3.85 a
	Control	51.66 jk	59.00 i-l	5.90 jk	6.43 hi	1.72 g	2.01 ef
100 %RRN only	Fe	59.33 def	67.00 d-g	7.23 e	7.63 c-g	1.79 ef	2.45 cd
	Cu	54.00 hij	73.66 bcd	6.92 fg	8.43 a-d	1.90 b	3.30 b
	Zn	56.00 gh	70.66 c-f	7.00 f	7.80 b-f	1.88 bc	3.02 b
	Fe+Cu+Zn	61.33 cde	59.66 h-l	7.07 ef	7.73 b-g	1.96 a	3.28 b
	Control	51.66 jk	51.66 m	6.23 i	6.61 hi	1.75 fg	2.18 de
LSD at 0.05 level		**3.26**	**6.71**	**0.17**	**0.87**	**0.05**	**0.30**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

Table (8). Effect of the interaction between nitrogen levels + Cerealine biofertilizer and foliar spray with some microelements on fresh and dry weight / plant of onion during 2021/2022 and 2022/2023 seasons

Treatments		Fresh weight / plant (g)		Dry weight / plant (g)	
		Days after transplanting			
N +Bio	Microelements	90	120	90	120
		2021/2022 season			
Cerealine only	Fe	56.00 hi	130.00 k	11.30 g-i	17.79 hij
	Cu	58.66 fgh	134.33 k	11.46 f-i	18.46 f-i
	Zn	57.33 gh	175.00 efg	11.03 hij	18.06 ghi
	Fe+Cu+Zn	70.66 bc	172.00 fg	13.50 cd	19.55 e-h
	Control	49.00 j	142.33 j	8.96 k	16.00 j
50 %RRN + cerealine	Fe	57.00 h	152.33 i	10.33 j	20.89 b-e
	Cu	62.00 def	153.00 i	12.03 efg	21.27 b-e
	Zn	60.33 efg	194.33 c	11.80 e-i	20.93 b-e
	Fe+Cu+Zn	74.33 b	181.00 d	14.00 bc	21.68 bc
	Control	53.33 i	151.67 i	11.33 ghi	17.29 ij
75 %RRN +cerealine	Fe	65.66 d	170.00 g	12.36 ef	22.40 ab
	Cu	70.33 c	176.33 def	13.37 cd	22.16 ab
	Zn	63.00 de	212.33 b	11.96 e-h	22.13 ab
	Fe+Cu+Zn	87.33 a	224.67 a	14.96 a	23.79 a
	Control	59.66 fgh	177.33 def	11.00 ij	18.39 f-i
100 %RRN only	Fe	65.00 d	179.67 de	12.63 de	21.73 bc
	Cu	69.66 c	189.67 c	13.72 c	20.10 c-f
	Zn	61.66 ef	154.33 i	13.40 cd	19.83 d-g
	Fe+Cu+Zn	85.00 a	220.33 a	14.56 ab	21.40 bcd
	Control	59.00 fgh	160.33 h	10.94 ij	19.00 f-i
LSD at 0.05 level		3.14	5.57	0.82	1.84
		2022/2023 season			
Cerealine only	Fe	58.33 f-i	148.00 i	11.10 cdef	17.63 ij
	Cu	58.33 f-i	151.33 i	11.13 cdef	18.21 g-j
	Zn	56.33 g-j	153.00 i	10.88 def	17.13 j
	Fe+Cu+Zn	69.33 bc	170.00 h	13.40 ab	19.27 e-h
	Control	48.33 k	139.00 j	8.70 h	17.33 ij
50 %RRN +Cerealine	Fe	55.66 ij	170.00 h	10.26 fg	19.76 def
	Cu	61.33 e-h	169.33 h	11.55 cde	20.10 cde
	Zn	60.33 e-i	172.33 gh	11.65 cde	20.56 b-e
	Fe+Cu+Zn	72.66 b	180.67 fg	13.56 ab	21.58 abc
	Control	51.66 jk	149.33 i	10.96 def	16.93 j
75 %RRN +Cerealine	Fe	64.33 cde	196.67 cd	11.80 cd	21.86 ab
	Cu	69.66 bc	206.33 b	12.93 b	21.63 ab
	Zn	61.33 e-h	198.33 bc	11.80 cd	21.21 bc
	Fe+Cu+Zn	85.66 a	215.67 a	13.66 ab	23.00 a
	Control	61.66 efg	179.00 g	10.80 ef	17.90 hij
100 %RRN only	Fe	63.66 def	188.33 ef	11.90 c	21.07 bcd
	Cu	68.66 bcd	195.00 cde	13.23 ab	19.63 d-g
	Zn	60.33 e-i	190.00 de	12.96 b	19.52 efg
	Fe+Cu+Zn	83.33 a	220.33 a	14.00 a	20.70 b-e
	Control	56.00 hij	176.00 gh	9.82 g	18.60 f-i
LSD at 0.05 level		5.37	8.72	0.88	1.50

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

Table (9). Effect of nitrogen levels + cerealine biofertilizer on yield and its components and nitrogen use efficiency (kg bulb / kg N) of onion during 2021/2022 and 2022/2023 seasons

Treatments	Average bulb weight (g)	Culls yield (ton/fed.)	Marketable yield (ton /fed.)	Total yield (ton/fed.	Nitrogen use efficiency
	2021/2022 season				
Cerealine only	83.20 d	2.003 b	9.728 d	11.732 c	0.000 d
50 %RRN + Cerealine	108.95 c	2.022 b	16.330 c	18.352 b	147.12 a
75 %RRN + Cerealine	131.30 a	2.028 b	18.351 a	20.380 a	96.09 c
100%RRN only	126.27 b	2.128 a	17.852 b	19.980 a	122.19 b
LSD at 0.05 level	**2.12**	**0.087**	**0.481**	**0.553**	**3.99**
	2022/2023 season				
Cerealine only	81.21 d	1.777 c	9.458 d	11.236 c	0.000 d
50 %RRN + Cerealine	100.44 c	1.951 b	15.908 c	17.926 b	148.68 a
75 %RRN + Cerealine	129.66 a	1.931 b	18.158 a	20.190 a	99.48 c
100%RRN only	124.62 b	2.032 a	17.546 b	19.579 a	123.60 b
LSD at 0.05 level	**2.46**	**0.059**	**0.575**	**0.772**	**3.39**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.2.2 Effect of some microelements

The obtained results in Table 10 indicate that spraying with Fe, Cu and Zn at 50 ppm of each increased average bulb weight, marketable yield and total yield as well as NUE compared to control treatment (spraying with water), however spraying with the mixture of Fe+Cu+Zn at 50 ppm of each produced the highest values of average bulb weight (118.76 and 117.36 g), marketable yield (17.138 and 16.950 ton/fed.), total yield (19.034 and 18.744 ton/fed.) and NUE (138.71 and 137.75 kg bulbs/kg N) in the each of both seasons. Spraying with Fe at 50 ppm produced the highest values of culls yield (2.323 and 2.138 ton/fed.). On the other sides control treatment appeared the lowest values of average bulb weight (106.04 and 104.69g), marketable yield (14.169 and 13.969 ton/fed.), and total yield (16.193 and 16.065 ton/fed.) in both seasons.

The increases in total yield /fed. due to spraying onion plants with the mixture of Fe+Cu+ Zn at 50 ppm of each were about 9.72 and 11.06 %, 5.79 and 7.18%, 8.84 and 9.76% and 17.60 and 16.67% over spraying with Fe, Cu and Zn individually and control treatment in the 1st and 2nd seasons, respectively.

Although micronutrients like iron, copper, and zinc are present in plant tissue in parts per million and are needed in small amounts by plants, they are essential for a wide range of cellular and metabolic processes. Additionally, they are crucial for increasing onion output (**Hansch and Mendel, 2009**).

These results are in coincides with those of **Ballabh *et al.* (2013), Rizk, *et al.* (2014), Shukla, *et al*. (2015), Manna and Maity (2016)** and **Ahmed *et al*. (2019)**. They indicated that the maximum yield and its components were recorded with the onion plants which sprayed with different microelements than unsprayed plants.

Table (10). Effect of foliar spray with some microelements on yield and its components and nitrogen use efficiency (kg bulb / kg N) of onion during 2021/2022 and 2022/2023 seasons

Treatments	Average bulb weight (g)	Culls yield (ton/fed.)	Marketable yield (ton /fed.)	Total yield (ton/fed.)	Nitrogen use efficiency
	2021/2022 season				
Fe at 50 ppm	112.58 bc	2.323 a	15.023 c	17.347 c	117.38 c
Cu at 50 ppm	113.35 b	1.917 c	16.075 b	17.992 b	132.94 b
Zn at 50 ppm	111.43 c	2.068 b	15.420 c	17.488 c	112.12 d
Fe+Cu+Zn at 50 ppm of each	118.76 a	1.895 c	17.138 a	19.034 a	138.71 a
Control (without)	106.04 d	2.023 b	14.169 d	16.193 d	107.87 d
LSD at 0.05 level	**1.44**	**0.081**	**0.401**	**0.443**	**3.71**
	2022/2023 season				
Fe at 50 ppm	110.01 b	2.138 a	14.697 d	16.877 c	128.57 b
Cu at 50 ppm	110.96 b	1.816 c	15.584 b	17.401 b	127.43 b
Zn at 50 ppm	101.89 d	1.938 b	15.138 c	17.077 bc	116.51 c
Fe+Cu+Zn at 50 ppm of each	117.36 a	1.794 c	16.950 a	18.744 a	137.75 a
Control (without)	104.69 c	1.928 b	13.969 e	16.065 d	109.34 d
LSD at 0.05 level	**1.99**	**0.55**	**0.405**	**0.438**	**3.16**

3.2.3 Effect of the interaction

The interaction between 75%RRN with cerealine as biofertilzer and spraying with the mixture of Fe+Cu+Zn at 50 ppm of each significantly increased average bulb weight, marketable yield and total yield with no significant differences with 100 % RRN only and Fe+Cu+Zn at 50 ppm of each with respect to marketable yield and total yield /fed. in both seasons (Table11) as for culls yield , the interaction between cerealine and spraying with water (control treatment) gave the highest values of culls yield (2.646 and 2.516 ton/fed.) in both seasons.

Fertilizing onion plants with 75 %RRN (67.5 kg N/fed) with cerealine as biofertilzer and spraying with Fe+Cu+Zn at 50 ppm of each gave marketable yield and total yield equal to 100%RRN only (90 kg N/fed) and Fe+Cu+Zn at 50 ppm of each. This means that 75 %RRN plus cerealine and spraying with mixture of Fe+Cu+Zn at 50 ppm of each was the best treatment for enhancing average bulb weight (138.91 and 137.50 g), marketable yield (20.087 and 19.925 ton/fed.) and total yield (21.808 and 21.508 ton/fed.) in both seasons.

The increases in total yield/fed. due to the interaction between 75 %RRN + cerealine and spraying with the mixture of Fe+Cu+Zn at 50 ppm of each were about 21.31 and 22.76 % over 100 %RRN only in the 1st and 2nd seasons, respectively.

As for NUE, the interaction between 50 %RRN + cerealine and spraying with the mixture of Fe+Cu+Zn at 50 ppm gave the highest values of NUE (165.20 and 163.56 kg bulbs/kg N) in both seasons (each 1kg N produced 165.20 and 163.56 kg bulbs).

This results were in harmony with **Fouda (2016**) who indicated that using 50% NPK as soil addition and foliar application of (Fe + Zn + Cu) produced the highest values of total yield in onion.

Table (11). Effect of the interaction between nitrogen levels + Cerealine biofertilizer and foliar spray with some microelements on yield and its components and nitrogen use efficiency (kg bulb / kg N) of onion during 2021/2022 and 2022/2023 seasons

Treatments		Average bulb weight (g)	Culls yield (ton/fed.)	Marketable yield (ton /fed.)	Total yield (ton/fed.	Nitrogen use efficiency
N +Bio	Micro elements					
		2021/2022 season				
Cerealine only	Fe	83.07 lm	2.693 a	8.920 l	11.613 gh	0.000 j
	Cu	85.00 kl	1.437 i	10.140 k	11.577 gh	0.000 j
	Zn	81.93 m	1.920 g	10.173 k	12.093 g	0.000 j
	Fe+Cu+Zn	87.18 k	1.323 i	11.027 j	12.350 g	0.000 j
	Control	78.84 n	2.646 a	8.380 l	11.026 h	0.000 j
50 %RRN + Cerealine	Fe	106.10 i	2.008 efg	15.647 hi	17.655 ef	134.27 c
	Cu	111.31 h	1.944 g	17.027 ef	18.970 cd	164.29 a
	Zn	108.59 hi	1.993 fg	16.193 gh	18.187 de	135.42 c
	Fe+Cu+Zn	115.98 g	2.131 def	17.653 de	19.784 bc	165.20 a
	Control	102.75 j	2.036 defg	15.130 i	17.166 f	136.44 c
75 %RRN + Cerealine	Fe	133.40 b	2.171 de	18.200 cd	20.371 b	97.310 h
	Cu	129.77 cd	2.347 bc	18.980 bc	21.327 a	108.33 fg
	Zn	131.37 bc	2.170 de	17.620 de	19.790 bc	85.520 i
	Fe+Cu+Zn	138.91 a	1.721 h	20.087 a	21.808 a	105.09 g
	Control	123.05 e	1.733 h	16.870 efg	18.604 de	84.200 i
100 %RRN only	Fe	127.74 d	2.423 b	17.327 e	19.750 bc	120.55 de
	Cu	127.33 d	1.940 g	18.155 cd	20.095 b	126.19 d
	Zn	123.82 e	2.190 cd	17.693 de	19.883 bc	115.41 ef
	Fe+Cu+Zn	132.98 bc	2.407 b	19.787 ab	22.194 a	145.84 b
	Control	119.50 f	1.680 h	16.297 fgh	17.977 ef	102.98 gh
LSD at 0.05 level		2.88	0.162	0.802	0.886	7.43
		2022/2023 season				
Cerealine only	Fe	80.70 jk	2.133 cd	8.467 j	10.600 i	0.000 i
	Cu	82.40 ij	1.306 i	9.870 i	11.177 hi	0.000 i
	Zn	80.03 jk	1.666 h	9.817 i	11.483 gh	0.000 i
	Fe+Cu+Zn	85.77 i	1.266 i	10.837 h	12.103 g	0.000 i
	Control	77.14 kl	2.516 a	8.300 j	10.817 hi	0.000 i
50 %RRN + Cerealine	Fe	102.80 h	1.966 ef	15.353 fg	17.320 f	149.33 b
	Cu	107.50 g	1.846 g	15.967 ef	17.813 ef	147.47 b
	Zn	75.20 l	1.950 efg	15.973 ef	17.923 ef	143.11 bc
	Fe+Cu+Zn	115.57	2.030 de	17.433 cd	19.46 cd	163.56 a
	Control	101.13 h	1.966 ef	14.813 g	17.113 f	139.91 c
75 %RRN + Cerealine	Fe	130.83 b	2.100 d	18.063 bc	20.332 bc	108.13 f
	Cu	128.17 bc	2.246 bc	18.570 b	20.817 ab	107.11 f
	Zn	129.91 bc	2.083 d	17.400 cd	19.483 cd	88.890 h
	Fe+Cu+Zn	137.50 a	1.583 h	19.925 a	21.508 a	104.50 fg
	Control	121.88 de	1.643 h	16.833 de	18.810 de	88.810 h
100 %RRN only	Fe	125.70 cd	2.353 b	16.903 d	19.257 cd	128.25 d
	Cu	125.77 cd	1.866 fg	17.930 bc	19.797 bcd	127.70 d
	Zn	122.43 de	2.053 de	17.363 cd	19.417 cd	117.54 e
	Fe+Cu+Zn	130.60 b	2.300 b	19.603 a	21.903 a	145.19 bc
	Control	118.60 ef	1.590 h	15.930 ef	17.520 f	99.300 g
LSD at 0.05 level		3.98	0.111	0.810	0.877	6.32

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.3. Macro and microelements in bulbs

3.3.1 Effect of nitrogen levels and cerealine biofertilizer

Data in Table 12 indicate that N at 75 %RR with cerealine significantly increased macro nutrients i., e., N (1.77 and 1.64%), P (0.405 and 0.363 %) , K ((2.56 and 2.29 %) and micronutrients such as Fe (19.84 and 17.56 ppm) , Cu (4.06 and 3.55 ppm) and Zn (15.11 and 13.60 ppm) in bulb at harvesting time with no significant differences with 100 %RRN only with respect to N, P and K in both seasons . And vice versa, treated onion plants with cerealine only produced the lowest values of N (1.24 and 1.21 %), P (0.365 and 0.321 %), K (2.24 and 1.96 %), Fe (17.10 and 14.99 ppm), Cu (3.18 and 2.76 ppm) and Zn (11.66 and 10.10 ppm) in the each of the each of the two seasons.

The relative increases in N, P,K, Fe, Cu and Zn contents in bulbs due to fertilizing onion plants with 75 %RRN plus cerealine were about (42.74 and 35.54%), (10.95 and 13.08%), (14.28 and 16.84%), (16.02 and 17.14 %),(27.67 and 28.62%) and (29.59 and 34.65%) over treated with cerealine only in the 1st and 2nd seasons, respectively.

These results are consistent with those of **Dikshit 2015, Novello *et al*., 2021 and Attaya *et al*., 2024** on onion **.**

Table (12). Effect of nitrogen levels + Cerealine biofertilizer on macro and microelements in bulb of onion during 2021/2022 and 2022/2023 seasons

Treatments	Macro elements (%)			Microelements (ppm)		
	N	P	K	Fe	Cu	Zn
	2021/2022 season					
Cerealine only	1.24 c	0.365 c	2.24 c	17.10 d	3.18 d	11.66 d
50 %RRN + Cerealine	1.48 b	0.391 b	2.40 b	18.36 c	3.58 c	12.93 c
75 %RRN + Cerealine	1.77 a	0.405a	2.56 a	19.84 a	4.06 a	15.11 a
100%RRN only	1.78 a	0.401a	2.54 a	19.08 b	3.89 b	14.51 b
LSD at 0.05 level	**0.06**	**0.009**	**0.08**	**0.46**	**0.11**	**0.25**
	2022/2023 season					
Cerealine only	1.21 b	0.321 c	1.96 c	14.99 d	2.76 d	10.10 d
50 %RRN + Cerealine	1.25 b	0.348 b	2.15 b	16.13 c	3.12 c	11.48 c
75 %RRN + Cerealine	1.64 a	0.363 a	2.29 a	17.56 a	3.55 a	13.60a
100%RRN only	1.64 a	0.357 a	2.27 a	16.98 b	3.41 b	13.14 b
LSD at 0.05 level	**0.03**	**0.006**	**0.05**	**0.22**	**0.04**	**0.27**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.2 Effect of some microelements

The obtained results in Table 13 indicate that foliar spray with iron , copper and zinc individually or in the mixture significantly increased macro and micro elements contents in bulbs as compared to control treatment (spraying with water) in both seasons. In addition, spraying onion plants three times after 45, 60 and 75 days of transplantation with Fe+Cu+Zn at a rate of 50 ppm each produced the highest values of N (1.68 and 1.51%), P (0.417 and 0.376%), K (2.76 and 2.49%), Fe (19.97 and 17.98 ppm), Cu (4.22 and 3.80 ppm) and Zn (15.40 and 13.86 ppm) in bulbs at harvest in both seasons. In contrast, the lowest values were observed for the content of bulbs of the three macro elements and the three micro elements that were estimated with the control treatment in both seasons.

The relative increases in N, P,K, Fe, Cu and Zn contents in bulbs due to spraying onion plants with the mixture of Fe+Cu+Zn at 50 ppm of each were about (29.23 and 7.85%), (14.56 and 23.79%),

(22.12 and 30.36%), (13.14 and 26.08 %), (28.56 and 54.47%) and (25.50 and 32.63%) over spraying control treatment in the 1st and 2ndseasons, respectively.

In this concern**, El- Sherbeny *et al*., 2024** showed that spraying onion plants with Fe, Cu and Zn individually or in the mixture produced the highest concentration of N, P K, Fe, Cu and Zn content in bulb as compared to unsprayed plants.

Table (13). Effect of foliar spray with some microelements on macro and microelements in bulb of onion during 2021/2022 and 2022/2023 seasons

Treatments	Macro elements (%)			Microelements (ppm)		
	N	P	K	Fe	Cu	Zn
	2021/2022 season					
Fe at 50 ppm	1.66 ab	0.400 b	2.47 b	19.17 b	3.58 c	13.02 c
Cu at 50 ppm	1.59 c	0.385 c	2.33 cd	18.10 c	3.74 b	12.98 c
Zn at 50 ppm	1.61 bc	0.388 c	2.35 c	18.09 cd	3.56 c	14.11 b
Fe+Cu+Zn at 50 ppm of each	1.68 a	0.417a	2.76 a	19.97 a	4.22 a	15.40a
Control (without)	1.30 d	0.364 d	2.26 d	17.65 d	3.28 d	12.27 d
LSD at 0.05 level	**0.05**	**0.009**	**0.08**	**0.43**	**0.10**	**0.23**
	2022/2023 season					
Fe at 50 ppm	1.48 b	0.360 b	2.22 b	17.26 b	3.22 c	11.71 c
Cu at 50 ppm	1.35 d	0.347 c	2.10 c	16.29 c	3.37 b	11.68 c
Zn at 50 ppm	1.45 b	0.349 c	2.12 c	16.28 c	3.21 c	12.70 b
Fe+Cu+Zn at 50 ppm of each	1.51 a	0.376a	2.49 a	17.98a	3.80 a	13.86 a
Control (without)	1.40 c	0.305 d	1.91 d	14.26 d	2.46 d	10.45 d
LSD at 0.05 level	**0.03**	**0.006**	**0.05**	**0.21**	**0.04**	**0.25**

3.3 Effect of the interaction

The interaction between 75 %RRN with cerealine and foliar spray with Fe+Cu+Zn at 50 ppm of each significantly increased macro and microelements in bulbs (N, P ,K, Fe, Cu and Zn) with no significant differences with and the interaction between 100 %RRN only and foliar spray with Fe+Cu+Zn at 50 ppm of each in both seasons (Table 14). In the other hand, treated onion plants with cerealine biofertilzer only recorded the lowest values of N, P, K, Fe, Cu and Zn contents in bulb in both seasons.

This results were in harmony with **Abd El-Samad *et al*. (2011)** indicated that the interaction between fertilizing onion plant with 90 unit of nitrogen and spraying with Fe, Cu or Zn significantly increased N,P , K, Fe, Cu and Zn concentrations in bulbs than other treatments . Also, **Fouda (2016)** who showed that using 50% NPK as soil application and the mixture of Fe + Zn + Cu as foliar application gave the highest values of N, P, K, Cu, Fe and Zn, in onion bulbs.

Table (14). Effect of the interaction between nitrogen levels + Cerealine biofertilizer and foliar spray with some microelements on macro and microelements in bulb of onion during 2021/2022 and 2022/2023 seasons

Treatments		Macro elements (%)			Microelements (ppm)		
N +Bio	**Micro elements**	**N**	**P**	**K**	**Fe**	**Cu**	**Zn**
		2021/2022 season					
Cerealine only	**Fe**	1.32 de	0.385 e-h	2.34 f-i	17.34gh	3.06 gh	11.28 j
	Cu	1.25 e	0.370 h	2.16 jk	16.82 hi	3.24 g	11.27 j
	Zn	1.28 e	0.375 gh	2.18 jk	16.80 hi	3.05 gh	11.84 i
	Fe+Cu+Zn	1.35 de	0.398 cde	2.53 de	18.42 def	3.60 ef	12.84 g
	Control	1.02 f	0.300 i	2.03 k	16.15 i	2.96 h	11.11 j
50 %RRN + Cerealine	**Fe**	1.55 b	0.393 d-g	2.43 d-h	18.85cde	3.50 f	12.27 hi
	Cu	1.49 bc	0.384 e-h	2.29 hij	17.94 fg	3.60 ef	12.20 hi
	Zn	1.51 bc	0.385 e-h	2.31 g-j	17.93 fg	3.48 f	13.35 f
	Fe+Cu+Zn	1.58 b	0.415abc	2.74 bc	19.66 bc	4.23 b	14.88cd
	Control	1.28 e	0.378 fgh	2.23 ij	17.44 gh	3.10 gh	11.97 i
75 %RRN + Cerealine	**Fe**	1.89 a	0.414abc	2.58 cd	20.79 a	3.98 cd	14.55 d
	Cu	1.82 a	0.395 def	2.45 d-h	19.15 cd	4.14 bc	14.52 d
	Zn	1.83 a	0.398 cde	2.48 def	19.13 cd	3.98 cd	16.08 b
	Fe+Cu+Zn	1.91 a	0.432a	2.92 a	21.28 a	4.60 a	17.07 a
	Control	1.41 cd	0.389 e-h	2.40 e-h	18.87cde	3.60 ef	13.37 f
100 %RRN only	**Fe**	1.88 a	0.409 bcd	2.53 de	19.72 bc	3.79 de	13.98 e
	Cu	1.81 a	0.392 d-g	2.43 d-h	18.50 def	3.99 cd	13.93 e
	Zn	1.82 a	0.394 d-g	2.46 d-g	18.50 def	3.76 e	15.20 c
	Fe+Cu+Zn	1.90 a	0.425ab	2.88 ab	20.55 ab	4.47 a	16.83 a
	Control	1.51 bc	0.389 e-h	2.40 e-h	18.17 efg	3.46 f	12.63 gh
LSD at 0.05 level		**0.11**	**0.018**	**0.016**	**0.87**	**0.20**	**0.47**
		2022/2023 season					
Cerealine only	**Fe**	1.19 gh	0.347 ef	2.11 efg	15.61 g	2.76 i	10.15 kl
	Cu	1.13 h	0.333 g	1.94 j	15.14 h	2.92 h	10.14 l
	Zn	1.15 gh	0.338 fg	1.96 ij	15.12 h	2.75 i	10.66 jk
	Fe+Cu+Zn	1.22 g	0.358 de	2.28 cd	16.58 ef	3.24 f	11.56 hi
	Control	1.40 ef	0.230 i	1.53 k	12.54 j	2.17 k	8.00 m
50 %RRN + Cerealine	**Fe**	1.34 f	0.354 e	2.19 def	16.97 de	3.15 fg	11.04 ij
	Cu	1.02 i	0.346 ef	2.06 ghi	16.15 f	3.24 f	10.98 j
	Zn	1.36 ef	0.347 ef	2.08 gh	16.14 f	3.13 g	12.02 gh
	Fe+Cu+Zn	1.42 e	0.374 bc	2.47 b	17.69 c	3.81 c	13.39 cd
	Control	1.13 h	0.320 h	1.98 hij	13.70 i	2.29 j	10.00 l
75 %RRN + Cerealine	**Fe**	1.70 abc	0.373 bc	2.32 c	18.71 b	3.58 d	13.10 de
	Cu	1.64 bc	0.356 de	2.21 de	17.24 d	3.73 c	13.07 def
	Zn	1.65 abc	0.358 de	2.23 cd	17.22 d	3.58 d	14.47 b
	Fe+Cu+Zn	1.72 a	0.389 a	2.63a	19.15a	4.14 a	15.36 a
	Control	1.53 d	0.340 fg	2.06 ghi	15.48 gh	2.74 i	12.03 gh
100 %RRN only	**Fe**	1.69 abc	0.368 cd	2.28 cd	17.75 c	3.41 e	12.58 ef
	Cu	1.63 c	0.353 e	2.19 def	16.65 e	3.59 d	12.54 fg
	Zn	1.64 bc	0.355 e	2.21 de	16.65 e	3.39 e	13.68 c
	Fe+Cu+Zn	1.71 ab	0.383 ab	2.59a	18.50 b	4.02 b	15.15 a
	Control	1.55 d	0.330gh	2.09 fg	15.35 gh	2.67 i	11.77 h
LSD at 0.05 level		**0.06**	**0.012**	**0.10**	**0.42**	**0.08**	**0.50**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.4. Bulb quality (TSS and dry matter)

3.4.1 Effect of nitrogen levels and cerealine biofertilizer

Treated onion plants with cerealine only and 50 % RRN plus cerealine recorded the highest TSS (15.03 and 14.00 %) and DM content (15.52 and 14.55 %) in bulbs at harvesting time as compared to other treatments in both seasons, while 75 %RRN produced the lowest TSS (13.54 and 12.40) and DM(13.98 and 13.02 %) in each of the two seasons (Table 15).

Similar results were almost in agreement with those obtained by **Gupta *et al*., 2023, Singh *et al*., 2023, Vojnovi´c *et al*., 2023 and Arunachalam *et al*., 2024.** They showed that TSS and dry matter content were the best when fertilized onion plant with the moderate rate of nitrogen and treated with biofertilzer.

Table (15). Effect of nitrogen levels + Cerealine biofertilizer on bulb quality of onion during 2021/2022 and 2022/2023 seasons

Treatments	TSS (%)		Dry matter (%)		Weight loss percentage at fifth month	
	2021/2022 season	2022/2023 season	2021/2022 season	2022/2023 season	2021/2022 season	2022/2023 season
Cerealine only	15.03 a	14.00 a	15.52 a	14.55 a	9.01 d	10.38 d
50 %RRN + Cerealine	14.76 ab	13.87 ab	15.42 a	14.36 ab	12.70 c	13.90 c
75 %RRN + Cerealine	13.54 c	12.40 c	13.98 c	13.02 c	15.85 b	16.70 b
100%RRN only	14.50 b	13.50 b	14.97 b	14.05 b	19.85 a	20.35a
LSD at 0.05 level	**0.32**	**0.47**	**0.33**	**0.46**	**0.72**	**0.62**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.4.2 Effect of some microelements

Foliar spray with Zn at 50 ppm significantly increased TSS% (15.06 and 13.90) and DM%(15.60 and 14.40%) in both seasons with no significant differences with the mixture of Fe+Cu+Zn at 50 ppm of each in both seasons (Table 16).

These findings are supported by those obtained by **Goyal *et al*. (2017)** and **Ahmed *et al*. (2019)**. They mentioned that spraying onion plants with Cu, B and Zn alone or in combination increased bulb quality such as TSS, dry matter in bulb than unsprayed plants.

Table (16). Effect of foliar spray with some microelements on bulb quality of onion during 2021/2022 and 2022/2023 seasons

Treatments	TSS (%)		Dry matter (%)		Weight loss percentage at fifth month	
	2021/2022 season	2022/2023 season	2021/2022 season	2022/2023 season	2021/2022 season	2022/2023 season
Fe at 50 ppm	14.53 bc	13.43 ab	14.93 b	13.98 bc	14.00 c	14.84 c
Cu at 50 ppm	14.13 c	13.25 bc	14.85 b	13.80 cd	14.68 b	15.56 b
Zn at 50 ppm	15.06 a	13.90 a	15.60 a	14.40 ab	12.78 d	14.10 d
Fe+Cu+Zn at 50 ppm of each	14.90 ab	13.87 a	15.28 ab	14.49 a	14.46 b	15.46 b
Control (without)	13.68 d	12.77 c	14.20 c	13.31 d	15.85 a	16.70 a
LSD at 0.05 level	**0.41**	**0.49**	**0.42**	**0.48**	**0.37**	**0.56**

3.4.3. Effect of the interaction

The interaction between cerealine only and Zn at 50 ppm as foliar application increased TSS (16.46 and 15.20%) and DM (16.66 and 15.46%) in bulbs in both seasons (Table 17).

Table (17). Effect of the interaction between nitrogen levels + Cerealine biofertilizer and foliar spray with some microelements on bulb quality of onion during 2021/2022 and 2022/2023 seasons

Treatments		TSS (%)		Dry matter (%)		Weight loss percentage at fifth month	
N +Bio	Micro elements	2021/2022 season	2022/2023 season	2021/2022 season	2022/2023 season	2021/2022 season	2022/2023 season
Cerealine only	Fe	15.72ab	14.20 bcd	15.73 bcd	14.73 ab	9.53 l	10.97 jk
	Cu	14.46 d-g	13.66 b-f	15.33 c-f	14.33 bc	9.33 l	10.33 kl
	Zn	16.46a	15.20 a	16.66a	15.46 a	8.20 m	9.91 kl
	Fe+Cu+Zn	15.00 b-e	14.13 b-e	15.66 b-e	14.70 ab	7.53 m	9.20 l
	Control	13.53 hij	12.80 fgh	14.20 h-k	13.53 cde	10.46 k	11.51 j
50 %RRN + Cerealine	Fe	14.93 b-e	13.73 b-f	15.26 c-g	14.26 bc	12.13 ij	12.90 i
	Cu	15.13 bcd	14.46 ab	15.93abc	14.86 ab	12.81 hi	13.83 hi
	Zn	15.46 bc	14.33 abc	16.26ab	14.73 ab	11.43 jk	13.03 i
	Fe+Cu+Zn	14.60 def	13.93 b-e	15.40 c-f	14.73 ab	13.07 h	14.63 gh
	Control	13.66 g-j	12.90 fgh	14.26 hij	13.20 de	14.07 g	15.13 fg
75 %RRN + Cerealine	Fe	12.86 jk	12.06 hi	13.86 ijk	12.73 ef	15.37 f	16.12 ef
	Cu	12.66 k	11.46 i	13.36 k	12.00 f	16.23 e	16.83 e
	Zn	14.00 f-i	12.86 fgh	14.46 ghi	13.40 cde	14.26 g	15.31 fg
	Fe+Cu+Zn	14.86 cde	13.36 c-f	14.66 f-hi	14.00 bcd	16.20 e	17.15 de
	Control	13.33 ijk	12.26 ghi	13.53 jk	13.00 e	17.20 d	18.08 d
100 %RRN only	Fe	14.60 def	13.73 b-f	14.86 e-h	14.20 bc	18.97 c	19.40 c
	Cu	14.26 e-h	13.40 c-f	14.80 fgh	14.00 bcd	20.34 b	21.27 ab
	Zn	14.33 d-h	13.20 d-g	15.00 d-h	14.00 bcd	17.22 d	18.13 d
	Fe+Cu+Zn	15.13 bcd	14.06 b-e	15.40 c-f	14.53 ab	21.06 ab	20.86 b
	Control	14.20 e-h	13.13 efg	14.80 fgh	13.53 cde	21.67 a	22.08 a
LSD at 0.05 level		**0.82**	**0.99**	**0.84**	**0.97**	**0.74**	**1.13**

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

3.5. Storability

3.5.1 Effect of nitrogen levels and cerealine biofertilzer

Weight loss percentage in bulbs (at fifth month from storage) decreased with decreasing N levels (Table 15). This means that cerealine biofertilzer recorded minimum values of weight loss percentage (9.01 and 10.38 %0 in both seasons, followed by 50%%RRN which recorded (12.70 and 13.90 %). While, fertilizing plants with 100 %RRN only produced the maximum values (19.85 and 20.35%) in both seasons. The positive correlation between weight loss percentage and bulb TSS and DM further supports our findings (Table 15).

The results obtained are consistent with those published by **Hafez and Geries (2018)** they showed that the lowest weight loss percentage of onion bulbs during storage period was obtained when onions were fertilized with 80 kg N/ fed. and treated with biofertilzer, while the highest value was obtained with N at 120 kg /fed. only.

3.5.2. Effect of some microelements

All foliar spray with microelements had significantly decreased weight loss percentage as compared to unsprayed plants in both seasons (Table 16). However, Zn at 50 ppm as foliar spray recorded the minimum values of weight loss percentage in bulb during storage (12.78 and 14.10%), agnist control treatment which recorded the maximum weight loss percentage (15.85 and 16.70%) after five month from storage in both seasons. The positive correlation between weight loss percentage and bulb quality such as TSS and DM in bulb further supports our findings (Table 16).

These findings are in harmony with those obtained by Ali, et al. (2016) and Ahmed et al. (2019) on onion. They showed that. The lowest values of weight loss percentage in bulb during storage were recorded with spraying plants with Cu, B or Zn alone or in combination than unsprayed plants.

3.5.3. Effect of the interaction

The interaction between cerealine only and Zn at 50 ppm as foliar application recorded the lowest weight loss percentage (8.20 and 9.91 %), while the interaction between 100%RRN only and spraying with water produced the highest weight loss percentage (21.67 and 22.08 %) in bulbs at fifth month from storage in both seasons (Table 17).

3.6. Economic analysis

Results presented in Table 18 show that average of cost cultivation, gross return, net return and beneficial cost ratio of four nitrogen levels+ cerealine, total onion yield as affected by foliar spray with some micro elements as the means of two growing seasons.

Table (18). Averages cost of cultivation, gross return, net return and beneficial cost ratio of the interaction between nitrogen levels + Cerealine biofertilizer and foliar spray with some microelements (average of the two seasons)

Treatments		Cost of cultivation (L.E./feddan)	Gross return (L.E.)	Net return (L.E.)	Beneficial cost ratio
N +Bio	Microelements				
Cerealine only	Fe	43100	**55530**	12430	1.28
	Cu	43100	56885	13785	1.31
	Zn	43100	58940	15840	1.36
	Fe+Cu+Zn	43300	61130	17830	1.41
	Control	43000	54605	11605	1.26
50 %RRN + Cerealine	Fe	45500	87435	41935	1.92
	Cu	45500	91955	46455	2.02
	Zn	45500	90275	44775	1.98
	Fe+Cu+Zn	45800	98110	52310	2.14
	Control	45400	85695	40295	1.88
75 %RRN + Cerealine	Fe	49100	101755	52655	2.07
	Cu	49100	105360	56260	2.14
	Zn	49100	98180	49080	1.99
	Fe+Cu+Zn	49400	113290	63890	2.29
	Control	49000	93535	44535	1.90
100 %RRN only	Fe	50300	97515	47215	1.93
	Cu	50300	99730	49430	1.98
	Zn	50300	98250	47950	1.95
	Fe+Cu+Zn	50600	110240	59640	2.17
	Control	50200	88740	38540	1.76

50%RRN=45 kg N/fed., 75%RRN =67.5 kg N/fed. and 100%RRN =90 kg N/fed.

The obtained results consistent that the values of cost cultivation, gross return, net return and beneficial cost ratio were differed owing to the differences between treatments. Cerealine+75 % N and foliar spray with mixture microelements (Fe+Cu+Zn at 50 ppm of each) gave the highest gross return (113290 L.E., net return 63890 L.E. and beneficial cost ratio 2.29. Although, this treatment received the highest cost of cultivation as compared to all other treatments. Also, it could be seen that control with any nitrogen levels+ cerealine had the lowest cost of cultivation but it gave the lowest gross return, net return and beneficial cost ratio compared to all other treatments.

From the foregoing results, it could be concluded that, fertilizing onion plants grown in clay soil with 75 %RRN (67.5 kg N/fed.)+ cerealine biofertilzer and spraying the mixture of Fe+Cu+Zn at 50 ppm of each was the best treatment for increasing plant growth, productivity and bulb nutrition, as well as beneficial cost ratio, while fertilizing with cerealine only and spraying with the same mixture of microelements improved the bulb quality and storability.

References

Abd El-Samad, E.H., R.Kh.M. Khalifa, Z.A. Lashine and Shafeek M.R. (2011). Influence of urea fertilization and foliar application of some micronutrients on growth, yield and bulb quality of onion. Aust. J. Basic Appl.Sci., 5(5): 96-103.

Abdissa, T., Tekalign E. and Pant L.M. (2011). Growth, bulb yield and quality of onion (*Allium cepa* L.) as influenced by nitrogen and phosphorus fertilization on vertisol. growth attributes, biomass production and bulb yield. African Journal of Agricultural Research, 6 (14): 3252-3258.

Aboubaker, M.S., Maduako J.N. and Ahmed M. (2019). Effects of storage duration and bulb sizes on physiological losses of Agrifound light red onion bulbs (*Allium cepa* L.). Agric. Sci., Technol., 11:90-97.

Ahmed, M. E.M.; Ragab, M.E.; Al-Araby A.A. and Mahdy R. M. (2019). Effect of nano particles of chitosan, calcium and copper on growth, yield, quality and storability of onion (*Allium cepa* L.). Fayoum J. Agric. Res. Dev., 33 1(B):511-523.

Aisha, A.H., Rizk F. A., Shaheen A.M. and Abdel-Mouty M. M. (2007). Onion plant growth, bulbs yield and its physical and chemical properties as affected by organic and natural fertilization. Res.J. Agric. and Biol. Sci., 3(5): 380-388.

Ali, H.A. O., El-Shaikh K.A.A. and Sedra Z. (2016). Effect of foliar application with trace elements, potassium fertilization and storage methods on storability of three onion (*Allium cepa* L.) cultivars. American-Eurasian J. Agric. & Environ. Sci., 16 (7): 1304-1320.

Amare G., Mohammed W. and Tana T. (2020). Effect of plant spacing and np fertilizer levels on growth, seed yield and quality of onion (*Allium cepa* L.) at Shewa Robit, Northern Ethiopia. The Open Biotechnology Journal, 14(13):12-22.

Arunachalam T., Gade K., Mahadule P.A., Soumia P.S., Govindasamy V., Gawande S.J. and Mahajan V. (2024). Optimizing plant growth, nutrient uptake, and yield of onion through the application of phosphorus solubilizing bacteria and endophytic fungi. Front. Microbiol. 15:1442912. doi: 10.3389/fmicb., 1442912.

Ashenafi M. and Tenaye S. (2023). Yield and yield components of onion as influenced by intra-row spacing and nitrogen fertilizer levels in rift valley, Ethiopia. Asian J Res. Crop Sci., 8(4): 109-124.

Attaya E., Bardisi A.A., Osman A., Ismail H. and Alwutayd K.M. (2024). Effect of nitrogen fertilization levels and plant density on dry weight, yield components and bulb quality of onion plant. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 52(1): 13294-13294.

Ballabh, K., Deepak R. and Rawat S.S (2013). Effects of foliar application of micronutrients on growth, yield and quality of onion. Indian J. Hort., 70(2):260-265.

Black, C. A., Evans D. D., Ensminger L.E., White G. L. and Clark F. E. (1981). Methods of Soil Analysis. Part 2. Pp. 1-100. Agron. Inc. Madison. WI., USA.

Bremner, J.M. and Mulvaney C.S. (1982). Total nitrogen. In: Page, A.L., R.H. Miller, and D.R. Keeney (Eds.). Methods of Soil Analysis. Part 2, Am. Soc. Agron. Madison, W.I. USA, 595- 624.

Delogu, G., Cattivelli L., Pecchioni N., De Falcis D., Maggiore T., and Stanca A.M. (1998). Uptake and agronomic efficiency of nitrogen in winter barley and winter wheat. Eur. J. Agron., 9: 11–20.

Dikshit A. (2015). Effect of combined application of different nutrient sources on growth and yield attributing characters in onion cv. N-53. Plant Archives,15: 353-355.

Duncan, D. B. (1958). Multiple Range and Multiple F-Test. Biometrics, 11: 1-5.

El-Hadidi, E. M., El-Shazly M. M. and Hegazy H. M. M. (2016). Effect of N, P and Cu fertilization on onion yield, quality and nutrients uptake. J.Soil Sci. and Agric. Eng., Mansoura Univ., 7(2): 231 – 236.

El-Kramany M.F.; Ahmed M.K.A.; Bahr A.A. and Kabesh M.O. (2000). Utilization of bio-fertilizers in field crop production. Egypt. J. Appl. Sci., 15(11): 137-155.

El-Shaikh K. A. A., El-Damarany A. M., Marey R. A. and Manar A. M. Ahmed (2021). Response of some onion varieties for mineral, bio and nano fertilizers under upper Egypt conditions. Journal of Sohag Agriscience, 6(1):20-41.

El-Sherbeny T. M. S., Hashim M. E. and Hekal M. A. (2024). Impact of spraying with some micronutrients on onion (*Allium cepa* L.) yield and nutrients uptake with application of 15N . Arab J. Nucl. Sci. Appl., 57 (2): 49-62.

FAO (2024). Statistical Database. Food and agricultural organization of the united nations. Available at http:\\www.faostat.fao.org

Feteh, A.M.A.(2020). Effect of potassium and microelements applications on yield and quality of onion. Ph. D. Thesis Fac. Agric., Zagazig University

Fouda K. F. (2016). Response of onion yield and its chemical content to npk fertilization and foliar application of some micronutrients. Egypt. J. Soil Sci. Vol. 56, No. 3, pp.549- 560.

Geisseler D., Ortiz R.S. and Diaz J. (2022). Nitrogen nutrition and fertilization of onions (*Allium cepa* L.)-A literature review. Scientia Horticul 291: 110591.

Goyal R., Uike V. and Verma H. (2017). Effect of foliar application of micronutrients on growth and yield of onion (*Allium cepa* L.) cv. Agrifound dark red. Agric. Sci. Digest., 37(2): 160-162.

Gupta P., Trivedi J., Sharma P. K. and Devi S. (2023). Effect of different bio-fertilizers and organic substances on quality parameters of rabi onion (*Allium cepa* L.). The Pharma Innovation Journal 2023; 12(4): 209-212.

Hafez E. and Geries L. (2018). Effect of nitrogen fertilization and biostimulative compounds on onion productivity. Cercetări Agronomice în Moldova, 1 (1): 75-90.

Hanna I., da Silva A. L., Dutta B. and Coolong T. (2024). Impact of Nitrogen Fertilizer Rate and Timing on Short-day Onion Production. Hort Tecnology, 34(1):13-19.

Hansch, R. and Mendel R.R. (2009). Physiological functions of mineral micronutrients (Cu, Zn, Mn, Fe,Ni, Mo, B, Cl). Current Opinion in Plant Bio., 12: 259-266.

Imani A.R. and Arshad M. (2019). Effect of nitrogen and phosphate bio-fertilizer on qualitative and quantitative characteristics of Azarshahr red onion cultivar . Journal of Horticultural Science, 33 (1): 13-28.

Jackson, M. L. (1970). Soil Chemical Analysis. Prentic Hall, Englewood Ceiffs, N. J.

Mann, L.K. (1952). Anatomy of garlic bulb and factors affecting bulb development. Hilgardia 21:195-231.

Manna D., Ghosal A., Adhikary R., Maity T. K. (2014). Influence of bio-fertilizers on growth, yield and quality of onion (*Allium cepa* L.) Cv. Sukhsagar. Environment & Ecology 32 (2A) : 728—730

Manna, D. and Maity T.K. (2016). Growth, yield and bulb quality of onion (*Allium cepa* L.) in response to foliar application of boron and zinc, J. Plant Nut., 39(3): 438-441.

Mohamed, A. G. ; El-Damarany A. M. and Marey R. A. (2018). Effect of planting dates and fertilization on yield and yield components of onion (*Allium cepa* L.) grown from sets. J. Plant Production, Mansoura Univ., 9 (12): 1031 – 1044.

Mortvedt, J. J., Cox F. R., Shuman L. M. and M. Welch R. (1991). Micronutrients in Agriculture, 2nd ed. Published by Soil Soc. Amer. Inc. Madison, Wisconsin, USA, pp. 760.

Novello, G., Cesaro P., Bona E., Massa N., Gosetti and Scarafoni F. (2021). The effects of plant growth-promoting bacteria with biostimulant features on the growth of a local onion cultivar and a commercial zucchini variety. Agronomy 11:888. doi: 10.3390/ agronomy1105088.

Olsen, S.R. and Sommers L.E. (1982). Phosphorus. In: Page. A.L., R.H. Miller, and D.R. Keeney (Eds). Methods of Soil Analysis. Part 2 Am. Soc. Agron. Madison, W.I. USA, pp. 403-430.

Rizk, F.A., Shaheen A.M., Abd El-Samad E.H. and Sawan O.M. (2012). Effect of different nitrogen plus phosphorus and sulphur fertilizer levels on growth, yield and quality of onion (*Aliium cepa* L.). J. Appl. Sci. Res., 8(7):3353-3361.

Rizk, F.A., Shaheen A.M., Abd El-Samad E.H. and El-Labban T.T. (2014). Response of onion plants to organic fertilizer and foliar spraying of some micro-nutrients under sandy soil conditions. J. Appl. Sci. Res., 10(5): 383-392.

Rizk, F.A., Shaheen A.M., Abd El-Samad E.H. and, Sawan O.M. (2012). Effect of different nitrogen plus phosphorus and sulphur fertilizer levels on growth, yield and quality of onion (*AIlium cepa* L.). J. Appl. Sci. Res., 8(7):3353-3361.

Shukla, L., Bose U.S. and Ahirwar M. K. (2015). Effect of foliar feeding of micronutrients on growth, yield and income from *rabi* onion var. agrifound light red. Ann. Plant Soil Res., 17(3): 307-310.

Singh S.,P. Singha K. and Ranjan A. R. (2023). Integrated effect of inorganic fertilizers and biofertilizers on growth and yield of onion (*Allium cepa* L) . Int. J. Environ. Clim. Change, 13 (10): 1234-1238.

Singh, M. S. and Dutta, S. (2006). Mustard and rapeseed response to azotobacter - a review. Agric. Rev., 27(3): 232-234.

Snedecor, G. W. and Cochran W. G. (1980). Statistical methods. 7th ed. Iowa State Univ. Press, Ames, Iowa, U.S.A., PP. 507.

Tariful A.K., Billal H.M., Nahida U.T., Hossain S., Islam R. and Salahin M. (2024). Growth and yield of onion (Bari Piaz4) as influenced by row spacing and organic and inorganic nitrogen with micro bio fertilizer. Adv. Biotechnol. Microbiol., 18 (2):1-10.

Tilahun M., Tena W. and Desta B. (2021). Effects of different nitrogen and sulfur fertilizer rates on growth, yield, quality and nutrient uptake of onion (*Allium cepa* L.) at Shewa Robit, North Shewa, Ethiopia. The Open Biotechnology Journal, 15: 59-67.

Vojnovi´c, Đ., Maksimovic I., Horecki T. and Banjac A. K. (2023). Onion (*Allium cepa* L.) yield and quality depending on biostimulants and nitrogen fertilization—A Chemometric Perspective. Processes, 11, 684. https://doi.org/ 10.3390/pr11030684.

Westerman, R.L. (1990). Soil Testing and Plant Analysis. Third Edition in the SSSA Book Series 3, Soil Sci. Soc. Am., Inc. Madison, Wisconsin, USA.

Yasari, E. and Patwardhan, A. M. (2007). Effects of (*Azotobacter and Azospirillum*) inoculants and chemical fertilizers on growth and productivity of canola (*Brassica napus* L.). Asian J. of Plant Sci., 6(1): 77-82.

تأثير التسميد بالسريالين والرش بالعناصر الصغرى على إنتاجية وجودة البصل

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إجريت تجربتين حقليتين خلال الموسمين الشتويين المتتاليين ٢٠٢١/٢٠٢٢ و ٢٠٢٢/٢٠٢٣ بمحطة البحوث الزراعية بالجميزة محافظة الغربية مصر ، لدراسة تأثير النيتروجين المعدني والحيوي والرش ببعض العناصر الصغرى منفردة أو فى مخلوط على نمو النبات والمحصول ومكوناته وكفاءة استخدام النيتروجين والقدره التخزينيه للبصل (صنف جيزة ٢٠).

كانت معامله التفاعل بين ٧٥% من النتيروجين الموصى به مع السريالين كسماد حيوي والرش الورقي بخليط من الحديد والنحاس والزنك بتركيز ٥٠ جزء في المليون لكل منهم أفضل المعاملات لزياده إرتفاع النبات وعدد الأوراق/نبات ونسبة التبصيل والوزن الطازج والجاف / النبات بعد ٩٠ و ١٢٠ يوما من الشتل والمحصول القابل للتسويق والمحصول الكلي / فدان، تركيز العناصر الكبرى والصغرى في الأبصال (النيتروجين والفوسفور والبوتاسيوم والحديد والنحاس والزنك) في كلا الموسمين. وفي هذا الصدد، فقد أعطت هذه المعاملة زيادات نسبية في المحصول الكلى /الفدان قدرت بحوالي ٢١,٣١ و٢٢,٧٦% عن معامله ١٠٠% من النتيروجين الموصى به فقط في الموسمين الأول والثاني على التوالي ، كما أعطت أعلى عائد إجمالي وصافي عائد ونسبة تكلفة . بينما أدى التفاعل بين المخصب الحيوى السريالين فقط والرش الورقي بالزنك بتركيز ٥٠ جزء في المليون إلى زيادة نسبة المواد الصلبة الذائبة ونسبة المادة الجافه في الأبصال والى خفض نسبة الفقد فى الوزن في الأبصال بعد خمسة أشهر من التخزين في كلا الموسمين. أما بالنسبة لكفاءة استخدام النيتروجين فقد أعطى التفاعل بين ٥٠% من الموصى به من النيتروجين (٤٥ كجم/ فدان نيتروجين) + المخصب الحيوى السريالين والرش بخليط الحديد + النحاس + الزنك بتركيز ٥٠ جزء في المليون أعلى القيم في كلا الموسمين.