Egypt. J. of Appl. Sci., 36 (3) 2021 *132-147*

BIO-AGRICULTURE AND ITS EFFECT ON THE PRODUCTIVITY AND QUALITY OF PEANUTS (*ARACHIS HYPOGAEA*) UNDER NORTH SINAI CONDITION - EGYPT.

Mahmoud A.M. El-Sayed
Soil Fertility and Microbiology Department, Desert Research Center, El-Mataria, Cairo, Egypt
Email - mahalyeg@yahoo.com, mahalyeg30@gmail.com

Key Words: Olive waste compost, Biomagic liquid fertilizer, *Rhizobium*, *Azotobacter*, Phosphorous dissolving bacteria (PDB), Peanut (*Arachis hypogaea*), North Sinai.

ABSTRACT

A field experiment was conducted at Baloza Experimental Station of the Desert Research Center (DRC) in North Sinai - Egypt. The GIS indices of this location are N3101-43.0296- E 32035-28.0431) in two successive summer seasons of 2015 and 2016. The most prominent objectives of the current work can be portrayed in recycling olive oil extraction waste, verifying the role played by bio-fertilizers in utilizing the manufactured compost, diminishing the pollution brought about by mineral fertilizers, testing the nutritional function of Biomagic to peanut plants, and figuring out the best combination treatment among all these production tools that give the highest possible peanut seed content at the best possible quality under the conditions of North Sinai of Egypt. The applied treatments involved applying olive compost vs. no application, spraying Biomagic nutrient solution vs. no spraying, inoculating the seeds with Rhizobium (the control treatment) vs. inoculating the seeds with *Azotobacter* and phosphorous dissolving bacteria both applied separately or together in a mixed inoculation. These treatments were arranged in a factorial experiment in three randomized complete blocks. Mean values were verified from each other using Dunkan least significant range (LSR) and denoted by alphabetical letters. In that, any two mean values sharing an alphabet letter are not significantly different. The superior combination treatment is to be composed of applying compost x canopy spraying x biofertilizers, shows that the best combination treatment was composed from applying compost + spraying plants' canopy with Biomagic x inoculating the seeds with a mixture of *Azotobacter* and PDB in both years of study. This treatment could significantly proliferate better growth conditions in the rhizosphere that nourished the most vigorous microbiological growth. It could lead to better peanut plants vegetative growth. It could also lead to the best significant peanut seed content with best quality. Detailed effects of all applied factors can be found in the research.

INTRODUCTION

Balasubramanian and Palaniappan (1994) reported that use of microbial inoculants in combination with FYM favored groundnut production. **Dharma (1996)** found that FYM stimulated the activities of microorganisms that render plant nutrients available to crops. **Ahmed *et al.* (1997)** stated that the highest dry matter accumulation, kernel yield and oil content were achieved by fertilization with farmyard manure. **Ismail *et al.* (1998)** reported significant increase in organic C, available N and P content of the soil with application of FYM possibly due to the increase in decomposition product of organic matter. Application of FYM at 10 to 15tha^{-1} increased the pod and seed yields and improved groundnut yield parameters as shelling percentage and 100 seed weight **(Subrahmaniyan *et al.,* 2000)**. Application of FYM at 21.9 tha-1 produced the highest DMP, pod yield and haulm yield, and gave higher net return and BCR (**Chandrasekaran *et al.,* 2007**). **Veeramani *et al.* (2012)** reported that excessive application of nitrogen and potassium to groundnut often resulted in excessive vegetative growth. Considering the availability of major elements in the soil and quantum of losses due to leaching and/or fixation of individual elements expected, a proper method and time of nutrient application deem necessary to increase pod yield. OMs effectively contribute to plant growth.

El- Boraie *et al.* (2009) examined the influence of biofertilization under drip irrigation system on peanut yield and yield components. They also studied soil microbiological properties. They found that seed inoculation with *Rhizobium* highly increased nodules number more than *Azotobacter*, which decreased the decomposition of organic matter in the soil. The highest significant pod yield was obtained from applying 983.73 mm irrigation quantity (Q), which was daily applied to plants, inoculating the seeds with a mixture of *Rhizobium* + *Azotobacter chroococcum* + *Bacillus megaterium*. **Gharib *et al.* (2009)** studied the effect of bacterial inoculation with *Rhizobium leguminoarum* bv. phaseoli and two strains of *Azotobacter chroococcum* and *Bacillus megaterium* as a biofertilizers on nodulation, N_2-fixation, population of rhizosphere microorganism, NPK-content, and yield of two snap bean cultivars under 25% of the recommended dose of NPK chemical fertilizers. They found that mixed (Rh + AZ + BM) inoculation treatments in the presence of 25% of the recommended dose of chemical NPK fertilizers had highly significant effects on snap been growth, nodulation, and N_2-fixation. Inoculation with *Rhizobium* + *Bacillus megaterium* (BM3) with 25% of the recommended NPK dose significantly increased all traits of vegetative growth, yield and its components and pods characteristics.

Foliar feeding of a nutrient promoted root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrients uptake **(El-Fouly and El-Sayed, 1997)**. In addition, supply of N either from foliar sources or symbiotic fixation resulted in greater nitrogen content in the leaf canopy and increased biomass production. Foliar feeding is often the most effective and economical way to correct plant nutrient deficiencies. Foliar application of nutrients improved nutrient utilization and lowered environmental pollution through reducing the amounts of fertilizers added to soil **(Abou-El-Nour 2002). Hanan *et al.* (2015)** experimented with urea-N rates and application routes; soil or foliar, with or without compost on the production of peanut (*Arachis hypogaea* L.). They indicated that the application of compost increased weight of peanut seeds and pods yields. They also recommended soil application to foliar application. **Tamer (2018)** reported that Biomagic is a microbial bioactive non hormonal foliar spray. It has amino acids thiamin, cysteine, glycine, histidine, isoleucine, leucine, lysine, phenylalanine, threonine, tryptophane, tyrosine, and valine. It contains vitamins thiamine, biotiene, choline, folic acid, niacin, pantothenic, pyrodxine, and rhiboflavin. It contains N, P, K, and Mg. It also contains micro nutrients Fe, Zn, Mn, Cu, B, Mo, Cd, and Ni. As described, Biomagic is a readymade product that can be sprayed on plants to promote their growth.

The objectives of the current work can be portrayed as a) Verifying the role played by bio-fertilizers in utilizing OMs to avoid the deteriorating effects of mineral fertilizers, b) Diminishing the pollution brought about by mineral fertilizers by recruiting organic compost, and c) Figuring out the best combination treatment among organic and biological fertilizers that gives the highest possible seed yield of peanut with best quality measures under the conditions of North Sinai of Egypt.

MATERIALS AND METHODS

Experimental site:

A field experiment was conducted at Baloza Experimental Station of the Desert Research Center (DRC) in North Sinai, Egypt. The GIS indices of this location are N3101-43.0296- E 32035-28.0431) in two successive seasons of 2015 and 2016.

The target of this study was to estimate the mutual effects of three basic factors. The first belonged to the application of OM (OM) versus no application (OM0 vs. OM1). The applied OM consisted of olive processing byproducts added to rice straw at 1: 2 ratio). The resultant compost was added to the soil at the rate of 5 tons fed^{-1} three weeks before planting. The second factor belonged to foliar fertilization with a non-hormonal bio-stimulant; i.e. Biomagic (M). The third factor belonged to biological inoculation (I) with *Rhizobium leguminosarum, Azotobacter chrococcum, and Bacillus megaterium* all applied separately, and in addition to applying a mixture of the latter two. Peanut seeds were coated with these inoculants by using 1% carboxy-methyl-cellulose (CMC) as an adhesive agent, and air-dried prior to seeding **(Hameeda, 2008)**. One month after seeding, half the plants were sprayed with Biomagic.

Biomagic is a microbial bioactive non hormonal foliar spray. It was kindly provided by Prof. Dr. Mohamed Abd El Fattah El-Sibaie (Prof. of Agric. Microbiology Dept. Desert Research Center). It has a pH 5.5. It has amino acids at 1.907% as thiamin, cysteine, glycine, histidine, isoleucine, leucine, lysine, phenylalanine, threonine, tryptophane, tyrosine, and valine. It contains vitamins at 0.038% as thiamine, biotiene, choline, folic acid, niacin, pantothenic, pyrodxine, and rhiboflavin. It contains N, P (P_2O_5), and K_2O at 1125, 559, 625 mg.l^{-1}., respectively. It also contains the micro nutrients Fe 160 mg.l^{-1}, Zn 124, Mn 100, Mg 45, Cu 45, B 14, Mo 12, Cd 7, and Ni 4 (Tamer 2018 and Hala 2009). As described, Biomagic is used as plant growth promoter. Biomagic is a readymade product that is formulated by the microbiological unit for propagating and marketing plant growth promoters at the Desert Research Center at El-Matariya, Cairo, Egypt.

Peanut (*Arachis hypogaea* L. cultivar Giza 6) seeds were purchased at the Agricultural assembly for producing and marketing enhanced seeds of field crops of the Ministry of Agriculture, Giza, Egypt. Seedbed was prepared by hand-hoeing to remove the weeds, then the field surface was furrowed and dripper lines were spread along the furrows. Seeding took place on March 27, 2016 in the first season, and on March 29, 2017 in the second season. On seeding day, water was dripped onto the furrows immediately prior to seeding. Using a wooden cone, two peanut seeds, treated or untreated, were sown in 30cm apart hills in the furrows which were 50cm apart from each other and covered with soil. Plant population was 28000 plant.feddan^{-1} after thinning to one plant.hill^{-1} (1 feddan=0.42 ha).

After 45 days from seeding, total microbial count, *Azotoacter* density, P-dissolvers density, *rhizobium* sp. and the most probable number (MPN) of cellulose decomposers density were measured in the rhizosphere under peanut plants. Peanuts were harvested after 130 days from planting. The following data were recorded; Plant height, plant dry weight, nodules' dry weight plant^{-1}, weight of seeds (g), and seed content (%) of oil, protein, phosphorus, and potassium. Determination of the these seed contents will be referred to later on within the samples analyses.

Noteworthy is that all other field practices such as irrigation, plants thinning, weed control, pest management, and NPK fertilization were achieved the same for all treatments.

Soil samples:

Samples of soil and irrigation water were collected for analysis at the time of seedbed preparation from the 0-30 cm surface soil layer. Physiochemical properties of the soil and water were determined. At harvest, soil samples were collected from the same top soil layer. All collected soil sampled were exposed to analysis after being air-dried, crushed, sieved through a 2mm sieve, and preserved for analysis.

For the initial soil samples, pH, electrical conductivity (EC), cationic and anionic profiles, and calcium carbonate were determined according to the methods described by **Richards (1954)** and **Jackson (1963). P**article size distribution was assessed by the pipette method of **Piper (1950)**. The obtained data are reported in Table 1 to give an image about the initial soil situation prior to cultivation. This is not going to be traced throughout peanut life span to concentrate on the objective of the current research work.

For water samples, pH, total salinity (EC), major cations (Na^+, K^+, Mg^{+2}, Ca^{+2}) and major anions (Cl^{-1}, SO_4^{-2}, CO_3^{-2}, HCO_3^{-1}) were determined by ion chromatography (ICS-1100, Dionex, Sunnyvale, CA, USA). The obtained data are reported in Table 1.

Table (1): Physicochemical and Chemical analysis of initial cultivated soil, irrigation water, Olive pomace and organic compost in Baloza station.

				Physical characteristics in the soil %						**Textural class**	
				Sand		**Silt**	**Clay**				
				91.12		**2**	**6.88**			**Sand**	
Chemical characteristics in the soil											
Depth	**pH**	**E.C $dS.m^{-1}$**	**$CaCO_3$ %**	**Cations $meq.l^{-1}$**				**Anions $meq.l^{-1}$**			
				Ca^{+2}	**Mg^{+2}**	**Na^+**	**K^+**	**CO_3^{-2}**	**HCO_3^-**	**Cl^-**	**SO_4^{-2}**
0-30cm	**7.9**	**2.70**	**1.00**	**15.60**	**3.12**	**6.33**	**1.95**	**--**	**2.44**	**10.65**	**13.90**
Physicochemical composition of El-Salam Canal irrigation water in Baloza Station.											
pH	**E.C ($dS.m^{-1}$)**			**Ca^{+2}**	**Mg^{+2}**	**Na^+**	**K^+**	**CO_3^{-2}**	**HCO_3^-**	**Cl^-**	**SO_4^{-2}**
8	**22.52**			**80.16**	**72.95**	**40.72**	**31.37**	**--**	**53.22**	**136.56**	**35.42**
Physical and chemical characteristics of Olive pomace (OP)											
pH	**E.C ($dS.m^{-1}$)**			**C %**	**N %**	**C/N Ratio**	**P %**	**K %**	**Total phenols %**		
6.1	**0.94**			**33.6**	**0.9**	**37.3**	**0.61**	**2.6**	**0.6**		
Physical and chemical characteristics of organic compost :											
PH	**E.C**		**Total carbon (%)**	**Total nitrogen (%)**	**C:N Ratio**		**P (%)**		**K (%)**		**Phenol (%)**
7	**3.35**		**27**	**1.29**	**39.6**		**0.36**		**2.3**		**0.053**

The recruited organic (olive) was composed of 60% olive pomace (OP) from an olive presses in North Sinai and 40% agricultural by-product of rice straw, weeds and palm fronds. Olive pomace was nourished with a highly active cellulose degrading bacteria (CDB) (*Pseudomonas fluorescents* sub sp.). The resulting compost was sampled and analyzed. The EC and pH were analyzed in 1:5 (v/v) soil to water extract. Organic carbon and total nitrogen were assessed and recorded as described by **Bremner and Mulvaney, (1982)** and **Cappuccino** and **Sherman (1992),** respectively. Then, C/N ratio was calculated and reported. Total phosphorus and potassium were measured as described by **Watanabe and Olsen, (1965); Mason, (1963),** respectively**.** In addition, total phenol content was measured using the modified method by **Romero *et al.* (2002).** The obtained data are reported in Table (1).

Microbiological determinations:

Microbiological analysis of soil included the determination of total microbial counts (10^6cfu g^{-1} dry soil), phosphate dissolver counts (10^3 cfu/g dry soil) by plating on modified Bunt and Rovira medium **(Abdel-Hafez, 1966)**, *Rhizobium leguminosarum,* Yeast extract manitol agar (YMA) medium **(Allen, 1959),** densities of *Azotobacter chroococcum* (10^3 cfu.g^{-1} dry soil), Ashby's modified medium **(Abdel-Malek and Ishac 1968)** and Estimates of number of cellulose decomposers by MPN technique (10^3 cells.g^{-1} dry soil) were calculated using Cochran's tables **(Cochran, 1950)**.

Applied treatments:

1. Organic fertilizer, OM
1.1. Without OM, OM0
1.2. Olive processing waste (60%) + rice straw (40%) added to soil at the rate of 5 mt/feddan, OM1.
2. Foliar nutrition, M
2.1. Control without foliar spraying, M0.
2.2. Foliar spraying with a readymade product Biomagic, M1.
3. Bio-fertilizer, I
3.1. Control treated with *Rhizobium sp*. only, I Rhizo.
3.2. Inoculated with *Azotoacter sp*, I Azoto.
3.3. Inoculated with phosphorous dissolving bacteria *Bacillus megaterium*, I PDB.
3.4. Mixed (Inoculated with *Azotoacter sp. and Bacillus megaterum*), I mix

Statistical analysis:

The factorial combinations among the three major treatments were arranged in the experimental field in a factorial design in three replicates. According to the general linear model (GLM) of the linear algebra, the mathematical model resembling the sources of variance affecting the measured traits of peanut will be followed. This model tells that the effects of the applied treatments will be exposed and discussed under the following sources, namely the influence of organic compost (OM), Biomagic (M), inoculation (I), OM x M, OM x I, M x I, and OM x M x I interaction. Therefore, the tabulated data will be under these seven sources of variance. To verdict among the various mean values for the effects of the applied treatments will be based on the Duncan least significant range (LSR) at 5% level of significance. All mean values will be denoted with alphabetical letters. In other words, every two mean values sharing an alphabet are to be considered as being not significantly different.

RESULTS AND DISCUSSION

Effects of applied treatments on soil microbiological counts and densities:

Data depicted in Table 2 show that the application of OM (compost) significantly enhance the biological population in the rhizosphere under peanut plants in both years of study compared to no application. This can directly reasoned by that compost resembles a basic substrate for all microorganisms. This finding coincides with that found by **Dharma (1996)** who stated that FYM stimulated the activities of microorganisms that render plant nutrients available to crops.

In Table 2, spraying Biomagic was steadily better than non-spraying in proliferating the highest significant total bacterial count, density of *Azotobacter*, density of P-dissolvers, *Rhizobium* sp., and MPN cellulose decomposers in both years of study. This can be related to the effect of Biomagic escaping the plant canopy and reaching the soil solution and being available to microorganisms and plant roots. This finding is supported by **Tamer (2018)**. He stated that Biomagic is a microbial bioactive non hormonal foliar spray. It has amino acids, vitamins, macronutrients N, P, K, Mg, and micronutrients. Biomagic can be sprayed on plants to promote their growth.

It can be seen that the mixed inoculation with *Azotobter* and PDB significantly proliferate better growth conditions in the rhizosphere to the microbial population in both years of study.

Mixed inoculation was significantly better, in this regard, than inoculation with *Azotobacter* alone was significantly better than inoculation with PDB alone. Mixed or separate inoculation with *Azotobter* and PDB significantly surpassed the control treatment which was inoculated with *Rhizobium* only. It can be stated that the following descending rank can effectively describe the situation among the four biological inoculation treatments: mixed > *Azotobacter* > PDB > control (inoculated with *Rhizobium*. Also, it can be concluded that mixed inoculation significantly lifted the influence of *rhizobium* inoculation for the nourishment of biological population in the rhizosphere under peanut plants. This observation virtually means more potential toward plant feeding with more nutrients for a better growth. These findings go firmly with those stated by **El- Boraie *et al.* (2009)** and **Gharib *et al.* (2009)** who found that the highest significant pod yield was obtained from inoculating the seeds with a mixture of *Rhizobium* + *Azotobacter chroococcum* + *Bacillus megaterium*.

With respect to the OM x I interaction, the application of compost and spraying the plants with Biomagic could have its significant fingerprints on the activation of biological population in the rhizosphere in both years of study.

Table 2. Influence of the applied treatments on counts of total bacterial, *Azotobacter*, P-dissolvers, *Rhizobium*, and MPN of cellulose decomposers in 2015 and 2016 at Balouza, North Sinai - Egypt.

Variables		Treatment	Total count (10^6 cfu.g^{-1} dry soil)		*Densities of Azotobacter* (10^3 cfu.g^{-1}dry soil)		Densities of P-dissolvers (10^3 cfu.g^{-1}dry soil)		*Rhizobium* spp x10^3		MPN of cellulose decomposers (10^3 cells.g^{-1} dry soil)	
			2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
OM		0	82 b	90 b	100 b	105 b	88 b	93 b	1.81 b	2.13 b	0.87 b	0.93 b
		1	105 a	113 a	128 a	133 a	119 a	129 a	3.19 a	3.61 a	1.20 a	1.30 a
M		0	80 b	89 b	9 7 b	101 b	87 b	95 b	2.23 b	2.56 b	0.94 b	1.00 b
		1	107 a	114 a	131 a	137 a	119 a	127 a	2.77 a	3.14 a	1.12 a	1.22 a
I		Rhizo.	78 d	84 d	81 d	85 d	71 d	77 d	1.05 d	1.36 d	0.82 d	0.91 d
		Azto.	95 b	102 b	119 b	126 b	104 b	114 b	2.95 b	3.35 b	1.06 b	1.14 b
		PDB	88 c	95 c	112 c	117 c	101 c	110 c	2.67 c	2.95 c	1.00 c	1.07 c
		Mix	115 a	126 a	144 a	149 a	134 a	143 a	3.34 a	3.81 a	1.25 a	1.33 a
OMxM		0x0	67 d	76 c	87 d	92 d	75 c	81 c	1.64 d	1.89 d	0.81 d	0.88 d
		0x1	97 b	104 b	113 b	118 b	99 b	105 b	1.98 c	2.37 c	0.92 c	0.97 c
		1x0	94 c	103 b	106 c	110 c	99 b	109 b	2.83 b	3.30 b	1.07 b	1.12 b
		1x1	118 a	124 a	149 a	156 a	138 a	149 a	3.56 a	3.92 a	1.33 a	1.47 a
OMxI		0xRh	67 f	73 f	74 g	79 g	61 f	68 g	0.21 h	0.37 g	0.733 e	0.80 f
		0xAzo.	83 d	91 d	103 d	110 d	87 d	92 e	2.34 e	2.73 e	0.90 cd	0.96 de
		0xPDB	76 e	83 e	97 e	102 e	84 de	89 f	2.11 f	2.29 f	0.86 d	0.90 ef
		0xMix	103 bc	114 b	127 c	131 c	115 c	121 d	2.58 d	3.12 d	0.98 c	1.04 d
		1xRh.	89 d	94 d	88 f	90 f	82 e	86 f	1.88 g	2.35 f	0.92 cd	1.01 d
		1xAzo.	106 b	114 b	134 b	142 b	122 b	135 b	3.55 b	3.98 b	1.22 b	1.31 b
		1XPDB	99 c	107 c	128 c	133 c	118 c	130 c	3.23 c	3.62 c	1.14 b	1.25 c
		1xMix	127 a	139 a	160 a	168 a	154 a	164 a	4.10 a	4.50 a	1.52 a	1.62 a
M x I		0xRh.	70 g	76 f	70 h	74 h	63 f	69 h	0.82 h	1.02 g	0.79 g	0.85 g
		0xAzo.	80 f	90 d	102 e	107 e	89 d	99 e	2.65 e	3.11 d	0.97 e	1.04 e
		0XPDB	76 f	84 e	95 f	101 f	86 d	95 f	2.50 f	2.78 e	0.93 e	0.96 f
		0xMix	96 d	107 c	120 d	124 d	111 c	117 d	2.96 c	3.48 c	1.07 c	1.15 d
		1xRh.	87 e	92 d	91 g	96 g	80 e	85 g	1.28 g	1.70 f	0.86 f	0.96 f
		1xAzo.	110 b	115 b	136 b	145 b	120 b	128 b	3.24 b	3.59 b	1.15 b	1.24 b
		1Xpdb	100 c	106 c	129 c	134 c	117 b	125 c	2.84 d	3.13 d	1.07 d	1.19 c
		1xMix	134 a	145 a	167 a	175 a	158 a	168 a	3.72 a	4.14 a	1.42 a	1.51 a
OM0	M0	Rhiz.	58 l	64 j	61 j	65 m	51 k	58 m	0.06 m	0.11 n	0.68 j	0.76 o
		Azto.	63 kl	73 i	95 gh	101 i	80 h	87 j	2.08 j	2.48 j	0.85gh	0.92 l
		PDB	61 kl	71 i	91 h	96 jk	77 hi	82 k	2.02 j	2.02 k	0.81 hi	0.86 m
		Mix	87 h	97 f	103 f	107 h	90 g	96 h	2.40 h	2.93 g	0.91 ef	0.97 j
	M1	Rhiz.	75 j	82 h	86 i	93 k	71 j	78 l	0.37 l	0.63 m	0.77 i	0.84 n
		Azto.	103 e	109 d	112 e	119 f	94 ef	98 h	2.60 g	2.97 g	0.95 e	1.00 i
		PDB	91 g	95 f	102 f	107 h	91 fg	95 hi	2.20 i	2.57 i	0.92 ef	0.94 k
		Mix	119 b	131 b	151 c	155 d	139 c	147 d	2.75 f	3.30 f	1.05 d	1.10 f
OM1	M0	Rhiz.	81 i	87 g	79 i	82 l	75 i	80 kl	1.58 k	1.93 l	0.89 fg	0.94 k
		Azto.	97 f	107 d	109 e	112 g	97 e	111 f	3.22 d	3.73 d	1.09 d	1.15 e
		PDB	90 g	98 ef	99 fg	106 h	94 ef	107 g	2.98 e	3.53 e	1.05 d	1.06 h
		Mix	106 de	118 c	138 d	141 e	131 d	138 e	3.52 c	4.02 c	1.24 c	1.33 d
	M1	Rhiz.	98 f	101 e	96 g	99 ij	89 g	92 i	2.18 i	2.77 h	0.95 e	1.08 g
		Azto.	116 c	120 c	160 b	171 b	146 b	159 b	3.88 b	4.22 b	1.34 b	1.47 b
		PDB	108 d	117 c	157 b	160 c	142 c	154 c	3.48 c	3.70 d	1.23 c	1.43 c
		Mix	148 a	159 a	183 a	195 a	177 a	190 a	4.68 a	4.98 a	1.79 a	1.91 a

Data also reveal that spraying Biomagic without compost had no significant difference from applying compost without spraying with Biomagic in the second year on total bacterial count, while in both years on the density of PDB. For the other counts in Table 2, spraying with Biomagic alone significantly surpassed the application of compost alone. Normally, the least effective situation on biological growth in the rhizosphere can be seen with 0 compost and 0 Biomagic.

These findings go well with those reported by **El-Fouly and El-Sayed (1997)** who reported that foliar feeding of a nutrient promoted root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrients uptake.

In addition, **El- Boraie *et al.* (2009)** recommended the daily application of irrigation water and inoculation with a mixture of *Rhizobium* + *Azotobacter chroococcum* + *Bacillus megaterium* to achieve the highest significant peanut pod yield. This implies that the application of Biomagic to the soil via fertigation in the form of short spurs from drip irrigation system; i.e. daily application will have to be beneficial to peanut seed production. Such mode of application is expected to give the roots greater chance to absorb nutrients avoiding the nutrients' losses that take place with the bulky application of irrigation water.

Regarding the OM x I interaction, Table 2 exhibits that the performance of the four biological treatments with organic compost was superior to without it for all measured biological traits; bacterial densities or counts. The best combination treatment is composed of applying compost and inoculating with a mixture of *Azotobacter* and PDB. This finding holds true for both years of study. It coincides with the finding of **Balasubramanian** and **Palaniappan (1994)** who reported that the use of microbial inoculants in combination with FYM favored groundnut production. This finding parallels that found by **Dharma (1996)** who stated that FYM stimulated the activities of microorganisms and rendered plant nutrients available to crops' roots.

Concerning the M x I interaction, Table 2 tells that the performance of biofertilizers treatments with Biomagic was prominent to that without it in both years of study. The best combination treatment was that composed of inoculating peanut plants with a mixture of *Azotobacter* and PDB with spraying the plants with Biomagic. In support to this finding, **El-Fouly and El-Sayed (1997)** stated that foliar feeding of a nutrient promoted root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrients uptake. In addition, **Abou-El-Nour (2002)** concluded that supplying N either from foliar sources or symbiotic fixation resulted in greater nitrogen content in the leaf canopy and increased biomass production.

For the 3-factor interaction (OM x M x I), Table 2 shows that the superior treatment was that composed of applying compost + spraying with Biomagic + mixed inoculation with *Azotobacter* and PDB. This was true in both years of study for all measure biological counts and densities. This finding comes true with that by **Gharib *et al.* (2009)** who stated that mixed (Rh + AZ + BM) treatments in the presence of 25% of the recommended dose of chemical NPK fertilizers had highly significant effects on snap been growth, nodulation, and N_2-fixation. In support, **Tamer (2018)** reported that Biomagic is a microbial bioactive non hormonal foliar spray which is eligible for being sprayed on plants to promote their growth. In other words, it is nutritive to microorganisms when it reaches soil solution.

Effects of applied treatments on plant height, dry weight, and nodule dry weight:

Data enclosed in Table 3 reveal that the scenarios of effects shown in Table 2 and discussed popped up approximately the same in Table 3. In that, the application of compost could significantly surpass no application in producing the highest plant height, plant dry weight, and nodules dry weight. This held true for both years of study. These findings are supported by those of **Dharma (1996)** who found that FYM stimulated the activities of microorganisms that render plant nutrients available to crops.

Also, **Ahmed *et al.* (1997)** stated that the highest dry matter accumulation, kernel yield and oil content were achieved by fertilization with farmyard manure. **Ismail *et al.* (1998)** reported that FYM application increased peanut dry matter production. In addition, **Subrahmaniyan *et al.* (2000)** stated that application of FYM increased pod and seed yields and improved groundnut yield parameters as shelling percentage and 100 seed weight. Also, **Chandrasekaran *et al.* (2007**) found that application of FYM produced the highest DMP. Also, **Veeramani *et al.* (2012)** reported that OMs effectively contribute to plant growth.

Biomagic application significantly enhanced peanut plant height, dry matter production, and nodules formation (Table 3) as compared with no application. This is supported by the findings of **El-Fouly and El-Sayed (1997)** who stated that foliar feeding promoted and increased biomass production.

Table 3 tells that mixed inoculation with *Azotobacter* and PDB proved to be significantly > *Azotobacter* alone > PDB alone > the control that was treated with *Rhizobium* in both years of study in peanut plant height, plant dry matter production, and nodules dry weight. **El- Boraie *et al.* (2009)** and **Gharib *et al.* (2009)** who found that the highest significant pod yield was obtained from inoculating the seeds with a mixture of *Rhizobium* + *Azotobacter chroococcum* + *Bacillus megaterium*.

Viewing the mean values for the organic x Biomagic interaction in Table 3 reveals that applying compost and spraying the plants with Biomagic could surpass applying organic alone or spraying with Biomagic alone. This can be supported by the finding of **Hanan *et al.* (2015)** who found that the application of compost increased weight of peanut seeds and pods yields, but they recommended soil application to foliar application. This recommendation drew the attention toward the probable escape of Biomagic reaching the soil solution and contributing to the biological activities in the rhizosphere. In addition, foliar feeding of a nutrient promoted root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrients uptake and plant growth in general **(El-Fouly and El-Sayed, 1997)**. However, **Tamer (2018)** recommended foliar application to soil application reasoning by that Biomagic is a readymade product that can be sprayed on plants to promote their growth.

Table 3. Influence of the applied treatments on plant height, plant dry weight, and nodules dry weight plant^{-1} in 2015 and 2016 at Balouza, North Sinai - Egypt.

Variables		Treatment	Plant height (cm)		Plant dry weight (g)		Nodules dry weight.plant^{-1} (g)	
			2015	2016	2015	2016	2015	2016
OM		0	28 b	34 b	47 b	60 b	0.19 b	0.25 b
		1	48 a	54 a	92 a	113 a	0.65 a	0.71 a
M		0	34 b	38 b	57 b	73 b	0.31 b	0.37 b
		1	42 a	49 a	82 a	99 a	0.53 a	0.59 a
I		Rhizo.	26 d	33 d	50 d	62 d	0.23 d	0.28 d
		Azto.	41 b	47 b	75 b	90 b	0.45 b	0.50 b
		PDB	37 c	41 c	65 c	77 c	0.38 c	0.46 c
		Mix	48 a	54 a	89 a	116 a	0.63 a	0.69 a
OMxM		0x0	25 d	29 d	39 d	50 d	0.11 d	0.19 d
		0x1	32 c	39 c	55 c	69 c	0.27 c	0.32 c
		1x0	44 b	47 b	75 b	98 b	0.51 b	0.56 b
		1x1	52 a	60 a	110 a	129 a	0.80 a	0.87 a
OMxI		0xRh	21 g	25 h	35 h	45 h	0.12 h	0.16 g
		0xAzo.	29 ef	37 f	50 f	61 f	0.20 f	0.23 f
		0xPDB	27 f	30 g	41 g	54 g	0.14 g	0.25 f
		0xMix	37 d	43 d	62 e	78 d	0.29 e	0.37 e
		1xRh.	31 e	41 e	65 d	80 d	0.33 d	0.40 d
		1xAzo.	53 b	56 b	99 b	120 b	0.70 b	0.77 b
		1XPDB	47 c	52 c	89 c	101 c	0.62 c	0.67 c
		1xMix	61 a	65 a	116 a	154 a	0.97 a	1.02 a
M x I		0xRh.	23 g	30 g	44 h	54 h	0.17 f	0.20 g
		0xAzo.	37 d	40 d	61 e	78 e	0.31 d	0.35 f
		0XPDB	33 e	35 f	51 g	64 g	0.27 e	0.38 e
		0xMix	45 b	48 c	72 d	99 c	0.47 c	0.57 c
		1xRh.	29 f	37 ef	56 f	71 f	0.28 e	0.37 ef
		1xAzo.	45 b	53 b	89 b	103 b	0.59 b	0.65 b
		1Xpdb	41 c	47 c	79 c	91 d	0.48 c	0.54 d
		1xMix	54 a	61 a	106 a	133 a	0.78 a	0.82 a
OM0	M0d	Rhiz.	19 j	23 j	31 n	41 k	0.05 i	0.06 j
		Azto.	25 gh	30 h	40 l	51 j	0.09 i	0.10 j
		PDB	22 i	25 ij	34 m	43 k	0.08 i	0.26 i
		Mix	32 f	38 f	51 j	63 i	0.21 h	0.33 h
	M1	Rhiz.	23 hi	27 i	39 l	49 j	0.20 h	0.27 i
		Azto.	33 ef	44 e	60 h	72 g	0.30 g	0.37 gh
		PDB	31 f	34 g	48 k	65 hi	0.20 h	0.23 i
		Mix	42 d	49 d	73 f	92 e	0.37 f	0.40 g
OM1	M0	Rhiz.	27 g	36 fg	57 i	67 h	0.30 g	0.33 h
		Azto.	48 c	49 d	81 e	105 d	0.53 d	0.60 e
		PDB	44 d	45 e	68 g	84 f	0.47 e	0.50 f
		Mix	55 b	57 c	94 d	134 b	0.73 c	0.80 d
	M1	Rhiz.	35 e	46 e	74 f	92 e	0.37 f	0.47 f
		Azto.	57 b	62 b	118 b	134 b	0.87 b	0.93 b
		PDB	51 c	59 c	110 c	117 c	0.77 c	0.85 c
		Mix	66 a	73 a	138 a	173 a	1.20 a	1.23 a

The second 2-factor interaction in Table 3 belongs to organic compost x inoculation with biofertilizers shows that applying compost and inoculating with a mixture of Azotobacter and *Bacillus megaterium* was superior to all other combination treatments of this interaction. **El- Boraie *et al.* (2009)** and **Gharib *et al.* (2009)** who found that the highest significant pod yield was obtained from inoculating the seeds with a mixture of *Rhizobium* + *Azotobacter chroococcum* + *Bacillus megaterium*.

Table 3 shows also the Biomagic x inoculation on the same traits. Spraying the plants with rich nutrient solution; Biomagic, plus inoculating the seeds with a mixture of *Azotobacter chroococcum* + *Bacillus megaterium* significantly gave the highest plant height, plant dry matter production, and nodules weight plant^{-1} in both years of study.

From Table 3, presents the 3-factor interaction on the sametraits. The best treatment includes applying olive compost + inoculating the peanut seeds with a mixture of *Azotobacter chroococcum* + *Bacillus megaterium*.

Effects of applied treatments on seed yield.plant^{-1}, seed oil content (%), seed protein content (%), P content in seeds (%), and K content in seeds (%)

Table 4 shows how every source of variance among the applied treatments could translate its potential that was uncovered in tables 2 and 3 into seed yield.plant^{-1}, seed oil content.plant^{-1}, protein content.plant^{-1}, P content in seeds.plant^{-1}, and K content in seeds.plant^{-1} in the peanut growth seasons of 2015 and 2016. So, obviously seen is that the application of olive residues compost was evidently better than no application. So was the case with spraying Biomagic nutrient solution on peanut plants' canopy, spraying was evidently better than non-spraying on the five measured traits depicted in Table 4.

From among the four biological inoculation treatments, inoculating the seeds with a mixture of *Azotobacter chroococcum* and *Bacillus megaterium* proved to be the best. In addition, this treatment was significantly better than inoculating the seeds with *Rhizobium*. In the current research work *Azotobacter* could be elaborated in conjunction with the application of olive waste compost to wean peanut plants toward better growth parameters and then seed yield with better quality.

Table 4 depicts also the organic x Biomagic interaction for which the application of compost with spraying with Biomagic was the best combination treatment of this interaction on seed yield.plant^{-1}, seed oil content.plant^{-1}, protein content.plant^{-1}, P content in seeds.plant^{-1}, and K content in seeds.plant^{-1}in 2015 and 2016.

The second 2-factor interaction mentioned in Table 4 belongs to the OM x I. Albeit obvious from the data, it deserves mentioning that the best combination treatment is applying compost with inoculating the seeds with a mixture of *Azotobacter* and PDB in both years of study.

Table 4. Influence of the applied treatments on seed weight.plant^{-1}, seed oil %, seed protein %, seed P %, and seed K % in 2015 and 2016 at Balouza, North Sinai, Egypt.

Variables		Treatment	Seed weight. plant^{-1}		Seed oil %		Seed protein %		Seed P %		Seed K %	
			2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
OM		0	36 b	40 b	36 b	37 b	14 b	15 b	0.15 b	0.17 b	1.22 b	1.27 b
		1	65 a	70 a	43 a	44 a	20 a	21 a	0.32 a	0.35 a	1.51 a	1.64 a
M		0	42 b	46 b	39 a	40 b	16 b	17 b	0.21 b	0.24 b	1.26 b	1.35 b
		1	60 a	64 a	40 a	42 a	18 a	19 a	0.26 a	0.28 a	1.47 a	1.57 a
I		Rhizo.	42 d	45 d	36 c	37 c	15 c	15 c	0.19 c	0.22 c	1.19 d	1.26 d
		Azto.	50 b	55 b	40 b	41 b	17 b	18 b	0.24 b	0.27 b	1.42 b	1.46 b
		PDB	46 c	51 c	38 bc	40 b	16 bc	17 bc	0.23 b	0.25 b	1.31 c	1.40 c
		Mix	65 a	69 a	44 a	46 a	20 a	21 a	0.28 a	0.31 a	1.55 a	1.71 a
OMxM		0x0	30 d	33 d	35 b	37 b	13 c	14 c	0.14 c	0.16 c	1.16 d	1.23 d
		0x1	42 c	47 c	37 b	38 b	14 c	15 c	0.17 c	0.19 c	1.28 c	1.31 c
		1x0	53 b	58 b	42 a	43 a	18 b	19 b	0.28 b	0.33 b	1.37 b	1.46 b
		1x1	79 a	81 a	44 a	45 a	22 a	22 a	0.36 a	0.37 a	1.66 a	1.83 a
OMxI		0xRh	30 g	33 g	34 e	35 e	13 e	13 e	0.13 e	0.15 f	1.08 g	1.13 h
		0xAzo.	37 f	41 f	36 de	37 e	13 de	14 e	0.15 e	0.18 de	1.27 e	1.28 f
		0xPDB	35 f	40 f	36 de	37 e	13 e	14 e	0.15 e	0.17 ef	1.18 f	1.23 g
		0xMix	42 e	47 e	39 c	41 cd	16 cd	17 d	0.18 d	0.20 d	1.37 d	1.43 d
		1xRh.	55 d	57 d	39 c	40 d	17 c	18 cd	0.26 c	0.28 c	1.30 e	1.38 e
		1xAzo.	63 b	69 b	43 b	44 b	20 b	21 b	0.33 b	0.36 b	1.57 b	1.63 b
		1XPDB	58 c	62 c	41 bc	43 bc	19 b	20 bc	0.31 b	0.34 b	1.45 c	1.57 c
		1xMix	88 a	90 a	49 a	50 a	24 a	25 a	0.38 a	0.42 a	1.74 a	1.98 a
M x I		0xRh.	35 g	37 g	35 e	36 e	14 f	15 f	0.18 g	0.20 g	1.10 h	1.17 g
		0xAzo.	41 e	47 e	39 cd	41 c	16 d	17 d	0.21 e	0.25 d	1.30 e	1.37 d
		0XPDB	38 f	43 f	38 d	40 cd	15 e	16 e	0.20 f	0.24 e	1.21 g	1.30 f
		0xMix	53 c	56 cd	42 b	44 b	18 b	19 b	0.25 d	0.29 b	1.45 c	1.55 b
		1xRh.	50 d	53 d	38 d	39 d	16 d	16 e	0.21 e	0.23 f	1.28 f	1.35 e
		1xAzo.	59 b	63 b	40 c	41 c	18 b	18 c	0.27 b	0.29 b	1.53 b	1.55 b
		1Xpdb	55 c	59 c	39 cd	40 cd	17 c	18 c	0.26 c	0.27 c	1.42 d	1.50 c
		1xMix	78 a	81 a	46 a	47 a	22 a	22 a	0.31 a	0.33 a	1.66 a	1.87 a
OM0	M0	Rhiz.	22 l	23 k	33 f	33 h	12 g	13 i	0.12 i	0.14 k	1.02 l	1.07 k
		Azto.	31 k	36 j	36 e	37 g	13 fg	14 h	0.14 hi	0.16 ij	1.20 i	1.27 i
		PDB	30 k	34 j	35 ef	36 g	13 fg	14 h	0.13 i	0.15 jk	1.12 k	1.20 j
		Mix	38 j	41 i	37 e	39 f	15 def	16 f	0.17 g	0.19 gh	1.30 g	1.40 g
	M1	Rhiz.	38 j	43 hi	35 ef	36 g	13 fg	14 h	0.14 hi	0.16 ij	1.13 k	1.20 j
		Azto.	43 hi	47 g	37 e	37 g	14 efg	15 g	0.17 g	0.19 gh	1.33 f	1.30 h
		PDB	40 ij	45 gh	36 e	37 g	13 fg	14 h	0.16 gh	0.18 hi	1.23 h	1.27 i
		Mix	46 gh	53 f	40 d	42 de	17 cd	18 d	0.20 f	0.21 g	1.43 d	1.47 f
OM1	M0	Rhiz.	48 fg	51 f	37 e	39 f	16 cde	17 e	0.23 e	0.27 f	1.17 j	1.27 i
		Azto.	51 f	58 e	43 c	44 c	18 c	19 c	0.29 d	0.34 de	1.40 e	1.47 f
		PDB	46 gh	51f	41 d	43 cd	18 c	18 d	0.27 d	0.32 e	1.30 g	1.40 g
		Mix	67 d	72 c	47 b	48 b	21 b	22 b	0.34 c	0.39 b	1.60 c	1.70 d
	M1	Rhiz.	61 e	63 d	40 d	41 e	18 c	19 c	0.28 d	0.29 f	1.43 d	1.50 e
		Azto.	76 b	80 b	43 c	44 c	22 b	22 b	0.37 b	0.38 bc	1.73 b	1.80 b
		PDB	71 c	72 c	41 d	42 de	21 b	22 b	0.35 bc	0.36 cd	1.60 c	1.73 c
		Mix	109 a	109 a	51 a	52 a	26 a	27 a	0.43 a	0.45 a	1.88 a	2.27 a

The third interaction of M x I treatments revealed in Table 4 that the best combination treatment of this interaction was due to spraying Biomagic with inoculating the seeds with a mixture of *Azotobacter* and PDB in both years of study.

For the one 3-factor interaction which belong to applying OM x M x I, Table 4 shows that the best combination treatment was composed from applying compost + spraying plants' canopy with Biomagic x inoculating the seeds with a mixture of *Azotobacter* and PDB in both years of study.

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الزراعة الحيوية وأثرها على إنتاجية وجودة الفول السودانى تحت ظروف شمال سيناء – مصر

محمود علي محمدالسيد

قسم خصوبة وميكروبيولوجيا الاراضي– مركز بحوث الصحراء

أجريت تجربة ميدانية في محطة بحوث بالوظة التابعة لمركز بحوث الصحراء بشمال سيناء – مصر. في موسمين متتاليين خلال عامى 2015 و 2016. ويمكن تصوير أبرز أهداف هذا العمل هو إعادة تدوير النواتج الثانوية لمخلفات زيت الزيتون، والتحقق من الدور الذي تلعبه اللقاحات الحيوية في تحسين نواتج تلك المخلفات، وتقليل التلوث الناجم عن الأستخدام المتزايد من الأسمدة المعدنية ، ودراسة الأهمية الغذائية للسماد الحيوي لنباتات الفول السوداني، واكتشاف أفضل خليط من بين جميع أدوات الإنتاج والتي تعطي أعلى محصول ممكن من بذور الفول السوداني بأفضل جودة ممكنة في ظل ظروف شمال سيناء.

شملت المعاملات ثلاث عوامل رئيسية هى (سماد الزيتون المعالج مقابل عدم الاستخدام، الرش بمحلول المغذيات الحيوية (بيوماجيك) مقابل عدم الرش، وتلقيح البذور بالأزوتوباكتر والبكتيريا المذيبة للفوسفات، مقابل تلقيح البذور بالريزوبيوم فقط (كنترول) وكلاهما مطبق بشكل منفصل أو خليط). تم ترتيب هذه المعاملات في تجربة تطبيقية في ثلاث مجاميع كاملة العشوائية. تم التحقق من القيم المتوسطة من بعضها البعض باستخدام نطاق Dunkan الأقل أهمية (LSR) والمشار إليها بأحرف أبجدية. بحيث لا تختلف أي قيمتين متوسطتين تشتركان في حرف أبجدي اختلافًا كبيرًا. تتكون الأضافات المختلطة من السماد العضوى + الرش بالبيوماجيك + تلقيح البذور بخليط من بكتريا الأزوتوباكتر والبكتريا المذيبة للفوسفات خلال سنوات الدراسة، والتى أعطت أفضل النتائج. يمكن أن يؤدي هذا الخليط إلى توافر ظروف نمو أفضل بشكل كبير في منطقة الجذور والتي تغذي النمو الميكروبيولوجي الأكثر نشاطًا.مما يؤدي إلى نمو نباتي أفضل وبالتالى الوصول إلى أفضل محصول من بذور الفول السوداني وبأفضل جودة.