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EFFECT OF BIO AND CHEMICAL FERTILIZATION ON YIELD AND FRUIT QUALITY OF OKRA (*Abelmoschus esculentus* (L.) UNDER SOHAG CONDITIONS

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Okra, NPK, Biofertilizers
Nitrobin
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Potasumag

Abstract
The study was carried out at the Experimental Farm of Faculty of Agriculture, Sohag University, Sohag, Egypt during of 2015 and 2016 seasons. The experiment amid to investigate the efficiency of biofertilizers i.e. (Nitrobin, Phosphorine and Potasiomag) as an effective alternative for nitrogen, phosphorus and potassium chemical fertilizer on okra green fruits and protein percentage. NPK chemical fertilizers were added at four rates i.e. (43.75, 87.5, 131.25 and 175 kg N/fed.), (15, 30, 45 and 60 kg P_2O_5/fed.) and (12.5, 25, 38 and 50 kg K_2O/fed.), respectively. The four rates represent 1/4, 1/2, 3/4 and the whole recommended dose of NPK according to the Ministry of Agriculture, Egypt. Two okra (*Abelmoschus esculentus* (L.) Moench) cultivars i.e. Balady and Eskandrani were used in this study. The obtained results indicated that there were significant differences between the two okra cultivars and among different fertilizer treatments in most studied characteristics in both studied seasons. The interaction between Eskandrani cultivar and bio-fertilizers plus 3/4 NPK significantly enhanced vegetative growth traits, green fruits yield characteristics and its components as well as seed yield characteristics except number of seeds/pod in both seasons. However, the highest protein percentage recorded when Eskandrani cultivar fertilized by recommended dose of chemical NPK or bio-fertilization plus 1/2 NPK or bio-fertilization plus 3/4 NPK with no significant differences among them in both seasons.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is a member under *Malvaceae* Family and is also known as Lady's finger. It is an annual vegetable crop grown from seed in tropical and sub-tropical parts of the world (**Thakur and Arora, 1986)**. It is well distributed throughout the Indian sub-continent and East Asia (**Rashid, 1990**). Its tender green fruits are popular as vegetable among all classes of people in Egypt and elsewhere in the world. It's become essential to use the untraditional fertilizers as a substitute or supplement for chemical fertilizers. In this regard, Nitrogen bacterial bio-fertilizers play an important role in fixing the atmospheric nitrogen and produces

thiamin, riboflavin, nicotin, indole acitic acid and giberalin **(Tien *et al*., 1979** and **Hartmann *et al*., 1983**). Also, phosphate solubilizing microorganisms (PSM) including bacteria have provided an alternative biotechnological solution in sustainable agriculture to meet the P demands of plants **(Zaidi *et al*. 2009)**. Thus, integrated nutrient management has become an accepted strategy to bring about improvement in soil fertility and protecting the environment. Bio-fertilizers a cost effective renewable energy source play a crucial role in reducing the inorganic fertilizer level and at the same time increasing the crop yield besides maintaining the soil fertility. Many researchers studied the effective of bio-fertilizers on improve plant growth and yield such as **Prabu and Pramanik (2002), Khan *et al*. (2007), Ashrafuzzaman *et al*., (2003), Mishra *et al*., (2009), Kadlag, *et al*., (2010), Gupta *et al*., (2011), Dudhat and Asodaria (2012), Mal *et al*., (2013), Tensingh Baliah *et al*., (2015)** and **Choeki and Rekha (2016).** Considering the above facts, the present research was under taken with the following objectives: study the effect of biochemical fertilization on yield and fruit quality of okra under Sohag conditions.

MATERIALS AND METHODS

The present study was carried out during the summer seasons of 2015 and 2016 at the Experimental Farm at El-kowther Faculty of Agriculture, Sohag University, Sohag, Egypt. Some physiochemical characteristics of soil are presented in Table1.

Table (1): Some physiochemical characteristics of El-Kawther experimental farm (New reclaimed soil).

Character	value	Character	value	Character	value	Character	value
Depth (cm)	0-30	$CaCO_3$%	3.0	P (ppm)	14	Sand %	65.92
EC (1-5) dsm^{-1}	0.6	Clay %	12.08	K (ppm)	240	Texture grade	Sandy Loam
pH	8.4	Silt %	22	Organic matter %	0.59	N (ppm)	40

Two okra (*Abelmoschus esculentus* L. Moench) cultivars i.e., (Balady and Eskandrani) were obtained from Vegetable Seed Production Technology Dept., Hort. Res. Inst., Agric. Res. Center, Giza, Egypt. Seed of okra cultivars were treated with bio-fertilizers before sowing. The following chemical fertilizers were used during the study: Nitrogenous fertilizer was added in the form of ammonium nitrate (33.5%N) at three equal doses i.e. (30, 45 and 60 days) from sowing. Nitrogenous fertilizer was added at

four rates (43.75, 87.5, 131.25 and 175 kg N/fed.) The four rates represent 1/4, 1/2, 3/4 and the whole recommended dose according to the Ministry of Agriculture, Egypt. Phosphorus fertilizer was added during soil preparation at four rates (15, 30, 45 and 60 kg P_2O_5/fed.) in the form of calcium super phosphate (15% P_2O_5). The four rates represent 1/4, 1/2, 3/4 and the whole recommended dose according to the Ministry of Agriculture, Egypt. Potassium fertilizer was added at two equal doses in the form of potassium sulfate (50% K_2O).Potassium fertilizer was added at four rates (12.5, 25, 38 and 50 kg K_2O/fed.). The four rates represent 1/4, 1/2, 3/4 and the whole recommended dose according to the Ministry of Agriculture, Egypt.

Bio-fertilizers: Nitrobin (contains two non-symbiotic nitrogen fixing bacteria, *Azotobacter chroococcum* and *Azospirillum barasilense*) with cell density about 1x10 (CFU/g of 8 inoculum). Nitrobin produced by Ministry of Agriculture, Agriculture Research Center, Bio-fertilizers unit. Phosphorine ((containing phosphate dissolving bacterium namely *Bacillus megatherium* or *megaterium*) with cells density around 2x10 (CFU/g of inoculum). Phosphorine produced by Ministry of Agriculture, Agriculture Research Center, Bio-fertilizers unit. Potasiomag (containing potassium dissolving bacterium namely *Bacillus circulans*) *(Bacillus circulance* $1*10^7$/g) (2kg/fed.) was isolated by bio-fertilizer unit, Faculty of Agriculture, Ain Shams University. Both chemical and bio-fertilization treatments were applied as follows. The recommended dose of chemical fertilization (NPK), Bio-fertilizer (Nitrobin + Phosphorin + Potasiomag), Bio-fertilizer + chemical N fertilizer (the recommended dose 175 kg NH_4NO_3 per feddan), Bio-fertilizer + chemical P fertilizer (the recommended dose 400 kg P_2O_5/fed.)., Bio-fertilizer + chemical K fertilizer (the recommended dose 100 kg K_2SO_4 / fed.)., Bio-fertilizer + 1/4 the recommended dose of NPK, Bio-fertilizer + 1/2 the recommended dose of NPK, Bio-fertilizer + 3/4 the recommended dose of NPK. The experiment was laid out in Randomized Complete Block (RCB) design with three replications and split plot arrangement having two factors i.e., Factor A (Okra Cultivars) including Balady and Eskandrani and Factor B (Combination of chemical and bio-fertilization). The two cultivars were arranged in the main plots and fertilizer treatments were assigned in the sub-plots. Organic fertilizer was

added at rate of 30 m^3 / fed. during soil preparation for all studied treatments. Each experimental unit was 10.5 m^2 consisted of five ridges 60 cm apart and 3.5 m length (three ridges were used to determine the green yield parameters and the other two ridges for determine the dry seed yield parameters). Sowing was done in 1st and 5th March in the first and second seasons, respectively by sowing three seeds per hill at 30 cm spacing. Growing plants were thinned to one plant just before first irrigation. Fruits harvesting were done at every three days. Normal cultural procedures known for commercial okra production other than the applied treatments were followed.

Collection of data

Ten plants were selected randomly from net plot area in each plot and tagged with a label for recording observations on various growth, yield and quality parameters as per the schedule of observations. Data were recorded on the following parameters from the sample plants during experiment. The plants in the outer rows were selected for data collection of growth of okra and the other rows were selected for data collection of yield of okra. Measurements as follow: Plant height (cm), Number of branches / ~~per~~ plant, Number of green fruit per plant, Average fruit weight (g), Early yield (ton/fed), Total yield (ton/fed), Number of seeds/ fruit, Weight of 100 seeds (g) and Protein percentage (according to methods outlined by **Jakson 1967)**.

Statistical analysis:

The collected data on various parameters were statically analyzed using MSTAT package program. The mean for all the treatment was calculated and analyses of variances of all the characters were performed by F-variance test. Data obtained during the two seasons of the study were statistically analyzed and treatments means were compared using the Duncan's multiple range tests **(Gomez and Gomez, 1984).**

RESULTS AND DISCUSSION

Plant height (cm)

Data dealing with the effect of chemical and bio-fertilization on plant height (cm) of two okra cultivars during 2015 and 2016 seasons are illustrated in Table (2). It's clear that the two studied cultivars differed significantly in this trait in both seasons. Eskandrani cultivar gave the tallest plants in both seasons. This finding may be due to the genetic variations between cultivars. Chemical and bio-fertilizers affect significantly on this trait in both seasons. The highest values of plant height i.e, (177.8 and

189.8cm) were produced by the bio-fertilizers plus 3/4 the recommended dose of chemical fertilizers. These results are held well in the two experimental seasons. Such results suggest that bio-fertilizers have the ability to supply plants by promoting substances, which could stimulate plant growth traits (**Lambert *et al*., 1979**). Moreover, several investigators emphases that chemical and bio-fertilization enhances plant height such as **Ashrafuzzaman *et al*., (2003), Manga and Mohammed (2006), Omotoso and Shittu (2007) and Uwah *et al*., (2010).** The interaction between the two okra cultivars and different fertilization treatment are presented in Table (2). The interaction between Eskandrani cultivar and bio-fertilizers plus 3/4 NPK gave the highest values i.e, (186.3 and 199.9 cm) in the first and second seasons, respectively. However, the lowest values i.e, (152.3 and 168.9 cm) were resulted in the combination between Balady cultivar and bio-fertilizers plus potassium chemical fertilizer in both seasons. It might be due to the increase in the nutrient availability and preponderance of different groups of microorganisms in soil, which create a favorable condition for proper vegetative growth in general and increased plant height in particular (**Meyer and Anderson, 2003)**. The highest dose of nitrogen might have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth and thereby increasing plant height (**Meyer and Anderson, 2003**). It is evident from the above results that the bio-fertilizers had a beneficial effect on growth attributes, this may be attributed to the plant growth regulating substance such as IAA, GA and/or cytokines which is produced by *Azosperillum* know to promote better growth (**Tiwary *et al*., 1998; Panward and Elanchezhian, 1999; Rethati *et al*., 2000).**

Number of branches/plant

Results concerning with the effect of chemical and bio-fertilization on number of branches of two okra cultivars during 2015 and 2016 seasons are presented in Table (2). It is obviously that the two studied cultivars differed significantly in number of branches in both seasons. Balady gave higher number of branches in the first season. Results in the same table reveal that fertilizations treatments affect this trait significantly in both seasons. Using bio-fertilizers plus 3/4 recommended doses of NPK produced the highest number of branches with no significant differences with the recommended doses of NPK in both seasons. The highest dose of nitrogen might

have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth (**Meyer and Anderson, 2003).** Regarding the interaction between the two studied factors, values in table (3) clear that the interaction between Eskandrani cultivar and bio-fertilizers plus 3/4 recommended doses of NPK significantly increased this trait and gave the highest number of branches in the second seasons as compared by chemical fertilizer separately. The increase in plant vegetative growth as a result of application of inorganic fertilizers alone or in combination with chemical could be attributed to increased uptake of nutrients in the plants leading to enhanced cell division and cell formation and hence the vegetative growth increased. This significant increase in vegetative growth is in agreement with those reported by (**Anburani and Manivannan, 2002; Prabhu *et al.*, 2002 and Wange and Kale, 2004).**

Number of green fruit/ plant

Results presented in Table (2) indicated that both two studied cultivars differed significantly in both seasons .However , Eskandarany cultivar gave higher number of pods / plant as compared by Balady cultivar in both seasons. Eskandarany cultivar exceeds Balady cultivar by (4.34 and 15.48 %) in the first and second season, respectively. Regarding the effect of different fertilization treatment, data in the above mentioned Table show that both the recommended dose of chemical NPK and bio-fertilizer plus 3/4 NPK significantly increased this character as compared by all other treatments in both seasons. Moreover, the two treatments did not differ significantly between them. Regarding discussion the former results, several workers have reported linear increase in green pod yield of okra with the application of fertilizers (**Gupta *et al*., 1981, Singh, 1995, Mohanta 1998 and Sadat, 2000.** Concerning the effect of interaction between the two cultivars and different fertilization treatments, results in Table (4) Cleary reveal that the interactions significantly effect on number of pods / plant in both seasons. Meanwhile, the highest values of this character i.e, (67.67 and 72.67) were produced by Eskandarani cultivar when fertilized by recommended doses of NPK plus 1/2 NPK and 3/4 NPK in the first and second seasons, respectively. Increase in fruit yield and its parameters may be due to increase in vegetative growth which worked as an efficient photosynthesis structure and produced high amount of carbohydrates in the plant system.

More number of branches which have borne more number of flowers, have resulted higher fruits per plant and fruit yield and their attributes (**Prabhu *et al*., 2002**).

Average fruits weight (g)

As shown in Table **(**3**)** the two okra cultivars differed in average pod weight (gm), but the differences were more announced and statistically approved in the second season with Balady cultivar. With regard to the effect of fertilization treatments on average pod weight (gm), values in Table (7) revealed that this character effected significantly by fertilization treatments in both seasons. The highest values fluctuated between chemical and bio-fertilizers treatments. The highest values were produced by the recommended doses of NPK in the first season. While, in the second season, the bio-fertilization plus 1/2 NPK gave the highest values of this character. These results are in general trend with those found by **Manga and Mohammed (2006)** and **Sunita *et al*., (2006).** This might occur due to increased photosynthetic area and translocation of photosynthates in plants which subsequently accelerated the formation of more number of large sized fruits with more number of seeds/ fruits resulting in increase in fruit weight. Regarding the effect of different studied interactions, results indicated that fertilized Eskandaraniٍ cultivar with recommended dose of NPK gave the highest values but did not differ significantly with values produced by Balady cultivar with bio-fertilization plus 3/4 NPK in the first season. However, in the second season, the interaction between Balady cultivar and bio-fertilization only gave best values for this character , but also did not differ significantly with the interaction between Balady with bio-fertilization plus 3/4 NPK. The increase in fresh fruits weight of okra due to bio-fertilizer application could be attributed to easy solubilization effect of released plant nutrient leading to improve nutrient status and water holding capacity of the soil. The results obtained were in agreement with the findings of **Premsekhar and Rajashree (2009).**

Early yield (ton/fed.)

Results listed in Table (3) clearly reveal that okra cultivar type significantly affect on early fresh yield in the first season. However, Eskandaraniٍ cultivar surpassed Balady cultivar in both seasons (Shaheen, *et al.,* 2007). Data in the same Table show that chemical and bio-fertilization affect significantly on early fresh yield in both season. The highest values i.e, (2.451 and 4.227 ton/fed.) were recorded by bio-fertilization plus 3/4 NPK in the

first and second season, respectively. The favorable effect of bio-fertilizer in promotion of aforesaid growth parameters might be due to the fact that bio-fertilizer play a key role in energetic metabolism and biosynthetic reaction as a component of ATP. DNA, NADP and RNA which governs cell multiplication resulting in rapid plant growth. These results are in agreement with those reported **by El-shaikh (2005) and Uwah *et al.*, (2010).** Concerning the influence of interaction between okra cultivars and fertilization treatments, results in Table (3) clearly indicate that fertilized Eskandarani cultivar with bio-fertilization plus 3/4 NPK yielded the highest early fresh yield in the first season. While, fertilized Balady cultivar by the same fertilizer treatment gave the highest values in both seasons. The stimulating effect of bio-fertilizer on the growth performance of crop might also be due to the rapid availability of nutrient from the soil to the plant as well as to micro-organism responsible for nitrogen fixation and all these related with increasing in plant yield. These results are in agreement with those reported by **El- shaikh (2005) and Uwah *et al.*, (2010).**

Total yield (ton/fed.)

Results tabulated in Table (4) indicated that the two tested cultivars i.e (Balady and Eskandarani) did not differ significantly regarding this character in both seasons. Concerning the effect of fertilization treatments on total yield values in Table (9) reveal that fertilization treatments affect significantly on this character in both seasons. Moreover, the highest total yield i.e., (6.275 and 7.305 ton/fed.) were achieved by bio-fertilization plus 3/4 NPK in to the first and second season, respectively. This might be due to the better availability and uptake of nutrients by plants for a longer duration of crop growth. Similar findings of significantly higher number of fruits/ plant by integrated application of fertilizers have also been reported by **Prabhu *et al.*, (2003)** in okra. The interaction between the two studied factors in Table (4) clearly show that interactions significantly effect on this character in both seasons .The highest values of total yield i.e., (6.504 and 7.305 ton/fed.). were resulted in the interaction between Eskandarani cultivar and bio-fertilization plus 3/4 NPK in the first and second season respectively. These results could be explained in the light of increments induced in most previous discussed characters i.e., (plant height, number of branches, number of green fruits/ plant, fruit length and diameter, early yield)

surly reflection increasing of total yield. They finding the increase in yield of okra due to bio-fertilizer application could be attributed to easy solubilization effect of released plant nutrient leading to improve nutrient status and water holding capacity of the soil. The results obtained were in agreement with the findings of **Sanwal *et al*., (2007)** in turmeric (*Curcuma longa*) **Premsekhar and Rajashree (2009).**

Number of seeds/ fruit

Data dealing with the effect of chemical and bio-fertilization on number of seeds / pod of two okra cultivars during 2015 / 2016 seasons are presented in Table (4). The results indicate that the two tested cultivars did not differ significantly in this character in both seasons. However, Eskandaraniٕ cultivar gave slightly increments more than Balady cultivar in both seasons. Using different fertilization treatment effect on number of seeds / pod, but the differences were more announced and statistically approved only in the first seasons. Furthermore, the highest values of this character i.e., (55 and 54.83) were obtained from the recommended dose of chemical NPK in the first and second season, respectively. Many others came to the same general trend **El-shaikh (2005) and Sajid *et al*., (2012).** The interaction between the two studied factors significantly affects this character in both seasons. The highest values of number of seeds / pod i.e., (61.67 and 62.33) were recorded when Balady cultivar fertilized with bio-fertilizer plus recommended dose of nitrogen in the first and second season, respectively. This has been the consequence as a result of higher nutrient availability and increased nitrogen from both chemical and inorganic fertilizers which had profound influence in mobilizing the nutrients from the unavailable form of nutrients mainly due to improved physical, chemical and biological properties of the soil. Many authors assure this result such as **El- sheikh (2005) and Sajid *et al*., (2012).**

Weight of 100 seeds (g.)

Weight of 100-seeds is an important component of seed yield of okra. Data presented in Table (4) show that the two studied cultivars differed in this character, but the differences failed to be a significant from the statistical point of view only in the second season. Eskandaraniٕ cultivar produced the highest values in both seasons. These results are in agreement with those mentioned by **Chattopadhyay and Sahana (2000).** Regarding the effect of fertilization treatments, data in the same Table (4) revealed that fertilization treatments

significantly effect on this character in both seasons. The highest values were obtained by the recommended dose of chemical fertilizer NPK followed by bio-fertilization plus 3/4 NPK with no significant differences between them in both seasons. These results are in line with those reported by **Marschner (1995)** who mentioned that, phosphorus positively effect on metabolic processes including cell division, expansion and formation and movement of carbohydrate. Also, encouraging blooming, pod setting, fertility, weight of 1000-seed, seed yield and germination percentage. These results in harmony with those found by **El-Shaikh (2005) and Firoz (2009).** The interaction between the two studied factors significantly affected this character in both seasons. The highest values i.e, (6.735) were achieved by the combination between chemical NPK and Eskandaranɣ cultivar in both seasons. These results could be explained in the light of an improvement in seed quality attributes may be attributed to the fact that the providing of adequate nutrition to the mother plant has reflected on seed quality attributes due to efficient accumulation and assimilation of photosynthates.

Protein percentage

Data listed in Table (4) show that protein percentage was affected by type of cultivars. Eskandaranɣ cultivar value higher than Balady cultivar but differences was not significant from the statistical point of view. Fertilizing the two tested cultivars significantly effect on this trait. The highest value was produced by bio-fertilization plus 3/4 NPK. The increase in nitrogen content in fruits might be due to adequate fertilization have also been observed by **Nanthakumar and Veeragavathatham (2001).** The accumulation of higher protein content in the fruits might be correlated with the increased activity of nitrate reductase enzyme which helps in synthesis of certain amino acids and proteins. These results are also corroborated by the findings of **Chander *et al*., (2005), Ramesh *et al*., (2006), Yadav *et al*., (2006) and Garhwal *et al*., (2007).** Regarding the interaction between the two studied factors, data in Table (4) indicate that this trait significantly affected by fertilization treatments. However, the highest protein percentage recorded when Eskandaranɣ cultivar fertilized by recommended dose of chemical NPK or bio-fertilization plus 1/2 NPK or bio-fertilization plus 3/4 NPK with no significant differences among them.

Table 2: Effect of chemical and bio-fertilizers on plant height (cm), number of branches and number of green fruit/ plant of two okra cultivars during 2015 and 2016 seasons under Sohag conditions.

Fertilization Treatments (B)		Plant height (cm)						Number of branches/plant						Number of green fruit/ plant					
		2015 season			2016 season			2015 season			2016 season			2015 season			2016 season		
		Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean
		Balady	Eskandaranyi		Balady	Eskandaranyi		Balady	Eskandaranyi		Balady	Eskandaranyi		Balady	Eskandaranyi		Balady	Eskandaranyi	
1	Recommended dose of NPK(R.D NPK)	159.3 hi	171.7 c	**165.5 C**	185.3 c	184.4 c	**184.9 B**	3.967 ab	3.617 abc	**3.792 A**	4.000 abc	3.633 bcd	**3.817 AB**	43.00 c	66.13 a	**54.57 A**	64.00 bc	66.47 b	**65.23 AB**
2	(Nitrobin + phosphorin+ potasiomag) (Biofertilizer)	152.7 jk	156.3 ijk	**154.5 E**	173.4 fg	172.9 fg	**173.2 D**	3.600 abc	2.100 e	**2.850 B**	3.267 cd	3.100 d	**3.183 D**	34.33 d	59.00 b	**46.67 C**	51.67 e	66.67 b	**59.17 C**
3	Biofertilizer + Recommended dose of N fertilizer	165.8 def	163.9 ^{B} e-h	**164.8 CD**	178.6 de	182.8 cd	**180.7 C**	3.953 ab	3.033 cd	**3.493 A**	3.333 cd	3.633 bcd	**3.483 BCD**	32.00 df	65.47 a	**48.73 BC**	55.87 de	65.33 b	**60.60 C**
4	Biofertilizer + Recommended dose of P fertilizer	160.7 ghi	162.7 fgh	**161.7 D**	182.3 cd	176.2 ef	**179.3 C**	4.410 a	3.017 cd	**3.713 A**	2.933 d	3.600 bcd	**3.267 CD**	29.33 ef	64.67 a	**47.00 C**	52.87 e	65.33 b	**59.10 C**
5	Biofertilizer + Recommended dose of K fertilizer	152.3 k	157.2 ij	**154.8 E**	168.9 g	175.1 ef	**172.0 D**	4.067 ab	2.693 de	**3.380 AB**	3.000 d	3.100 d	**3.050 D**	26.67 f	67.33 a	**47.00 C**	58.93 cd	66.33 b	**62.63 BC**
6	Biofertilizer + 1/4 (R.D NPK)	162.7 fgh	168.9 cde	**165.7 C**	175.3 ef	186.3 c	**180.8 C**	3.977 ab	3.467 bcd	**3.722 A**	3.000 d	4.133 ab	**3.567 BCD**	33.33 df	65.33 a	**49.33 BC**	52.60 e	68.33 ab	**60.47 C**
7	Biofertilizer + 1/2 (R.D NPK)	164.7 d-g	178.0 b	**171.3B**	175.4 ef	192.9 b	**184.1 B**	3.583 abc	3.567 abc	**3.575 A**	3.333 cd	4.200 ab	**3.767 ABC**	33.33 df	67.67 a	**50.50 B**	56.67 de	68.33 ab	**62.50 BC**
8	Biofertilizer + 3/4 (R.D NPK)	169.3 cd	186.3 a	**177.8 A**	179.7 de	199.9 a	**189.8 A**	4.187 ab	3.800 abc	**3.993 A**	3.667 bcd	4.600 a	**4.133 A**	42.67 c	66.33 a	**54.50 A**	63.33 bc	72.67 a	**68.00 A**
Mean		**160.9 B**	**168.1 A**		**177.4 B**	**183.8 A**		**3.968 A**	**3.162 B**		**3.320 A**	**3.750 A**		**34.33 B**	**65.24 A**		**56.99 B**	**67.43 A**	

* **Means followed by the same letter or letters are not significantly difference at level 5 %.**

Table 3: Effect of chemical and bio-fertilizers on average fruits weight (g), early yield (ton/fed.) and total yield (ton/fed.) of two okra cultivars during 2015 and 2016 seasons under Sohag conditions.

		Average fruits weight (g)						Early yield (ton/fed.)						Total yield (ton/fed.					
		2015 season			2016 season			2015 season			2016 season			2015 season			2016 season		
		Okra cultivars (A)			Okra cultivars (A)			Okra cultivars (A)			Okra cultivars (A)			Okra cultivars (A)			Okra cultivars (A)		
Fertilization Treatments (B)		Balady	Eskandarany	Mean	Balady	Eskandarany	Mean	Balady	Eskandarany	Mean	Balady	Eskandarany	Mean	Balady	Eskandarany	Mean	Balady	Eskandarany	Mean
1	Recommended dose of NPK(R.D NPK)	15.03 bc	18.41 a	**16.72 A**	19.13 a-d	16.00 c-f	**17.56 AB**	1.406 gh	1.774 fgh	**1.590 DE**	1.821 ijk	2.270 ghi	**2.045 D**	4.652 c	3.804 de	**4.228 C**	5.229 c	4.605 d	**4.917 CD**
2	(Nitrobin + phosphorin+ potasiomag) (Biofertilizer)	11.77 d	13.46 cd	**12.62 B**	23.48 a	12.01 f	**17.74 AB**	1.734 fgh	2.378 bcd	**2.056 BC**	1.359 k	2.881 def	**2.120 D**	3.690 de	5.774 ab	**4.732 B**	2.574 f	6.574 b	**4.574 DE**
3	Biofertilizer + Recommended dose of N fertilizer	13.97 cd	13.78 cd	**13.87 B**	18.23 bcd	11.73 f	**14.98 BC**	1.801 efg	2.162 c-f	**1.982 BC**	3.032 def	2.662 fgh	**2.847 C**	3.432 ef	3.891 de	**3.662 D**	5.592 c	4.690 d	**5.141 BC**
4	Biofertilizer + Recommended dose of P fertilizer	11.72 d	13.00 cd	**12.36 B**	18.58 bcd	13.00 f	**15.79 BC**	1.392 gh	2.276 cde	**1.834 CDE**	1.470 k	2.774 efg	**2.122 D**	2.235 g	3.787 de	**3.011 E**	5.543 c	4.589 d	**5.066 C**
5	Biofertilizer + Recommended dose of K fertilizer	11.84 d	15.65 abc	**13.74 B**	16.55 cde	12.00 f	**14.28 C**	1.442 gh	1.659 fgh	**1.550 E**	1.632 jk	2.159 hij	**1.896 D**	2.707 fg	3.231 ef	**2.969 E**	4.693 d	4.029 e	**4.361 E**
6	Biofertilizer + 1/4 (R.D NPK)	11.79 d	13.00 cd	**12.39 B**	20.35 abc	15.06 def	**17.70 AB**	1.287 h	2.557 abc	**1.922 CD**	4.137 b	3.057 def	**3.597 B**	3.756 df	3.835 de	**3.795 CD**	5.516 c	4.640 d	**5.078 C**
7	Biofertilizer + 1/2 (R.D NPK)	12.69 cd	14.00 cd	**13.35 B**	21.16 ab	17.50 b-e	**19.33 A**	1.785 fgh	2.783 ab	**2.284 AB**	3.805 bc	3.283 cdf	**3.544 B**	5.427 b	4.458cd	**4.943 B**	5.723 c	5.260 c	**5.491 B**
8	Biofertilizer + 3/4 (R.D NPK)	17.33 ab	15.35 bc	**16.34 A**	21.34 ab	17.00 b-e	**19.17 A**	1.963 def	2.939 a	**2.451 A**	5.017 a	3.436 cd	**4.227 A**	6.046 ab	6.504 a	**6.275 A**	6.977 ab	7.305 a	**7.141 A**
Mean		**13.27 A**	**14.58A**		**19.85 A**	**14.29 B**		**1.601 B**	**2.316 A**		**2.780 A**	**2.820 A**		**3.993 A**	**4.410 A**		**5.230 A**	**5.210 A**	

* **Means followed by the same letter or letters are not significantly difference at level 5 % .**

Table 4: Effect of chemical and bio-fertilizers on number of seeds/ fruit, weight of 100 seeds (g.) and protein percentage

of two okra cultivars during 2015 and 2016 seasons under Sohag conditions.

Fertilization Treatments (B)		Number of seeds/ fruit						Weight of 100 seeds (g.)						Protein percentage		
		2015 season			2016 season			2015 season			2016 season			2016 season		
		Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean	Okra cultivars (A)		Mean
		Balady	Eskandarany		Balady	Eskandarany		Balady	Eskandarany		Balady	Eskandarany		Balady	Eskandarany	
1	Recommended dose of NPK(R.D NPK)	54.00 b	56 ab	**55.00 A**	54.67 ab	55.00 ab	**54.83 A**	6.333 abc	6.735 a	**6.534 A**	6.397 abc	6.735 a	**6.566 A**	15.75 de	20.14 a	**17.94 AB**
2	(Nitrobin + phosphorin+ potasiomag) (Biofertilizer)	44.67 cd	52.00 b	**48.33 CD**	45.33 cde	55.33 ab	**50.33 A**	5.900 cd	5.200 e	**5.550 C**	5.744 f	5.200 g	**5.472 D**	15.32 de	14.00 e	**14.66 E**
3	Biofertilizer + Recommended dose of N fertilizer	61.67 a	41.67 d	**51.67 A-D**	62.33 a	41.67 e	**52.00 A**	6.267 abc	6.143 bc	**6.205 AB**	5.423 g	6.140 cdf	**5.781 C**	16.19 cd	18.38 ab	**17.29 BC**
4	Biofertilizer + Recommended dose of P fertilizer	43.00 d	53.00 b	**48.00 D**	43.67 e	53.67 e	**48.67 A**	6.267 abc	6.333 abc	**6.300 AB**	6.027 def	6.342 bcd	**6.185 B**	15.75 de	15.76 de	**15.75 DE**
5	Biofertilizer + Recommended dose of K fertilizer	51.33 b	50.00 bc	**50.67 A-D**	53.00 bc	50.00 b-e	**51.50 A**	5.521 de	6.567 ab	**6.044 B**	5.315 g	6.575 ab	**5.945 C**	18.82 ab	14.44 de	**16.63 CD**
6	Biofertilizer + 1/4 (R.D NPK)	44.67 cd	55.33 ab	**50.00 BCD**	44.33 de	55.33 ab	**49.83 A**	6.149 bc	6.370 abc	**6.260 AB**	6.125 cdf	6.341 bcd	**6.233 B**	14.01 e	15.32 de	**14.66 E**
7	Biofertilizer + 1/2 (R.D NPK)	55.33 ab	52.67 b	**54.00 AB**	55.33 ab	52.33 bcd	**53.83 A**	6.058 bc	6.475 ab	**6.267 AB**	5.871 ef	6.475 abc	**6.173 B**	15.32 de	20.14 a	**17.73 ABC**
8	Biofertilizer + 3/4 (R.D NPK)	54.00 b	52.00 b	**53.00 ABC**	54.00 ab	52.33 bcd	**53.17 A**	6.333 abc	6.531 ab	**6.432 A**	6.274 bcd	6.525 ab	**6.399 AB**	17.80 bc	20.01 a	**18.90 A**
Mean		**51.08 A**	**51.58 A**		**51.58 A**	**51.96 A**		**6.104 A**	**6.294 A**		**5.900 B**	**6.290 A**		**16.12 A**	**17.27 A**	

* **Means followed by the same letter or letters are not significantly difference at level 5 % .**

Recommendations:

It could be recommended that fertilizing okra Eskandrani cultivar by bio-fertilizers (Nitrobin, Phosphorine and Potasiomag) plus 3/4 NPK to obtain the highest green fruits yield ton/ fed., the highest seed yield and the highest protein percentage under the same conditions.

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