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Response of some onion varieties for mineral, bio and nano fertilizers under upper Egypt conditions

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Abstract

This study was conducted at the experimental farm of Shandaweel Research Station, Agricultural Research Center (ARC), Sohag Governorate, during the two seasons of 2016/2017 and 2017/2018 to study the response of some onion varieties different fertilization treatments (without fertilization, 100% NPK, biofertilizer + humic acid, bio fertilizer + humic acid + nano-ZnO, 75% NPK + Biofertilizer + nano-ZnO, 50% NPK + biofertilizer + nano-ZnO, 75% NPK + humic acid + nano-ZnO, 50% NPK + humic acid + nano-ZnO, mineral NPK 75% + Biofertilizer + humic acid + nano-ZnO and mineral NPK 50% + Biofertilizer + humic acid + nano-ZnO). The highest means of bulb diameter were recorded for Shandaweel 1, while the lowest means were recorded for Giza 20, in both seasons. The highest means of bulb diameter were obtained under the treatment of 75% NPK + bio fert. + humic + nano-ZnO at 90 days in the second season and at 120 days in both seasons, while the treatment of 75% NPK + humic + nano-ZnO appeared the highest values of bulb diameter at 90 days in the first season. Shandaweel 1 variety attained the highest values of plant fresh weight and plant dry weight at 90 days in both seasons, while Giza 6 Mohassan recorded the lowest values at 90 days in the 2nd season. The treatments of 75% NPK+ bio fert. + humic + nano-ZnO appeared the highest values of plant fresh weight and plant dry weight at 90 days, while the treatment of 100% NPK appeared the highest values at 120 days, in both seasons. The highest values of average bulb weight, total yield/fed and exportable yield/fed, were obtained by planting of Giza 20 variety under 75% NPK + biofert. + humic + nano-ZnO, in both seasons. The highest values of local marketable yield/fed, were obtained by planting of Giza 20 variety under 75% NPK + humic + nano-ZnO, in both seasons. The highest means of TSS% were recorded under the treatment of no fertilization in both seasons, while the lowest means were obtained under the treatments of 75% NPK + humic + nano-ZnO, in the first season and under 50% NPK + humic + nano-ZnO in the second season.

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Onion – Nano fertilizers – Upper Egypt.

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INTRODUCTION

Onion (*Allium cepa.* L) is one of the most important vegetable crops in Egypt for local markets and export as fresh or dried. The great advances in techniques and methods of production of this crop in Egypt during the last decade perhaps open enormous pathways for exportation. In Egypt, onion production was approximately 3.08 million tons produced from the harvested area of 87 948 ha, in 2019 (FAOSTAT, 2020). During the last three years, Egypt ranked fourth of the main onion exporters worldwide after the Netherlands, India and China (FAOSTAT, 2019).

Mineral fertilizers play an important role of onion plant growth and productivity. Farmers have adopted the strategy of increasing crop yields by applying large amounts of chemical fertilizers. Although mineral fertilizers play important role in increasing onion plant growth and productivity, but this increments should be considered as second priority after minimizing of possible health hazard due to chemical accumulated in plant fresh parts and fruits (El–Shaikh *et al.*, 2009). In addition, increased use of chemical fertilizers in an unbalanced manner has created problem of multiple nutrient deficiencies, diminishing soil fertility and unsustainable crop yields. At present, there are more negative effects for heavy using of chemical fertilizations, so, many attempts has been made to critically examine the use of different sources of nutrients to obtain better yields and to maintain good soil health.

It is become essential to use the untraditional fertilizers as a substitute or supplement for chemical fertilizers. In this regard, N bacterial biofertilizers play an important role in fixing the atmospheric nitrogen and producing thiamin, riboflavin, nicotin, IAA and gibberellin (Hartmann *et al.*, 1983). Also, Phosphorate solubilizing microorganisms including bacteria have provided an alternative biotechnological solution in sustainable agriculture to meet the P demands of plants (Zaidi *et al.*, 2009). Humate is an organic substance having bio-regulatory effects. Humic acid is a commercial product containing many elements which improve the soil fertility and increase the availability of nutrients and consequently increase plant growth and yield. Applications of humic acid led to a significant increase in soil organic matter which in turn improves plant growth and crop production. Currently use of nanomaterials has been expanded in every fields of science including agriculture. Application of micronutrient fertilizers in the form of NPs is an important route to release required nutrients gradually and in a controlled way, which is essential to mitigate the problems of fertilizer pollutions (Naderi and Abedi, 2012). When materials are transformed to a nanoscale, they change their physical, chemical and biological characteristics as well as catalytic properties and even more increase the chemical and biological activities (Mazaherinia *et al.,* 2010). ZnO NPs have tremendous physical, optical and antimicrobial properties, as far as their usage is concerned nanoparticles play a significant role in agriculture, where colloidal solution of ZnO NPs is used in nano fertilizers, metal nanoparticles when applied as foliar spray, enhances crop production, so it is required to commercialize metal nanoparticles for sustainable agriculture (Farooqui *et al.*, 2016). The present investigation was designed as an attempt to reduce or replace mineral fertilizers on onion via using biofertilizers, humic acid and zinc oxide nano particles for the three studied onion cultivars.

MATERIALS AND METHODS

This investigation was conducted at the experimental farm of Shandaweel Agricultural Research Station, Agricultural Research Center (ARC), during the two winter seasons of 2016/2017 and 2017/2018 to study the effect of fertilization with mineral, bio, humic and nano fertilization on yield, quality and storability of some onion varieties under Sohag conditions. The land of the experiment was left uncultivated on the preceding summer in the two successive seasons. The soil of the experiment area was clay loam in texture. The mechanical and chemical analyses for the soil of the experimental sites were presented in Table (1). The seeds in this experiment were sown in the nursery on 25 August and 3th September in the first and second seasons respectively, Nursery bed was sown with onion seeds of Shandaweel 1, Giza 6 Mohassan and Giza 20. All the normal practices of onion nursery were applied as recommended. Seedlings were transplanted in 1st November in the two seasons. The experimental plot size was 10.5 m2, it consists of six ridges, 50 cm in wide and 3.5 m in length. Seedlings were planted 7 cm apart on both sides of ridge, ridging directions was north-south (NS). Nitrogen fertilization was applied at two equal doses in the form of ammonium nitrate (33.5% N), the first dose was applied one month after transplanting and the second was added one month later. Super phosphate (15.5% P2O5) was applied during soil preparation. Potassium sulfate (50% K2O) was applied at two equal doses, the first dose was applied one month after transplanting and the second was added one month later. The recommended dose of NPK fertilization was 120 kg N + 45 kg P205 + 50 kg K2O. The amount of humic acid (2 kg/fed) were divided into two equal halves. The first part was added one month after transplanting and the other one was added one month later. Humic acid as Ultra Humi Max 80% compound (Potassium Humated 80% and Potassium10%) was injected through the irrigation water for the treated experimental plots. The bio-fertilizers, which containing active bacteria was obtained from Bacterilization Unite, Microbiology Dept, Soils and Water Res. Inst., ARC, Giza. The inocula used was Nitrobin (composed with amixture of Azotobacter chroococcum, Azospirillum barasilense) , Phosphorin (composed with Bacillus circulus) and Potassiumaj (composed with Bacillus megaterium). Seedlings of onion were dug and inoculation by soaking their roots in the specific aqueous solution of the biofertilizer for 30 minutes just before transplanting. Uninoculated seedlings (control) were soaked in tap water. The recommended dose of biofertilizers is two packets /feddan. Zinc oxide NPs (ZnO 15nm) was introduced from Nano Gate company. Foliar spraying with ZnO NPs was applied at 5 ppm in two times; the first time was applied one month after transplanting and the other was added one month later. The other normal agricultural practices of onion were applied at the recommended. The experimental design was split plot with three replicates. The main plots were devoted for three onion varieties (Shandaweel 1, Giza 6 Mohassan and Giza 20), while the sub plots were devoted for the combination between the different fertilizer treatments (without fertilization, 100% NPK, biofertilizer + humic acid, bio fertilizer + humic acid + nano-ZnO, 75% NPK + Biofertilizer + nano-ZnO, 50% NPK + biofertilizer + nano-ZnO, 75% NPK + humic acid + nano-ZnO, 50% NPK + humic acid + nano-ZnO, mineral NPK 75% + Biofertilizer + humic acid + nano-ZnO and mineral NPK 50% + Biofertilizer + humic acid + nano-ZnO).

Table (1): The mechanical and chemical analysis for the soil of the experimental sites.

Determination		Season 2016/2017	Season 2017/2018
Mechanical analysis	Textural class	Clay loam	Clay loam
Chemical analysis	pH	7.24	7.21
	EC (mmhos/cm)	1.09	0.98
	Organic matter (%)	1.09	1.15
	Available N (ppm)	16.00	16.05
	Available P (ppm)	8.22	8.35
	Available K (ppm)	246	232
Cations (meq/100g)	Ca	14.45	13.88
	Mg	6.55	6.48
	Na	3.83	3.63
	K	0.43	0.45
	HCO_3	5.40	5.58
	SO_4	10.02	9.85
	Cl	9.58	9.30
Available nutrients (ppm)	Fe	9.71	9.59
	Cu	0.42	0.39
	Zn	1.61	1.49
	Mn	0.97	0.97

Data recorded

A- Vegetative growth characteristics

A random sample of 10 plants from each experimental plot was taken at 90 and 120 days of transplanting and the following vegetative characters were recorded: Plant height (cm), number of leaves/plant and bulbing ratio (cm).

B- Bulb yield and its components

At harvest time, all plants in the experimental plot were uprooted to determine average bulb weight (g), total yield (ton/fed.), exportable yield (ton/fed) and local marketable yield (ton/fed).

C- Bulb quality

1- Double bulbs percentage (%): It was estimated by dividing number of double bulbs by the total number of bulbs x 100.

2- Bolters percentage (%): It was estimated by dividing number of bolter bulbs by the total number of bulbs x 100.

3- Total soluble solids (T.S.S): It was determined immediately after harvest by a hand refractometer in representative sample of ten bulbs according to A.O.A.C. (1975).

4- Bulb dry matter (D.M.%): It was determined by estimating the loss in sample of bulbs fresh weight after drying for four hours at 105°C and then at 70°C in a drying oven, according to the following formula:

$$D.M.\% = \frac{\text{Sample dry weight}}{\text{Sample fresh weight}} x100$$

E- Storability: Hundred single bulbs yield of each plot was placed in a common burlap bags and kept under normal storage conditions. Total weight loss% of bulb was estimated after 2, 4 and 6 months of storage according to the formula of Wills *et al.* (1982) as follow:

$$\text{Total weight loss \%} = \frac{\text{Original bulb weight} - \text{Remained bulb weight}}{\text{Original bulb weight}} X\,100$$

Statistical analysis

All data collected were subjected to analysis of variance according to Snedecor and Cochran (1967).Treatment means were compared by Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

A- Vegetative growth characters

1- Plant height (cm)

Data in Table (2) revealed that the three studied varieties were significantly differed in plant height characteristic in both seasons at 90 and 120 days from planting. Giza 20 variety recorded the highest values of plant height in both seasons at the two growth stage compared to the other studied varieties, While, Shandaweel 1 variety attained the lowest values at 90 days in the second season and at 120 days in both seasons. These results may be due to the genetics differences among the three studied varieties. These results are in agreements with that found by Morsy et al. (2011).

Fertilization treatments significantly affected plant height at 90 days in the first season only. Application of 75% NPK + biofertilizer + humic + nano-ZnO achieved the highest values of plant height at 90 days in the second season and at 120 days, in both seasons. In contrary, the treatment of control (without fertilization) appeared the lowest values of plant height at 90 days in both seasons, and at 120 days in the second season, while the treatments of 75% NPK + humic + nano- ZnO appeared the lowest values at 120 days, in the first season (Table 2). The differences between T9, T5 and T9, T7 appeared that plant height was significantly increased by using humic acid or biofertilizers at 120 days in the 1st season. The increase in plant height under application of 75% NPK + biofertilizer + humic + nano- ZnO revealed that this treatment offered all needs to the plant which reflected in increasing plant growth. Similar results in this respect were reported by)Devi and Ado, 2005; Sangetha and Singaram, 2007; Ahmed, 2009; El-shaikh et al., 2009 and Singh et al., 2017) who found that the combined treatments of chemical fertilizers with biofertilizers or humic gave a tallest plant, and by DeRosa et al. (2010) and Nair et al. (2010) who reported that nano nutrients may have properties that are effective to crops, release the nutrients on demand, controlled release of chemicals fertilizers that regulate plant growth and enhance target activity.

The effect of the interaction between onion varieties and fertilization treatments on plant height was significant at 90 and 120 days in in both seasons. The highest values of plant height in the first season were obtained by planting Shandaweel 1 and application of bio-fertilizer + humic, and by planting Giza 20 and application of bio-fertilizer + humic + nano- ZnO, at 90 and 120 days, respectively. While, the highest values of plant height in the second season was obtained by planting of Giza 20 and application of 75% NPK + bio-fertilizer + humic + nano- ZnO at 90 and 120 days. (Table 2).

2- Number of leaves/plant

Data in Table (3) showed that the studied varieties were significantly differed in number of leaves /plant characteristic at 90 and 120 days, in both seasons. The highest means of number of leaves/plant were recorded for Giza 20 variety, while the lowest means were recorded for Shandaweel 1 variety. These results were true at 90 and 120 days, in both seasons. The differences between varieties were reported by many investigators (Pal *et al.*, 1988; Marey and Morsy, 2010 and Morsy *et al.*, 2011). The results in Table (3) indicated that there were a significant differences among the ten fertilization treatments for number of leaves/plant at 90 and 120 days in both seasons. The highest means of number of leaves/plant were obtained under the treatment of 75% NPK + bio-fertilizer + humic + nano- ZnO, while the lowest means were obtained under no fertilization, in both seasons.

Similar findings in this respect were mentioned by El-Desuki, (2004), Sangetha and Singaram (2007) and Singh *et al.* (2017) who found that the combination of biofertilizers or humic with chemical fertilizers have significantly increased most of the growth parameters, and by Seddiqui *et al.* (2015) who revealed that the appropriate elucidation of physiological, biochemical, and molecular mechanism of nanoparticles in plant leads to better plant growth and development.

The effect of the interaction between onion variety and fertilization treatments was significant at 90 and 120 days, in both seasons. In the first season the highest values of number of leaves/plant were recorded for Giza 20 variety when fertilized with 75% NPK + bio-fertilizer + humic + nano- ZnO at 90 days, and when fertilized with bio-fertilizer + humic + nano- ZnO at 120 days. While, in the second seasons the highest values of number of leaves were recorded for Giza 20 variety when fertilized with 50% NPK + bio-fertilizer + nano-ZnO, or by 75% NPK + humic + nano-ZnO at 90 and 120 days, respectively (Table, 3).

3- Bulbing ratio

Data in Table (4) showed that bulbing ratio differed significantly due to differences onion varieties at 90 and 120 days in both seasons. Data cleared that the best results of bulbing ration were determined by Shandaweel 1 variety as it gave the lowest values (0.44 – 0.50) at 90 days and (0.32 – 0.29) at 120 days in the first and second season, respectively. These results are in line with those obtained by Shalaby *et al.* (1991) and Gamei and yasso (2007) who reported that Shandaweel 1 variety showed the superiority of bulbing ratio.

Fertilization treatments significantly affected bulbing ratio at 90 and 120 days in the first season (Table 4). The lowest means of bulbing ratio (the best) were recorded by the treatment of biofertilizer + humic or biofertilizer + humic+ Zno at 90 days in the first and second season, respectively , while the lowest means at 120 days were obtained under no fertilization in both seasons. The differences between T3 and T4 revealed that bulbing ratio was significant increased by using nano nano-ZnO in the first season, while the differences between T5 and T9 or between T7 and T9 appeared that humic acid or biofertilizers application significantly decreased bulbing ratio at 90 and 120 days in the 1st season. These results are in line with that El-Shaikh (2005) and El-Shaikh et al. (2017) who reported that the most of onion plant by using both humic and bio fertilizer lead to improved bulbing ratio in onion plants.

The effect of interaction between onion varieties and fertilization treatments was significant at 90 and 120 days in both seasons. The lowest (best) values of bulbing ratio at 90 days were obtained for Giza 6 mohassan variety when fertilized with biofertilizer+ humic or Shandaweel 1 under biofertilizer+ humic+Zno (Table 4) in the first and second season, respectively.

Table (2): Plant height (cm) of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018 at 90 and 120 days.

Treatments		Plant height (cm)			
		2016/2017		2017/2018	
		90 days	120 days	90 days	120 days
Onion varieties (A)					
Shandaweel 1		47.31 AB	60.06 B	60.69 C	79.06 B
Giza 6 Mohassan		45.16 B	62.46 B	63.57 B	79.21 B
Giza 20		48.81 A	71.74 A	70.48 A	86.16 A
Fertilization treatments (B)					
T_1- Without fertilization		42.77 B	64.54 BCD	61.96 A	69.70 E
T_2- 100% NPK		48.04 AB	68.70 AB	62.18 A	77.37 D
T_3- Bio-fertilizers + humic		51.52 A	66.38 BC	65.70 A	78.26 CD
T_4- Bio-fertilizers + humic + ZnO		45.96 AB	64.55 BCD	65.72 A	80.03BCD
T_5- 75% NPK + bio-fertilizers + ZnO		47.16 AB	64.46 BCD	65.92 A	83.37 A-D
T_6- 50% NPK + bio-fertilizers + ZnO		45.41 B	60.13 CD	65.29 A	86.09 ABC
T_7- 75% NPK + humic + ZnO		48.02 AB	58.83 D	65.89 A	87.99 AB
T_8- 50% NPK + humic + ZnO		47.78 AB	61.05 CD	64.00 A	82.11 A-D
T_9- 75% NPK+bio-fert. + humic+ZnO		48.13 AB	73.45 A	66.70 A	88.62 A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		46.13 AB	65.45 BCD	65.78 A	81.23 A-D
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	41.53 def	64.57d-i	53.87 c	68.30 gh
	T_2- 100% NPK	47.33 b-f	65.22d-i	54.20 c	78.82 c-h
	T_3- Bio-fertilizer + humic	59.00 a	66.02c-h	63.10 bc	80.58 b-g
	T_4- Bio-fertilizer + humic + ZnO	44.10 b-f	49.62 jk	59.67 bc	82.14 b-g
	T_5- 75% NPK + bio-fertilizer + ZnO	47.67 b-f	62.82 d-i	63.00 bc	84.18 b-f
	T_6- 50% NPK + bio-fertilizer + ZnO	47.10 b-f	54.30h-k	63.77 abc	85.62 b-f
	T_7- 75% NPK + humic + ZnO	49.33 a-f	44.70 k	63.57 abc	80.86 b-g
	T_8- 50% NPK + humic + ZnO	41.67 c-f	56.82g-k	61.67 bc	72.42 e-h
	T_9-75% NPK+bio-fert. + humic+ZnO	49.00 a-f	72.14a-f	62.57 bc	82.18 b-g
	T_{10}-50% NPK+bio-fert.+humic+ZnO	46.33 b-f	64.42d-i	61.53 bc	75.50 d-h
Giza 6 Mohassan	T_1- Without fertilization	46.33 b-f	62.03d-j	60.67 bc	65.34 h
	T_2- 100% NPK	46.67 b-f	68.46b-g	61.33 bc	70.46 fgh
	T_3- Bio-fertilizers + humic	44.77 b-f	72.70a-e	63.10 bc	76.42 d-h
	T_4- Bio-fertilizers + humic + ZnO	41.77 c-f	62.42d-j	69.70 ab	74.42 d-h
	T_5- 75% NPK + bio-fertilizers + ZnO	43.77 b-f	52.14ijk	64.47 abc	86.82 b-e
	T_6- 50% NPK + bio-fertilizers + ZnO	43.90 b-f	67.50c-h	62.77 bc	78.18 d-h
	T_7- 75% NPK + humic + ZnO	45.30 b-f	59.22f-j	64.33 abc	94.02 abc
	T_8- 50% NPK + humic + ZnO	50.57 a-e	52.58ijk	63.53 abc	79.86 b-h
	T_9-75% NPK+bio-fert. + humic+ZnO	48.77 b-f	67.62c-g	61.20 bc	81.50 b-g
	T_{10}-50% NPK+bio-fert.+humic+ZnO	39.77 f	59.90e-j	64.57 abc	85.10 b-f
Giza 20	T_1- Without fertilization	40.43 ef	67.01c-h	71.33 ab	75.47 d-h
	T_2- 100% NPK	50.13 a-f	72.42a-f	71.00 ab	82.82 b-g
	T_3- Bio-fertilizers + humic	50.80 a-e	60.42d-j	70.90 ab	77.78 d-h
	T_4- Bio-fertilizers+ humic + ZnO	52.00 abc	81.62 a	67.80 ab	83.54 b-g
	T_5- 75% NPK + bio-fertilizers + ZnO	50.03 a-f	78.42abc	70.30 ab	79.10 c-h
	T_6- 50% NPK + bio-fertilizers + ZnO	45.23 b-f	58.58g-j	69.33 ab	94.46 ab
	T_7- 75% NPK + humic + ZnO	49.43 a-f	72.58a-f	69.77 ab	89.10 a-d
	T_8- 50% NPK + humic + ZnO	51.10 a-d	73.74a-d	66.80 abc	94.06 abc
	T_9-75% NPK+bio-fert. + humic+ZnO	46.63 b-f	80.58ab	76.33 a	102.18 a
	T_{10}-50% NPK+bio-fert.+humic+ZnO	52.30 ab	72.02a-f	71.23 ab	83.10 b-g

Means followed by the same letter or letters are not significantly different of the 5% significance level.

Table (3): Number of leaves/plant of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018 at 90 and 120 days.

Treatments		Number of leaves/plant			
		2016/2017		2017/2018	
		90 days	120 days	90 days	120 days
Onion varieties (A)					
Shandaweel 1		8.03 B	10.27 B	8.91 B	12.27 B
Giza 6 Mohassan		8.04 B	10.69 B	8.95 B	12.53 AB
Giza 20		10.23 A	13.27 A	9.99 A	13.25 A
Fertilization treatments (B)					
T_1- Without fertilization		7.52 D	10.14 E	7.86 E	11.97 D
T_2- 100% NPK		8.72 BC	11.41 CD	9.05 CD	12.18 CD
T_3- Bio-fertilizers + humic		8.72 BC	11.69 C	9.19 CD	12.54 BCD
T_4- Bio-fertilizers+ humic + ZnO		9.55 A	12.34 B	9.53 BC	12.86 ABC
T_5- 75% NPK + bio-fertilizers + ZnO		8.05 CD	11.00 CD	8.12 DE	12.30 CD
T_6- 50% NPK + bio-fertilizers+ ZnO		8.63 BC	11.07CD	10.44 AB	13.08AB
T_7- 75% NPK + humic + ZnO		9.12 AB	10.78 D	9.16 CD	13.07 AB
T_8- 50% NPK + humic + ZnO		9.11 AB	10.94 D	9.69BC	12.72 BCD
T_9- 75% NPK+bio-fert. + humic+ZnO		9.68 A	13.51 A	10.91A	13.49 A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		8.59 BC	11.21 CD	8.88 CDE	12.63 BCD
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	6.93 lm	8.23 p	7.42 fg	10.77 i
	T_2- 100% NPK	9.64 c-g	11.70 f-j	8.40 d-g	11.43 ghi
	T_3- Bio-fertilizers + humic	6.72 mn	9.43 nop	9.64 c-f	11.63 f-i
	T_4- Bio-fertilizers + humic + ZnO	10.32 b-e	9.43nop	8.88 d-g	13.53 a-d
	T_5- 75% NPK + bio-fertilizers+ ZnO	7.20 klm	10.43 k-o	8.17 efg	12.43 c-h
	T_6- 50% NPK + bio-fertilizers + ZnO	7.48 j-m	11.00 i-m	9.48 c-f	13.57 abc
	T_7- 75% NPK + humic + ZnO	7.76 i-m	9.53 no	10.00 b-e	12.10 d-i
	T_8- 50% NPK + humic + ZnO	7.48 j-m	9.33 op	8.52 d-g	11.47 ghi
	T_9-75% NPK+bio-fert. + humic+ZnO	8.12 h-l	13.30 bcd	10.30 a-e	12.90 b-f
	T_{10}-50% NPK+bio-fert.+humic+ZnO	8.68 f-j	10.33 k-o	8.28 efg	12.90 b-f
Giza 6 Mohassan	T_1- Without fertilization	5.68 n	9.57 no	6.90 g	12.43 c-h
	T_2- 100% NPK	7.96 h-m	10.57 j-o	8.52 d-g	11.97 e-i
	T_3- Bio-fertilizers + humic	8.29 h-l	10.43 k-o	9.56 c-f	13.00 b-f
	T_4- Bio-fertilizers + humic + ZnO	7.92 h-m	11.37 h-l	9.12c-g	12.23 c-h
	T_5- 75% NPK + bio-fertilizers + ZnO	7.88 h-m	10.23 l-o	8.80 d-g	11.33hi
	T_6- 50% NPK + bio-fertilizers + ZnO	8.00 h-m	11.53 g-k	9.48c-f	12.20 c-h
	T_7- 75% NPK + humic + ZnO	8.80 f-j	9.90 mno	8.28 efg	12.53 c-h
	T_8- 50% NPK + humic + ZnO	9.08 e-i	9.40 nop	9.36 c-f	13.23 a-e
	T_9-75% NPK+bio-fert. + humic+ZnO	8.92 f-i	13.67 bc	10.42 a-e	13.47 a-d
	T_{10}-50% NPK+bio-fert.+humic+ZnO	7.88 h-m	10.20 l-o	9.04 c-g	12.90 b-f
Giza 20	T_1- Without fertilization	9.96 b-f	12.63 c-g	9.26d-f	12.70 b-h
	T_2- 100% NPK	8.56 g-k	11.97 e-i	10.24 a-e	13.13 b-e
	T_3- Bio-fertilizers + humic	11.16 ab	15.20 a	8.36d-g	13.00 b-f
	T_4- Bio-fertilizers + humic + ZnO	10.4 bcd	16.23 a	10.60a-d	12.80 b-g
	T_5- 75% NPK + bio-fertilizers + ZnO	9.08 e-i	12.33d-h	7.40fg	13.13 b-e
	T_6- 50% NPK + bio-fertilizers + ZnO	10.4 bcd	10.67 j-n	12.36a	13.47 a-d
	T_7- 75% NPK + humic + ZnO	10.8 abc	12.90 b-f	9.20c-f	14.57 a
	T_8- 50% NPK + humic + ZnO	10.76 abc	14.10 b	11.20abc	13.47 a-d
	T_9-75% NPK+bio-fert. + humic+ZnO	12.00 a	13.57 bc	12.00ab	14.10 ab
	T_{10}-50% NPK+bio-fert.+humic+ZnO	9.20 d-h	13.10b-e	9.32 c-f	12.10 d-i

Means followed by the same letter or letters are not significantly different of the 5% significance level.

Table (4): Bulbing ratio of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018 at 90 and 120 days.

Treatments		Bulbing ratio			
		2016/2017		2017/2018	
		90 days	120 days	90 days	120 days
Onion varieties (A)					
Shandaweel 1		0.44 B	0.32 B	0.50 B	0.29 B
Giza 6 Mohassan		0.52 AB	0.35 B	0.59 B	0.31 B
Giza 20		0.60 A	0.44 A	0.76 A	0.3 A
Fertilization treatments (B)					
T_1- Without fertilization		0.44 B	0.23 D	0.61 A	0.35 A
T_2- 100% NPK		0.56 B	0.38 B	0.60 A	0.30 A
T_3- Bio-fertilizers + humic		0.30 C	0.47 A	0.63 A	0.33 A
T_4- Bio-fertilizers + humic + ZnO		0.70 A	0.39 B	0.52 A	0.31 A
T_5- 75% NPK + bio-fertilizers + ZnO		0.50 B	0.30 CD	0.60 A	0.35 A
T_6- 50% NPK + bio-fertilizers + ZnO		0.49 B	0.33 BC	0.63 A	0.32 A
T_7- 75% NPK + humic + ZnO		0.47 B	0.35 BC	0.67 A	0.33 A
T_8- 50% NPK + humic + ZnO		0.55 B	0.35 BC	0.64 A	0.32 A
T_9- 75% NPK+bio-fert. + humic+ZnO		0.67 A	0.47 A	0.66 A	0.32 A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		0.54 B	0.39 B	0.60 A	0.31 A
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	0.39 g-k	0.20 k	0.43 d	0.32 b-e
	T_2- 100% NPK	0.45 d-k	0.36 c-i	0.55 bcd	0.26 de
	T_3- Bio-fertilizers + humic	0.27 jk	0.45 a-e	0.53 bcd	0.33 a-e
	T_4- Bio-fertilizers + humic + ZnO	0.48 c-j	0.37 c-i	0.42 d	0.27 de
	T_5- 75% NPK + bio-fertilizers + ZnO	0.41 f-k	0.24 ijk	0.51 bcd	0.43 ab
	T_6- 50% NPK + bio-fertilizers + ZnO	0.43 e-k	0.25 h-k	0.52 bcd	0.29 de
	T_7- 75% NPK + humic + ZnO	0.33 ijk	0.24 ijk	0.52 bcd	0.28 de
	T_8- 50% NPK + humic + ZnO	0.49 c-j	0.32 e-k	0.49 bcd	0.25 e
	T_9-75% NPK+bio-fert. + humic+ZnO	0.60 b-g	0.46 a-e	0.58 bcd	0.28 de
	T_{10}-50% NPK+bio-fert.+humic+ZnO	0.59 b-h	0.29 g-k	0.44 cd	0.25 e
Giza 6 Mohassan	T_1- Without fertilization	0.52 b-i	0.22 jk	0.44 cd	0.29 de
	T_2- 100% NPK	0.65 b-e	0.35 c-j	0.59 bcd	0.29 cde
	T_3- Bio-fertilizers + humic	0.24 k	0.49 abc	0.65 a-d	0.32 b-e
	T_4- Bio-fertilizers + humic + ZnO	0.75 ab	0.34 d-j	0.46 bcd	0.30 cde
	T_5- 75% NPK + bio-fertilizers + ZnO	0.50 c-i	0.28 h-k	0.60 bcd	0.31 b-e
	T_6- 50% NPK + bio-fertilizers + ZnO	0.56 b-h	0.35 c-j	0.61 a-d	0.30 b-e
	T_7- 75% NPK + humic + ZnO	0.45 d-k	0.34 d-j	0.74 a-d	0.34 a-e
	T_8- 50% NPK + humic + ZnO	0.49 c-j	0.30 f-k	0.59 bcd	0.30 cde
	T_9-75% NPK+bio-fert. + humic+ZnO	0.68 bc	0.45 a-e	0.67 a-d	0.28 de
	T_{10}-50% NPK+bio-fert.+humic+ZnO	0.37 h-k	0.35 c-j	0.56 bcd	0.33 b-e
Giza 20	T_1- Without fertilization	0.41 f-k	0.28 h-k	0.97 a	0.45 a
	T_2- 100% NPK	0.59 b-h	0.44 a-f	0.65 a-d	0.36 a-e
	T_3- Bio-fertilizers + humic	0.39 g-k	0.46 a-e	0.72 a-d	0.34 a-e
	T_4- Bio-fertilizers+ humic + ZnO	0.89 a	0.47 a-d	0.68 a-d	0.36 a-e
	T_5- 75% NPK + bio-fertilizers + ZnO	0.59 b-h	0.37 c-i	0.70 a-d	0.31 b-e
	T_6- 50% NPK + bio-fertilizers + ZnO	0.49 c-i	0.39 b-h	0.77 a-d	0.38 a-d
	T_7- 75% NPK + humic + ZnO	0.62 b-f	0.47 a-d	0.76 a-d	0.38 a-d
	T_8- 50% NPK + humic + ZnO	0.66 bcd	0.42 a-g	0.83 ab	0.42 abc
	T_9-75% NPK+bio-fert. + humic+ZnO	0.73 ab	0.51 ab	0.73 a-d	0.42 abc
	T_{10}-50% NPK+bio-fert.+humic+ZnO	0.65 b-e	0.53 a	0.82 abc	0.37 a-e

Means followed by the same letter or letters are not significantly different of the 5% significance level.

B. Bulb yield and its components

1- Average bulb weight (gm)

Average bulb weight differed significantly due to the differences among onion studied varieties in both seasons (Table 5). The highest means of bulb weight (82.45 and 105.19 gm) were obtained for Giza 20 variety, while, the lowest means (68.26 and 89.44 gm) were recorded by Giza 6 mohassan variety, in the first and second season, respectively. The variation in bulb weight amongst different varieties may be due to their different genetic makeup and adaptation ability to a specific environment condition. These results are in accordance with those found by Mohamed and Gamei (1999), Gamie and Yasso (2007) and Marey and Morsy (2010).

Data in Table (5) indicated that there are a significant differences among the ten fertilization treatments for average bulb weight in both seasons. The highest means of bulb weight i.e. (87.51 and 105.74 gm) were obtained from treatment of 75% NPK + biofertilizer + humic + nano-ZnO, while the lowest means (63.85 and 79.42) were recorded under no fertilization, in the first and second seasons, respectively. In the 1st season the differences between T3 and T4 revealed that average bulb weight was significantly increased by using nano-ZnO, this result reflects the role of nano-ZnO compound in encouraging crop growth and increasing the weight of bulbs, this result was in line with that found by Raliya and Tarafdar (2013) who reported that ZnO NPs induced a significant improvement in Cyamopsis tetragonoloba plant biomass, shoot and root growth, root area, chlo-rophyll and protein synthesis, rhizospheric microbial population, acid phos-phatase, alkaline phosphatase and phytase activity in cluster bean rhizosphere.

The effect of interaction between onion varieties and fertilization treatments was significant in both seasons. The highest values of bulb weight (100.7 and 120.56 g) were achieved by Giza 20 and application of 75% NPK + biofertilizer + humic + nano-ZnO, while the lowest values (53.40 and 71.29 g) were recorded by planting Giza 6 Mohassan under no fertilization, in the first and second season, respectively (Table 5).

2. Total yield (ton/fed.)

Data in Table (5) revealed that the three studied varieties were significantly differed in total yield characteristic in both seasons. Giza 20 variety attained the highest values of total yield (17.83 and 18.62) followed by Shandaweel 1 variety (14.88 and 15.45), while, Giza 6 mohassan variety recorded the lowest values of total yield in both seasons. These results are in line with that found by Mohamed and Gamei (1999), Gamie and Yasso (2007) and Marey and Morsy (2010), Morsy *et al.* (2011) who reported that Giza 20 variety had superiority for obtaining the greatest of total yield. Many researcher reported a genotypic differences in respect to onion yield/fed between different varieties Mohanty and Prusti, (2001), Changmei *et al.* (2002), Leilah *et al.* (2003), El-Damarany and Obiadalla-Ali (2005) and Yaso (2007).

Fertilization treatments significantly affected total yield in both seasons. Application of 75% NPK + biofertilizer + humic + nano-ZnO appeared the highest means of total yield. While, no fertilization treatment appeared the lowest means, these results were true in both seasons (Table, 10). These results are in harmony with those mentioned by Jayathilake *et al.* (2003), Devi and Ado (2005), El-Shaikh (2005), El-Shaikh (2007) and Singh *et al.* (2017) who reported that the mixtures between bio and mineral fertilization appeared the highest of total yield, El-Shaikh *et al.* (2017) who reported that the treatment (bio + humic+3/4 NPK) gave the best results for total bulbs yield. This may be due to application of biofertilizers and their direct roles in nitrogen fixation, phosphate and potassium solubilization, production of substances like phytohormones and increase in nutrient uptake in addition to the beneficial role of humic acid in raising the quality and productivity of onion plant. High nitrogen fixation ability of Azotobacter and Azospirillum which also produces thiamin. Riboflavin, nicotin, indol acetic acid and giberalin was reported by Tien *et al.* (1979) and Hartmann *et al.* (1983). Moreover, the solubilization effect of phophbacterins of Bacillus sp. Is generally due to the production of organic acids that lower the soil PH and bring about the dissolution of bound forms of phosphate (Saber, 1993). In addition, humic acid containing many elements which improve the soil fertility and increase the availability of nutrients and consequently increase plant growth and yield as mentioned by Eric *et al.* (2000) and Abd El-Aal *et al.* (2005). As well as Reynolds (2002) suggested that micronutrients in the form of NPs can be used in crop production to increase yield.

The effect of interaction between onion varieties and fertilization treatments on total yield was significant in both seasons. The highest values of total yield (20.87 and 21.37 ton/fed.) were obtained by planting Giza 20 variety when fertilized with 75% NPK + biofert. + humic + nano-ZnO while, the lowest values of total yield (8.70 and 8.13 ton/fed.) were recorded by Giza 6 Mohassan or Shandaweel 1 variety under no fertilization in the 1st and 2nd season respectively.

3. Exportable yield (ton/fed.)

The exportable yield/fed differed significantly due to the differences among the three studied varieties in both seasons (Table 6). The highest values of exportable yield i.e.(14.99 and 13.65 ton/fed.) were recorded by Giza 20 variety followed by Shandaweel 1 variety (13.20 and 13.06), while, the lowest values i.e. (10.45 and 11.69 ton/fed.) were recorded by Giza 6 mohassan in the first and second season, respectively. These results are in agreement with that found by Shalaby *et al.* (1991) who reported that exportable yield were greater for Shandaweel 1 than Giza 6 Mohassan, these differences may be due to the differences between studied varieties.

Data in Table (6) indicated significant differences among the ten fertilization treatments for exportable yield in both seasons. The highest means of exportable yield were obtained from the treatment of 75% NPK + biofertilizer + humic+ nano-ZnO, while, the lowest means of exportable yield were recorded under the treatment of no fertilization, in both seasons. These results cleared that addition of biofertilizer, humic and nano-ZnO saved 25-50% of the recommended mineral fertilization. These results were in coincide with that found by Thilakavathy and Ramaswany (1999) who cleared that the application of Azospirillum or the phosphobacteria gave an increase in yield by 18.3% and saved 25% of inorganic fertilizer. El-Shaikh *et al.* (2017) who found that the treatment (humic+bio+3/4NPK) gave the best of exportable yield. These results may be attributed to the increase in microbial production of indol acetic acid (IAA), gebberrellins and cytokinins. There is also evidence that the growth hormones produced by bacteria came in same instances increase growth rates and improve yields of host plants (Tein *et al.*, 1979). The rate of change of bulb yield was dependent upon the rate of change of plant height and number of leaves per plant appears very important role in increasing the yield.

The effect of interaction between onion varieties and fertilization treatments on exportable yield was significant in both seasons. The highest values of exportable yield (18.03 and 17.73 ton/fed.) were obtained by Giza 20 variety when fertilized with 75% NPK + biofertilizer + humic + nano-ZnO. The lowest values of exportable yield (7.63 and 6.13 ton/fed.) were recorded by Giza 6 mohassan or Shandaweel 1 variety under no fertilization, in the first and second seasons, respectively (Table, 6).

4. Local marketable yield (ton/fed.)

Local marketable yield differed significantly due to the differences among the onion varieties in both season (Table 6). Giza 20 variety attained the highest values of local marketable yield while, Giza 6 Mohassan variety attained the lowest values in both seasons. Mohamed and Gamei (1999) , Gamei and Yasso (2007) and Morsy *et al.* (2011).

Data in Table (6) indicated that fertilization treatments significantly affect local marketable yield in the second season only. The treatment of

75%NPK + biofertilizer + humic + nano-ZnO appeared the highest means of local marketable yield compared with other treatment in the first season while, application of 100% NPK appeared the highest means in the second season. The lowest means of local marketable yield were obtained by the treatment of 50% NPK + humic + nano-ZnO in the 1st season while, the treatment of 50% NPK + biofertilizer + humic + nano- ZnO in the 2nd season. This result was in line found by Hamouda (2006) and Kandil *et al*. (2013) who found that inoculation onion plant with bioferilizers or application of humic acid improved the marketable yield of onion, El-Shaboury and Ewas (2020) who reported that under 75% NPK in combination the dual application of humic acid showed a significant augmentation in all vegetative growth , yield and quality of onion.

The effect of the interaction between onion varieties and fertilization treatments on Local marketable yield /fed. was significant in both seasons. The highest values of local marketable yield were obtained by planting Giza 20 under 75% NPK + humic + Nano- ZnO in both seasons. The lowest values of local marketable yield were recorded by Giza 6 mohassan variety and application of 75%NPK + humic + Nano- ZnO in the 1st season while, in the 2nd season the lowest values were recorded by Shandaweel 1 variety when fertilized with 50% NPK + biofertilizer + humic + Nano- ZnO (Table 6).

C- Bulb quality

1. Double bulbs

Data in Table (7) revealed that the three studied varieties were significantly differed in double bulbs% characteristic. Giza 6 Mohassan variety attained the lowest values of double bulbs% in 1st season while, Shandaweel 1 variety recorded the lowest values in 2nd season. Giza 20 variety attained the highest means of double bulbs% in both seasons. The obtained variation in double bulbs% might be due to the genetic difference among the used onion varieties. Similar results were reported by Marey and Morsy (2010) who revealed that Giza 20 Original exhibited the highest means of double bulbs%.

Fertilization treatments significantly affected the double bulbs % in both seasons. The treatment of 50% NPK + humic + nano-ZnO appeared the lowest values of double bulbs% in 1st season while, the treatment of non-fertilization appeared the lowest values in 2nd season.

Application of 75% NPK + biofertlization + nano-ZnO appeared the highest values of double bulbs% in both seasons. These results confirmed that the increase in nitrogen fertilization is one of the most important reasons that increase the phenomenon of duplication. Similar results were reported by Mohamed and Hemida (2004) and May *et al*. (2007) who found that percentage of doubles tended to decrease with reducing N levels.

The effect of interaction between onion varieties and fertilization treatments on double bulb% was significant in both seasons. In the first season, the lowest values of double bulbs % were recorded by Giza 6 Mohassan when fertilized with biofertilizer + humic while, in the second season the lowest double bulbs% were recorded by Shandaweel 1 variety under non fertilization (Table, 14). The highest values of double bulbs% were obtained by planting Giza 20 when fertilized with 75% NPK + humic + Nano-ZnO or fertilized with 75% NPK + biofertilizer + Nano-ZnO in the first and second season respectively.

2. Bolters%

Bolters % differed significantly due to the differences between the three onion varieties in the second season only (Table 7). In the 1st season Shandaweel 1 and Giza 6 Mohassan variety appeared the lowest means of bolters%, while Giza 20 variety appeared the highest means.

In the 2nd season Shandaweel 1 variety appeared the lowest means of bolters%, while Giza 6 Mohassan variety appeared the highest means. This is because the genetic makeup of this variety may be more resistant to the trait of bolters % than other varieties. These results were in harmoney with obtained by Maery and Morsy (2010) and

Hirave *et al.* (2015) who found that the varieties differd with each other in the trait of boltering percentage.

Data in Table (7) indicated that the effect of fertilization treatments on bolters% did not reach the level of significant in both seasons. The lowest means of bolters% were recorded from the treatments of 50% NPK + biofertlization + nano-ZnO in 1st season or 75% NPK + biofert. + nano-ZnO in 2nd season. The treatment of biofertilizer + humic showed the highest means of bolters% in the 1st season while, the treatment of biofert. + humic + nano-ZnO showed the highest means in the 2nd season. These results are in general agreement with those reported by Abdissa *et al.* (2011) who reported that the proportion of bolters per plot decreased by about 11 and 22% in response to the application of 69 and 92 kg N/ha., respectively over the control.

The effect of the interaction between onion varieties and fertilization treatments on bolters was significant both seasons. The lowest values of bolters% were recorded by planting Shandaweel 1 variety under non fertilization in the 1st season or under 75% NPK+ humic + nano-ZnO in the 2nd season (Table. 7). In the first season, the highest values of bolters % were obtained by planting Giza 20 variety under non fertilization while, in the second season the highest values of bolters were recorded for Giza 6 Mohassan variety and application of 50%NPK + biofertilizer + nano-ZnO.

3. Bulb dry matter%

Data in Table (8) revealed that the three studied varieties were significantly differed in bulb dry matter% characteristic in both seasons. Giza 20 variety attained the highest means of dry matter% in both seasons while, Shandaweel 1 variety attained the lowest means in both seasons. The superiority of the Giza 20 variety in this trait may be due to the late maturation of the variety than the rest varieties and thus the continuation of the photosynthesis process, thus continuing of the transporting compounds from the leaves to the bulbs. Similar results were obtained by Morsy *et al.* (2011)

Fertilization treatments significantly affected dry matter% in both seasons. The highest means of bulb dry matter% were obtained from non-fertilization in the 1st season or by application of 50% NPK+ bio+ Zno in the 2nd season. The lowest means of dry matter% were recorded under the treatment of biofertilizer + humic + Nano-ZnO in the 1st season while, the treatment of biofertilizer + humic appeared the lowest means in the 2nd season. Similar findings in this respect were reported by Geries *et al.* (2007).

The effect of the interaction between onion varieties and fertilization was significant in both seasons. The highest values of bulb dry matter% were obtained by Giza 20 variety under the fertilization treatment of 75%NPK + biofertilizer + humic + nano-ZnO in the 1st season ,while, the highest values in the 2nd season were obtained by Giza 6 Mohassan under 75% NPK + humic + nano-ZnO and by Giza 20 under 50%NPK+ bio+ humic+ nano-ZnO. The lowest values of dry matter % were recorded by the variety of Giza 6 Mohassan when fertilized with 50%NPK+biofert.+humic + nano-ZnO in the 1st season, while in the 2nd season, the lowest values were recorded by Shandaweel 1 variety when fertilized with 75%NPK+ humic + nano-ZnO (Table, 8).

4. Total soluble solids% (TSS)

Data in Table (8) revealed that TSS% differed significantly due to the differences among the three studied varieties in the first season but it did not differ significantly in the second season. Giza 20 variety attained the highest means of TSS%, while, Shandaweel 1 variety attained the lowest means, these results were true in both seasons. Similar results were obtained by Gamie and Yasso (2007) and Morsy *et al.* (2011) who indicated that Giza 20 variety had the superiority for obtaining the highest means of TSS% in both seasons.

Fertilization treatments significantly affected TSS% in both seasons. The highest means of TSS% were recorded from the treatment of no fertilization. The lowest means of TSS% were obtained under the application of 75% or 50% NPK + humic + nano-ZnO in the 1st and 2nd season, respectively. The effect of the interaction between onion varieties and fertilization was significant in both seasons. The highest values of TSS% were obtained by Giza 6 mohassan and Giza 20 varieties under the fertilization treatments of bio+ humic+ nano-Zno or 50%NPK+ bio+ humic+ Zno in the 1st and 2nd season, respectively. While, the lowest values of TSS% were recorded by Shandaweel 1 variety under 100 % NPK in the first season or by Giza 6 mohassan under 75% NPK+ humic+ Zno (Table, 8).

D. Storability characteristics

1- Total weight loss% at 60 days

Total loss % differed significantly due to the differences among the three onion varieties in the second season only (Table 9). The highest means of total loss % were achieved by planting Giza 6 Mohassan variety in the 1st season or Shandaweel 1 variety in the 2nd season. The lowest means of total loss % were recorded for Giza 20 in both season, the reason for this may be due to the high dry matter percentage in this variety compared to other varieties, in addition to its superior genetic ability to store. The same trend was obtained by Mohamed and Gamei (1999) who found that Giza 20 variety was the best in storability.

Data in Table (9) indicated significant differences among the ten fertilization treatments for total loss % in both seasons. The highest means of total loss % were obtained when fertilized with (75% NPK + humic + nano-ZnO) while, the lowest means of total loss % were recorded under without fertilization these results were in both seasons. Similar trend in this respect were reported by Mozumder *et al.* (2007) who found that excessive nitrogen caused rapid deterioration and weight loss of bulbs during storage at ambient temperature.

The effect of the interaction between onion varieties and fertilization treatments on total loss % was significant in both seasons. The highest values of total loss % were obtained by planting Giza 6 Mohassan in the 1st season when fertilized with 75% NPK + humic + nano-ZnO, while Giza 20 variety appeared the highest values under the treatment of 50% NPK + humic + nano-ZnO in the 2nd season. The lowest values of total loss % were recorded by Giza 6 Mohassan under without fertilization in the 1st season while, in the 2nd season the lowest values of total loss % were recorded by Giza 20 variety under (biofertilizer + humic).

2- Total weight loss% at 120 days

Data in table (9) revealed that total loss % differed significantly due to the differences among the studied onion varieties in both seasons. Giza 20 variety attained the highest means of total loss% while, Shandaweel 1 variety attained the lowest means of total loss %, these results were true in both seasons.

Fertilization treatments significantly affected total loss % in both seasons (Table 9). Application of 50% NPK + biofertilizer + humic + Nano- ZnO appeared the highest means of total loss % in the 1st season while, the treatment of 75% NPK + biofertilizer + humic + Nano- ZnO recorded the highest means in the 2nd season. The lowest means of total loss% were recorded under non-fertilization in the 1st season while, the lowest means in the 2nd season were recorded under the treatment of 50% NPK + biofert. + nano-ZnO. Similar results were obtained by Mozumder *et al.* (2007) and Kandil *et al.* (2013).

The effect of the interaction between onion varieties and fertilization treatments on total loss% was significant in both seasons. The highest values of total loss% were obtained by planting Giza 20 variety under the treatment of 50% NPK + biofertilizer + humic + nano- ZnO in the 1st season or Giza 6 Mohassan under the treatment 75% NPK + humic + Nano- ZnO in the 2nd season. The lowest values of total loss % were recorded for

Shandaweel 1 variety and application of 50 % NPK + biofertilizer + nano- ZnO in the 1st season or application of 50% NPK + humic + nano- ZnO in the 2nd season.

3- Total weight loss% at 180 days

Data in Table (9) showed that the three studied varieties were significantly differed in total loss % in the 2nd season only. The highest means of total loss% were recorded by Giza 6 Mohassan variety while, the lowest means were recorded by Shandaweel 1 variety, these results was true in both seasons. Giza 20 cultivar was the best in the plant height, number of leaves/plant, bulb weight, total and marketable yields, and the percentage of remaining bulbs after 150 days of storage period. The variances between studied variety in storability may be due to the genetic variation between them. The obtained differences among onion genotypes concerning to storability were recorded by many researcher El-kafoury *et al.* (1996), Abbey *et al.* (2000), Leilah *et al.* (2003) and Morsy *et al.* (2011).

Fertilization treatments significantly affected total loss % in both seasons. Application of 75% NPK + biofertilizer + humic + Nano- ZnO appeared the highest means of total loss %. The treatment of non-fertilization appeared the lowest means in both seasons. These results are in accordance with El-Shaikh *et al.* (2017) who reported that application of Bio + humic gave the highest values of weight loss%.

The effect of the interaction between onion varieties and fertilization treatments on total loss % was significant in both seasons. The highest values of total loss % were obtained by planting Giza 20 variety when fertilized with bio + humic + nano- ZnO in the 1st season while in the 2nd season, the highest values of total loss % were recorded by planting Giza 6 Mohassan variety under the treatment of 75% NPK + biofertilizer + humic + nano- ZnO. The lowest values of total loss% were recorded by Shandaweel 1 variety under biofertilizer + humic + Nano- ZnO in both seasons (Table, 9).

Table (5): Average bulb weight (gm) and total yield (ton/fed.) of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018.

Treatments		2016/2017		2017/2018	
		Average bulb weight (gm)	Total yield (t/fed.)	Average bulb weight (gm)	Total yield (t/fed)
Onion varieties (A):					
Shandaweel 1		76.16 B	14.88 B	97.65 B	15.45 B
Giza 6 Mohassan		68.26 C	13.26 C	89.44 C	12.67 C
Giza 20		82.45 A	17.83 A	105.19 A	18.62 A
Fertilization treatments (B)					
T_1- Without fertilization		63.85 F	10.81 G	79.42 C	10.03 G
T_2- 100% NPK		74.44 D	15.26 E	99.85 B	17.01 B
T_3- Bio-fertilizers + humic		78.42 CD	13.62 F	97.77 B	13.17 F
T_4- Bio-fertilizers + humic + ZnO		83.14 B	13.68 F	97.31 B	13.93 E
T_5- 75% NPK + bio-fertilizers + ZnO		80.74 BC	17.41 B	100.05 B	15.94 D
T_6- 50% NPK + bio-fertilizers + ZnO		75.38 D	15.74 DE	99.95 B	17.34 BC
T_7- 75% NPK + humic + ZnO		75.44 D	16.52 C	100.19 B	16.91 BC
T_8- 50% NPK + humic + ZnO		68.12 EF	15.43 DE	95.59 B	16.61 CD
T_9- 75% NPK+bio-fert. + humic+ZnO		87.51 A	18.71 A	105.74 A	18.18 A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		69.19 E	16.06 CD	98.37 B	16.67 CD
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	60.88 kl	9.67 p	79.23 lmn	8.13 n
	T_2- 100% NPK	78.81 def	12.63 k-n	108.62 bcd	16.33 gh
	T_3- Bio-fertilizers + humic	66.38 h-k	10.97 o	91.24 h-k	13.27 k
	T_4- Bio-fertilizers + humic + ZnO	83.26 bcd	13.20 j-m	92.99 g-j	11.86 lm
	T_5- 75% NPK + bio-fertilizers + ZnO	78.69 def	20.73 a	107.98 b-e	13.48 k
	T_6- 50% NPK + bio-fertilizers + ZnO	90.10 b	18.97 bc	101.83 d-h	17.77 ef
	T_7- 75% NPK + humic + ZnO	81.47 cde	16.00 gh	100.72 d-i	18.47 de
	T_8- 50% NPK + humic + ZnO	75.38 d-g	14.30 ij	95.12 f-j	18.10def
	T_9-75% NPK+bio-fert. + humic+ZnO	83.02 bcd	18.33cd	95.42 f-j	20.00bc
	T_{10}-50% NPK+bio-fert.+humic+ZnO	63.59 jk	14.00 ij	103.30 d-g	17.07fg
Giza 6 Mohassan	T_1- Without fertilization	53.40 l	8.70 p	71.29 n	8.47 n
	T_2- 100% NPK	71.39 f-j	15.00 hi	76.82 mn	14.03jk
	T_3- Bio-fertilizers + humic	70.59 f-j	12.43 lmn	95.47 f-j	10.63 m
	T_4- Bio-fertilizers + humic + ZnO	76.98 def	11.93 mno	82.88 klm	11.43m
	T_5- 75% NPK + bio-fertilizers + ZnO	73.01 e-i	13.33 jkl	93.95 g-j	14.93ij
	T_6- 50% NPK + bio-fertilizers + ZnO	64.53 ijk	12.47 lmn	90.67 ijk	13.53 k
	T_7- 75% NPK + humic + ZnO	72.94 e-i	13.87 ijk	94.22 g-j	12.90kl
	T_8- 50% NPK + humic + ZnO	54.01 l	11.63 no	94.03 g-j	13.73jk
	T_9-75% NPK+bio-fert. + humic+ZnO	78.79 def	16.93efg	101.25 d-i	13.17 k
	T_{10}-50% NPK+bio-fert.+humic+ZnO	66.90 g-k	16.33 fg	93.79 g-j	13.90 jk
Giza 20	T_1- Without fertilization	77.27 def	14.07ij	87.76 jkl	13.50 k
	T_2- 100% NPK	73.10 e-i	18.13cde	114.11 abc	20.67 ab
	T_3- Bio-fertilizers + humic	98.30 a	17.47def	106.60 b-e	15.60hi
	T_4- Bio-fertilizers + humic + ZnO	89.19 bc	15.90gh	116.07 ab	18.50de
	T_5- 75% NPK + bio-fertilizers + ZnO	90.50 b	18.17cde	98.20 d-j	19.40cd
	T_6- 50% NPK + bio-fertilizers + ZnO	71.50 f-j	15.80gh	107.35 b-e	20.73ab
	T_7- 75% NPK + humic + ZnO	71.90 f-j	19.70 ab	105.62 c-f	19.37cd
	T_8- 50% NPK + humic + ZnO	74.96 d-h	20.37 a	97.61 e-j	18.01def
	T_9-75% NPK+bio-fert. + humic+ZnO	100.7 a	20.87 a	120.56 a	21.37 a
	T_{10}-50% NPK+bio-fert.+humic+ZnO	77.07 def	17.83cde	98.03 d-j	19.03cde

Means followed by the same letter or letters are not significantly different of the 5% level.

Table (6): Exportable yield (ton/fed.) and local marketable yield (ton/fed.) of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018.

Treatments		2016/2017		2017/2018	
		Export. yield (t/f)	Local mark. yield (t/f)	Export. yield (t/f)	Local mark. yield (t/f)
Onion varieties (A)					
Shandaweel 1		13.20 B	1.64 B	13.06 A	2.39 B
Giza 6 Mohassan		11.69 C	1.57 B	10.45 B	2.22 B
Giza 20		14.99 A	2.84 A	13.65 A	4.97 A
Fertilization treatments (B)					
T_1- Without fertilization		9.06 G	1.76 A	6.81 G	3.22 ABC
T_2- 100% NPK		13.17 E	2.09 A	13.18 D	3.83 A
T_3- Bio-fertilizers + humic		11.54 F	2.08 A	9.86 F	3.31 ABC
T_4- Bio-fertilizers + humic + ZnO		11.52 F	2.16 A	10.58 E	3.35 ABC
T_5- 75% NPK + bio-fertilizers + ZnO		14,97 B	2.30 A	12.96 D	2.98 ABC
T_6- 50% NPK + bio-fertilizers + ZnO		13.97 CD	1.78 A	13.97 BC	3.38 ABC
T_7- 75% NPK + humic + ZnO		14.54 BC	1.98 A	13.41 CD	3.50 AB
T_8- 50% NPK + humic + ZnO		13.70 DE	1.73 A	13.44 CD	3.17 ABC
T_9- 75% NPK+bio-fert. + humic+ZnO		16.29 A	2.42 A	15.38 A	2.80 BC
T_{10}- 50% NPK+bio-fert.+humic+ZnO		14.17 CD	1.89 A	14.30 B	2.37 C
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	8.30 n	1.37 cde	6.13 m	2.00 f-j
	T_2- 100% NPK	11.27 ijk	1.37 cde	12.90ef	3.43 b-h
	T_3- Bio-fertilizers + humic	9.67 m	1.30 cde	10.23hij	3.03 d-j
	T_4- Bio-fertilizers + humic + ZnO	11.37ij	1.83 b-e	10.03ij	1.83 g-j
	T_5- 75% NPK + bio-fertilizers + ZnO	17.90 a	2.40 a-e	11.93efg	1.55 ij
	T_6- 50% NPK + bio-fertilizers + ZnO	17.93 a	1.03 de	15.43 c	2.33 e-j
	T_7- 75% NPK + humic + ZnO	14.57def	1.43 cde	15.73bc	2.73 d-j
	T_8- 50% NPK + humic + ZnO	13.07gh	1.23 cde	15.63bc	2.47 e-j
	T_9-75% NPK+bio-fert. + humic+ZnO	15.67bcd	2.67 a-d	16.90ab	3.10 d-j
	T_{10}-50% NPK+bio-fert.+humic+ZnO	12.23hi	1.77 b-e	15.67bc	1.40 j
Giza 6 Mohassan	T_1- Without fertilization	7.63 n	1.07 de	6.53m	1.93 f-j
	T_2- 100% NPK	13.70fg	1.30 cde	11.13ghi	2.90 d-j
	T_3- Bio-fertilizers + humic	10.63j-l	1.80 b-e	8.20kl	2.43 e-j
	T_4- Bio-fertilizers + humic + ZnO	10.03lm	1.90 b-e	9.27jk	2.17 e-j
	T_5- 75% NPK + bio-fertilizers + ZnO	11.20i-l	2.13 a-e	12.43efg	2.50 e-j
	T_6- 50% NPK + bio-fertilizers + ZnO	10.77j-m	1.70 b-e	11.83fg	1.70 hij
	T_7- 75% NPK + humic + ZnO	13.10gh	0.77 e	11.23 ghi	1.67 hij
	T_8- 50% NPK + humic + ZnO	10.07klm	1.57 b-e	10.37hij	3.37 c-i
	T_9-75% NPK+bio-fert. + humic+ZnO	15.17b-e	1.77 b-e	11.50gh	1.67 hij
	T_{10}-50% NPK+bio-fert.+humic+ZnO	14.63c-f	1.70 b-e	12.03efg	1.87 f-j
Giza 20	T_1- Without fertilization	11.23i-l	2.83 abc	7.77 l	5.73 a
	T_2- 100% NPK	14.53def	3.60 a	15.50 C	5.17 ab
	T_3- Bio-fertilizers + humic	14.33ef	3.13 ab	11.13ghi	4.47 a-d
	T_4- Bio-fertilizers + humic + ZnO	13.17gh	2.73 abc	12.43efg	6.07 a
	T_5- 75% NPK + bio-fertilizers + ZnO	15.80bc	2.37 a-e	14.50cd	4.90 abc
	T_6- 50% NPK + bio-fertilizers + ZnO	13.20gh	2.60 a-d	14.63 c	6.10 a
	T_7- 75% NPK + humic + ZnO	15.97 b	3.73 a	13.27de	6.10 a
	T_8- 50% NPK + humic + ZnO	17.97 a	2.40 a-e	14.33cd	3.67 b-f
	T_9-75% NPK+bio-fert. + humic+ZnO	18.03 a	2.83 abc	17.73 a	3.63 b-g
	T_{10}-50% NPK+bio-fert.+humic+ZnO	15.63bcd	2.20 a-e	15.20 c	3.83 b-e

Means followed by the same letter or letters are not significantly different of the 5% significance level.

Table (7): Double bulbs% and bolters% of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018.

Treatments		2016/2017		2017/2018	
		Double bulbs %	Bolters%	Double bulbs %	Bolters%
Onion varieties (A)					
Shandaweel 1		1.62 B	1.99 A	4.22 C	1.92 B
Giza 6 Mohassan		1.21 B	1.99 A	9.37 B	2.39 A
Giza 20		3.68 A	2.34 A	11.31 A	2.24 AB
Fertilization treatments (B)					
T_1- Without fertilization		1.80 CD	2.41 A	5.21 E	2.42 A
T_2- 100% NPK		2.32 ABC	2.19 A	7.93 CD	2.61 A
T_3- Bio-fertilizers + humic		1.62 CD	2.52 A	7.49 D	1.55 A
T_4- Bio-fertilizers + humic + ZnO		1.66 CD	2.01 A	8.40 BCD	2.75 A
T_5- 75% NPK + bio-fertilizers + ZnO		2.83 A	1.71 A	10.06 A	1.53 A
T_6- 50% NPK + bio-fertilizers + ZnO		2.53 AB	1.68 A	9.06 ABC	2.45 A
T_7- 75% NPK + humic + ZnO		2.81 A	2.15 A	9.58 AB	1.57 A
T_8- 50% NPK + humic + ZnO		1.26 D	2.45 A	8.57 BCD	2.59 A
T_9- 75% NPK+bio-fert. + humic+ZnO		2.83 A	1.91 A	8.47 BCD	1.63 A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		2.01 BC	2.06 A	8.21 CD	2.74 A
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	1.69 efg	0.72 b	0.69 n	3.54 abc
	T_2- 100% NPK	1.06 e-h	2.52 b	6.32 ij	2.24 a-d
	T_3- Bio-fertilizers + humic	1.59 efg	2.20 b	3.90 kl	1.18 bcd
	T_4- Bio-fertilizers + humic + ZnO	1.35 efg	3.07 b	3.24 klm	2.72 a-d
	T_5- 75% NPK + bio-fertilizers + ZnO	2.98 cd	0.75 b	4.58 jk	2.71 a-d
	T_6- 50% NPK + bio-fertilizers + ZnO	1.67 efg	2.01 b	4.30 kl	0.77 bcd
	T_7- 75% NPK + humic + ZnO	2.19 def	2.29 b	3.61 kl	0.66 d
	T_8- 50% NPK + humic + ZnO	1.71 efg	3.09 b	6.82 i	1.89 a-d
	T_9-75% NPK+bio-fert. + humic+ZnO	1.52 efg	0.92 b	7.12 hi	1.41 bcd
	T_{10}- 50% NPK+bio-fert.+humic+ZnO	0.40 gh	2.33 b	1.60 mn	2.05 a-d
Giza 6 Mohassan	T_1- Without fertilization	1.46 efg	0.82 b	2.34 lmn	2.51 a-d
	T_2- 100% NPK	0.64 gh	2.15 b	8.37 f-i	3.10 a-d
	T_3- Bio-fertilizers + humic	0.00 h	2.83 b	9.50 efg	0.71 cd
	T_4- Bio-fertilizers + humic + ZnO	0.48 gh	1.62 b	11.17 cde	2.41 a-d
	T_5- 75% NPK + bio-fertilizers + ZnO	1.56 efg	1.94 b	8.33 f-i	1.11 bcd
	T_6- 50% NPK + bio-fertilizers + ZnO	1.36 efg	1.65 b	10.31 def	4.34 a
	T_7- 75% NPK + humic + ZnO	0.83 fgh	2.34 b	10.48 cde	2.74 a-d
	T_8- 50% NPK + humic + ZnO	0.51 gh	2.37 b	10.62 cde	3.61 ab
	T_9-75% NPK+bio-fert. + humic+ZnO	3.54 bc	2.46 b	10.68 cde	0.70 cd
	T_{10}- 50% NPK+bio-fert.+humic+ZnO	1.68 efg	1.73 b	11.88 cd	2.68 a-d
Giza 20	T_1- Without fertilization	2.25 de	5.69 a	12.59 c	1.22 bcd
	T_2- 100% NPK	5.27 a	1.89 b	9.10 e-h	2.49 a-d
	T_3- Bio-fertilizers + humic	3.27 bcd	2.54 b	9.07 e-h	2.76a-d
	T_4- Bio-fertilizers + humic + ZnO	3.15 cd	1.34 b	10.80 cde	3.12 a-d
	T_5- 75% NPK + bio-fertilizers + ZnO	3.95 bc	2.42 b	17.29 a	0.77 bcd
	T_6- 50% NPK + bio-fertilizers + ZnO	4.56 ab	1.38 b	12.57 c	2.23 a-d
	T_7-75% NPK + humic + ZnO	5.41 a	1.81 b	14.66 b	1.31 bcd
	T_8- 50% NPK + humic + ZnO	1.57 efg	1.90 b	8.28 f-i	2.26 a-d
	T_9-75% NPK+bio-fert. + humic+ZnO	3.42 bcd	2.36b	7.61 ghi	2.78 a-d
	T_{10}-50% NPK+bio-fert.+humic+ZnO	3.95 bc	2.12 b	11.16 cde	3.50 a-d

Means followed by the same letter or letters are not significantly different of the 5% significance level.

Table (8): Bulb dry matter% and T.S.S% of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018.

Treatments		2016/2017		2017/2018	
		Dry matter %	T.S.S %	Dry matter %	T.S.S %
Onion varieties (A)					
Shandaweel 1		15.28 B	13.77 B	14.51 B	13.35 A
Giza 6 Mohassan		15.75AB	14.05AB	14.65 AB	13.47 A
Giza 20		16.08 A	14.51 A	14.97 A	13.62 A
Fertilization treatments (B)					
T_1- Without fertilization		16.86 A	14.68 A	15.04 AB	14.03 A
T_2- 100% NPK		15.26 CDE	14.34 AB	14.72 AB	12.63 C
T_3- Bio-fertilizers + humic		14.94 E	14.19 AB	13.68 C	13.61 AB
T_4- Bio-fertilizers + humic + ZnO		14.81 E	14.24 AB	14.38 BC	13.48 AB
T_5- 75% NPK + bio-fertilizers + ZnO		16.26 AB	14.03 ABC	15.07 AB	13.82 A
T_6- 50% NPK + bio-fertilizers + ZnO		16.38 AB	14.14 AB	15.31 A	13.93 A
T_7- 75% NPK + humic + ZnO		15.58 B-E	13.30 C	14.73 AB	12.99 BC
T_8- 50% NPK + humic + ZnO		15.85 BCD	13.81 BC	15.24 AB	12.60 C
T_9- 75% NPK+bio-fert. + humic+ZnO		16.01 BC	13.89 ABC	14.38 BC	13.90 A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		15.10 DE	14.47 AB	14.55 AB	13.80 A
Interaction (A x B)					
Shandaweel 1	T_1- Without fertilization	15.06 f-j	14.97 a-d	14.52 a-g	14.23 a-f
	T_2- 100% NPK	14.39 h-l	13.17 f	15.69 abc	12.50 h-k
	T_3- Bio-fertilizers + humic	15.49 e-i	14.70 a-e	13.58 efg	14.97 ab
	T_4- Bio-fertilizers + humic + ZnO	13.43 kl	13.10 f	14.43 a-g	12.83 e-k
	T_5- 75% NPK + bio-fertilizers + ZnO	14.83 g-k	13.43 ef	15.13 a-f	13.07 c-k
	T_6- 50% NPK + bio-fertilizers + ZnO	17.82 bc	13.93 c-f	15.49 a-d	13.93 b-h
	T_7- 75% NPK + humic + ZnO	15.37 f-i	13.10 f	13.09 g	13.27 c-j
	T_8- 50% NPK + humic + ZnO	16.19 d-g	13.10 f	15.77 ab	12.07 jk
	T_9-75% NPK+bio-fert. + humic+ZnO	13.72 jkl	13.87 def	13.18 g	14.47 a-d
	T_{10}-50% NPK+bio-fert.+humic+ZnO	16.49 c-f	14.30 b-f	14.22 b-g	12.17 ijk
Giza 6 Mohassan	T_1- Without fertilization	17.25 bcd	13.70 def	15.66 abc	14.27 a-e
	T_2- 100% NPK	15.61 e-i	14.17 c-f	14.27 a-g	13.40 c-j
	T_3- Bio-fertilizers + humic	14.33 i-l	14.17 c-f	13.52 fg	12.53h-k
	T_4- Bio-fertilizers + humic + ZnO	14.89 g-k	15.77 a	14.08 c-g	13.90 b-h
	T_5- 75% NPK + bio-fertilizers + ZnO	18.04 ab	13.63 def	14.66 a-g	13.83 b-h
	T_6- 50% NPK + bio-fertilizers + ZnO	16.02 d-g	14.20 c-f	14.61 a-g	14.07 a-g
	T_7- 75% NPK + humic + ZnO	16.95 b-e	13.10 f	15.90 a	11.70 k
	T_8- 50% NPK + humic + ZnO	16.14 d-g	14.30 b-f	14.51 a-g	12.73 f-k
	T_9-75% NPK+bio-fert. + humic+ZnO	14.99 f-j	13.80 def	15.72 abc	14.53 abc
	T_{10}-50% NPK+bio-fert.+humic+ZnO	13.32 l	13.70 def	13.52 fg	13.77 b-h
Giza 20	T_1- Without fertilization	18.27 ab	15.37 abc	14.93 a-f	13.60 b-i
	T_2- 100% NPK	15.78 d-i	15.70 ab	14.20 b-g	12.00 jk
	T_3- Bio-fertilizers + humic	15.00 f-j	13.70 def	13.94 d-g	13.33 c-j
	T_4- Bio-fertilizers + humic + ZnO	16.12 d-g	13.87 def	14.64 a-g	13.70 b-h
	T_5- 75% NPK + bio-fertilizers + ZnO	15.91 d-h	15.03 a-d	15.42 a-d	14.57 abc
	T_6- 50% NPK + bio-fertilizers + ZnO	15.30 f-i	14.30 b-f	15.82 ab	13.80 b-h
	T_7- 75% NPK + humic + ZnO	14.43 h-l	13.70 def	15.19 a-e	14.00 b-h
	T_8- 50% NPK + humic + ZnO	15.22 f-j	14.03 c-f	15.44 a-d	13.00 d-k
	T_9-75% NPK+bio-fert. + humic+ZnO	19.33 a	14.00 c-f	14.26 a-g	12.70 g-k
	T_{10}-50% NPK+bio-fert.+humic+ZnO	15.48 e-i	15.40 abc	15.90 a	15.47 a

Means followed by the same letter or letters are not significantly different of the 5% significance level.

Table (9): Storability of some onion varieties as affected by fertilization treatments during seasons of 2016/2017 and 2017/2018 seasons at 60 days from storage.

Treatments		2016/2017			2017/2018		
		Total loss% at 60 days	Total loss% at 120 days	Total loss% at 180 days	Total loss% at 60 days	Total loss% at 120days	Total loss% at 180 days
Onion varieties (A)							
Shandaweel 1		21.92 A	24.47 C	34.74 A	20.45 A	42.19B	35.43B
Giza 6 Mohassan		22.40 A	26.94 B	37.49 A	17.74 B	54.10A	41.57A
Giza 20		21.33 A	35.84 A	36.29 A	17.03 B	55.83A	37.28B
Fertilization treatments (B)							
T_1- Without fertilization		16.58D	24.08D	30.12D	15.14E	47.28C	26.98B
T_2- 100% NPK		22.92BC	29.52BC	37.33A-C	16.70C-E	51.89A-C	41.32A
T_3- Bio-fertilizers + humic		22.17BC	29.46BC	31.94CD	18.91BC	52.70A-C	31.35B
T_4- Bio-fertilizers + humic + ZnO		20.81C	26.79CD	34.77B-D	19.35B	49.64BC	30.35B
T_5- 75% NPK + bio-fertilizers + ZnO		23.37A-C	30.49BC	39.06AB	18.60B-C	55.37AB	40.67A
T_6- 50% NPK + bio-fertilizers + ZnO		20.85C	24.57D	33.44B-D	18.15B-C	39.38D	32.53B
T_7- 75% NPK + humic + ZnO		25.51A	32.84B	41.27A	22.77A	53.15A-C	43.01A
T_8- 50% NPK + humic + ZnO		21.02BC	29.31BC	36.72A-C	20.26B	50.66A-C	41.22A
T_9- 75% NPK+bio-fert. + humic+ZnO		23.64AB	27.49CD	42.37A	18.02B-D	57.19A	47.13A
T_{10}- 50% NPK+bio-fert.+humic+ZnO		21.98BC	36.29A	34.68B-D	16.15DE	49.81BC	46.39A
Interaction (A x B)							
Shandaweel 1	T_1- Without fertilization	15.56jk	23.85k-n	32.50e-i	13.62l-o	34.80ij	23.87 l
	T_2- 100% NPK	24.65b-e	29.17g-l	38.75c-g	24.90a-c	53.45c-g	44.67a-g
	T_3- Bio-fertilizers + humic	22.49d-f	38.45b-d	31.78f-j	22.72b-d	39.35hij	31.84h-l
	T_4- Bio-fertilizers + humic + ZnO	22.21e-g	14.83op	21.17 j	21.59b-h	42.78g-j	13.71m
	T_5- 75% NPK + bio-fertilizers + ZnO	17.07h-k	16.10op	34.84d-h	22.54b-e	47.72e-h	25.57kl
	T_6- 50% NPK + bio-fertilizers + ZnO	14.09 k	12.09 p	27.19h-j	17.28g-m	35.29ij	26.44j-l
	T_7- 75% NPK + humic + ZnO	28.51a-c	23.12l-n	47.88a-c	25.47ab	37.39h-j	47.72a-f
	T_8- 50% NPK + humic + ZnO	22.98d-f	21.01m-o	36.93c-h	17.33g-m	34.26 j	48.41a-e
	T_9-75% NPK+bio-fert. + humic+ZnO	28.63ab	32.38d-i	34.29e-h	21.14b-i	59.00a-e	43.58b-h
	T_{10}-50% NPK+bio-fert.+humic+ZnO	23.03d-f	33.73d-h	42.02b-f	17.90e-l	37.89h-j	48.53a-d
Giza 6 Mohassan	T_1- Without fertilization	13.15k	16.66op	35.48d-h	17.71f-m	39.41h-j	28.96i-l
	T_2- 100% NPK	15.22jk	24.36j-n	43.23a-e	13.02m-o	56.23b-f	35.69f-l
	T_3- Bio-fertilizers + humic	21.38e-h	19.60no	29.55g-j	23.35b-d	63.13a-d	34.22g-l
	T_4- Bio-fertilizers + humic + ZnO	16.67i-k	28.37g-l	29.60g-j	14.58k-o	47.28e-h	44.01a-h
	T_5- 75% NPK + bio-fertilizers + ZnO	27.29a-d	38.55b-d	39.30c-g	18.64d-k	56.02b-f	54.95ab
	T_6- 50% NPK + bio-fertilizers + ZnO	24.14b-e	34.55c-g	33.33e-i	20.57c-j	36.65h-j	28.87i-l
	T_7- 75% NPK + humic + ZnO	31.57a	32.83d-i	45.82a-d	20.50c-j	70.16a	43.33b-h
	T_8- 50% NPK + humic + ZnO	22.33e-g	26.23i-m	47.41a-c	15.59k-n	52.92c-g	36.26e-k
	T_9-75% NPK+bio-fert. + humic+ZnO	28.44a-c	19.43no	40.81c-g	16.92h-n	60.43a-d	55.67a
	T_{10}-50% NPK+bio-fert.+humic+ZnO	23.77c-f	28.78g-l	30.34g-j	16.52i-n	58.78a-e	53.77a-c
Giza 20	T_1- Without fertilization	21.02e-i	31.74e-i	22.39 ij	14.09k-o	67.64ab	28.09i-l
	T_2- 100% NPK	28.89ab	35.03c-g	30.01g-j	12.17no	46.00f-j	43.61b-h
	T_3- Bio-fertilizers + humic	22.65d-f	30.33f-k	34.49e-h	10.66o	55.62c-f	28.00i-l
	T_4- Bio-fertilizers + humic + ZnO	23.55d-f	37.17b-e	53.55 a	21.87b-g	58.86a-e	33.33g-l
	T_5- 75% NPK + bio-fertilizers + ZnO	25.74b-e	36.82b-f	43.05a-e	14.62k-o	62.39a-d	41.48d-h
	T_6- 50% NPK + bio-fertilizers + ZnO	24.32b-e	27.08h-m	39.81c-g	16.61i-n	46.19f-i	42.27c-h
	T_7- 75% NPK + humic + ZnO	16.45i-k	42.55ab	30.11g-j	22.33b-f	51.89d-g	37.99d-j
	T_8- 50% NPK + humic + ZnO	17.74g-k	40.70a-c	25.81h-j	27.86a	64.81a-c	39.00d-i
	T_9-75% NPK+bio-fert. + humic+ZnO	13.84k	30.67e-j	52.02ab	16.01j-n	52.14d-g	42.14c-h
	T_{10}-50% NPK+bio-fert.+humic+ZnO	19.13f-j	46.35 a	31.67f-j	14.03k-o	52.75d-g	36.86d-k

Means followed by the same letter or letters are not significantly different of the 5% significance level.

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الملخص العربى

استجابة بعض أصناف البصل للأسمدة المعدنية والحيوية وأسمدة النانو تحت ظروف مصر العليا

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اقيمت هذه الدراسة فى مزرعة التجارب الزراعية بمحطة بحوث جزيرة شندويل – مركز البحوث الزراعية – محافظة سوهاج ، فى موسمى 2016/ 2017 و 2018/2017، لدراسة استجابة بعض اصناف البصل (شندويل1 ، و جيزة 6 محسن، وجيزة 20)، لمعاملات التسميد المختلفة (بدون تسميد، و100% "نيتروجين–فوسفور-بوتاسيوم"، وأسمدة حيوية + حمض الهيوميك، و أسمدة حيوية + حمض الهيوميك + نانوأكسيد الزنك، و75 % "نيتروجين–فوسفور–بوتاسيوم" + اسمدة حيوية + اكسيد زنك نانو، و50% "نيتروجين–فوسفور–بوتاسيوم + اسمدة حيوية + اكسيد زنك نانو، و75% "نيتروجين–فوسفور–بوتاسيوم" + حمض الهيوميك + اكسيد زنك نانو، و50% "نيتروجين–فوسفور-بوتاسيوم" + حمض الهيوميك + اكسيد زنك نانو، و75% "نيتروجين-فوسفور-بوتاسيوم" + اسمدة حيوية + الهيوميك + اكسيد زنك نانو، و50% "نيتروجين-فوسفور-بوتاسيوم" + اسمدة حيوية + الهيوميك + اكسيد زنك نانو. تم تحقيق أعلي قيمه من قطر البصله من خلال الصنف شندويل 1 بينما كانت أقل قيمه من خلال الصنف جيزه 20 فى كلا الموسمين. تم الحصول علي أعلي قيمه من قطر البصله عن طريق المعامله 75% من الأسمده المعدنيه + الأسمده الحيويه + الهيوميك + نانو أكسيد الزنك عند 90 يوم في الموسم الثاني وعند عمر 120 يوم في كلا الموسمين، بينما أعطت المعامله 75% من الأسمده المعدنيه + الهيوميك + نانو أكسيد الزنك أعلي القيم من قطر البصله في عمر 90 يوم في الموسم الأول. - حقق الصنف شندويل 1 أعلي القيم من الوزن الغض والجاف للنبات عند عمر 90 يوم في كلا الموسمين بينما اعطي الصنف جيزه 6 محسن أقل القيم عند عمر 90 يوم في الموسم الثاني. اظهرت معاملة 75% من الأسمده المعدنيه + الأسمده الحيويه + هيوميك + نانو أكسيد الزنك الي تحقيق أعلي القيم من الوزن الغض والجاف للنبات عند عمر 90 يوم ، بينما اعطت اضافة الاسمده المعدنيه بمعدل 100% اعلي القيم من الوزن الغض والجاف للنبات عند عمر 120 يوم وذلك في كلا الموسمين. تم الحصول علي اعلي القيم من متوسط وزن البصله والمحصول الكلي وكذلك التصديري عن طريق زراعة الصنف جيزه 20 مع استخدام المعامله 75% من الاسمده المعدنيه + الاسمدة الحيوية + الهيوميك+ نانو اكسيد الزنك، فى كلا الموسمين. تم الحصول علي اعلي القيم من المحصول التسويقي المحلي عن طريق الصنف جيزه 20 وتحت المعامله 75% من الاسمده المعدنيه + الهيوميك+ نانو اكسيد الزنك، فى كلا الموسمين. تم الحصول على اعلى قيمة من نسبة المواد الصلبه الذائبه الكليه من خلال معاملة عدم التسميد في كلا الموسمين، بينما تم تحقيق أقل قيمه من خلال المعامله 75% من الاسمده المعدنيه+ الهيوميك + نانو اكسيد الزنك في الموسم الأول ومن خلال المعامله 50% من الأسمده المعدنيه + الهيوميك + نانو أكسيد الزنك في الموسم الثاني.