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Effect of Biofertilizer Applications on Yield Components and Ginned Cotton Characteristics of some Egyptian Cotton Genotypes Growing in Clay and Calcareous Soil

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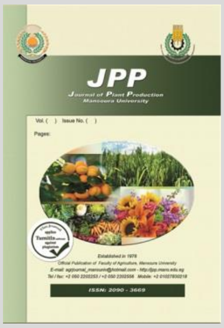

ABSTRACT

Two years field study were carried out in El-Noubaria and Sakha research station, Cotton Research Institute, Agricultural Research Center at Giza, Egypt, during 2018 and 2019 seasons. The aim of this study was to study the effects of inoculating some Egyptian cotton genotypes (Giza 97 and Giza 96) grown on clay and calcareous soils with different bio-fertilizers *(Bacillus Polymxa, Bacillus megaterium, Bacillus circulans, Azotobacter and Azospirillum)* on yield components and ginned cotton characteristics. Results showed that when added the bacterial strains to the soil three times at 65, 85 and 105 days after sowing through the irrigation water of cotton plants, the bio treatments improved the absorption and available of NPK leading to reproductive organ, exhibited the result higher significant values due all the treatments with using low amount of mineral fertilizers. There was a significant increase in Sakha region with clay soil for most traits compared to Noubaria region with calcareous soil, while there were no significant differences in Noubaria region for short fiber index and upper half mean. The bio treatments in most traits under study give that highly significant increased. Generally, the application of Biofertilizer improved yield and its components and ginned cotton properties of some Egyptian cotton genotypes in clay and calcareous soils.

Keywords: Biofertilizer; Cotton genotypes; Bacillus; Azotobacter; Azospirillum; Yield traits; Fiber quality; Yarn properties.

INTRODUCTION

Extensive use of chemical fertilizer affects negatively on soil health (Atieno *et al.*, 2020). Probably, bio-fertilizers are the promising alternatives to chemical fertilizers (Nosheen *et al.*, 2021). This cost effective approach can supply plants with nutrients continuously during the entire period of crop growth without deteriorating soil quality (Roy, 2021) or polluting the surrounding environment (Nayak *et al.*, 2019). Moreover, they suppress soil borne pathogens (Mohamed *et al.*, 2019 and Ramakrishna *et al.*, 2019) and supply plants with growth promoting substances like hormones vitamins, amino acids *etc*. Accordingly, bio-fertilization is thought to be the suitable approach for sustaining long term soil fertility to meet global food demands (Nosheen *et al.*, 2021). Recently, biofertilization is gaining the worldwide attention under the broad general category known as plant growth promoting rhizobacteria (PGPR) or plant health promoting rhizobacteria (Olanrewaju *et al.*, 2017). To what extent can biofertilizers substitute commercial fertilizers in cotton production, this point was a matter of concern in this study.

Tolba *et al.* (2021), They found that, the Egyptian cotton variety (Giza 97) was significantly superior to the variety (Giza 94) when treated with mineral fertilization as recommended dose and foliar spray of compost tea plus algae extracts treatment recorded the greatest No. of sympodial/plant, No. of fruiting sites/plant, No. of opened bolls/plant, No. of total bolls/plant, opened bolls %, seed cotton yield/plant, lint cotton yield/plant, boll weight, lint %, seed cotton yield/fed and lint cotton yield/fed , followed by the treatment of cotton plants with 75% of the mineral fertilizers and spraying with algae extract during the two seasons of the study compared with the treatment of 100% of the mineral fertilizers, which gave significantly the lowest average values of those characteristics.

The Egyptian cotton variety of Giza 97 and Giza 94 treated with 75 % mineral fertilization as recommended dose and foliar spray of compost tea plus algae extracts produced the highest mean values of No. of sympodial/plant, No. of opened bolls/plant, boll weight, lint %, seed cotton yield/fed, lint cotton yield/fed, fiber bundle strength, micronaire value, fiber diameter, fiber circumference and lea count strength product as well as recorded the lowest mean values of No. of neps/100 m in the first and second seasons. Tolba *et al .* (2021).

PGPR strains were selected to attain the aim of the study *i.e. Paenibacillus polymyxa*, *Bacillus megaterium*, *Bacillus circulans*, *Azotobacter and Azospirillum*. In case of *Paenibacillus polymyxa* (previously known as *Bacillus polymyxa*), this bacteria has the ability to fix atmospheric nitrogen and solubilize phosphate (Padda *et al.*, 2017); therefore, improve the growth and productivity of cotton plants (Abhishek Mathur, 2021).

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Bacillus species secrete organic acids that lower soil pH and facilitate the solubility of mineral in the soil (Ambergerig, 1993), especially phosphorus; consequently plant inoculation with *Bacillus sp.* can increase P availability and uptake by the grown plants, e.g. Bacillus megaterium (Mukhtar *et al.,* 2017) and *Bacillus circulans* (Kalayu, 2019). This might take place via release of siderophores that chelate and increase nutrient availability in soil (Ravikumar *et al.,* 2003, Chauhan *et al.,* 2015 and Ansari *et al.,* 2017). Several reports highlighted their positive effects on promoting cotton growth (Diaz, *et al.,* 2019) and productivity (weight of bolls, number of bolls per plants, seed cotton yield) as well as fiber quality parameters (span length, uniformity ratio, micronaire value, tenacity, EIG %) (Ambergerig, 1993). On the other hand, Azotobacter and Azospirillum species are N-fixers (Reddy *et al.,* 2018) also; they increased P solubility besides increasing the uptake of soil N by plants (Nosheen, *et al.,* 2019). Every type of these biofertilizer has its own mode of action (Mohamed *et al.,* 2019). It remove thought that the combined inoculations can further increases in plant growth than single inoculations (Ahmed *et al.,* 2020; Ahmed *et al.,* 2021). The main goal of the current study was to investigate the effects of inoculating of some Egyptian cotton genotypes grown on clay and calcareous soils with different bio-fertilizers on yield components and ginned cotton characteristics.

MATERIALS AND METHODS

Study Site:

This experiment was conducted at El-Noubaria and Sakha Agriculture Research Station, Cotton Research Institute, Agriculture Research Center Giza, Egypt during the two successive summer seasons 2018 and 2019.

El-Noubaria station is located at the East side of Cairo-Alexandria desert road, about 47 km south of Alexandria Governorate. Sakha station is located at the south side, about 2 km of Kafr El-Sheikh governorate. The sites of the study are considered within the semi-arid and arid regions. The two sites are dominated by a Mediterranean climate with hot arid summer and little rainfall precipitation in winter. This climate is good for growing cotton which requires up to 160 to 180 days until ripening. Generally, cotton was planted after harvesting Egyptian clover (legumes crop) in both sites of the experiment.

Soil sampling:

Soil samples of the experiment were collected from the surface layer (0- 30 cm) before treatment applications in both seasons. The soils were air dried, passed through 2 mm sieve. Particle size distribution was determined by the pipette method, using sodium hexametaphosphate as a dispersing agent (Kroetsch and Wang, 2007). Soil organic matter (SOM) was determined by using the modified Walkley and Black method (Nelson and Sommers, 1996). The soil EC, pH and $CaCO_3$ were also estimated (Sparks, 1996). Main properties of the soils are given in Table 1.

Cotton genotypes and microorganisms inoculum preparations:

Egyptian cotton (*Gossypium barbadence L.*) seed cultivars of long stable Giza 97 and extra-long stable, Giza 96 were brought from the Cotton Research Institute, Agricultural Research Centre at Giza, Egypt.

Microorganisms belong *Bacillus polymxa* (B.p.), *Bacillus megaterium* (B.m.), *Bacillus circulans* (B.c.), *Azotobacter* (AZot.) and *Azospirillum* (Azos.) were provided by the bio-fertilizers inoculum were prepared in Department of Microbiology Soil, Water & Environment Research Institute, Agricultural Research Centre, at Giza, Egypt.

Table 1. Physiochemical properties of the studied soils (2018 and 2019) seasons.

Properties	Average of 2018 and 2019	
	El-Nubaria	Sakha
Physical analysis:		
Course sand, %	37.1	9.99
Find sand, %	36.1	11.57
Silt, %	8.0	18.79
Clay, %	18.8	59.65
Texture (USDA)	Sandy loam	Clay
Chemical analysis:		
pH	8.08	7.62
EC, dSm^{-1}	1.23	0.53
$CaCO_3$, g kg^{-1}	220.13	8.98
SOM , g kg^{-1}	1.28	2.97

Note: pH of 1:2.5 soil: water suspension; EC of soil past extract ;USDA is the United States Department of Agriculture

The liquid inoculum of microorganisms was mixed with sterilized peat to be used either separately or in combination as follows: 20-ml inoculum (bacterial concentration of about 109 cells per ml) was diluted with 10 L water to get a bacterial suspension of 2×10^{-7} cells /ml. Two kg cotton seeds (Giza 97 and Giza 96) were dipped in this suspension and stirred for 15 min. Thereafter, treated seeds were removed, spread on a thin layer on paper, air dried and sown in soils.

Experimental design:

A field experiment was laid out in a combined split plot design with 3 replicates in El-Noubaria and Sakha research stations, comprising four factors: (1) Cotton varieties (in main -plots), (2) cultivation area (site), (3) the growing seasons and (4) fertilization treatments (in sub-plots) which are follows;

1- Control (100% mineral fertilizer recommended dose 60 kg N / feddan, 30 kg K / feddan and 15 kg P_2O_5 /feddan)
2- *Bacillus polymxa* (B.p) + 50% of the recommended NPK doses.
3- *Bacillus megaterium* (B.m) + 50% of the recommended NPK doses.
4- *Bacillus circulans* (B.c) + 50% of the recommended NPK doses.
5- *Azotobacter* (Azoto.) +50% of the recommended NPK doses.
6- *Azospirillum*. (Azospir.) + 50% of the recommended NPK doses.
7- Mix (B.p., B.m., B.c., Azoto, and Azospir.).

Seeds of cotton (Giza 97 and Giza 96) were sown using a hand drill. Inoculations with biofertilizers were repeated three times at 65, 85 and 105 days after sowing with the irrigation water (5 L fed^{-1}). All agriculture managements were applied as recommended for these areas.

Sampling and collecting data:

Yield characteristics:

After 180 days of planting, 10 plants were sampled randomly from each plot to calculate the following:

- Boll weight (BW, g): The average weight of 50 bolls in gram.
- Lint percentage (Lint%): The ratio of lint weight to seed cotton weight in the sample expressed as percentage.

The whole plot was also harvested at the physiological maturity stage to estimate Seed cotton yield (kentar per feddan k/f)

Fiber quality:

Samples of lint cotton from each treatment under each location were tested in the laboratories of the Cotton Technology Research Division at Giza, Cotton Research Institute to determine fiber quality, under the controlled conditions of 8 ± 0.5 mist, 65 ± 2% relative humidity and 70 ± 2F ° temperatures for all samples. Fiber properties were measured by using High Volume Instrument (HVI) according to (ASTM. D-4605-1986) for fiber properties:

- Short fiber index (SFI %)
- Fiber length: upper half means mm (UHM).
- Uniformity index (UI, %).
- Micronaire reading (Mic.).
- Fiber mechanical characters:

* Strength in gram /Tex (St.).
* Elongation % (El. %) the percentage of Elongation, which occurs before a fiber bundle breaks.

Yarn properties:

Studied samples were yarns strength, yarn evenness and neps count at the ring spinning system 60 s carded count yarns at 4 (T.M.) for tests of yarn properties were determined at the Spinning Research Department of Cotton Research Institute of Giza, Egypt for tests of yarn properties.

- **Yarn Strength (YS):** (lea product) was determined by testing the skein strength on the Good Brand Lea Tester to estimate the lea strength (lea product) in pounds (ASTM: D-1578, 1967) from the following formula. Lea product = corrected breaking load in pounds × nominal count.
- **Coefficient of variation**: coefficient of variation or the mean yarn evenness (Cv. %).
- **No. of neps** (Neps) / 100 m, of the yarn were measured by Uster Tester III as described by the designation of the ASTM: D. 1578, 1967.

Statistical analysis:

Data analyses were computed by M-Stat 6.311 (1998-2005) for a factorial combined split plot design over all seasons and locations according the procedure of Snedecor and Cochran (1981). To test differences among studied mean values; the least significant difference (L.S.D.) method was used at 0.05 level of probability.

RESULTS AND DISCUSSION

Data presented in Table 2 indicated that the mean values of cotton yield; fiber and yarn quality did not reach significantly between the two seasons of study; yet, the boll weight changed significantly. Also, upper half mean, uniformity index and strength were significant variations between the two seasons. All yarn properties: i.e., yarn strength, yarn evenness and number of neps count gave insignificant value.

Results in the Table 2, reported that the mean values of the locations for yield, fiber quality and yarn properties in Egyptian cotton cultivars *i.e.* boll weight, seed cotton yield and lint percentage gave significant increase. Also, the fiber quality i.e. uniformity index, micronaire reading, strength and elongation of the under study significantly increase. There was a significant increase in the Sakha region with clay soil for most of the traits under study compared to the Noubaria region with calcareous soil, while there were no significant differences between regions for short fiber index, upper half mean, coefficient of variation and number of neps count. On the other hand, the uniformity index, coefficient of variation yarn evenness and the number of neps count. These results are in conformity with those revealed by Ahmed *et al.*, 2021.

Referring to data in Table 2, cleared that the effects of varieties on yield, fiber and yarn properties in Egyptian cotton cultivars under study were highly significant except for the boll weight and lint percentage insignificantly. G97 variety produced significantly higher seed cotton yield (8.98 Kentar/feddan) than G 96 (8.39 Kentar/feddan).

Table 2. Impact of years, locations, varieties and biofertilizers on yield, fiber and yarn properties in Egyptian cotton cultivars

Years												
Character.		**Yield**				**Fiber**					**Yarn**	
Years	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
2018	2.35	8.58	36.43	6.04	33.11	85.79	4.01	42.72	6.61	2320.2	11.8	106.7
2019	2.39	8.53	36.36	5.80	32.99	85.52	3.98	42.50	6.75	2346.6	11.7	106.7
LSD 0.05	**	Ns	Ns	Ns	**	**	Ns	*	Ns	Ns	Ns	Ns
					Locations							
Location	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
El-Noubaria	1.92	7.58	35.75	5.98	33.05	85.55	4.07	42.34	6.56	2368.5	11.8	106.7
Sakha	2.82	9.53	37.04	5.86	33.45	85.76	3.92	42.88	6.81	2298.3	10.7	98.7
L S D 0.05	**	**	**	Ns	Ns	*	**	**	**	**	Ns	Ns
					Varieties							
Varieties	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
G 97	2.38	8.98	36.38	5.45	32.90	85.25	4.10	42.93	6.05	2201.7	10.0	78.7
G 96	2.34	8.39	36.23	5.86	36.18	86.76	3.73	44.02	6.00	2378.7	11.2	92.5
LSD 0.05	Ns	**	Ns	**	**	**	**	**	**	**	**	**
					Biofertilizers							
Treat.	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
cont.	2.26	7.41	35.27	9.37	32.79	85.18	3.93	42.52	6.53	2360.4	11.9	100.0
B.P.	2.38	8.12	36.26	5.20	33.05	85.52	3.98	42.03	6.67	2349.3	10.7	102.1
B.M.	2.36	8.44	36.33	5.09	32.84	85.78	4.02	42.58	6.69	2374.2	9.5	104.6
B.C.	2.40	8.42	36.74	4.96	33.05	85.94	3.99	42.43	6.86	2343.7	10.5	94.6
Azot.	2.39	8.74	36.79	5.61	32.95	85.28	3.97	43.21	6.47	2266.0	11.7	101.7
Azos.	2.35	8.80	36.17	5.07	32.99	85.80	4.02	42.97	6.63	2289.6	9.6	114.1
Mix	2.45	9.96	37.23	5.15	33.69	86.08	4.02	42.52	6.91	2350.6	11.8	131.0
LSD 0.05	Ns	0.417	Ns	0.725	0.456	0.34	Ns	0.417	0.298*	Ns	0.469	6.719

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

Results presented in Table 2, cleared the highly significant mean performances for yield, fiber and yarn properties was found when using microorganisms. The use of bio-fertilization gave a highest significant increase for most of traits under study. The highest value of seed cotton yield (9.96K/F) was produced by using mix of bio-fertilizer and the lowest values for this trait with control (7.41K/F). Many researchers reported advantageous impacts of biofertilizer on the crop growth and yield through the biosynthesis of biologically active substances, investigation of rhizosphere microbes, production of phytopathogenic inhibitors, alteration of nutrient uptake and eventually magnifying the biological nitrogen fixation, this result had been achieved through Chauhan *et al.,* 2015 and Ahmed *et al.,* 2008.

Results presented in table 3 cleared that interaction between years and varieties on yield, fiber and yarn properties in Egyptian cotton cultivars, gave insignificant values except for the seed cotton yield, which showed high significance. G97 gave the highest value (9.07 and 8.90K/F) in 2018 and 2019seasons, respectively. Referring to the fiber quality showed high significance for all traits under study, except for short fiber index and strength gave insignificant values. On the other hand, yarn properties under study showed insignificant values.

Data presented in Table 3, showed that the effect of the interaction between years and location for yield and fiber properties in Egyptian cotton varieties under study were highly significant except for the lint percentage, uniformity index, micronaire reading and the elongation as well as, the yarn strength, yarn evenness and the number of neps count were insignificant value. These results are in conformity with those revealed by (Ahmed *et al.,* 2020 A and Arafa *et al.,* 2013).

Data in the Table 3, indicated that the effect of the interaction between location and varieties for all the yield traits under study gave insignificant values except for seed cotton yield which showed that the highly significance. In addition, referring to all fiber quality under study showed the high significance; except for the trait uniformity index it gave insignificant result. On the other hand, the trait of elongation showed a significant decreased. While we find that all the yarn properties in Egyptian cotton cultivars under study i.e. yarn strength, yarn evenness and number of Neps count gave insignificant values. The cv Giza 97 was better in expressing of all traits under study, especially the trait of the seed cotton yield it gave 10.19 k/ f in Sakha region, Kafr El-Sheikh Governorate, compared to the behavior of the other cultivar Giza 96, which gave 8.94 k/f. Similar results were in agreement with Waller and Duncan (1969).

In Table 3, data showed the effect of the interaction between years, location and varieties for yield, fiber and yarn properties in Egyptian cotton cultivars, results notes that the yield traits i.e. boll weight gave significant increased, except lint percentage, which was insignificant. While, on the other hand, seed cotton yield showed that high significant. Referring to the fiber quality showed high significance for all traits under study except the short fiber index, uniformity index and strength have given insignificant values; while, yarn properties under study gave insignificant values.

The Sakha region was distinguished in the first season of 2018 in the seed cotton yield and lint percentage which amounted to (10.24 K/F), (37.09%) respectively, while the second season 2019 was distinguished by a highly for boll weight (2.92 g.). These results are in harmony with (Ahmed *et al.,* 2020).

Table 3. Impact of the interaction between years, locations and varieties on yield, fiber quality and yarn properties in Egyptian cotton cultivars

Years x Locations														
Character.			**Yield**			**Fiber**						**Yarn**		
Years	**Location**		**BW g.**	**SCY k\f**	**Lint%**	**SFI%**	**UHM**	**UI%**	**Mic**	**St..**	**El.%**	**YS**	**C.v %**	**Neps**
2018	Nobaria		1.93	7.35	35.82	5.95	33.30	85.81	4.09	42.41	6.47	2342.2	11.4	106.7
	Sakha		2.76	9.81	37.04	6.14	33.71	85.78	3.92	43.02	6.76	2298.3	10.7	99.7
2019	Nobaria		1.91	7.80	35.68	6.01	32.80	85.29	4.05	42.28	6.66	2394.8	11.8	106.7
	Sakha		2.87	9.25	37.04	5.58	32.39	85.74	3.91	42.73	6.85	2298.3	10.6	97.7
L S D 0.05			0.036	0.315	Ns	0.344	0.262	Ns	Ns	0.315	Ns	Ns	Ns	Ns
Years x Varieties														
Years		Varieties	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
2018		G 97	2.35	9.07	36.40	5.60	33.29	85.13	4.11	43.01	6.22	2166.6	10.1	76.7
		G 96	2.34	8.61	36.29	5.80	36.59	87.21	3.66	44.21	6.00	2374.4	11.2	92.5
2019		G 97	2.41	8.90	36.35	5.31	32.51	85.38	4.09	42.85	5.99	2236.9	10.1	78.7
		G 96	2.38	8.16	36.16	5.95	35.89	86.30	3.78	43.82	6.09	2383.1	12.1	92.5
LSD 0.05			Ns	0.386	Ns	Ns	0.422	0.321	0.080	Ns	0.276	Ns	Ns	Ns
Locations x Varieties														
	Locations	Varieties	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
	Noubaria	G 97	1.91	7.78	35.74	4.96	32.55	84.96	4.16	42.44	5.99	2236.9	11.1	78.7
		G 96	1.91	7.83	35.59	5.97	36.19	86.51	3.75	43.95	6.02	2448.8	11.2	92.5
	Sakha	G 97	2.85	10.19	37.01	5.95	33.25	85.55	4.04	43.42	6.27	2166.6	12.1	70.7
		G 96	2.82	8.94	36.86	5.74	36.16	86.99	3.69	44.08	5.98	2308.6	11.2	90.5
LSD 0.05			Ns	0.386	Ns	0.671	0.422	Ns	0.080	0.386	0.276*	Ns	Ns	Ns
Years x Locations x Varieties														
Years	Loca.	Vari.	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
2018	Nobari	G 97	1.93	7.89	35.79	4.74	32.45	84.84	4.23	42.45	5.73	2166.6	12.1	78.9
		G 96	1.91	7.82	35.71	5.77	36.95	87.21	3.67	44.21	5.88	2440.1	12.2	90.5
	Sakha	G 97	2.78	10.24	37.09	6.47	34.12	85.42	3.98	43.57	6.70	2166.6	12.1	78.4
		G 96	2.78	9.41	36.86	5.77	36.86	87.21	3.66	44.21	5.88	2308.6	12.2	92.5
2019	Nobari	G 97	2.00	7.66	35.70	5.19	32.65	85.07	4.08	42.43	5.91	2307.2	12.1	76.7
		G 96	1.96	7.85	35.46	6.17	35.44	85.81	3.83	43.70	6.15	2457.5	12.2	92.5
	Sakha	G 97	2.92	10.14	37.01	5.42	32.36	85.68	4.10	43.27	5.99	2166.6	12.1	75.7
		G 96	2.86	8.47	36.86	5.72	35.78	86.79	3.72	43.95	6.02	2308.6	12.2	92.5
LSD 0.05			0.063 *	0.545	Ns	Ns	0.596	Ns	0.114	Ns	0.390	Ns	Ns	Ns

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

The effect of the interaction between years and microorganisms for fiber and yarn properties in Egyptian cotton cultivars in Table 4, indicated that all the yield traits under study highly significant increased except the seed cotton yield gave insignificant increased. Referring to the fiber and yarn quality they all showed non-significant increased for all the traits under study except the strength gave highly significant increased. As mentioned above similar was stated by El-Shazly *et al.* (2019).

In the same table, data show the effects of the interaction between locations and treatments for yield in Egyptian cotton varieties the seed cotton yield and lint percentage give insignificant values. On the other hand boll weight showed that high significant. General, fiber and yarn properties in Egyptian cotton varieties give insignificant values, except the micronaire reading gave highly significant increased. As mentioned above similar trend was stated by: Ahmed *et al.,* (2020) and Tolba *et al.* (2021).

The results of the interaction between varieties, location and treatments and it's shown in the Table 5, all the yield traits give that highly significant increased, except for seed cotton yield showed its insignificantly increased. On the other hand, all the fiber quality and yarn properties in Egyptian cotton varieties under study showed insignificant values except for the characteristic micronaire reading they showed high moral value. These results are in harmony with Attia *et al.,* 2008 and Tolba *et al.* (2021).

Referring to the results of the interaction between the varieties and treatments shown in Table 6, data indicated that all the yield traits reach the values. While, all the fiber quality showed the high significant values except the characteristic of short fiber index and upper half mean. While on the other hand all the yarn properties under study showed high moral values except the characteristic yarn strength, it showed insignificant value. These results are in conformity with those revealed by (Neeru *et al.,* 2005; Ahmed *et al., 2019* and Tolba *et al.* (2021).

Table 4. Impact of interaction between the years, locations and biofertilizers on yield, fiber quality and yarn properties in Egyptian cotton cultivars

Years x biofertilizers													
Character.		**Yield**			**Fiber**						**Yarn**		
Years	**Treat.**	**BW g.**	**SCY k\f**	**Lint%**	**SFI%**	**UHM**	**UI%**	**Mic**	**St..**	**El.%**	**YS**	**C.v %**	**Neps**
2018	cont.	2.19	7.24	35.26	9.38	33.37	85.39	3.89	42.83	6.55	2365.1	11.9	101.0
	B.P.	2.39	8.07	36.36	5.20	33.55	85.81	3.89	42.06	6.49	2335.2	10.7	102.1
	B.M.	2.33	8.34	36.36	5.07	33.36	85.98	4.03	42.70	6.56	2369.2	11.5	104.6
	B.C.	2.38	8.49	36.76	4.78	33.36	86.06	3.97	42.52	6.93	2330.4	11.5	94.6
	Azot.	2.36	8.86	36.85	5.74	33.17	85.13	4.00	43.48	6.28	2228.2	12.7	101.7
	Azos.	2.32	9.16	36.18	5.05	33.80	85.90	4.09	43.29	6.52	2265.7	12.6	114.1
	Mix	2.45	9.93	37.22	5.08	33.95	86.27	4.04	42.14	6.93	2347.9	11.8	131.9
2019	cont.	2.32	7.58	35.22	9.35	32.22	84.96	3.96	42.21	6.51	2355.7	11.9	103.0
	B.P.	2.37	8.17	36.15	5.19	32.55	85.23	3.97	42.01	6.85	2363.4	10.7	102.1
	B.M.	2.38	8.54	36.29	5.11	32.32	85.60	4.01	42.46	6.82	2379.2	11.5	104.6
	B.C.	2.42	8.34	36.73	5.13	32.74	85.83	4.01	42.34	6.79	2357.1	11.6	94.6
	Azot.	2.42	8.61	36.73	5.48	32.74	85.43	3.94	42.94	6.66	2303.8	12.6	102.7
	Azos.	2.39	8.45	36.16	5.09	32.20	85.71	3.95	42.65	6.75	2313.5	12.5	114.8
	Mix	2.44	10.00	37.23	5.22	33.43	85.88	4.00	42.89	6.88	2353.2	11.8	130.1
LSD 0.05		0.068	Ns	0.909	1.025*	Ns	Ns	Ns	0.589	Ns	Ns	Ns	Ns
Locations x biofertilizers													
Location	Treat.	BW g.	SCY k\f	Lint%	SFI%	UHM	UI%	Mic	St..	El.%	YS	C.v %	Neps
Nobarai	cont.	1.85	7.24	35.08	9.80	32.61	84.58	4.01	41.62	6.22	2402.7	11.9	106.0
	B.P.	1.93	8.07	35.87	5.46	32.93	85.38	4.01	42.14	6.41	2363.4	10.7	100.1
	B.M.	1.91	8.34	35.76	5.10	32.61	85.43	4.11	42.30	6.55	2411.1	11.4	104.6
	B.C.	1.93	8.49	36.10	4.98	33.11	85.93	4.08	41.85	6.81	2357.1	11.5	92.6
	Azot.	1.93	8.86	36.04	5.19	33.33	85.84	4.05	42.87	6.50	2318.2	12.6	101.7
	Azos.	1.95	9.16	35.53	4.85	33.20	85.79	4.13	43.20	6.53	2313.5	12.5	116.1
	Mix	1.93	9.93	35.87	5.50	33.59	85.90	4.06	42.40	6.90	2413.6	11.7	130.0
Sakha	cont.	2.66	7.58	35.40	9.93	32.98	85.78	3.84	43.42	6.84	2318.2	11.9	100.0
	B.P.	2.83	8.17	36.64	4.95	33.17	85.66	3.94	41.92	6.93	2335.2	10.7	102.1
	B.M.	2.80	8.54	36.88	5.08	33.07	86.14	3.92	42.86	6.84	2337.3	11.4	104.6
	B.C.	2.87	8.34	37.39	4.93	32.99	85.95	3.91	43.02	6.91	2330.4	11.5	92.6
	Azot.	2.85	8.61	37.45	6.03	32.58	84.71	3.89	43.54	6.45	2213.8	12.7	100.7
	Azos.	2.76	8.45	36.81	5.29	32.80	85.82	3.91	42.73	6.74	2265.7	12.6	112.1
	Mix	2.97	10.00	38.57	4.79	33.80	86.25	3.98	42.63	6.91	2287.6	11.7	130.4
LSD 0.05		0.589	Ns	Ns	Ns	0.490	Ns	0.589	Ns	Ns	Ns	Ns	Ns

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

Table 5. Impact of the first-order interaction between the years, locations and biofertilizers on yield, fiber and yarn properties in Egyptian cotton cultivars

Years x Locations x biofertilizers														
Character.			**Yield**			**Fiber**						**Yarn**		
Year	**Location**	**Treat.**	**BW g.**	**SCY k\f**	**Lint%**	**SFI%**	**UHM**	**UI%**	**Mic**	**St..**	**El.%**	**YS**	**C.v %**	**Neps**
2018	Noubaria	cont.	1.81	6.44	35.12	9.39	32.97	85.08	4.04	41.94	6.15	2412.0	11.9	99.0
		B.P.	1.97	7.52	36.08	5.45	33.24	85.74	4.01	42.18	6.28	2335.2	10.7	102.1
		B.M.	1.92	7.35	35.83	5.12	32.79	85.74	4.13	42.32	6.41	2401.1	11.4	104.6
		B.C.	1.94	7.44	36.12	4.79	33.31	86.02	4.03	41.83	6.85	2330.4	12.6	94.6
		Azot.	1.93	7.49	36.15	4.90	33.53	85.95	4.11	43.17	6.28	2242.5	12.5	100.7
		Azos.	1.97	7.50	35.54	4.61	33.57	85.92	4.19	43.45	6.41	2265.7	11.7	114.1
		Mix	1.95	7.73	35.86	5.40	33.74	86.21	4.10	41.94	6.85	2408.2	10.7	131.0
	Sakha	cont.	2.57	8.03	35.40	9.38	33.77	85.72	3.74	43.71	6.96	2318.2	11.4	99.0
		B.P.	2.81	8.62	36.64	4.97	33.87	85.88	3.96	41.93	6.71	2335.2	11.5	102.1
		B.M.	2.74	9.33	36.89	5.01	33.93	86.22	3.94	43.08	6.71	2337.3	12.7	104.6
		B.C.	2.82	9.54	37.39	4.77	33.42	86.10	3.92	43.22	7.01	2330.4	12.6	94.6
		Azot.	2.79	10.23	37.54	6.58	32.82	84.30	3.89	43.78	6.28	2213.8	11.7	100.7
		Azos.	2.67	10.81	36.81	5.49	34.02	85.88	3.99	43.12	6.63	2265.7	11.9	114.1
		Mix	2.96	12.13	38.57	4.77	34.17	86.33	3.98	42.34	7.01	2287.6	10.7	130.9
2019	Noubaria	cont.	1.89	7.16	35.04	9.21	32.235	84.07	3.98	41.30	6.29	2393.3	11.4	100.4
		B.P.	1.90	7.70	35.66	5.47	32.62	85.02	4.02	42.09	6.54	2391.7	11.5	102.4
		B.M.	1.89	7.83	35.70	5.08	32.44	85.11	4.08	42.29	6.69	2421.1	12.6	104.7
		B.C.	1.93	7.86	36.07	5.18	32.92	85.84	4.13	41.87	6.78	2383.6	12.6	94.6
		Azot.	1.93	8.10	35.92	5.48	33.12	85.72	4.00	42.58	6.71	2393.8	11.7	99.7
		Azos.	1.93	7.81	35.50	5.09	32.82	85.67	4.07	42.94	6.64	2361.3	11.9	114.1
		Mix	1.91	8.12	35.89	5.60	33.43	85.60	4.03	42.86	6.95	2418.9	10.7	131.0
	Sakha	cont.	2.75	7.99	35.40	8.49	32.19	85.84	3.94	43.12	6.73	2318.2	11.4	98.0
		B.P.	2.84	8.63	36.64	4.92	32.48	85.43	3.92	41.92	7.16	2335.2	12.3	102.1
		B.M.	2.87	9.25	36.89	5.14	32.20	86.07	3.91	42.64	6.96	2337.3	12.6	104.6
		B.C.	2.92	8.82	37.39	5.09	32.55	85.81	3.90	42.82	6.81	2330.4	11.7	99.7
		Azot.	2.91	9.12	37.55	5.49	32.34	85.12	3.89	43.31	6.61	2213.8	11.0	112.1
		Azos.	2.85	9.09	36.81	5.09	31.57	85.76	3.84	42.35	6.86	2265.7	12.0	121.0
		Mix	2.98	11.88	38.57	4.82	33.43	86.17	3.97	42.93	6.82	2287.6	11.1	103.1
	LSD 0.05		0.096	Ns	1.286	Ns	Ns	Ns	0.174	Ns	Ns	Ns	Ns	Ns

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

Table 6. Impact of the first-order interaction between the varieties and biofertilizers on yield, fiber and yarn properties in Egyptian cotton cultivars

Varieties x biofertilizers													
Character.			**Yield**				**Fiber**					**Yarn**	
Variety	**Treat.**	**BW g.**	**SCY k\f**	**Lint%**	**SFI%**	**UHM**	**UI%**	**Mic**	**St..**	**El.%**	**YS**	**C.v %**	**Neps**
G 97	cont.	2.30	8.16	35.27	9.09	32.50	84.46	3.95	43.06	5.58	2336.5	10.3	75.7
	B.P.	2.39	8.51	36.08	4.67	32.48	85.06	4.08	41.71	6.36	2189.9	10.8	66.3
	B.M.	2.35	8.78	35.80	4.28	32.80	85.73	4.07	42.52	6.16	2348.5	11.0	77.0
	B.C.	2.41	8.79	36.84	4.35	32.91	85.96	4.19	43.03	6.27	2094.9	12.3	71.0
	Azot.	2.38	9.06	37.07	5.40	32.74	84.24	4.12	44.00	5.66	2104.4	11.3	73.3
	Azos.	2.39	9.16	36.23	5.12	33.29	85.55	4.21	43.35	6.17	2073.7	12.2	90.0
	Mix	2.45	10.32	37.160	4.25	33.59	85.79	3.97	42.81	6.18	2264.3	12.5	97.3
G 96	cont.	2.40	7.22	35.18	9.88	36.20	86.69	3.97	44.28	5.68	2316.8	11.9	87.0
	B.P.	2.41	7.69	35.88	5.68	36.41	86.61	3.76	44.08	5.98	2400.0	10.6	81.7
	B.M.	2.34	8.51	36.28	5.83	35.79	86.88	3.77	44.53	5.71	2405.8	12.1	76.0
	B.C.	2.38	8.07	36.45	4.97	35.83	86.42	3.50	43.53	6.40	2505.0	11.1	82.7
	Azot.	2.37	8.46	36.06	4.67	36.46	86.67	3.67	44.87	5.81	2318.6	12.2	91.3
	Azos.	2.36	9.01	36.44	4.63	35.91	87.12	3.62	44.21	5.84	2380.0	12.8	94.0
	Mix	2.43	9.76	37.26	5.35	36.66	86.88	3.75	42.60	6.49	2324.8	11.5	135.0
LSD 0.05		Ns	Ns	Ns	Ns	Ns	0.600	0.150	0.722	0.516	Ns	0.813	11.64

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

Considering to the results in Table 7, for the impact of the interaction between year, varieties and treatments indicated that yield traits insignificant increased as well as, the fiber quality give highly significant increased with short fiber index, uniformity index, strength and insignificant increased with upper half mean, micronaire reading and elongation. While we find that, the impact of previous interaction of all the yarn properties in Egyptian cotton cultivars under study showed insignificant values. These results are in conformity with those revealed by Arafa and El-Gebaly 2007 and Tolba *et al.* (2021).

Table 7. Impact of the first-order interaction between the years, varieties and biofertilizers on yield, fiber and yarn properties in Egyptian cotton cultivars

Years x Varieties x biofertilizers														
Character.				**Yield**					**Fiber**				**Yarn**	
Year.	**Var.**	**Treat.**	**BW g.**	**SCY k\f**	**Lint%**	**SFI%**	**UHM**	**UI%**	**Mic**	**St..**	**El.%**	**YS**	**C.v %**	**Neps**
2018	G 97	cont.	2.34	8.16	35.28	9.90	32.95	83.85	3.96	43.37	5.59	2336.5	12.3	75.7
		B.P.	2.37	8.51	36.16	4.53	33.00	85.10	4.09	41.51	6.64	2147.5	10.8	66.3
		B.M.	2.30	8.78	35.97	3.67	33.19	85.80	4.07	42.59	6.21	2348.5	11.0	77.0
		B.C.	2.39	8.81	36.94	4.27	32.89	86.13	4.21	43.00	6.65	2055.0	12.3	7.1
		Azot.	2.36	9.27	37.08	6.13	33.78	83.50	4.20	44.53	5.65	2046.5	13.3	73.3
		Azos.	2.38	9.52	36.26	5.31	33.93	85.61	4.28	43.37	6.39	2002.0	12.23	90.0
		Mix	2.43	10.44	37.12	4.42	37.50	85.94	3.94	42.70	6.46	2230.0	12.5	97.3
	G 96	cont.	2.17	7.09	35.23	9.50	37.10	87.75	4.01	45.20	5.60	2330.8	11.9	87.0
		B.P.	2.43	7.92	36.04	5.95	36.45	87.50	3.69	44.33	5.50	2400.0	10.6	81.7
		B.M.	2.35	8.57	36.38	6.50	36.35	86.60	3.68	44.67	5.57	2390.8	12.1	76.0
		B.C.	2.33	8.54	36.39	4.40	37.00	86.85	3.36	43.87	6.70	2505.0	11.1	8.7
		Azot.	2.35	8.70	36.23	3.90	37.40	87.40	3.55	45.13	5.43	2263.0	13.2	91.3
		Azos.	2.33	9.71	36.46	4.30	36.85	86.85	3.60	44.87	5.86	2380.0	14.0	94.0
		Mix	2.44	9.77	37.27	4.83	29.66	84.60	3.77	41.40	6.50	2351.0	11.5	135.0
2019	G 97	Cont.	2.42	8.51	35.26	4.852	32.06	85.65	4.07	42.75	5.58	2232.3	10.8	66.3
		B.P.	2.39	8.78	36.01	4.88	31.95	85.80	4.08	41.92	6.09	2348.5	11.0	77.0
		B.M.	2.42	8.77	35.99	4.42	32.29	84.98	4.17	42.47	6.11	2134.8	12.3	71.0
		B.C.	2.40	8.86	36.75	4.67	32.63	85.48	4.21	43.07	6.00	2162.3	13.0	73.3
		Azot.	2.40	8.80	37.06	4.93	32.58	85.64	4.15	43.47	5.54	2145.5	12.2	90.0
		Azos.	2.47	8.66	36.20	4.09	32.80	85.64	4.01	43.35	5.95	2298.5	12.3	97.3
		Mix	2.31	10.20	37.20	9.27	33.25	85.72	3.94	42.92	5.89	2302.8	11.9	87.0
	G 96	cont.	2.38	7.34	35.12	5.40	34.90	86.26	3.83	43.37	5.76	2400.0	10.6	81.7
		B.P.	2.33	7.46	35.72	5.16	35.73	86.24	3.87	43.83	6.41	2420.8	12.1	76.0
		B.M.	2.43	8.45	36.19	5.53	35.13	86.48	3.79	44.40	5.85	2505.0	11.1	82.7
		B.C.	2.39	7.60	36.51	5.43	35.33	86.85	3.63	43.19	6.10	2374.3	13.0	91.3
		Azot.	2.39	8.22	35.89	4.96	35.92	86.91	3.74	44.40	6.18	2380.0	14.0	94.0
		Azos.	2.42	8.30	36.43	5.87	34.42	84.15	3.45	43.19	5.83	2298.5	11.5	135.0
		Mix	2.29	9.75	37.26	9.50	36.47	84.94	3.44	44.62	6.49	2428.0	11.5	137.3
L S D 0.05			Ns	Ns	Ns	1.775	Ns	0.848	Ns	1.021	Ns	Ns	Ns	Ns

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

Data in Table 8, show that the impact means value of the first-order interaction between the locations, varieties and treatments for yield traits i.e. boll weight, seed cotton yield and lint percentage as well as, the fiber quality i.e. short fiber index, upper half mean and micronaire reading insignificant values, except for uniformity index strength and elongation showed they the high significance. On the other hand, the yarn properties i.e. yarn Strength, yarn evenness and number of neps count in Egyptian cotton cultivars under study, give insignificant values. These results are in conformity with those revealed by El-Shazly *et al.*, 2019 and Tolba *et al.* (2021).

Table 8. Impact of the first-order interaction between the locations, varieties and biofertilizers on yield, fiber and yarn properties in Egyptian cotton cultivars

Locations x Varieties x biofertilizers														
Character.				**Yield**					**Fiber**				**Yarn**	
Locat.	**Var.**	**Treat.**	**BW g.**	**SCY k\f**	**Lint%**	**SFI%**	**UHM**	**UI%**	**Mic**	**St..**	**El.%**	**YS**	**C.v %**	**Neps**
El-Noubaria	G 97	cont.	2.34	8.16	35.24	9.27	31.71	83.90	4.07	41.45	5.61	2336.5	12.3	75.8
		B.P.	2.37	8.51	35.93	4.92	32.02	84.71	4.10	42.29	5.65	2232.3	10.8	66.3
		B.M.	2.30	8.78	35.86	4.12	32.33	85.08	4.19	42.54	5.59	2348.5	11.0	77.0
		B.C.	2.39	8.81	36.37	4.24	32.83	85.42	4.26	42.23	6.12	2134.8	12.3	71.0
		Azot.	2.36	9.27	36.17	4.27	33.13	85.17	4.19	42.95	5.56	2161.3	13.3	73.3
		Azos.	2.38	9.52	35.34	3.89	32.98	85.07	4.27	43.26	6.08	2145.5	12.2	90.0
		Mix	2.43	10.44	35.30	4.02	32.89	85.35	4.00	42.24	6.12	2298.5	12.5	97.3
	G 96	cont.	2.17	7.09	34.72	9.36	36.20	86.50	3.98	43.95	5.68	2443.5	11.9	87.0
		B.P.	2.43	7.92	35.77	5.78	36.17	86.41	3.81	44.08	5.99	2400.0	10.6	81.7
		B.M.	2.35	8.57	35.65	6.15	35.79	86.51	3.77	44.53	5.75	2516.6	12.1	76.0
		B.C.	2.33	8.54	35.39	4.97	35.84	86.42	3.56	43.53	6.40	2505.0	11.1	82.7
		Azot.	2.35	8.70	35.74	4.67	36.41	86.44	3.69	44.68	5.87	2417.3	13.2	91.3
		Azos.	2.33	9.71	35.81	5.11	36.53	86.72	3.67	44.21	5.92	2380.0	14.0	94.0
		Mix	2.44	9.77	36.02	5.50	36.44	86.58	3.75	42.68	6.49	2479.5	11.0	135.0
Sakha	G 97	cont.	2.36	8.37	35.30	9.92	33.30	85.02	3.83	44.58	5.56	2336.5	12.3	75.7
		B.P.	2.42	8.51	36.23	4.45	32.94	85.41	4.07	41.13	7.08	2147.5	10.8	66.3
		B.M.	2.39	8.78	36.10	4.43	33.26	86.37	3.95	42.51	6.73	2348.5	11.0	77.0
		B.C.	2.42	8.77	37.32	4.45	32.99	86.51	4.13	43.83	6.41	2055.0	12.3	71.0
		Azot.	2.40	8.86	37.98	6.53	32.45	83.31	4.23	45.05	5.63	2046.5	13.3	73.3
		Azos.	2.40	8.80	37.12	6.53	33.60	86.03	4.16	43.45	6.29	2002.0	12.2	90.0
		Mix	2.47	8.66	39.02	4.48	34.29	83.23	3.94	43.38	6.23	2230.0	12.5	97.3
	G 96	cont.	2.31	10.20	35.64	9.13	36.20	83.89	3.97	44.62	5.66	2190.0	11.9	87.0
		B.P.	2.38	7.34	35.99	5.57	36.66	86.81	3.71	44.08	5.91	2400.0	10.6	81.7
		B.M.	2.33	7.46	36.92	5.52	35.79	87.25	3.77	44.53	5.66	2295.0	12.1	76.0
		B.C.	2.43	8.45	37.52	4.97	35.84	86.42	3.44	43.53	6.40	2505.0	11.1	77.8
		Azot.	2.39	7.60	36.38	4.67	36.51	86.88	3.65	45.07	5.74	2220.0	13.2	82.7
		Azos.	2.39	8.22	37.08	4.15	35.29	87.53	4.04	44.22	5.77	2380.0	14.0	91..3
		Mix	2.42	8.30	38.51	5.20	36.88	87.19	4.05	42.51	6.49	2170.0	11.5	94.0
L S D 0.05			Ns	Ns	Ns	Ns	Ns	0.848	Ns	1.021	0.729	Ns	Ns	Ns

BW: Boll weight, SCY: Seed cotton yield, SFI: Short fiber index, UHM: Upper half mean, UI: Uniformity index Mic: Micronaire reading, St.: Strength in gram/Tex, El.: the percentage of Elongation, YS: Yarn Strength C.v: coefficient of variation, ( ) Significant at 0.01 level of probability (*) Significant at 0.05 level of probability. (Ns) insignificant

CONCLUSION

Generally, it could be concluded that the applications of bio fertilizer improved the absorption and available of NPK leading to vegetative growth and reproductive organ and exhibited the higher significant values in all the treatments under use low amount of mineral treatment. The bio treatments in most of traits under study give that highly significant increased. Therefore the use bacterial strains as a bio-fertilization for Egyptian cotton cultivars, which means decreased the mineral fertilizer and the pollution.

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تأثير تطبيقات الأسمدة الحيوية على الصفات المحصوليه وصفات القطن المحلوج لبعض التراكيب الوراثيه للقطن المصرى النامى في الأراضي الطينية والجيرية

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أجريت الدراسة بمحطه بحوث النوبارية و سخا بمعهد بحوث القطن، مركز البحوث الزراعيه بالجيزة، مصر خلال موسمي صيف 2018 ، 2019م لدراسة تأثير السلالات البكتيرية مع 50٪ من NPK الموصى به ومعاملة الخليط منها وايضا المقارنة مع الكنترول 100٪ من NPK الموصى به على الصفات المحصوليه وصفات القطن المحلوج لبعض التراكيب الوراثيه للقطن المصرى في الاراضي الطينية والجيرية. أظهرت النتائج أنه عند إضافة السلالات البكتيرية إلى التربة ثلاث مرات عند 65 ، 85 ، 105 يوم من الزراعه اثناء الري لنباتات القطن ادت المعاملات الحيوية الي تعزيز تحسين التربة مع إتاحة تيسير N وإمتصاص NPK الغير ميسر مما يؤدي إلى زيادة النمو الثمرى .كما أظهرت النتائج قيم معنويه عاليه بسبب المعاملات الحيوية مع كمية منخفضة من NPK. لوحظ زيادة معنوية في التربة الطينية (سخا) لمعظم الصفات مقارنة بالتربة الجيرية (النوبارية) ، بينما لا توجد فروق معنوية في التربة الجيرية لمؤشر الألياف القصيرة ومتوسط النصف العلوي. كما أدى استخدام الاسمدة الحيوية إلى زيادة معنوية عاليه على معظم الصفات تحت الدراسة. عموما, ادي تطبيق الأسمدة الحيوية الي تحسين جودة الصفات المحصوليه وصفات القطن المحلوج لبعض التراكيب الوراثيه للقطن المصرى في الاراضي الطينية والجيرية.