

## Effectiveness of bio-fertilizers with organic matter on the growth, yield and nutrient content of Onion (*Allium cepa L.*) plants

Shaymaa I. Shedeed, S.A.A EL-Sayed and Doaa M. Abo Bash

National Research Center, Plant Nutrition, Dept.,  
Dokki, Cairo, Egypt

### ABSTRACT

The present investigation was conducted during two successive seasons (2011 and 2012) to optimize the use of cattle manures at rates of 10, 20 and 40 ton  $\text{fed}^{-1}$  with or without bio-fertilizer (nitrobeine). Obtained results proved that all the tested vegetative growth parameters (fresh and dry weight of bulb and leaves, bulb diameter and plant length) were significantly improved by increasing organic matter levels combination with bio-fertilizer (cattle manure + nitrobeine). Moreover, the highest values were obtained from the application of using organic cattle manure 20 ton  $\text{fed}^{-1}$  + nitrobeine in chlorophyll a, b, a+b and carotenoids by 0.187, 0.106, 0.293 and 0.132, respectively. Also, Nitrogen, Phosphorus, potassium and sodium uptake of bulb and leaves tissues as follows: (8.86, 1.56, 7.72 and 1.44 kg  $\text{fed}^{-1}$ ) and (5.21, 0.40, 4.94 and 0.88 kg  $\text{fed}^{-1}$ ), respectively. As well as, protein content recorded highest significant values in Onion plants.

**Key words:** Bio-fertilizers -Nutrients content -Organic matter -Onion plant (*Allium cepa L.*).

### INTRODUCTION

Onion (*Allium cepa L.*) is one of the most important vegetable crops grown in Egypt, not only for local consumption but also for exportation. It is considered to be a high cash value crop for Egyptian farmers. This is because the international market demands of the Egyptian dry, Fresh and processed Onions. Among the constraints for low productivity in onion, imbalanced nutrition is the main limiting factor. The continuous and imbalanced use of fertilizers is adversely affecting the sustainability of agricultural production besides causing environmental pollution <sup>[1]</sup>. The main factors that limit the exportable quantities of the Egyptian whether fresh or dry Onions is the pesticides and mineral fertilizers residuals <sup>[2]</sup>.

Mineral fertilizers play an important role of onion plant growth and productivity. Many investigators reported that the vegetative growth of onion plants and minerals uptake was increased with increasing the level of NPK- fertilizers. On the other hand, we can say that continuous usage of inorganic fertilizers affects soil structure. Hence, organic fertilizers can serve as alternative to mineral fertilizers as reported by <sup>[3]</sup> for improving soil structure.

Organic matter such as sheep and chicken manure, improves soil physical and chemical properties that are important for plant growth. Application of organic fertilizer increased the biomass yield of the main crop <sup>[4]</sup>. Bio-fertilizers i.e. nitrobeine has greater amounts of bacteria which were responsible for fixation of nitrogen by atmosphere. The inoculation with associative N-fixing bacteria led to improve of plant growth and yield <sup>[5]</sup>. Moreover, many researchers reported that using bio-fertilizers with adding mineral or organic fertilizers led to improve the vegetative growth, yield and quality of plant <sup>[6]</sup>. Mixture of chicken manure and bio-fertilizer increases the yield of Onion and enriched nutrient content in tuber was reported by <sup>[7]</sup>.

The presented study, therefore aimed to involve and adopt a suitable strategy of integrated nutrient supply by using bio-fertilizers and organic matter to study reducing the amount of chemical fertilizers application.

## MATERIAL AND METHODS

Pot experiment was conducted in natural conditions to study the performance of onion to different types of fertilizers. All the pots were filled with similar soil. The experiment was carried out on sandy soil (90.2% sand, 6.85% silt and 2.95% clay) and chemical properties of the soil were determined according to <sup>[8]</sup> as shown in (Table 1).

**Table (1) Some physical and chemical properties of soil sample experimental before sowing:**

pH (1:2.5)	EC (1:5)	Cation ( meq/L)				Anion ( meq/L)				CaCO <sub>3</sub> %	O.M %
		Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	CO <sub>3</sub> <sup>-</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>		
7.15	0.30	0.68	0.62	1.15	0.55	0.00	1.14	0.61	1.25	7.49	0.52

The experiment included nine treatments were as follows:

- Mineral fertilizer (150 unit N as ammonium sulphate, 75 unit P<sub>2</sub>O<sub>5</sub> as triple super phosphate and 48 K<sub>2</sub>O as potassium sulphate).
- Organic matter using three rates 10, 20 and 40 ton fed<sup>-1</sup> cattle manure, The characterization from of the cattle manure used was (pH 8.00, EC 3.11, N 0.4 %, P 0.64%, K 0.038 % and micronutrient content (Fe, Zn, Mn & Cu) 913, 68, 238 & 42 ppm, respectively).
- Bio-fertilizer as nitrobeine by soaking onion transplants in nitrobeine for 15 minute before transplanting, which is a commercial product contains active microorganisms that were responsible for fixation of nitrogen by atmosphere.
- Combinations of rates of organic manure (10, 20, 40 ton fed<sup>-1</sup>) and nitrobeine product (cattle manure + nitrobeine).
- In addition to the control O.M different rates of treatment (free from fertilizers).

Three replicates for each treatment and each pot with five transplants of onion. The seedlings were planted at November 2011, as five seedlings per pot (30 cm) in diameter filled with ten kg soil to evaluate the response of Onion plants to different types of fertilizers.

## Plant samples and chemical analysis:

For measuring growth parameters, three plant samples were harvested (90 days after transplanting) from each pot and the obtained data were recorded for plant length, bulb diameter and plant fresh and dry weight for leaves and bulb. The following chemical analyses were conducted chlorophyll a, b, a+b and carotenoids contents in leaves according to <sup>[9]</sup>. Total nitrogen was determined in dried leaves by Kjeldahl method, <sup>[8]</sup>. While, P was determined by spectrophotometer method and K and Na by flame emission

according to <sup>[10]</sup>. Protein percentage was estimated by multiplying nitrogen percentage by the factor 6.25 according to <sup>[11]</sup>.

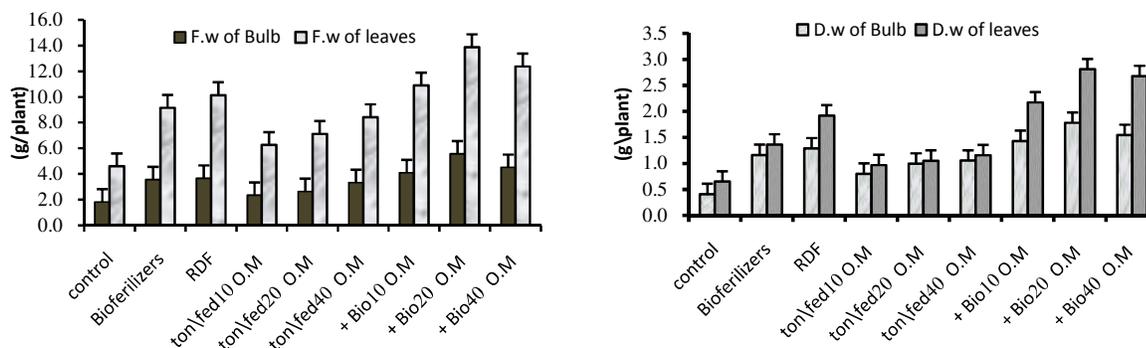
### Statistical analysis:

Statistical analysis were carried out using cost at software program (1985) and treatment means were compared at 0.05 level using the revised L.S.D test as illustrated by <sup>[12]</sup>.

## RESULTS AND DISCUSSION

### Growth characters

**Fig (1)** shows that the remarkable increased in both fresh and dry weight of bulb and leaves at vegetative growth as affected by addition of bio-fertilizer particularly as combination with cattle manure at the rate of 20 ton fed<sup>-1</sup> as compared with recommended dose fertilizer or the same of organic matter individually. This result may be due to the role of bio-fertilizers (nitrobeine) on increasing the availability of nutrients to plant absorption which in turn on increasing the vegetative growth of onion plants. <sup>[13]</sup> reported that application of nitrobeine achieved the following merits, decreasing the amount of mineral-N by 25% and increasing the availability of various nutrients by plant.



**Fig (1):** Fresh and dry weight (g plant<sup>-1</sup>) of onion plants as affected by different types of fertilizers at vegetative growth (Data mean of two seasons).

Concerning at harvest, the growth parameters were significant increased by increasing organic matter levels and using bio-fertilizer such as fresh and dry weight of bulb and leaves, Bulb diameter and plant length of onion plant that presented in Table 2. All growth parameters were significantly influenced by combination of organic cattle manure 20 ton ha<sup>-1</sup> with nitrobeine which led to the markedly increased in all growth parameters of onion plants. The maximum fresh weight of bulb and leaves 23.9 and 14.4 g plant<sup>-1</sup>, dry weight of bulb and leaves 4.59 and 2.77 g plant<sup>-1</sup>, Bulb diameter 4.17 cm and plant length 55.3 cm, respectively. Similar findings were supported by several researchers as <sup>[14]</sup>, <sup>[15]</sup>, <sup>[16]</sup> and <sup>[7]</sup> worked on Onion plants. They found the best result from organic matter with bio-fertilizer. This may be due to that organic matter activates many species of living organisms which release phytohormones and may stimulate the plant growth and the absorption of nutrients <sup>[17]</sup>. Concerning the influence of using bio-fertilizer with organic matter on the various vegetable growth

**Table 2:** Fresh and dry weight ( $\text{g plant}^{-1}$ ), bulb diameter (cm) and plant length (cm) of onion plants as affected by different types of fertilizers at harvest (Data mean of two seasons).

Treatments	Fresh weight Bulb	Dry weight Bulb	Fresh weight Leaves	Dry weight Leaves	Bulb Diameter	Plant Length
	$\text{g plant}^{-1}$				$\text{cm plant}^{-1}$	
Control no fertilizers	15.25	2.58	5.22	0.76	1.25	29.60
Bio-fertilizers	20.26	3.81	9.32	1.99	2.55	42.80
RDF	22.21	3.96	11.24	2.14	2.89	44.13
O.M 10 %	17.25	3.52	7.85	1.70	1.65	38.23
O.M 20 %	18.96	3.65	8.11	1.83	1.96	39.47
O.M 40 %	20.11	3.72	8.89	1.90	2.34	41.27
O.M 10 % + Bio	20.25	4.19	10.46	2.37	3.07	46.03
O.M 20 % + Bio	23.94	4.59	14.36	2.77	4.17	55.33
O.M 40 % + Bio	22.72	4.34	12.30	2.52	3.98	52.83
<b>LSD 0.05 %</b>	<b>0.673</b>	<b>0.052</b>	<b>0.048</b>	<b>0.031</b>	<b>0.067</b>	<b>3.05</b>

**RDF: Recommended doses of fertilizers**

parameters of Onion plants, the recorded results deified that the inoculation of Onion seedling stimulated plant length, bulb and leaves fresh and dry weight and bulb size compared with the uninoculated treatments as was found by <sup>[17]</sup>. The enhancing effect of the bio-fertilizer application with the organic matter has been attributed to several mechanisms, including biological nitrogen fixation, dissolving immobilized P and producing plant growth promoting substances <sup>[19]</sup>.

**Chemical constituents****Photosynthetic pigments**

It is clear from **Table 3** that, the combination of organic matter with bio-fertilizer increases the content of photosynthetic pigments (chlorophyll a, b, a+b and carotenoids). The highest values were obtained from the application of using organic cattle manure 20 ton  $\text{fed}^{-1}$  + nitrobiene. The increment effect of chlorophyll a, b, a+b and carotenoids by 0.187, 0.106, 0.293 and 0.132, respectively. These results are confirmed by those recorded by <sup>[20]</sup>, <sup>[21]</sup> worked on pea plants and <sup>[17]</sup> worked on onion plants. This can be attributed to the sufficient N uptake, enhanced onion plants to absorb more N and in turn to build more chlorophyll structure.

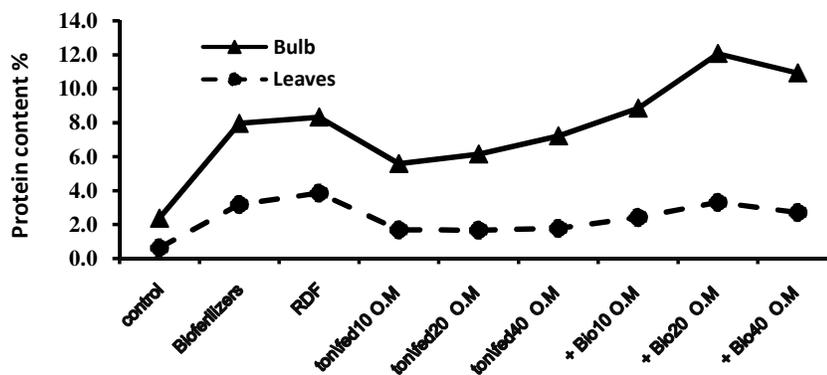
**Table 3:** Chlorophyll a, b, a+b and carotene contents as affected by different types of fertilizers at vegetative growth (Data mean of two seasons).

Treatments	Chlorophyll (a)	Chlorophyll (b)	Chlorophyll ( a + b )	Carotene
	mg/g f.w			
Control no fertilizers	0.079	0.006	0.085	0.057
Bio-fertilizers	0.139	0.031	0.170	0.101
RDF	0.160	0.038	0.198	0.106
O.M 10 %	0.092	0.015	0.107	0.068
O.M 20 %	0.109	0.024	0.133	0.080
O.M 40 %	0.134	0.026	0.160	0.092
O.M 10 % + Bio	0.161	0.040	0.201	0.117
O.M 20 % + Bio	0.187	0.106	0.293	0.132
O.M 40 % + Bio	0.173	0.090	0.263	0.126
<b>LSD 0.05 %</b>	<b>0.038</b>	<b>0.054</b>	<b>0.0014</b>	<b>0.021</b>

RDF: Recommended doses of fertilizers

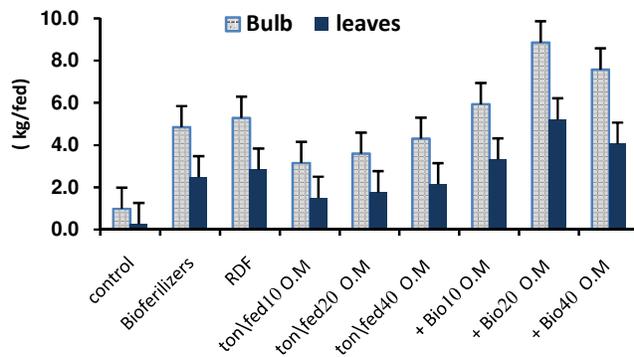
#### Protein content:

Protein content followed the same trend obtained previously in photosynthetic pigments (Fig 2) was also increased by using the combination treatments of organic matter and bio-fertilizer. Meanwhile, protein content gave the highest values for bulb and leaves (12.07 and 3.31%), respectively, by using the application of organic cattle manure 20 ton fed<sup>-1</sup> + nitrobenzene, this increment might have influenced plant growth directly through its effects on ion uptake or by the effect on growth regulators. These results were in line with those obtained by [22].

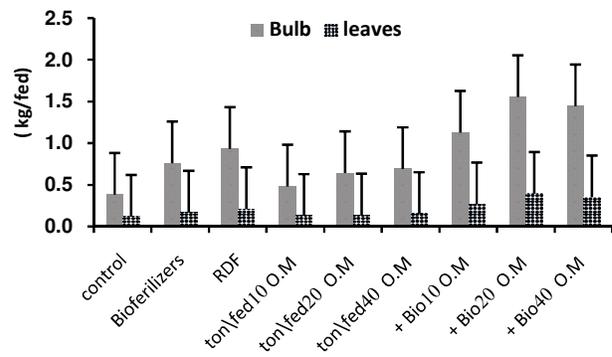
**Fig 2:** Protein content (%) as affected by different types of fertilizers at harvest (Data mean of two seasons).

#### Mineral composition:

Data of nitrogen, phosphorus, potassium and sodium uptake represented in Figures (3 and 4). The results of nitrogen and phosphorus uptake of bulbs and leaves of onion plant are presented in Fig. (3). N and P uptake recorded highest significant values in bulb and leaves tissues of onion plant (8.86, 1.56 kg fed<sup>-1</sup>) and (5.21, 0.40 kg fed<sup>-1</sup>) respectively, by using organic cattle manure 20 kg fed<sup>-1</sup> + nitrobenzene application.



**N Uptake at harvest**

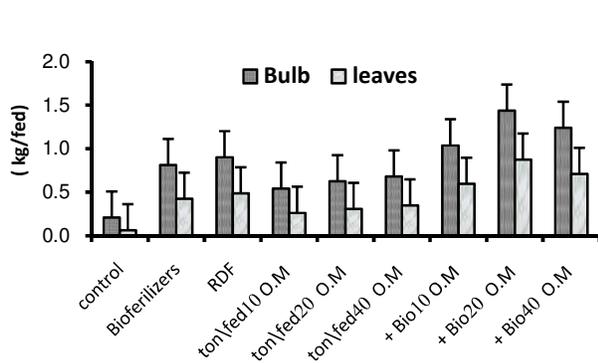


**P Uptake at harvest**

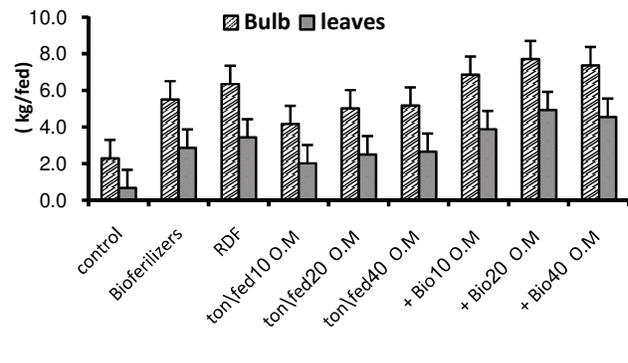
**Fig (3):** Nitrogen and phosphorus uptake ( $\text{kg fed}^{-1}$ ) of onion plants as affected by different types of fertilizers at harvest (Data mean of two seasons).

In the regard of potassium and sodium uptake, data in Fig 4 represented K and Na uptake in Onion tissues that increased by using organic cattle manure at the rate of  $20 \text{ ton fed}^{-1}$  in combination with nitrobeine application. In general, K and Na uptake recorded highest significant values in bulb and leaves tissues of onion plants ( $1.44, 7.72 \text{ kg fed}^{-1}$ ) and ( $0.88, 4.94 \text{ kg fed}^{-1}$ ) respectively.

The highest values of K and Na content were recorded with plants received  $20 \text{ ton fed}^{-1}$  organic fertilizer mixture with nitrobeine. These results may be due to the role of organic fertilizer on promotion of onion plants growth and the role of bio-fertilizer on increasing the availability of N and P to onion plant absorption. This result is in harmony with those reported by [14], [23] and [24].



**Na Uptake at harvest**



**K Uptake at harvest**

**Fig (4):** Sodium and potassium uptake ( $\text{kg fed}^{-1}$ ) of onion plants as affected by different types of fertilizers at harvest (Data mean of two seasons).

**CONCLUSION:**

Finely, from the previous mentioned results we could concluded that the rate of  $20 \text{ ton fed}^{-1}$  organic matter represented in cattle manure combination with bio-fertilizers (nitrobeine) were recommended to obtain the highest growth parameters, chemical constituent and mineral composition that will lead to the best quality in onion plant.

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