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IMPROVE WHEAT PRODUCTIVITY BY USING A COMBINATION OF MINERAL NITROGEN, ORGANIC AND BIOLOGICAL FERTILIZERS UNDER NEW SANDY SOIL CONDITIONS

Mohamed Sonya H.*, Ahmed Amani M., Salem Gihan M., Kandil Hebe B.A., Amer Rabab A.A., ShamseldinRawia O. and Abo El-Soud A.A.

Department of Agricultural Microbiology, Soils, Water and Environmental Research Institute, Agricultural Research Centre, P.O. Box, 12619, Giza, Egypt.
*Corresponding author: Mohamed Sonya H. (E-mail: drsonyasweri@gmail.com)

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ABSTRACT

Two experiment were conducted among two successive winter seasons (2019/2020 and 2020/2021) at Ismailia Research Station, Ismailia Governorate. The experiments were designed to improve wheat productivity by using a combination of mineral nitrogen, organic and biological fertilizers under new sandy soils conditions. A number of sixteen treatments designed by using recommended dose of nitrogen (Ammonium nitrate) or its half, organic fertilizer (Farm yard manure), grain inoculated with SWERI inoculum asbiofertilizer (*Azotobacter chroococcum, B. megatherium*and *B. circulant*), and *Streptomyces luteogriseus*. The experimental results showed that the cultivated soil was belongs to sandy soil type and was poor in each of NPK elements, with low rate of each of microbial counts and dehydrogenase activity before planting. These parameters were improved after cultivation of wheat inoculated with biofertilizers and organic fertilizer compared to before planting. This was obvious when plant heights and weights of each of plant sample, straw, grains, ears and hundred wheat grains were estimated. It was also noted that nitrogen content and protein percentages in wheat grains as well as straw were improved. Treatment No. 16 consists of SWERI, and actinomycetes inoculums, as biofertilizers, and organic fertilizer combined with 50% of recommended dose of mineral nitrogen was the most effective ones compared to each of blank (unfertilized soil cultivated with un-inoculated grains, T01)or control (soil fertilized with the recommended of mineral nitrogen and cultivated with un-inoculated grains, T02). This was reflected by increasing the expected wheat yield obtained among treatment No. 16. This treatment was also gave the highest yield amounted of grains and straw which approximately an average of 19.1 Ardab per Feddan, while each of blank and control gave 7.25 and 12.8 Ardab per Feddan respectively. As a conclusion, treatment contained the SWERI and actinomycetes inoculums, organic fertilizer and 50% of recommended dose of mineral nitrogen has led to stimulate the growth of wheat plants in sandy soils, which promises the possibility of expanding the cultivation of such soils with wheat. Therefore, one can recommend with these experimental findings, which may contribute in a large and effective way to bridge the food gap, especially with the continuous increase in population numbers.

Keywords: Wheat, mineral fertilizer, organic fertilizer, biofertilizer, actinomycetes, productivity.

INTRODUCTION

Wheat (*Triticumaestivum* L.) which belongs to the grass family Poaceae (Gramineae) is considered the first important and strategic cereal crop for the majority of world's populations. Wheat is both the most important grain and the single largest crop by area in Egypt (**FAO 2022**).

It is the most important staple food of about two billion people and provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally (**Briggle and Reitz, 1963 and Simmonds, 1976)**. Wheat exceeds in acreage and production every other grain crops, *i.e.*, rice, maize, etc., and it is cultivated over a wide range of climatic conditions (**Tomić*et al*., 2016**).

In Egypt, wheat represents almost 10 % of the total value of agricultural production and about 20 % of all agricultural imports (**GASC, 2020**), and this is due to the majority of Egyptians are able to purchase a form of flat bread called Baladi at a heavily subsidized price. Wheat has managed to increase its share of the winter cropped area ranged from 41 to 47%, and the cultivated area is limited to the narrow strip along the Nile Valley (**FAO, 2015**). Therefore attempts have been made to expand the cultivated area in Egypt by reclaiming new lands using irrigation. The amount of wheat production in Egypt is about of 9 million metric tons in 2021 with an increase of 1.12% from the previous years (**FAO, 2022**), in a trial to increase wheat cultivation area to decrease dependency on wheat importing.

Organic manures applications were found to enhance plant growth or improve yield. A trial to evaluate the efficiency of four organic conditioners (composted town refuse, poultry manure, sewage sludge and biogas residues) for improvement the chemical and physical characters of four soils was carried out at El- Fayoum area known with their below production levels (**El-Shakweer *et al*., 1998)**.

Effect of long-term manuring and fertilization on soil biological properties under the long term fertilization experiment on wheat was evaluated on Vertisols using nine treatments (**Katkar*et al*., 2011).** They showed that the soil enzyme activity, *viz*. dehydrogenase (55.01 µg TPF/g/24 hr), urease (47.9 mg NH_4 /kg/ 24 hr) and cellulase (52.23 µg glucose/g/24 hr) were significantly influenced with the application of 100% RDF + FYM at 10 tones/ha.

This study was designed to determine the effect of a combination of 50% nitrogen fertilezation (mineral), organic fertilizer and SEWRI inoculum plus an identified strain of streptomycetes as a biofertilizer agent on improvement of wheat productivity under the conditions of new sandy soils.

MATERIALS AND METHODS

Location and seasons: During the 2019/2020 and 2020/2021 two experiments in successive winter seasons wereconducted at Ismailia Agricultural Research Station, Ismailia Governorate, Egypt.

Source of wheat grains: Wheat grains cultivar (Misr 01) was kindly obtained from Seed Management, Agricultural Research Center (ARC), Giza, Egypt.

Soil analyses and preparation: Before planting and during plant bed preparation, soil sample was taken from the surface layer 0-30 cm and analyzed for the most proper mechanical and physiochemical properties according to method of **Kilmer and Alexander (1949**) and recorded in **Table-1.** The soil was prepared for cultivation as described by **Helmy *et al*., (2014)**.

Table -1: Mechanical and chemical analyses of cultivated soil among two seasons.

Parameters		1st Season	2nd Season
Mechanical analysis	Sand (%)	40.60	41.500
	Find sand (%)	44.30	44.200
	Silt (%)	11.50	12.000
	Clay (%)	4.500	04.800
	Textures	Sandy	Sandy
Chemical analysis	pH (1:2.5)	7.850	07.890
	E.C. (dSm^{-1} at 25ºC)	3.060	03.070
	SP (%)	25.00	26.000
Soluble cations (meq/L)	Ca^{2+}	9.000	08.400
	Mg^{2+}	8.000	08.400
	Na^+	1.000	00.950
	K^+	12.00	11.500
Soluble anions (meq/L)	CO_3^{2-}	00.00	00.000
	HCO_3^-	01.20	01.250
	Cl^-	22.30	23.300
	SO_4^{2-}	06.50	05.400
Total-N	(%)	0.018	00.020
NPK content	Total soluble-N (mg Kg^{-1})	64.00	067.20
	Available-P (mg Kg^{-1})	5.560	05.950
	Available-K (mg Kg^{-1})	71.94	069.50
DTPA-extract (mg Kg^{-1})	Iron	0.880	00.920
	Manganese	0.120	00.136
	Zinc	0.110	00.120
	Copper	0.170	00.250

DTPA: Di-ethylene tri-amine penta acetic acid.

Organic fertilizer: The used organic fertilezer (farm yard manure-FYM) was obtained from Ismailia Research Station farm. The chemical analyses of farm yard manure are presented in **Table-2.**

Table-2: Characteristics of farmyard manure conditioner used in the two experiment seasons at Ismailia station.

Properties	1st season	2nd season
pH	7.25	7.46
E.C. (dS/m at 25ºC)	4.89	4.19
Organic-C (%)	15.65	16.77
Total N (%)	1.16	1.31
C/N ratio	13.50	12.80
Total-P (%)	0.56	1.16
Total-K (%)	1.42	1.26
Total soluble-N (ppm)	86.0	75.8
Available-P (ppm)	14.3	26.0

Available-K (ppm)	765.0	725.0
DTPA extractable (ppm):		
Fe	148.5	124.8
Mn	35.8	33.9
Zn	16.4	32.5
Cu	3.56	3.82
Total count of bacteria	5.0×10^6	4.5×10^6
Total count of fungi	6.4×10^6	4.5×10^6
Total count of actinomycetes	4.2×10^6	3.8×10^6
Dehydrogenase activity (**µg TPF/g soil/24 hr**)	126.8	115.8

Bacterial strains inoculums: Microorganisms in SWERI inoculums biofertilizer were representing as nitrogen fixing bacteria (*Azotobacter chroococcum*), phosphate dissolving bacteria (*Bacillus megatherium* var. Phosphaticum) and potassium dissolving bacteria (*Bacillus circulant*) and kindly provided by Biofertlizers Production Unit, Soils, Water and Environmental Research Institute (SWERI), ARC, Giza, Egypt.

Actinomycete strain as a biofertilizer agent: An identified halotolerant streptomycete strain named as *Streptomyces luteogriseus* was obtained from Department of Agricultural Microbiol**o**gy, ARC, Giza, Egypt. This isolate was previously isolated from soil, Taif, KSA and completely identified by **Mohamed *et al*., (2013).**

Preparation of actinomycetes inoculums: Inoculum of the *Streptomyces* strain was prepared by scraping the heavy spores from the surface of the bacterial growth of starch nitrate slant (**Mohamed 1998**) in the presence of 5 mL sterilezed d.H_2O and used for preparing the inoculumas described by **Osman *et al*., (2007).**

Grains inoculation: Wheat grains of each treatment were inoculated at the rate of 1.5 g inoculums per 150 g grains using 16% Arabic gum solution as a sticking agent followed by air drying for 15 minutes in the shade and sown direct.

NPK estimation: NPK in soil samples cultivated were estimated before and after planting according to the method of **Attanandana *et al*., (1999)**.

Dehydrogenase activity: Dehydrogenase activity (DH) in soilwas estimated before and after planting based on the method of **Stevenson (1959)**.

Microbial total count: The total counts of microbes (bacteria, fungi and actinomycetes) in the soil samples before and after cultivated with wheat subjected to different fertilizers treatments were determined as described by the methods of **Clark (1965)**.

Field experiment design: Two fields experiments were conducted at the Ismailia Research Station, Ismailia Governorate during two successive winter seasons (2019/2020 and 2020/2021). The soil was divided into plots each of 10.5 m^2 and a space of 1.2 m between adjacent plots were left empty. A Randomize Complete Block Design with three replicates was applied in each season. Sixteen treatments were distributed in each plot as follows:

Codes	Experiment treatments	
	Soil Fertilizers	**Wheat grains inoculation**
T01	Unfertilized	Un-inoculated (Blank)
T02	Recommended dose of mineral nitrogen*	Un-inoculated (Control)
T03	Unfertilized	Inoculated with SEWRI
T04	Unfertilized	Inoculated with Actinomycetes.
T05	Unfertilized	Inoculated with SEWRI + Actinomycetes.
T06	½ recommendeddoseof mineral nitrogen	Inoculated with SEWRI
T07	½ recommendeddoseof mineral nitrogen	Inoculated with Actinomycetes
T08	½ recommendeddoseof mineral nitrogen	Inoculated with SEWRI + Actinomycetes
T09	Organic fertilizer	Un-inoculated
T10	Organic fertilizer+ recommendeddoseof mineral nitrogen	Un-inoculated
T11	Organic fertilizer	Inoculated with SEWRI
T12	Organic fertilizer	Inoculated with Actinomycetes.
T13	Organic fertilizer	Inoculated with SEWRI+Actinomycetes.
T14	Organic fertilizer and ½ recommendeddoseof mineral nitrogen	Inoculated with SWERI
T15	Organic fertilizer and ½ recommendeddoseof mineral nitrogen	Inoculated with Actinomycetes
T16	Organic fertilizer and ½ recommendeddoseof mineral nitrogen	Inoculated with SWERI+Actinomycetes

*: It was used due to the recommendation of Ministry of Agriculture and Land Reclamation.

Post harvesting measurements: In eachexperiment, plant height (**Pepe and Heiner, 1975**), weights of whole wheat sample, wheat straw, wheat ears, wheat grains and thousand wheat grains were determined, and three replicates were applied for each of the 16 treatments. From each replicates a number of wheat plants were collected to determine the previous measurements.

Nitrogen and protein contents: Nitrogen content and crude protein percentage in both of wheat grains and straw were estimated using the methods of **Mosse (1990)** and **Hames *et al*., (2008)** respectively.

Calculation of wheat crop per Feddan: Wheat crop produced among the sixteen treatments was calculated according to the following equations:

The average weight of wheat grains per plant in grams	The average weight of wheat grains of the sample / (number of samples / treatment) 20	Equation (1)
Wheat grain weight in grams/m^2	The result of equation (1) X 300 (number of plants per square meter)	Equation (2)
Wheat grain weight in kilograms/Feddan	The result of equation-2 in grams X 4000 (Feddan area) / 1000	Equation (3)
The amount of wheat yield in Ardab/Feddan	The result of equation (3) / 150 (150 Kg per Ardab)	Equation (4)

RESULTS AND DISCUSSION

Wheat as edible grains is considered the oldest and important cereal crops. It is grown under different climates and soil type, this is because it is adapted to temperature locations with rainfall (**Shewry, 2009**). He also reported that one of the most important breeding programs aims in wheat is improving productivity under drought conditions in arid and semi-arid regions. One of the major limiting factors for a wide range of crops in Egypt as well as worldwide is soil fertility (**Youseif*et al*., 2017)**.

Among two winter seasons (2019/2020 and 2020/2021) this study was conducted at Ismailia Research Station, Ismailia Governorate in a trial to improve productivity of wheat under new sandy soils conditions by fertilization of the soil by mineral nitrogen (Ammonium nitrate)and organic fertiizer (Farm yard manure), followed by cultivation with wheat grains inoculated with SWERI soil biofertilizer (*Azotobacter chroococcum, B. megatherium*and *B. circulant*), and *Streptomyces luteogriseus*as a biological fertilizer among sixteen treatments. In Egypt, similar trail was conducted by **Badran (2009)**, who were evaluated the production and performance of two wheat cultivars (Sakha 69 and Giza 164) were in sandy soil among an experiment carried out in El-Boustan region, Alexandria, by using three bio-nitrogen fertilization treatments (untreated, Microbin and Nitrobin) and five rates of chemical nitrogen fertilizer doses. In the same context, **Abdelmageed*et al*., (2019)** showed that to minimize the gap between production and consumption in Egypt, the Egyptian wheat productivity showed be improved through the use of promising wheat cultivars, expansion of new lands, modern agricultural practices, improved field irrigation efficiency and water-saving agricultural practices. Therefore, that study focused on use of a mixture of mineral, organic and biological fertilizers to improve wheat productivity under new sandy soil.

The *Streptomyces* strain under investigation was belonging to gray colour series with dark gray reverse side of substrate mycelium. Its spore chains belonged to section Rectus-Flexibilis or spiral with hairy surface. This strain was also found to have a good growth on Cazpek's medium, produces melanoid, and did not produce soluble pigments. In the presence of all sugars as sole carbon source the strain was able to give a good growth. The strain was not inhibited with streptomycin appeared antimicrobial activities, and grew on NaCl concentrations up to 21% (**Mohamed *et al*., 2013**).

The importance of NPK fertilizers in wheat production was reported by **Nisar *et al*., (1992)** and **Gill and Saleem (1994)**. In this study, results in **Table-3** showed that level of NPK among the two seasons in the cultivated soil, before planting, were relatively low as the total soluble-N, available-P and available-K (mg Kg^{-1}) was ranged from 64.00 to 67.20; 5.56 to 5.95 and 69.50 to 71.94 respectively.

On planting and treating, the NPK was determined in soil samples collected from the fourteen fertilizer treatments (T03-T16) plus blank treatment (unfertilized and cultivated with wheat grains un-inoculated T01) and control (Soil fertilized with recommended dose of mineral nitrogen and cultivated with un-inoculated wheat grains).

Results in **Table-3**showedthat, the NPK was raised up, as the percentage of total soil-nitrogen among the two seasons was ranged, from 0.019 to 0.033, available of P ranged from 07.20 to 11.81 mg Kg^{-1}, and available K ranged from 30.06 to 39.54 mg Kg^{-1} compared to blank soil sample T01 (0.019%, 07.20 (mg Kg^{-1}) and 30.06 (mg Kg^{-1}), respectively, and control soil sample T02 (0.028%, 9.82 (mg Kg^{-1}) and 31.14 (mg Kg^{-1}), respectively). The result is in agreement with that reported by **Malghani *et al*., (2010).**

The presence of viable and physiologically active microorganisms could be indicated by rate of activity of DHs (**Furtal and Gajda, 2017**). The changes in soil microbial population could be controlled by DHs, therefore, it is considered as an important parameter of soil quality. In this study, rate of dehydrogenase enzyme activity among the two seasons reached to 3.90 or 3.95 µg

TPF/g soil/24 hr was fewer in blank (T01) and control treatment (T02), respectively. In the other fourteen treatments DHA was improved as ranged from 4.1.00 to 5.80 µg TPF/g soil/24 hr (**Table 3**).

Table-3: Means of total nitrogen (N) (%), available phosphor (P) & potassium (K) and dehydrogenase activity (DHA) in soil cultivated with wheat subjected to different fertilizer treatments among two seasons.

Treatments	Total nitrogen (%)		Available P (mg Kg^{-1})		Available K (mg Kg^{-1})		DHA (µg TPF/g soil/24 hr)	
	Seasons		Seasons		Seasons		Seasons	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd
T01	0.019	0.020	07.20	07.80	30.06	32.80	3.90	4.2
T02	0.028	0.032	09.82	11.20	31.14	34.60	3.95	4.0
T03	0.027	0.028	07.24	08.50	35.28	33.80	4.90	4.1
T04	0.022	0.023	07.23	08.60	33.04	33.50	4.40	4.6
T05	0.029	0.030	07.20	09.20	33.71	34.60	4.50	4.2
T06	0.026	0.025	09.28	08.80	32.31	33.80	4.60	4.2
T07	0.032	0.034	08.32	11.80	31.24	35.80	4.05	4.2
T08	0.031	0.025	10.45	09.60	32.04	34.60	4.40	4.2
T09	0.020	0.030	07.66	09.80	31.58	35.40	4.05	4.8
T10	0.025	0.028	08.32	09.50	36.88	34.50	5.15	4.6
T11	0.028	0.028	09.45	10.4 0	38.15	39.24	5.20	5.1
T12	0.028	0.027	09.28	10.20	37.34	36.60	5.20	4.8
T13	0.030	0.031	09.84	10.68	39.42	39.54	5.20	5.4
T14	0.032	0.032	09.85	10.30	37.34	35.80	5.20	5.0
T15	0.032	0.030	09.91	10.50	32.31	35.80	4.60	4.8
T16	0.032	0.033	11.41	11.40	37.34	36.20	5.20	5.8

The total microbial counts in the soil before planting (uncultivated) were few about ($35X10^4$) of bacteria, ($22X10^3$) fungi and ($24X10^3$) actinomycetes compared to soil subjected to different fertilizer treatments and cultivated with wheat grains inoculated with SWERI or actinomycetes or both (SWERI+actinomycetes). On planting and treating among the two seasons, the microbial total counts were developed in the soil samples collected from the 14 fertilizer treatments compared to the blank-soil sample (T01) as well as control soil treatment (T02) (**Table 4**). This was obvious from the counts of bacteria ($28.8\text{-}52X10^5$), fungi ($0.6\text{-}1.3X10^4$) and actinomycetes ($1.6\text{-}2.7X10^4$) while the bacterial count was the highest followed by total counts of actinomycetes and fungi.

Table-4: Means of microbial total counts in soil cultivated with wheat subjected to different fertilizers treatments among two seasons.

Treatments	Microbial total counts					
	Bacteria (X10^5)		Fungi (X10^4)		Actinomycetes (X10^4)	
	Seasons		Seasons		Seasons	
	1st	2nd	1st	2nd	1st	2nd
T01	28.8	34.0	0.6	0.6	1.6	1.0
T02	28.9	36.0	0.7	0.5	2.9	1.2
T03	27.0	40.0	0.9	0.8	2.6	1.2
T04	28.8	42.0	0.7	0.6	2.5	1.6
T05	32.3	35.0	0.7	0.5	1.9	1.2
T06	37.1	42.0	0.7	0.8	2.0	1.2
T07	33.3	42.0	0.8	0.7	2.1	1.4
T08	41.8	50.0	0.9	0.9	2.7	1.4
T09	26.7	28.0	0.8	0.6	2.7	1.6
T10	32.5	38.4	0.9	0.8	2.1	2.5
T11	37.1	44.0	0.8	0.8	2.7	2.0
T12	40.2	48.6	0.8	0.8	2.8	2.4
T13	33.3	44.0	0.7	1.0	2.6	1.8
T14	38.4	44.0	0.8	1.2	2.5	2.0
T15	39.7	48.0	0.7	1.1	2.4	2.0
T16	45.6	52.0	0.7	1.3	2.7	2.2

Results in **Table-5** showed three postharvest measurements namely, height of plant, weight of ears per sample and weight of hundred grains among two seasons were determined.

As overall, treatment No. 16 includes soil fertilized by each of 50% of recommended dose of mineral nitrogen plus organic fertilizer and cultivated with wheat grains inoculated with mixture of SWERI and actinomycetes as biofertilizers was the most effective ones compared to blank-soil sample (T01) and control soil treatment (T02). The means of the three postharvest measurements gave higher values ranged from 40.15 to 52.55 (cm); 36.95 to 65.25 (g) and 62.25 to 70.85 (g), respectively, compared to T01 (33.70 (cm), 20.60 (g) and 55.55 (g)) and T02 (40.05 (cm), 37.95 (g) and 58.60 (g)). It was also noted that fertilization of soil with organic fertilizer and half recommended dose of mineral nitrogen increased the measurements of three postharvest parameters whatever grains inoculated with SWERI (T14), actionmycetes (T15) and both of them (T16) compared to the other eleven treatments and blank (T01) as well as control (T02). While, the absence of mineral nitrogen in spite of inoculation of wheat grains with SWERI and actinomycetes was the reason in reducing the effective, as T13 appeared measurements lower than that of contain mineral nitrogen (T14, T15 and T16). This could be explained by the ability of actinomycetes strain to utilize each of mineral nitrogen as well as organic fertilizer to be available by plant as a simple organic material. This was supported by the measurement of T10 contained soil fertilized by organic fertilizer and recommended dose of mineral nitrogen and cultivated with wheat grain did not treated with SWERI or actinomycetes. In other mean fertilization of soil with organic manure and cultivation with grains inoculated with SWERI (T11) or actinomycetes (T12).

Table-5: Wheat plant height (cm), ears weight (g/plant) and weight of thousand grains (g) of different treatments among two seasons.

Treatments	Plant height (cm)			Ears weight (g/plant)			Weight of thousand grain (g)		
	Seasons			Seasons			Seasons		
	1st	2nd	Means	1st	2nd	Means	1st	2nd	Means
T01	32.6	34.8	33.70	20.6	20.6	20.60	54.9	56.2	55.55
T02	37.9	42.2	40.05	37.4	38.5	37.95	53.1	64.1	58.60
T03	39.8	40.5	40.15	35.4	38.5	36.95	57.7	66.8	62.25
T04	36.0	37.1	36.55	34.7	37.4	36.05	40.1	60.0	50.05
T05	39.9	44.7	42.30	44.1	45.4	44.75	61.4	70.6	66.00
T06	43.2	44.3	43.75	50.6	51.7	51.15	61.9	71.3	66.60
T07	39.6	38.5	39.05	38.9	40.9	39.90	43.7	63.5	53.60
T08	43.5	46.2	44.85	53.6	54.7	54.15	64.7	71.8	68.25
T09	38.9	40.2	39.55	40.2	41.5	40.85	59.7	68.2	63.95
T10	41.3	40.4	40.85	47.0	48.8	47.90	63.5	70.2	66.85
T11	43.3	45.9	44.60	53.8	53.0	53.40	62.6	69.7	66.15
T12	43.4	46.4	44.90	38.7	40.6	39.65	62.5	72.9	67.70
T13	44.4	46.4	45.40	45.2	55.9	55.90	62.8	68.2	65.50
T14	42.3	42.2	42.25	55.8	56.4	56.10	66.1	73.4	69.75
T15	45.6	46.1	45.85	59.7	61.8	60.75	63.5	75.0	69.25
T16	52.2	52.9	52.55	65.9	64.6	65.25	66.3	75.4	70.85
LSD 0.05	3.5	3.2		2.5	2.4		2.5	2.4	

Results in **Table-6**present determination of three postharvest measurements are grain weight (kg/m^2), straw weight (g/m^2) and weight of whole plants (g/m^2). Results proved that the presence of mineral nitrogen fertilizer whatever in the recommended dose (RD) (T02 and T10) or half recommended dose (T06, T07, T08, T14, T15 and T16) was also effective whatever wheat grains were inoculated with SWERI (T06 and T14) or actionmycetes (T07 and T15) or both (T15 and T16) compared to blank (T01) or control (T02) or T10. Among the two seasons, the three measurements were highest when soil was fertilized with organic manure in the presence of half recommended dose of mineral nitrogen and cultivated with wheat grains inoculated with SWERI and actinomycetes as shown in T16 compared to the other 14 treatments including the blank (T01) and control (T02). The grain weight (kg/m^2) rose from 275.25 (T01) to 719.85 (T16), while the weight of straw (g/m^2) raised from 61.95 to 172.75, and weight of whole plants (g/m^2) raised from 337.20 to 892.60 when compared to T01. The differences between measurements of T02 (control) and T16 were 282.45, 67.75 and 350.2 of grains weight, straw weight and weight of whole plants, respectively, and this is indicating the possibility of obtaining better a crop of wheat if it is cultivated in the sandy soils with the contents of the T16 treatment. The role of actinomycetes as a biofertilizer was obvious in increasing the weight of whole plants due to its ability to decompose the organic fertilizer into simple compounds easy to be used by plants. It was also confirmed the importance of reducing the use of mineral fertilizers and replacing it with organic fertilizers in the presence of a microorganisms that can breakdown it down into components that benefit plants without affecting the environment.

Table-6: Grain weight (kg/m^2), Straw weight (g/m^2) and weight of whole plants (g/m^2) of different treatments among two seasons.

Treatments	Grain weight (kg/m^2)			Straw weight (Kg/m^2)			Weight of whole plants (Kg/m^2)		
	Seasons			Seasons			Seasons		
	1st	2nd	Means	1st	2nd	Means	1st	2nd	Means
T01	263.0	287.5	275.25	54.9	069.0	61.95	317.9	356.5	337.20
T02	410.3	464.5	437.40	98.5	111.5	105.00	508.8	576.0	542.40
T03	378.6	499.5	439.05	90.9	119.9	105.40	469.5	619.4	544.45
T04	361.4	562.0	461.70	106.7	124.9	115.80	448.1	696.9	572.50
T05	482.8	594.0	538.40	115.9	142.6	129.25	598.7	736.6	667.65
T06	547.5	626.0	626.00	131.4	150.2	140.80	678.8	776.2	727.50
T07	522.7	558.0	540.35	121.4	137.9	129.65	624.1	715.9	670.00
T08	585.2	654.5	619.85	140.4	167.8	154.10	725.6	867.2	796.40
T09	280.0	364.3	322.15	103.3	124.0	113.65	383.3	488.3	435.80
T10	430.9	540.4	485.65	103.4	129.7	116.55	534.3	670.1	602.20
T11	548.5	658.2	603.35	169.2	158.0	163.60	717.7	816.2	766.95
T12	520.9	541.0	530.95	111.0	143.8	127.40	621.9	694.8	658.35
T13	590.5	708.6	649.55	141.6	160.1	150.85	722.1	878.7	800.40
T14	617.3	716.7	667.00	148.1	172.0	160.05	765.4	888.7	827.05
T15	648.4	717.5	682.95	155.6	172.2	163.90	804.0	889.7	846.85
T16	705.0	734.7	719.85	169.2	176.3	172.75	874.1	911.1	892.60
LSD 0.05	66.3	69.2		29.2	79.1				

In Egypt, **Kandil*et al*., (2016)** carried out two field experiments at the experimental Station Farm of Kalabsho and Zayian district during the two successive winter seasons of 2013/2014 and 2014/2015, to determine the effect of foliar application with humic acid, amino acid and mixture of humic and amino acids under nitrogen fertilizer levels (166, 214 and 262 kg N/ha) on yield, yield attributes and grain quality characters of three cultivars of bread wheat (Shaka 93, Gemiza 9 and Giza 168) grown in newly reclaimed sandy saline soil conditions. In this study results of the nitrogen content and crude protein percenttagein both grains and straw shown in **Table 7** obtained from the sixteen treatments showed that the content of nitrogen or protein in grains was higher than in straw for the same treatments. Also, the least averages of protein percent of grain were for treatments T01 (9.1), T09 (9.5), T04 (10.2) and T10 (12), while the rest of the treatments were not higher than T16which was keeping its superiority in both of the nitrogen and protein content, whether in straw or grains. This may be explained by the fact that the formation of treatment 16 of each of half recommended dose of mineral fertilization in the presence of the SWERI inoculum and organic fertilizer in addition to actinomycetes has led to stimulating the growth of wheat plants in sandy lands, which promises the possibility of expanding the cultivation of such lands with wheat, which may contribute in a large and effecttive way to bridge the food gap, especially with the continuous increase in population numbers.

Table-7: Nitrogen and crude protein (%) in grains and straw of wheat subjected to different fertilizers treatments among two seasons.

Treatments	Grains				Straw			
	% Nitrogen		% Protein		% Nitrogen		% Protein	
	Seasons		Seasons		Seasons		Seasons	
	1st	2nd	1st	2nd	1st	2nd	1nd	2nd
T01	1.5	1.6	09.1	10.0	0.8	1. 0	5.1	5.9
T02	2.2	2.4	13.5	14.7	1.1	1.2	6.9	7.6
T03	2.1	2.2	12.8	13.9	0.8	1.0	5.1	6. 2
T04	1.6	1.9	10.2	12.0	0.8	1.0	4.8	6. 3
T05	2.2	2.4	13.9	14.9	0.8	1.1	5.1	7.1
T06	2.3	2.3	14.2	14.3	1.1	1.1	6.6	6.6
T07	2.4	2.6	15.0	16.2	1.0	1.1	5.9	7.0
T08	2.4	2.5	14.6	15.6	1.2	1.3	7.4	8.1
T09	1.5	1.7	09.5	10.8	0.8	1.2	4.8	7.3
T10	1.9	2.2	12.0	13.7	0.9	1.0	5.9	6.2
T11	2.2	2.5	13.9	15.5	1.2	1.4	7.3	9.0
T12	2.1	2.3	13.2	14.3	1.1	1.3	6.3	7.8
T13	2.3	2.5	14.4	15.7	1.1	1.4	7.6	8.7
T14	2.4	2.5	15.0	15.7	1.1	1.3	6.9	7.0
T15	2.2	2.3	13.5	14.5	1.1	1.3	7.0	7.4
T16	2.4	2.8	15.0	17.2	1.2	1.3	7.5	8.3

The experimental results are in harmony with that reported by **Arif *et al*., (2017)**, which showed that low and declining soil organic matter contents pose a significant threat to soil fertility, crop productivity and economic returns in arid and semi-arid agroecosystems. Holistic approaches are required to build and sustain soil organic matter in such soils to enhance nutrients use efficiencies and meet food security.

Results in **Tables8**and **9**refer to the calculation of the quantity of wheat yield resulting from the sixteen treatments of the study. The results indicate that the 16th treatment can be given 2.65 times the first treatment, known as the blank (7.17 ardab per feddan), where the mean yield amounted to approximately 19.00 ardab per feddan, while the control (T02) gave 11.76 ardab per Feddan, and it was the highest among the treatments. In the second classification, treatment numbers T15, T14, T13, T08, T06, T11, T12 and T04 were the best, with yields of about 17.50, 17.13, 16.54, 16.53, 15.36, 15.65, 14.52 and 14.36, respectively. The results in the sameTables-8 and 9showed the variation in the rate of increase in the wheat yield obtained from the 14 samples under study compared to the Blank (T01: unfertilized soil cultivated with un-inoculated wheat grains) and the control (T02: soil fertilized by the recommended dose of mineral nitrogen and cultivated with un-inoculated wheat grains).It was proved that the 16th treatment containing half recommended dose of mineral nitrogen, SEWRI, organic fertilizer and actinomycetes was the best, as the rate of increase in yield was 164.99, and 62.80 % compared to T01 and T02, respectively. While the non-addition of the SEWRI inoculums as in the 15th treatment led to a decrease in the rate of increase to 25.5 and 15.68 % compared to T01 and T02 respectively, and it's still reliable as well.

Table-8: Yield of wheat grains weight subjected to different fertilizers treatments among two seasons.

Treatments	Grain weight					
	(kg/Fed)			(Ardb/Fed)		
	Seasons			Seasons		
	1st	2nd	Means	1st	2nd	Means
T01	1052.0	1100.0	1076.0	07.01	07.33	07.17
T02	1641.2	1858.0	1749.6	10.94	12.40	11.67
T03	1514.4	1998.0	1756.2	10.10	13.32	11.71
T04	1445.4	2248.0	1846.7	09.44	14.99	12.22
T05	1931.2	2376.0	2153.6	12.87	15.84	14.36
T06	2189.8	2503.8	2346.8	14.60	16.69	15.65
T07	2060.6	2332.0	2196.3	13.73	15.55	14.64
T08	2340.6	2618.0	2479.3	15.60	17.45	16.53
T09	1120.0	1288.6	1204.3	07.50	08.59	8.045
T10	1723.6	1942.6	1833.1	11.50	12.95	12.23
T11	2194.0	2413.4	2303.7	14.63	16.09	15.36
T12	2093.2	2263.2	2178.2	13.95	15.09	14.52
T13	2362.0	2598.2	2480.1	15.75	17.32	16.54
T14	2469.0	2667.8	2568.4	16.46	17.80	17.13
T15	2593.6	2731.8	2662.7	17.29	18.21	17.75
T16	2819.8	2879.4	2849.6	18.80	19.20	19.00
LSD 0.05	265.0	276.8		1.76	1.85	

Table-9: Yield increasing rates of wheat subjected to different fertilizers treatments among two seasons.

Treatments	Yield increasing rates of wheat grains							
	(Kg/Fed)				(Ardb/Fed)			
	1st Season		2nd Season		1st Season		2nd Season	
	Compared to T01	Compared to T02	Compared to T01	Compared to T02	Compared to T01	Compared to T02	Compared to T01	Compared to T02
T01	0000.0		0000.0		00.00		00.00	
T02	0589.2	0000.0	0758.0	0000.0	03.93	00.0	05.07	00.0
T03	0462.4	-126.8	0898.0	0140.0	03.09	-0.84	05.99	0.92
T04	0393.4	-195.8	1148.0	0390.0	02.43	-1.50	07.66	2.59
T05	0879.2	0290.0	1276.0	0518.0	05.86	1.93	08.51	3.44
T06	1137.8	0548.6	1403.8	0645.8	07.59	3.66	09.36	4.29
T07	1008.6	0419.4	1232.0	0474.0	06.72	2.79	08.22	3.15
T08	1288.6	0699.4	1518.0	0760.0	08.59	4.66	10.12	5.05
T09	0068.0	-521.2	0188.6	-569.4	00.49	-3.44	01.26	-3.81
T10	0671.6	0082.4	0842.6	0084.6	04.49	0.56	05.62	0.55
T11	1142.0	0552.8	1313.4	0555.4	07.62	3.69	08.76	3.69
T12	1041.2	0452.0	1163.2	0405.2	06.94	3.01	07.76	2.69
T13	1310.0	0720.8	1498.2	0740.2	08.74	4.81	09.99	4.92
T14	1417.0	0827.8	1567.8	0809.8	09.45	5.52	10.47	5.40
T15	1541.6	0952.4	1631.8	0873.8	10.28	6.35	10.88	5.81
T16	1767.8	1178.6	1779.4	1021.4	11.79	7.86	11.87	6.80

Conclusion: One can recommend with use of treatment T16 (soil fertilized with half recommended dose of nitrogen and organic manure, cultivated with wheat grains inoculated with SWERI inoculums+Actinomycetes) to improve wheat yield, especially in sandy soils, and to reduce the use of mineral fertilizers, in soil, which could be affect human health when leaked with waste water. Use of actinomycetes in the presence of organic fertilizer has led to stimulating the growth of wheat plants in sandy soils, which promises the possibility of expanding the cultivation of such soils with wheat, which may contribute in a large and effective way to bridge the food gap, especially with the continuous increase in population numbers.

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