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Impact of Bio, Organic and Inorganic Fertilization on Growth and Chemical Constituents of Wheat Plant

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ABSTRACT

Two field experiments were held in a private farm at El-Mansoura District, Dakahlia Governorate, Egypt during the 2015/2016 and 2016/2017 seasons to study the effect of bio-, organic and mineral fertilizers on the growth and chemical composition of wheat plant, Sids 12 cultivar. The experiments were carried out in a split plot design with four replicates. The main plots were assigned to organic and bio-fertilizers (control= B_0O_0, organic only= B_0O_1, Bio only= B_1O_0, bio+organic= B_1O_1). While the sub plots were allocated to five levels of mineral fertilization (0-25-50-75-100% of the recommended fertilizers of NPK doses for wheat plant). The results showed that grain yield productivity as a result of adding the organic + biological treatment (B_1O_1) + without adding mineral fertilizers, was almost identical to that treated with 50% of mineral fertilization without biological and organic fertilization in both seasons. While straw yield obtained due to adding biological +organic treatment (B_1O_1) + without adding mineral fertilizers, was almost matched with 75% of mineral fertilization without biological and organic fertilization (B_0O_0) in both seasons. Also, the distinction of treating organic fertilizer only appeared in comparison to the biological only, while the effect of overlap between them was the largest under all levels of mineral fertilization concerning for all characteristics of the study. From the results of this study, mineral fertilization at the level of 100% with the addition of biological and organic fertilizers can be recommended to wheat plant under the conditions of Dakahlia Governorate, Egypt.

Keywords: Wheat, bio-fertilization, organic fertilization, mineral fertilizers, grain, straw, chemical constituents.

INTRODUCTION

Wheat (*Triticum aestivum L.*) is taken into account the foremost strategic crop for Egypt and a few other developing countries. Wheat is employed specially as a person's food. It's far the main sources of energy, protein and fiber in human diet, staple food for nearly 35% of the planet population and for this reason, it is foremost vital cereal crop globally. Wheat grain is a staple meals used for human. Despite the fact that wheat is beneficial as a cattle feed. In Egypt, the whole cultivated land of wheat reached approximately 3.196 million feddan and the full production surpassed 8.800 million tons with an average of 18.36 ardab/fed (FAO, 2019). Wheat production isn't always enough for regional intake in Egypt. Consequently, a superb attempt had been exerted to raise wheat production both by increasing the cultivated area or maximizing yield to be able to meet the persistent demand and reduce the gap among the production and the consuming of wheat.

It is properly recognized that vertical growth and maximize productiveness of any harvest ought to be executed by the usage of appropriate agronomic practices. Moreover, the reported function of the agronomical strategies for example, bio and organic fertilization as properly as nitrogen, phosphorus and potassium (NPK) fertilization rates has very indispensable impact on the prosperity and chemical components of wheat crop.

In latest years, the tendency is to discover the opportunity of supplementing chemical fertilizers with greater specifically biofertilizers of microbial origin. This technique goals to limit the environmental pollution which resulted from chemical fertilizers and additionally to decrease its coasts, hence upkeep of excessive yielding. Biofertilizers can be typically described as preparations containing live or inert cells of productive strains of nitrogen fixation and phosphorous and potassium dissolvability utilized for applying to soil with the goal of increasing speed certain positive microbial procedures to expand the degree of the availability of nutrients supplements in a structure which can be effortlessly absorbed by plants. Biofertilizers may influence plant development by at least one components, for example, nitrogen fixation, bettering nutrient uptake, creation of organic acids, assurance against plant pathogens and discharge prosperity regulators such as IAA and GA3, which motivated growth and brought about high yield. Utilization of biofertilizers (Azotobacter, Cerealien and Phosphorien) accelerated the development of wheat plants (Mahmoud and Mohamed, 2008 ; Ahmed *et al.*, 2011 ; El-Habbasha *et al.*, 2013 and Singh *et al.*, 2016). Fouda (2007) indicated that inoculated wheat seeds earlier than sowing with Cerealine altogether expanded phosphorus and potassium content in grains. Khalil *et al.* (2011) published that best noteworthy straw nitrogen content of wheat can be acquired with inoculation with the aid of nitrobien. Grageda-Cabrera *et al.*, (2018) revealed that the inoculation of wheat with biofertilizers appreciably improved the quantity of N in the plant.

The persisted use of mineral fertilizers reasons health and ecological risks, for example, soil and surface water contamination by means of nitrate leaching. In this way, decreasing the quantity of nitrogen fertilizers utilized to the field without causing a nitrogen deficiency will be the essential aim in land management. Recycling of organic

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wastes should be one of the potential alternatives to diminish the utilization of mineral fertilizer. Compost as the organic waste can be a precious and cheaper fertilizer and supply of plant nutrients. Beneficial outcomes of organic fertilizer on soil structure, aggregation and water-holding capability had been mentioned (Odlare *et. al.*, 2008). Bar-Tal *et. al.*, (2004) revealed that utilization of cattle manure fertilizer on sandy soil elevated total dry weight of wheat. Antoun *et.al.*, (2010) mentioned that NPK contents in wheat grain and straw had been drastically expanded by way of utility of compost. Harb *et. al.*, (2012) confirmed that the best fertilizer rate was (6 $t.fed^{-1}$) which gave the best outcomes for growth characteristics of wheat plant in contrast with the most reduced rate (2 $t.fed^{-1}$) under sandy soil conditions of west delta region of Egypt. Talha (2013) showed that use of various treated composted substances have been progressively viable in expanding N, P and K% in wheat grains. El-Guibali (2016) published that utility of compost appreciably elevated N, P and K contents of wheat plant and grain protein. Subhan *et al*. (2017) indicated that compost and cattle manure gave a relevant variant in growth and development of wheat plant. Ali *et. al.*, (2018) demonstrated the critical impact of 12 tons of compost/ha on dry weight, stem weight and fresh weight of leaves of durum wheat under the condition of Sulaimani region of Iraq.

NPK fertilization is amongst the indispensable variables influencing growth, yield and exceptional of wheat. Hence, utility the appropriate rate of NPK is one of the main impacts for growing wheat yield and quality. In this regard, Meena *et. al.*, (2013) mentioned that sizeable enhancement in dry matter creation of wheat with utilization of 100% NPK. Youssef *et. al.*, (2013) revealed that utilization of chemical fertilizers in recommended portion gave the most elevated estimations of fresh and dry matter of wheat plant. Seadh and El-Metwally (2015) suggested that absolute best values of growth attributes, P and K% in grains and straw of wheat had been acquired from expanding NPK fertilization rates up to 100% of the suggested dose (80.0 kg N + 22.5 kg P_2O_5 + 24.0 kg $K_2O.fed^{-1}$). Singh *et. al.*, (2016) confirmed that the increase attributes of wheat indicated an expansion with increment in the NPK fertilization rates. 125% of the recommended dose of mineral fertilizers recorded extensively most noteworthy grain and straw yields. Seadh *et al.* (2017) demonstrated that using 100% of recommended dose of mineral fertilizers for wheat plant gave the most elevated estimations of growth attributes and K% in grains. Subhan *et. al.*, (2017) indicated that the mineral fertilizers gave considerably greater total dry weight of wheat plant.

Subsequently, this investigation used to be mounted to decide the interplay impact of bio, organic and mineral fertilization on wheat yield and its nutrients uptake under environmental conditions of Dakahlia Governorate, Egypt.

MATERIALS AND METHODS

Two field experiments were conducted in a private Farm at El-Mansoura Center, Dakahlia Governorate, Egypt during the two successive winter growing seasons of 2015/2016 and 2016/2017. The main objective of this study is to determine the effect of bio, organic and inorganic fertilization on growth and chemical constituents of wheat plant, (Sids 12 cultivar).

The experiment was carried out in a split plot design with four replicates. The main-plots were allocated to four bio-organic fertilization treatments *i.e.* without bio-and organic fertilizers (control treatment=B_0O_0), treated wheat seeds with bio-fertilizer alone (B_1O_0), organic fertilizer alone (B_0O_1) and both organic and bio fertilizers (B_1O_1). Whereas the sub-plot treatments were 5 levels of mineral fertilizers (0, 25, 50, 75 and 100%) of the recommended dose of NPK for wheat plant.

The bio-fertilizer comprised Azospirlum (nitrogen fixation) + *Bacillus megaterium* (P dissolvent) + *Bacillus circulans* ((K dissolvent) which were added at the rate of 500 g/fed for each one. These bio-fertilizers were produced by Biofertilizer Unit at Sakha, Microbiology Research Institute, Agriculture Research Center (ARC), Giza, Egypt, which included free-living bacteria able to fix atmospheric nitrogen, solublizing phosphorus and potassium, respectively in the rhizo-sphere of soil. The organic fertilizer was a compost which was obtained from Super Bio Organic Fertilizers Company and was added to the experimental field during soil preparation at a rate of 14 $tons.fed^{-1}$, where it was mixed with the soil at depth from 0- 20 cm. Analysis of the used compost shown in Table 1 and was carried out according the methods described by Page *et al.*, (1982) and Black (1983).

Table 1. Chemical analysis of compost during the two seasons:

Compost characteristics	1st season 2015 / 2016	2nd season 2016 / 2017
Moisture (%)	23.00	24.00
Weight of 1 m^3 (kg)	700.00	750.00
pH(1:10)	7.90	7.95
EC (1 : 10) dSm^{-1}	5.04	5.12
OM (%)	27.53	29.03
C (%)	15.97	16.84
N (%)	1.20	1.28
C/N ratio	13.31 : 1	13.58:1
P (%)	0.62	0.74
K (%)	1.09	1.13

The sub-plots were devoted for five levels of chemical fertilization with the suggested dose of chemical fertilizers of nitrogen, phosphorus and potassium (NPK) for wheat plant with five levels (0, 25, 50, 75 and 100%) of the Ministry of Agriculture recommended dose which was 70.0 kg $N.fed^{-1}$, 15.5 kg $P_2O_5.fed^{-1}$ and 25.0 Kg $K_2O.fed^{-1}$,respectively. Urea (46%N), ordinary super phosphate (6.8% P) and potassium sulfate (41.5% K) fertilizers were utilized as sources for N, P and K, respectively. Phosphorus fertilizer was included at planting date whereas, N and K fertilizers were applied as broadcasting in two equal doses, at the first and the second irrigation.

Hence the experiment comprised 20 treatments with four replicates to be 80 experimental plots. Each experimental unit was 20 m^2. Soil samples were collected randomly from the experimental field area at a depth of 0-30 cm prior to soil preparation to asses some physical and chemical properties of the soil which listed in Table 2. Soil samples were air dried, sieved and mechanical analysis was done using pipette method as mentioned by Klute (1986) to determine the texture of the soil. Soil reaction pH in 1:2.5 soil-water suspensions using Beckman pH meter was measured in addition electrical conductivity (EC), $dS.m^{-1}$, at 25 °C in 1:5 soil-water extract was measured according to Hesse, (1971).

Saturation percentage (SP) was assessed utilizing the approach mentioned by Dewis and Freitas, (1970). Total calcium carbonate was determined using calcimeter apparatus with 1:3 HCl according to Page (1982). Organic matter% was determined by modified Walkly and Black Method mentioned by Jackson, (1972). Soluble ions were determined according to

Black, (1965). Available form of nitrogen was estimated utilizing the method of micro-Kjeldahl as mentioned by Bremner and Mulvaney, (1982). Available form of phosphorus was assessed calorimetrically at 660 µm wavelength in bicarbonate extract using a spectrophotometer as mentioned by Olsen and Sommers, (1982). Available form of potassium was estimated in ammonium acetate extract and determined according to Black, (1965).

Table 2. Some physical and chemical properties of the experimental soil during the two seasons.

Soil characteristics	First season 2015/2016	Second season 2016/2017
Sand %	24.20	24.20
Silt %	24.10	23.80
Clay %	51.70	52.00
Texture	Clay	Clay
pH in 1: 2.5 suspension	7.85	7.92
EC $dS.m^{-1}$ in 1: 5 extract	2.80	3.10
$CaCO_3$ %	1.89	2.00
SP%	70.00	72.00
OM%	1.65	1.60
Soluble Cations (meq L^{-1})		
Ca^{++}	9.10	10.20
Mg^{++}	8.70	9.20
Na^{+}	9.00	10.10
K^{+}	1.20	1.50
Soluble Anions (meq L^{-1})		
$CO_3^{=}$	-	-
HCO_3^{-}	11.40	12.10
Cl^{-}	3.30	4.50
$SO_4^{=}$	13.30	14.40
Available nutrients mg/kg soil		
Nitrogen (N)	31.00	28.00
Phosphorus (P)	12.00	13.00
Potassium (K)	227.00	211.00

Wheat seeds 60 $kg.fed^{-1}$ (268 $g.plot^{-1}$) have been planting on twenty fifth November in first and second seasons by the way of broadcasting method. The regular cultivation practices, for example irrigation, weed administration etc., had been executed in accordance to the traditional wheat production.

Wheat plants were reaped following 140 days at its completely matured stage (at the end of April). All plants of one square meter from each plot were gathered, weighed promptly in the field to determine the grain and straw yield. Representative samples were moved to the laboratory, where they were air dried then oven dried at 70 oC until regular weight. The dry matter counted for grain and straw yield were determined. Also, samples of oven dry weight of grain and straw were ground utilizing spotless rotary. At that point, some substance examinations, for example, elements content(%) of N,P and K in wheat plant were measured utilizing the digestion of 0.2 g from every straw and grain samples. The plant samples have been digested using the method described by Chapman and Pratt, (1961). Nitrogen used to be measured by way of Kildahl technique referenced by Jackson (1972), Phosphorous was resolved calorimetrically at a frequency of 660 µm with the aid of techniques portrayed by Olsen and Sommers, (1982). Potassium was measured by using Jenway Flame photometer according to Jackson, (1972). Nutrients uptake by grains and straw have been calculated in kg.fed-1 by multiplying elements % by dry weight of grain and straw.

All records had been statistically analyzed in accordance to the approach of analysis of variance (ANOVA) for the spilt plot layout as posted by using Gomez and Gomez (1984) via methods of "Co-State" Computer software program package. Least significant difference (LSD) approach was utilized to test the variations and contrasts between means of treatments implies at probability level of 5% as described with the aid of Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Grain yield

Results in Table 3 gave the idea that dry grain weight, $kg.fed^{-1}$ of wheat reacted notably to the impact of organic and bio fertilizers treatments in each seasons. The most elevated mean values were 2535 and 2541 $kg.fed^{-1}$ with an expansion of 33.00% and 34.66% contrasted with the control (without bio and organic fertilizers B_0O_0) in the first and second season, individually. These increments in dry grain weight acquired because of including 14 tons $compost.fed^{-1}$ mixture with bio-fertilizer. The impact of bio-fertilizer (B_1O_0) or organic fertilizer alone (B_0O_1) gave much less impact comparing to the previous treatment (B_1O_1) however they have induced significant effect compared to the control. The organic treatment gad much better effect on the grain yield of wheat than the bio-treatment. The means grain yield were 2271 and 2267 $kg.fed^{-1}$ for organic fertilizer (19.2 and 20.1% increase over control) whereas were 2026 and 2029 $kg.fed^{-1}$ for bio-fertilizer (6.3 and 7.5% increase over the control) in the 1st and 2nd season, respectively. The data of Table 3 reveal also that the combined effect of organic and bio-fertilizers on grain yield of wheat plant in the presence of chemical fertilization is very good than the individual effect of each on as mentioned before. The grain yield can be arranged in the order B_1O_1+mineral > B_0O_1+mineral > B_1O_0+mineral > B_0O_0+mineral. Significant interactions between the three treatments under study on the grain yield were found. The lowest values were 1262 and 1248 $kg.fed^{-1}$ were obtained at the treatment of B_0O_0 without mineral fertilization, on the other hand the highest grain yield 3319 and 3311 $kg.fed^{-1}$ were found due to the application of B_1O_1 and 100% of the mineral fertilization in the 1st and 2nd season, respectively.

Table 3. Effect of mineral, organic and bio-fertilizers on grains dry weight $kg.fed^{-1}$of wheat plant at harvesting stage during both seasons.

Treatments	Grains dry weight $kg.fed^{-1}$													
	0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control B_0O_0	1262	1248	1572	1569	1884	1914	2231	2239	2579	2464	1906	1887		
Organic B_0O_1	1501	1491	2026	2019	2388	2389	2508	2502	2933	2936	2271	2267	**	**
Bio B_1O_0	1346	1357	1645	1652	2021	2024	2346	2340	2775	2769	2026	2029	39.19	59.48
Organic+bioB_1O_1	1851	1857	2130	2145	2501	2503	2874	2887	3319	3311	2535	2541		
Means of Mineral	1490	1488	1843	1846	2198	2207	2490	2492	2901	2870				
F test of Mineral treatments			**	**										
LSD at 5% of mineral treatments			59.53	38.13										
LSD at 5% for interaction			** 238.1	** 152.5										

The expand in the grain yield in the inoculated traits may to be attributable to the exudation of plant growth regulators (PGRs), such as auxins, gibberellin and cytokinin which would enhance the grain yield of wheat plant. These outcomes are in an amicability with those got by Vessey, (2003); Mahmoud and Mohamed (2008); Ahmed *et. al.,* (2011); El-Habbasha *et. al.,* (2013); Piccinin *et. al.,* (2013) and Ali *et. al.,* (2018).

Data in Table 3 show also that expanding the chemical fertilizers (NPK) levels (0.25, 50, 75, and 100% of the advocated dose) expanded drastically the dry weight of wheat grains in each season. The most perfect imply values have been 2901 and 2870 kg.fed^{-1} with an expansion of 94.70% and 92.87% in contrast to the control (without chemical fertilizers) in the first and second season, separately. In this regard, at excessive N level, accessibility of nitrogen fulfilled plant prerequisite for growth and advancement which empower plant to produce progressively greater number of grains per spike and expanding singular grain weight which, thusly, decidedly elevated grain yield. Compost gradually discharges supplements as well as forestalls the misfortunes of mineral fertilizers through de-nitrification, volatilization and leaching due to binding to nutrients and releasing them with the passage of time. Therefore, all things considered, when applying enhanced organic manure alongside mineral fertilizers, organic fertilizer forestalls nutrients misfortunes. Thus, coordinated utilization of mineral fertilizers and organic fertilizer may additionally enhance the proficiency of mineral fertilizers and in this way enhance crop efficiency. These outcomes are in an agreement with Jan and Khan (2000), Arshad *et. al.,* (2004), Meena *et. al.,* (2013), Youssef *et. al.,* (2013), Singh *et. al.,* (2016) and Subhan *et. al.,* (2017).

Straw yield

As illustrated in Table 4 the straw dry weight kg.fed^{-1} of wheat responds significantly to the effect of organic and bio fertilization in both seasons. The highest values were 2726 and 2728 kg.fed^{-1} with B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season respectively. Fertilization treatments (B_1O_1, B_0O_1 and B_1O_0) increased over control by 61.68, 40.15 and 14.12% in the 1st season and by 63.94, 37.44 and 12.02% in the 2nd season, respectively. This increase in straw dry weight may be due to the role of organic fertilizer (Table 1) in increasing plant nutrients in soil and enhancing microbial activity to produce plant growth regulators (PGRs), which improve growth environment to increase root growth and density enabling plant to absorb water and nutrients efficiently which reflect on wheat yield. These results are in harmony with Dobbelaere *et. al.,* (2003), Mahmoud and Mohamed (2008), Selvakumar *et. al.,* (2009), Subhan *et. al.,* (2017) and Ali *et. al,*. (2018).

Table 4. Effect of mineral, organic and bio fertilizers on straw dry weight kg.fed^{-1} of wheat plant at harvesting stage during both seasons.

Treatments	Straw dry weight kg.fed^{-1}													
	0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control B_0O_0	1374	1283	1526	1439	1781	1725	1821	1901	1926	1975	1686	1664		
Organic B_0O_1	1875	1787	2008	1950	2101	2067	2602	2594	3228	3037	2363	2287	**	**
Bio B_1O_0	1513	1405	1677	1620	1821	1791	2240	2214	2369	2290	1924	1864	74.23	115.3
Organic+bioB_1O_1	1954	1920	2371	2346	2706	2693	2907	2955	3690	3728	2726	2728		
Means of Mineral	1679	1599	1896	1839	2102	2069	2393	2416	2804	2757				
F test of Mineral treatments			**	**										
LSDat 5% of mineral treatments			68.96	74.50										
LSD at 5% for interaction			** 275.8	** 298.1										

Data in Table 4 show also that increasing mineral fertilizer (NPK) rates (0, 25, 50, 75, and 100% of the recommended dose) increased significantly wheat dry straw weight in both seasons. The highest mean values were 2804 and 2757 kg.fed^{-1} with an increase of (67.00 % and 72.42 %) compared to the control (without mineral fertilization) in the 1st and 2nd season, respectively. Subsequently, it is very likely that when compost was applied along with chemical fertilizers, compost provides more plant nutrients and prevents nutrient losses. Consequently, integrated utilization of chemical fertilizers and recycled organic waste may increase available form of nutrients for plant leading to increase in root growth and nutrient uptake by plant that results in plant dry weight rise up. In this way, combination of inorganic fertilizer and compost positively influenced the dry matter production of plant at different growth stages and more plant biomass was recorded. These results are in a harmony with Parmer and Sharma, (2002), Wei and Liu, (2005). Ali, (2011), Soheil *et. al.,* (2012), Youssef *et. al.,* (2013) and Seadh and El-Metwally, (2015).

N uptake by grains

As shown in Table 5, the N-uptake by wheat grains kg.fed^{-1} responded significantly to the effect of organic and bio fertilizers in both seasons. The highest values are 113.1 and 112.5 kg.fed^{-1} with an increase of 104.04% and 94.03% with applying the treatment of B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season, respectively. These increases in N-uptake by grains obtained as a result of adding 14 tons.fed^{-1} organic matter (compost) combined by different bio-fertilizer. Also, it worth to notice that N-uptake with B_1O_1 compared to (B_0O_1) gave an increase by 86.13 and 79.66 in the 1st and 2nd season, respectively in the plots had no mineral fertilizers which confirm that organic matter and its components when they released, microorganisms activated widely and plant subsequently improved. Moreover, organic and bio-fertilizers promote root elongation, stimulation of leaf expansion and enhance water and nutrient uptake. these results are in a harmony with Vessey, (2003); Saini *et. al.,* (2004); Kandil *et al.,* (2011) and Talha, (2013).

Also, it worth to notice that N-uptake with B_1O_1 compared to (B_0O_1) gave an increase by 86.13 and 79.66 in the 1st and 2nd season, respectively in the plots had no mineral fertilizers which confirm that organic matter and its components when added to the soil, microorganisms activated widely and plant subsequently improved. Moreover, organic and bio-fertilizers promote root elongation, stimulation of leaf expansion and enhance water and nutrient uptake These results are in a harmony with Vessey, (2003); Antoun *et al.* (2010); Khalil *et al.* (2011); Talha (2013) and Grageda-Cabrera *et al.* (2018).

Table 5. Effect of mineral, organic and bio fertilizers on N-uptake by wheat grain kg.fed^{-1} at harvesting stage during both seasons.

Treatments		N % in wheat grain kg.fed^{-1}													
		0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	B_0O_0	28.39	28.13	40.55	41.38	53.70	56.47	68.61	73.33	85.89	90.59	55.43	57.98	**	**
Organic	B_0O_1	45.42	44.37	68.35	67.16	90.75	93.19	104.1	103.8	130.5	131.4	87.83	88.05	2.114	2.710
Bio	B_1O_0	35.32	35.65	46.06	47.10	62.13	62.27	79.76	79.61	104.1	102.5	65.47	65.43		
Organic+bio	B_1O_1	65.74	64.05	85.75	84.19	113.1	112.5	136.5	137.1	164.2	164.7	113.1	112.5		
Means of Mineral		43.72	43.05	60.18	59.95	79.93	81.13	97.26	98.49	121.1	122.3				
F test of Mineral treatments				**	**										
LSDat 5% of mineral treatments				2.269	2.164										
LSD at 5% for interaction				** 9.079	** 8.658										

Whereas increasing mineral fertilizer rates (0, 25, 50, 75, and 100 of the recommended dose) increased significantly N-uptake by grains in each season. The highest mean values were 121.1 and 122.3 kg.fed^{-1} with an increase of (176.99 % and 184.08 %) compared to the control (without mineral fertilization) in the 1st and 2nd season respectively. It is obvious that mineral fertilizers had significantly effect on nutrients uptake especially with Mono-cotyledon plants either individually or in combinations with organic and bio-fertilizers, this may be related to the mineralization of organic minerals and slow release of minerals in an available form from organic manure and also effect of bio-fertilizer on fixing and solubilizing nutrients in the rihzo-sphere combined with mineral fertilizer. These results are in accordance with that obtained by Zeidan *et al.* (2005), Sherpa *et al.* (2007); Mylavarapu and Zinati (2009); Yassen *et al.* (2010) and Seadh and El-Metwally (2015).

N uptake by straw

As shown in Table 6, the N-uptake by straw (kg.fed^{-1}) of wheat plant responded significantly to the effect of organic and bio fertilizers in both seasons. The highest values were 38.59 and 36.69 kg.fed^{-1} with an increase of 192.30 and 203.40% with B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season, respectively. These increases in N-uptake by straw obtained as a result of adding 14 tons.fed^{-1} organic matter (compost) combined by different bio-fertilizer.

Table 6. Effect of mineral, organic and bio fertilizers on N-uptake by wheat straw kg.fed^{-1} at harvesting stage during both seasons.

Treatments		N-uptake in wheat straw kg.fed^{-1}													
		0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	B_0O_0	4.810	3.522	8.403	6.854	13.81	11.23	16.84	16.15	22.17	22.72	13.20	12.09	**	**
Organic	B_0O_1	14.054	11.59	19.05	16.55	24.64	21.71	34.53	32.41	50.05	47.07	28.46	25.87	1.186	1.661
Bio	B_1O_0	7.934	6.340	12.51	10.52	19.52	17.07	26.32	26.01	32.57	30.91	19.77	18.16		
Organic+bio	B_1O_1	18.56	16.33	27.27	24.63	36.54	33.67	45.05	43.60	65.51	65.24	38.59	36.69		
Means of Mineral		11.34	9.449	16.81	14.64	23.63	20.91	30.69	29.54	42.57	41.49				
F test of Mineral treatments				**	**										
LSDat 5% of mineral treatments				1.037	1.220										
LSD at 5% for interaction				** 4.150	** 4.880										

Whereas increasing mineral fertilizer rates (0, 25, 50, 75, and 100 of the recommended dose) increased significantly N-uptake by straw in each season. The highest mean values were 42.57 and 41.49 kg.fed^{-1} with an increase of (275.30 and 339.10 %) compared to the control (without mineral fertilization) in the 1st and 2nd season, respectively. It is obvious that mineral fertilizers had significant effects on nutrients uptake especially with Mono-cotyledon plants either individually or in combinations with organic and bio-fertilizers, this may be related to the mineralization of organic minerals and slow release of minerals in an available form from organic manure and also effect of bio-fertilizer on fixing and solubilizing nutrients in the raihzo-sphere combined with mineral fertilizer. These results are in accordance with that obtained by Zeidan et. al., (2005), Sherpa et.al., (2007); Yassen et. al., (2010) and Seadh and El-Metwally, (2015).

P uptake by grains

As illustrated in Table 7 P-uptake in wheat grains (kg.fed^{-1}) responded significantly to the effect of organic and bio fertilizers in both seasons. The highest values were 0.753 and 0.823 kg.fed^{-1} with an increase of 79.42 and 98.81% with B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season, respectively. This increase in P-uptake in grains obtained as a result of adding 14 tons.fed^{-1} organic matter (compost) combined by different bio-fertilizers. Also, it is noticed that the means P-uptake with B_0O_1 was superior to B_1O_0 gave an increase of 24.16 and 23.87% in the 1st and 2nd season, respectively in the plots had no mineral fertilizers whereas under 25% of adding recommended dose of mineral fertilizers the means P-uptake with B_0O_1 was superior to B_1O_0 too but, gave an increase of 32.14 and 29.52% in the 1st and 2nd season, respectively which was the highest increase comparing with different levels of mineral fertilizers under the same treatments. These results confirm that organic and bio-fertilizer may need mineral fertilizers as activated material to pronounce their activity which affect soil and plant subsequently increased their nutrients availability and uptake These results are in a harmony with Vessey, (2003); Saini *et. al.,* (2004); Fouda, (2007), Antoun *et. al.*, (2010) and Talha, (2013).

Corresponding to mineral fertilizer rates (0, 25, 50, 75, and 100 of the recommended dose), it was noticed that P-uptake in grain increased significantly in each season. The highest mean values were 0.872 and 0.904 kg.fed^{-1} with an increase of (203.09 and 213.05%) compared to the control (without mineral fertilizers) in the 1st and 2nd season respectively.

It is obvious that mineral fertilizers had significant effects on nutrients uptake especially with Mono-cotyledon plants either individually or in combinations with organic and bio-fertilizers, this may be related to the mineralization of organic minerals and slow release of minerals in an available form from organic manure and also effect of bio-fertilizer on souliblizing nutrients in the raihzo-sphere combined with mineral fertilizer, which affect plant growth and its efficiency in absorbing nutrients and accumulates them in the plant organs. These results are in accordance with that obtained by Zeidan *et.al.,* (2005), Sherpa et. al., (2007); Yassen *et. al.,* (2010) and Seadh and El-Metwally, (2015).

Table 7. Effect of mineral, organic and bio fertilizers on P-uptake by wheat grain kg.fed^{-1} at harvesting stage during both seasons.

Treatments	P-uptake in wheat grain kg.fed^{-1}													
	0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control B_0O_0	0.208	0.206	0.295	0.291	0.405	0.407	0.524	0.526	0.665	0.641	0.420	0.414	**	**
Organic B_0O_1	0.297	0.294	0.446	0.439	0.585	0.586	0.665	0.676	0.865	0.888	0.572	0.576	0.0170	0.0154
Bio B_1O_0	0.239	0.238	0.337	0.339	0.460	0.455	0.563	0.562	0.763	0.748	0.473	0.468		
Organic+bioB_1O_1	0.407	0.418	0.549	0.568	0.700	0.757	0.913	1.031	1.194	1.341	0.753	0.823		
Means of Mineral	0.288	0.289	0.407	0.409	0.538	0.551	0.666	0.699	0.872	0.904				
F test of Mineral treatments			**	**										
LSDat 5% of mineral treatments			0.0191	0.0118										
LSD at 5% for interaction			** 0.0765	** 0.0474										

P uptake by straw

As shown in Table 8, the P-uptake in straw (kg.fed^{-1}) of wheat plant responded significantly to the effect of organic and bio fertilizers in both seasons. The highest mean values were 0.586 and 0.607 kg.fed^{-1} with an increase of 222.10 and 231.60% with B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season, respectively. These increases in P-uptake in straw obtained as a result of adding 14 tons.fed^{-1} organic matter (compost) combined by different bio-fertilizer.

Corresponding to P-uptake in straw of wheat it worth to say that P-uptake with B_1O_1 gave almost the same P-uptake in comparison with the interaction of 100% of the recommended dose of mineral fertilizers with control (B_0O_0). Also, B_1O_0 gave almost the same P-uptake in comparison with 25% of the recommended dose of mineral fertilizers with control (B_0O_0). Whereas, B_0O_1 gave almost the same P-uptake in comparison with 75% of the recommended dose of mineral fertilizers with control (B_0O_0) in both seasons. These results clarify that organic fertilizers had superior effect than bio-fertilizers and this may be due to that original soil organisms had their role in soulblizing and fixing nutrients in the soil which had been absorbed by plants and affecting their uptake. These results are in a harmony with Vessey, (2003); Antoun *et. al.,* (2010); Talha, (2013) and Grageda-Cabrera *et. al.,* (2018).

Table 8. Effect of mineral, organic and bio fertilizers on P-uptake by wheat straw kg.fed^{-1} at harvesting stage during both seasons.

Treatments	P-uptake in wheat straw kg.fed^{-1}													
	0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control B_0O_0	0.086	0.077	0.130	0.122	0.187	0.181	0.228	0.243	0.279	0.291	0.182	0.183	**	**
Organic B_0O_1	0.216	0.223	0.276	0.283	0.357	0.352	0.257	0.538	0.759	0.744	0.373	0.428	0.0431	0.0237
Bio B_1O_0	0.117	0.119	0.160	0.170	0.209	0.228	0.303	0.327	0.391	0.401	0.236	0.249		
Organic+bioB_1O_1	0.298	0.283	0.439	0.411	0.555	0.552	0.669	0.724	0.969	1.062	0.586	0.607		
Means of Mineral	0.179	0.176	0.251	0.247	0.327	0.328	0.364	0.458	0.600	0.625				
F test of Mineral treatments			**	**										
LSDat 5% of mineral treatments			0.0476	0.0166										
LSD at 5% for interaction			** 0.1905	** 0.0666										

Whereas increasing mineral fertilizer rates (0, 25, 50, 75, and 100 of the recommended dose) increased significantly P-uptake in straw in each season. The highest mean values were 0.600 and 0.625 kg.fed^{-1} with an increase of (234.36 and 255.75%) compared to the control (without mineral fertilization) in the 1st and 2nd season, respectively. Additionally, the results show that the use of mineral fertilizers, in combination with organic fertilizers prevents nutrient losses. Also, application of organic fertilizers may increase both soil microbial biomass and soil enzyme activity such as phosphatase enzyme which would affect insoluble forms of phosphorus hence increase nutrients uptake. It worth to know that mineralized nutrients from organic matter are not directly absorb by plants, especially in the critical yield-forming period. Hence, combining of compost with inorganic fertilizer is a good strategy for increasing nutrients uptake and crop productivity. Similar results were obtained by Cheuk *et al.* 2003; Soumare *et al.* (2003); Arshad *et al.* (2004); Hargreaves *et al.* (2008) and Agegnehu *et al.,* (2014).

K uptake by grains

As illustrated in Table 9, K-uptake by wheat grains (kg.fed^{-1}) responded significantly to the effect of organic and bio fertilizers in both seasons. The highest values were 70.56 and 67.60 kg.fed^{-1} with an increase of 256.18 and 249.72% with B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season, respectively. This increase in K-uptake in grains obtained as a result of adding 14 tons.fed^{-1} organic matter (compost) combined by different bio-fertilizers. Also, it is noticed that the means K-uptake with B_0O_1 was superior to B_1O_0 gave an increase by 66.76 and 64.47% in the 1st and 2nd season respectively in the plots had no mineral fertilizers whereas under 25% of adding recommended dose of mineral fertilizers the means of K-uptake with B_0O_1 was superior to B_1O_0 too but, gave an increase by 99.74 and 98.10% in the 1st and 2nd season, respectively which was the highest increase comparing with different levels of mineral fertilizers under the same treatments. These results confirm that organic and bio-fertilizer may need mineral fertilizers as activated material to pronounce their activity which affect soil and plant subsequently increased their nutrients availability and uptake These results are in a harmony with Saini *et. al.,* (2004); Fouda (2007); Salman *et. al.,* (2008); Antoun *et. al.,* (2010) and Talha, (2013).

Corresponding to K-uptake in grain of wheat it worth to say that K-uptake with B_1O_1 gave almost the same K-uptake in comparison with the interaction of 100% of the recommended dose of mineral fertilizers with control (B_0O_0).

Also, B_1O_0 gave almost the same K-uptake in comparison with 25% of the recommended dose of mineral fertilizers combined with control (B_0O_0). Whereas, B_0O_1 gave almost the same K-uptake in comparison with the interaction of 50% of the recommended dose of mineral fertilizers with control (B_0O_0) in both seasons. These results clarify that organic fertilizers had superior effect than bio-fertilizers and this may be due to that original soil organisms had their role in soulblizing and fixing nutrients in the soil which had been absorbed by plants and affecting their uptake. These results are in a harmony with Vessey, (2003); Antoun *et. al.,* (2010); Talha, (2013); Seadh and El-Metwally, (2015) and Grageda-Cabrera *et. al.,* (2018).

Table 9. Effect of mineral, organic and bio fertilizers on K-uptake by wheat grain kg.fed^{-1} at harvesting stage during both seasons.

Treatments		K-uptake in wheat grain kg.fed^{-1}													
		0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
Seasons		2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	B_0O_0	6.30	6.59	11.82	11.01	17.91	18.19	25.65	25.75	37.36	35.11	19.81	19.33	**	**
Organic	B_0O_1	18.77	17.54	30.40	30.29	43.00	43.00	53.93	52.54	71.12	71.19	43.44	42.91	1.556	1.039
Bio	B_1O_0	10.43	10.17	15.22	15.29	23.24	23.29	33.47	33.94	47.87	47.75	26.05	26.09		
Organic+bio	B_1O_1	29.61	31.52	42.60	42.89	65.65	60.66	90.54	83.72	124.4	119.2	70.56	67.60		
Means of Mineral		16.28	16.45	25.01	24.87	37.45	36.29	50.90	48.99	70.20	68.32				
F test of Mineral treatments				**	**										
LSDat 5% of mineral treatments				1.498	1.324										
LSD at 5% for interaction				** 5.993	** 5.299										

Corresponding to mineral fertilizer rates (0, 25, 50, 75, and 100 of the recommended dose), it was noticed that K-uptake in grain increased significantly in each season. The highest mean values were 70.20 and 68.32 kg.fed^{-1} with an increase of 331.20 and 315.32 % compared to the control (without mineral fertilizaters) in the 1st and 2nd season, respectively. It is obvious that mineral fertilizers had significant effects on nutrients uptake especially with Mono-cotyledon plants either individually or in combinations with organic and bio-fertilizers, this may be related to the mineralization of organic minerals and slow release of minerals in an available form from organic manure and also effect of bio-fertilizer on souliblizing nutrients in the raihzo-sphere combined with mineral fertilizer, which affect plant growth and its efficiency in absorbing nutrients and accumulates them in the plant organs. These results are in accordance with that obtained by Zeidan *et. al.,* (2005), Sherpa *et. al.,* (2007); Yassen *et. al.,* (2010); Seadh and El-Metwally, (2015) and Seadh *et. al.,* (2017).

K uptake by straw

As shown in Table 10, the K-uptake in straw (kg.fed^{-1}) of wheat plant responded significantly to the effect of organic and bio fertilizers in both seasons. The highest mean values were 56.68 and 49.92 kg.fed^{-1} with an increase of 330.37 and 222.69% with B_1O_1 compared to the control (B_0O_0) in the 1st and 2nd season, respectively. These increases in N-uptake in straw obtained as a result of adding 14 tons.fed^{-1} organic matter (compost) combined by different bio-fertilizer.

Table 10. Effect of mineral, organic and bio fertilizers on K-uptake by wheat straw kg.fed^{-1} at harvesting stage during both seasons.

Treatments		K-uptake in wheat straw kg.fed^{-1}													
		0%		25%		50%		75%		100%		Means of bio-Organic		LSD at 5%	
	Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Control	B_0O_0	4.127	5.129	8.412	9.035	13.37	14.63	17.30	20.90	22.63	27.66	13.17	15.47	**	**
Organic	B_0O_1	15.92	15.65	23.59	20.48	29.43	25.82	46.79	42.12	71.01	60.01	37.35	32.81	1.752	2.688
Bio	B_1O_0	8.327	7.969	12.51	13.77	17.29	18.89	25.78	27.68	32.60	33.20	19.30	20.30		
Organic+bio	B_1O_1	21.55	22.05	34.40	32.25	52.10	36.37	68.31	59.16	107.04	99.79	56.68	49.92		
Means of Mineral		12.48	12.70	19.73	18.88	28.05	23.93	39.55	37.47	58.32	55.16				
F test of Mineral treatments				**	**										
LSD at 5% of mineral treatments				1.408	2.021										
LSD at 5% for interaction				** 5.635	** 8.086										

Whereas increasing mineral fertilizer rates (0, 25, 50, 75, and 100 of the recommended dose) increased significantly K-uptake in straw in each season. The highest mean values were 58.32 and 55.16 kg.fed^{-1} with an increase of 367.31 and 334.33%) compared to the control (without mineral fertilization) in the 1st and 2nd season, respectively. Additionally, the results show that the use of mineral fertilizers, in combination with organic fertilizers prevents nutrient losses. Also, it is noticed that high absorption of potassium in wheat when adding organic and chemical fertilizers, may be due to the role of these fertilizers added to the soil in increasing the valid amount of these nutrients in the soil solution, in addition to the role of organic fertilizers in improving some of the physical and chemical soil properties in addition to the role of availability of these nutrients increasing the efficiency of the root system to absorb these nutrients and increase their concentration in the plant. This led to an increase in the efficiency of photosynthesis and then the absorbed quantities of potassium in the plant. It worth to know that mineralized nutrients from organic matter are not directly absorb by plants, especially in the critical yield-forming period. Hence, combining of compost with inorganic fertilizer is a good strategy for increasing nutrients uptake and crop productivity. Similar results were obtained by Cheuk *et al.* 2003; Soumare *et al.* (2003); Arshad *et al.* (2004); Salman *et al.* (2008); and Agegnehu *et al.,* (2014).

CONCLUSION

In conclusion, it's strongly suggested to use combination of organic and inorganic fertilizer to achieve highest yield. It is clear from the results of the present study that recommended dose of mineral fertilizer must be reconsidered by adding different sources of organic and bio-fertilizer under the conditions of old valley lands.

On the basis of above results, it can be concluded that the interaction effect between organic, bio and chemical fertilizers led to an increase in the indicators of growth as well as macronutrient uptake of wheat plant.

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تأثير التسميد الحيوى والعضوى والمعدنى على النمو والتركيب الكيميائى لنبات القمح

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أقيمت تجربتان حقليتان فى حقل خاص بمركز المنصورة ، محافظة الدقهلية ، مصر خلال موسمى 2016/2015 و2017/2016 م لدراسة تأثير التسميد الحيوي والعضوي والمعدنى على النمو والتركيب الكيميائى لنبات القمح صنف سدس 12. تم إجراء التجربة في تصميم قطع منشقة مرة واحدة فى أربعة مكررات. تم تخصيص القطع الرئيسية لمعاملات التسميد الحيوى والعضوى(كنترول=B_0O_0 ، عضوى فقط=B_0O_1 ، حيوى فقط=B_1O_0 ، حيوى+عضوى=B_1O_1). بينما خصصت القطع الشقية لخمسة مستويات من التسميد المعدنى (صفر-25-50-75-100% من التوصية السمادية لنبات القمح) توضح النتائج أن: إنتاجية محصول الحبوب نتيجة إضافة معاملة العضوى +الحيوى (B_1O_1) +بدون إضافة أسمدة معدنية كانت تضارع تقريبا محصول الحبوب عند التسميد بـ50% من التسميد المعدنى + الكنترول (B_0O_0) فى كلا الموسمين. بينما كان محصول القش نتيجة إضافة معاملة العضوى +الحيوى (B_1O_1) +بدون إضافة أسمدة معدنية كانت تضارع تقريبا محصول القش عند التسميد بـ75% من التسميد المعدنى + الكنترول (B_0O_0) فى كلا الموسمين . كذلك ظهر تميز معاملة السماد العضوى فقط بالمقارنة بالحيوى فقط بينما كان تأثير التداخل بينهما هو الأكبر تحت جميع مستويات التسميد المعنى لجميع صفات الدراسة. من نتائج هذه الدراسة يمكن التوصية بالتسميد المعدنى عند مستوى 100% مع إضافة الأسمدة العضوية والحيوية تحت الظروف البيئية بمحافظة الدقهلية ، مصر.