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REDUSING MINERAL FERTILIZERS DOSE OF WHEAT PLANT USING BIOFERTILIZERS: PLANT GROWTH PARAMETERS, YIELD AND YIELD COMPONENT.

El-Sirafy, M. Z. *; G. A. Baddour; Einas E. Yousif***

*** Soils Dept., Faculty of Agriculture, Mansoura University, Egypt.**

**** Plant Nutrition Dept., Soil, water and Enviro. Res, Inst., Agric. Res. Center.**

ABSTRACT

Pot and field experiments were conducted at the Agric. Exp. Station of El-Mansoura Univ. during the winter season of (2008- 2009) and (2009-2010); respectively to investigate the possibility of partial or entirely substituting bio and organic fertilizers for cultivation of wheat plants instead of inorganic fertilizer. Forty treatments were arranged in a split-split block design which were the simple possible combination between, two treatments of farmyard manure; with (FYM) and without were arranged as main plots. Four treatments of NPK fertilizers at the rates of 0, 50, 75 and 100% from the recommended doses by the Ministry of Agriculture and land reclamation (MALR) for wheat plants were randomly located as sup-plots. Wheat seeds were inoculated with biofertilizers and devoted as sub-sub plots as five treatments including; control, cerealin, phosphoren, K-mag and a mixture of them at the rate of 1:1:1.

The obtained results indicated that:

- The average values of all growth parameters (plant height, fresh and dry weight (g)), yield and its component for the plants treated with FYM were more than that obtained for the untreated plants during both seasons.
- For all the aforementioned traits, the average values were increased as the level of NPK-fertilization was increased from 0 to 75% RD. raising the two seasons.
- Co-insulated of wheat seeds which the mixture of biofertilizer studied was superior for increasing the average values of all traits, following by the treatments of cerealin, phosphorin, K-mag and finally the untreated one.
- The intermediate levels of NPK (75%) + mixture of biofertilizers + FYM seemed adequate and were associated with the highest mean values for the previously mentioned traits.

Thus, it could be recommended that inoculation of wheat seeds with the mixture of biofertilizers combined with N, P and K fertilization at the rates of 57, 11 and 14 kg.fed^{-1} respectively, and farmyard manure ; 20m^{3}.fed^{-1} are considered as the most suitable treatment for realizing the highest economic yield for wheat.

Keywords: NPK fertilizers, wheat plant, biofertilizers and yield.

INTRODUCTION

Wheat occupies about 33% of the total winter crop area in Egypt and as the major stable crop, consumed mainly as bread. More than one-third of the daily caloric intake of Egyptian consumers and 45% of their total daily protein consumption is derived from wheat. (Kherallah *et al.,* 2000).

As the universe is going now on the way of clean agriculture and minimizing pollution effects, organic and biofertilizers became of the best

management products to improve soil characteristics and productivity. They are considered as the most important factor in reducing the application of the inorganic fertilizers; consequently, reduce the adverse environmental impact of chemicals**.** The organic acids produced by microbial colonization on the mineral surfaces greatly accelerated the release of mineral elements to solution from feldspar sample. Microbes can enhance mineral dissolution rate by producing and excreting metabolic by-products that interact with the mineral surface. Complete microbial respiration and degradation of particulate and dissolved organic carbon can elevate carbonic acid concentration at mineral surfaces, in soils and in ground water. Micro-organisms can secrete growth promoting substances, e.g., indole acetic acid, gibberellins, cytokinins like substances and auxins. Biofertilization technology has taken a part to minimize production costs and at the same time, avoid the environmental hazards. (Khafagy 1999, Galal *et al.* 2001, Abdel-Malek, 2005, Aziz, 2007, Abbasdokht, 2008, Mohd and Zaki, 2009 and El-Sirafy, 2010).

Microbial inoculation of cereal crop by certain free living N2 fixing bacteria; bacteria solubilizing phosphorous and potassium had a greater important as a new technology, as it minimize the amount of applied chemical fertilizer and reduce the costs of crop production as well as reduce soil pollution. Several free-living bacteria species can fix atmospheric nitrogen such as *Azotobacter* and *Azospirillum* which are prepaired in commercial packets as a biofertilization, such as cerealin and phosphorein which contain bacteria solubilizing soil phosphorus and K-MAG which contain bacteria solubilizing silicate. (El-Zeky, 2005). This investigation has been conducted to evaluate the effect of using biofertilizers composed of active strains of a symbiotic N_2-fixer (Cerealin), phosphate dissolving bacteria (Phosphoren) and potassium releaser silicate bacteria (K-mag) in the presence and absence of FYM on the productivity of wheat for diminishing the adverse evolved from the continues application of chemical fertilizers in high doses and replacing it (at least partially) with biofertilizers cultivation management which so called clean agriculture.

MATERIALS AND METHODS

Pot and field experiments were conducted at the Agric. Exp. Station of El-Mansoura Univ. during the winter season of (2008- 2009) and (2009-2010); respectively to investigate the possibility of partial or entirely substituting bio and organic fertilizers for cultivation of wheat plants instead of inorganic fertilizer. Forty treatments were arranged in split-split block design which were the simple possible combination between, two treatments of farmyard manure; with (FYM) and without were arranged as main plots. Four treatments of NPK fertilizers at the rates of 0, 50, 75 and 100% from the recommended doses by the Ministry of Agriculture and land reclamation (MALR) for wheat plants were randomly located as sup-plots. Wheat seeds were inoculated with biofertilizers and devoted as sub-sub plots as five treatments including; control, cerealin, phosphoren, K-mag and a mixture of them at the rate of 1:1:1.

The pot experiment: 120 plastic pots (30 cm. diameter and 40 cm. depth) were used. Each pot was filled with 20 kg air dried soil taken from the surface layer of a private farm near El-Mansoura city. Half of the experimental pots were mixed with farmyard manure at the rate of 20 m^3.fed^{-1} as recommended by (MALR) for wheat plants. Each pot received about 280 gm. On 21th November 2008; 15 seeds of wheat per pot were sown. Three weeks later, the plants were thinned to the most suitable ten once per pot. Throughout the experiment, soil moisture was kept at 50% of water holding capacity by watering to the constant weight.

The field experiment: A field experiment was carried out at the Agric. Exp. station Fac. of Agric. El-Mansoura Univ., during the winter season of (2009-2010)**.** The plot area was 6 m^2 (2x3m). Each plot consisted of five rows, 3 m long and 40 cm wide. Wheat seeds cv. Gemmeza10 were planted on 22th November 2009 in hills 20 cm apart on the middle of raw. Two weeks later; plants were thinned to 2 plants per hill. Thus, the plant population could be estimated as about 100000 plants per feddan. Then, irrigation was carried out at the field capacity. Common agriculture practices known for wheat commercial production were applied as recommended by (M.A.L.R). After that, farmyard manure was added to each plot two weeks before sowing wheat seeds, each plot received 20 kg farmyard manure as recommended dose (20 m3/fed) that was equal 14 ton /fed. The soil was analyzed for some physical and chemical properties as shown at Table (1).

Seeds of wheat (*Triticum aestivum L*); variety of Gemmeza10 were divided into equal parts and coated with biofertilizers; cerealin, phosphorin, K-mag and a mixture of them at the rate of 1:1:1. Also, the untreated seeds were studied as a control treatment.

Table (1): Pysical and chemical properties of the studied soil during both seasons of 2008 and 2009.

Soil characters		**2008-2009**	**2009-2010**
Mechanical analysis (%)	**Coarse sand**	1.9	1.7
	Fine sand	19.7	15.2
	Silt	28.3	27.4
	Clay	50.1	55.7
	Texture class	**Clayey**	**Clayey**
E.C. dS.m^{-1}(1:5)		0.82	1.03
pH (1:2.5)		7.89	8.03
S.P. %		56	61
O.M. %		1.48	1.64
$CaCO_3$ %		1.93	1.77
Available (mg/kg)	**N**	32	46
	P	3.8	3.4
	K	218	225

Ripe farmyard manure (FYM) as a source of organic manure was taken from the station of animal production, Faculty of Agriculture, Mansoura University. Before sowing FYM was added at the rate of (20 m^3. fed^{-1}) and irrigated with water at the saturation percentage. Then, left for two weeks to

elucidate the damage on seeds and their roots resulted from the heat of decomposition.

Table 2: **Some chemical properties of organic manure during both seasons of 2008 and 2009.**

Seasons	O.M%	O.C%	N%	C/N	P%	K%	pH 1:5	E.Cds. m^{-1} 1:10
2008-2009	49.5	28.7	1.58	18.2	0.38	1.16	7.62	4.08
2009-2010	46.9	27.2	1.55	17.5	0.41	1.09	7.75	4.06

Urea (46 % N), super phosphate (15.5 % P_2O_5) and potassium sulphate (48 % K_2O) were the respective of N, P and K sources. Four treatments of N, P and K fertilizers at the rates of 0, 50, 75 and 100 % from the recommended doses for wheat plants i.e. 75, 15 and 18 kg.fed^{-1} for N, P and K, respectively were used. Treatments of N, P and K fertilizers were divided into two equal doses .The first dose was added after 21 days from sowing and the other two weeks later.

At boating stage (60 days after sowing), six plants were randomly taken from each treatment during both seasons and the vegetative growth parameters were determined in expression of plant height (cm) and fresh weight (g/$plant^{-1}$). Plant samples were oven dried at 70^0c tell constant weight was reached, then dry weight in gm per plant was calculated.

Representative samples of wheat plants were randomly taken from each treatment at harvesting stage (150 dayes after sowing); separated into grains and straw. Then the parameters of yield and its component were determined as follows:

Number of grains per spike, Spike length (cm), weight of 1000 seeds (gm), grain yield and straw yield.

Soil sample analysis:

- Mechanical analysis was determined following the international pipette method *(Kilmer and Alexander 1949)*, using NH_4OH as a depressing agent.
- Total carbonate as $CaCO_3$ was determined using Collin's calcimeter method *(Piper 1950).*
- Organic matter content was determined using Walkely's rapid titration method *(Jackson 1967).*
- Available N was measured using the conventional method of Kjeldahl as described by *Bremner and Mulvany (1982).*
- Available P was extracted with 0.5 M ($NaHCO_3$) adjusted at pH of 8.5 and was determined at a wavelength 660 nm by Spectrophotometer as described by *Olsen and Sommers (1982).*
- Available K was determined by extracting with ammonium acetate at pH 7 and measured using a flam photometer according to *Black (1965).*

Appropriate analyses of variance were performed using MSTAT-C software *(Freed, 1988)*. Mean of treatments were compared using new list significant differences (NLSD) as described by; (*Waller and Duncan; 1969).*

RESULTS

Growth parameters:

Data presented in Tables (3and 4) showed the effect of farmyard manure, mineral fertilization, bio-fertilization and its interactions on growth parameters of wheat expressed as plant height; cm, fresh weight gm.plant^{-1} and dry weight gm.plant^{-1} during both seasons of 2008-2009 and 2009-2010.

Referring the effect of farmyard manure data at Table 3 showed that; the average values of all plant growth parameters under investigation for wheat plants treated with farmyard manure were more than that obtained for the untreated plants. The differences between these values were significant during both seasons.

With regard to the effect of N, P and K fertilization on growth parameters of wheat plants date at the same Table indicated that the average values of all plant growth parameters in the 1st season were significantly increased as the levels of NPK were increased tell the rate of 75% from the recommended dose (RD) one. Raising the rate of NPK-fertilization from 75 to 100% RD tended to decrease the average values of all above parameters in the 1st season. In the second season (field Ex.); the heighest values of plant height (cm), fresh and dry weight (g/plant) were realized for the plants treated with NPK at the rates of 100% RD, while the differences between the mean values of dry weight (g/plant) due to raising the rate of NPK from 75 to 100% RD did not reach to the level of significance.

Data presented in Table 3 indicated that inoculated wheat seeds with cerealin, phosphorin, K-Mag and their mixture (Mix), significantly gave higher values of plant height, fresh weight and dry weight; g.plant^{-1} than the uninoculated treatments. Inoculation with mixture of bio-fertilizers studied was superior for increasing aforementioned traits followed by single inoculation with cerealin, phosphorin, K-Mag and finally the uninoculated plants. Such effect was happened during both seasons of the experimentation.

Data in Table 4 also reveal that inoculated wheat seeds with Cerealin, phosphorin and K-Mag or mixture of them in combination with the investigated rates of NPK fertilizers either with or without FYM addition significantly gave higher magnitudes of plant height, fresh weight or dry weight (gm.plant^{-1}) than the uninoculated treatments. The levels of NPK (75%) + mixture of biofertilizers + FYM seemed adequate and was associated with the highest mean values for the previously mentioned traits. Moreover, an application of NPK fertilizers up to 100% RD did not reflect any significant response on earliness traits. The highest mean values of dry weight (gm.plant^{-1}) were 22.14 in the 1st season and 18.84 in the 2nd season, respectively were realized at the best combined treatment; 75% NPK + Mix + FYM during both season of the experiment while, such effect significantly decreased the mean values of dry matter g/plant than those obtained from the plants treated with 75%RD + Mix + FYM and this trend was true during both seasons of study.

Table 3: Plant growth parameters of wheat plants as affected by FYM, NPK-fertilization and bio-fertilizers.

Char. / Treat.	Plant height (cm)	Fresh weight (g)	Dry weight (g)
First season (pot exp.)			
A- FYM			
Without	60.20	55.37	15.89
With	73.66	67.55	18.96
L.S.D at 5%	**4.65**	**3.45**	**2.20**
B- N, P and K			
0%	50.76	46.63	13.22
50% RD	68.83	63.19	17.92
75% RD	74.31	68.23	19.35
100% RD	73.80	67.78	19.22
L.S.D $_{at\ 5\%}$	**1.60**	**0.60**	**0.06**
C- Bio-fertilization			
Control	63.43	58.24	16.51
Cerealin	68.88	63.23	17.93
Phosphorene	66.04	60.66	17.20
K-Mag	64.73	59.45	16.86
Mix	71.56	65.71	18.63
L.S.D $_{at\ 5\%}$	**0.75**	**0.85**	**0.32**
Second season (field exp.)			
A- FYM			
Without	104.20	89.80	21.80
With	129.60	112.3	27.30
L.S.D $_{at\ 5\%}$	**2.30**	**4.25**	**0.80**
B- N, P and K			
0%	89.08	102.10	21.50
50% RD	120.63	108.40	24.40
75% RD	126.84	114.90	26.50
100% RD	130.82	120.60	27.10
L.S.D $_{at\ 5\%}$	**3.71**	**2.96**	**0.70**
C- Bio-fertilization			
Control	107.28	92.80	21.20
Cerealin	120.66	105.30	24.80
Phosphorene	113.51	102.60	23.70
K-Mag	111.61	69.40	22.60
Mix	127.15	107.50	25.90
L.S.D at 5%	**5.39**	**2.80**	**0.66**

Table 4: Effect of interaction between FYM, NPK-fertilization and bio-fertilization on plant growth parameters of wheat plants during both seasons of 2009 and 2010.

Treat.	Char.	Plant height (cm)		Fresh weight (g)		Dry weight (g)	
		0	FYM	0	FYM	0	FYM
First season (pot exp.)							
0%	Mix	50.6	61.9	46.53	56.77	13.35	15.94
	Cerealin	48.0	58.5	44.11	53.62	12.66	15.05
	Phosphorene	44.8	54.8	41.22	50.30	11.83	14.12
	K-Mag	43.2	53.0	39.77	48.64	11.41	13.65
	Control	41.8	51.0	38.48	46.81	11.04	13.14
50% RD	Mix	67.2	82.4	61.82	75.53	17.74	21.20
	Cerealin	64.1	78.6	58.93	72.04	16.91	20.22
	Phosphorene	60.7	74.2	55.87	68.06	16.03	19.11
	K-Mag	59.5	72.8	54.74	66.73	15.71	18.73
	Control	57.8	71.0	53.13	65.07	15.25	18.27
75% RD	Mix	70.4	86.0	64.72	78.85	18.57	22.14
	Cerealin	68.8	83.4	63.27	76.53	18.16	21.48
	Phosphorene	66.0	80.9	60.70	74.20	17.42	20.83
	K-Mag	65.1	79.8	59.89	73.21	17.19	20.55
	Control	64.1	78.6	58.93	72.04	16.91	20.22
100% RD	Mix	69.3	84.7	63.76	77.69	18.30	21.81
	Cerealin	67.2	82.4	61.82	75.53	17.74	21.20
	Phosphorene	66.0	80.9	60.70	74.20	17.42	20.83
	K-Mag	64.9	79.5	59.73	72.87	17.14	20.46
	Control	64.4	78.7	59.25	72.21	17.00	20.27
L.S.D at 5%		1.60		1.32		0.06	
Second season (field exp.)							
0%	Mix	87.30	110.03	75.21	102.80	18.28	23.17
	Cerealin	82.64	104.01	71.20	97.18	17.31	21.91
	Phosphorene	77.41	97.53	66.70	91.12	16.20	20.54
	K-Mag	74.57	94.23	64.24	88.04	15.61	19.85
	Control	72.18	90.93	62.20	84.96	15.11	19.15
50% RD	Mix	116.05	146.52	100.00	136.89	24.29	30.87
	Cerealin	110.48	139.58	95.20	130.41	23.14	29.39
	Phosphorene	104.69	131.97	90.20	123.30	21.91	27.79
	K-Mag	101.96	129.35	87.85	120.85	21.35	27.24
	Control	99.80	125.94	85.99	117.67	20.89	26.52
75% RD	Mix	121.40	153.00	104.60	142.94	25.42	32.22
	Cerealin	117.76	148.22	101.46	138.49	24.65	31.22
	Phosphorene	114.01	109.57	98.24	102.38	23.87	23.09
	K-Mag	112.53	141.86	96.96	132.53	23.56	29.87
	Control	110.48	139.58	95.20	130.41	23.14	29.39
100% RD	Mix	125.5	157.4	107.95	146.11	25.13	31.75
	Cerealin	116.05	146.52	100.00	136.89	24.29	30.87
	Phosphorene	114.01	143.67	98.24	134.24	23.87	30.27
	K-Mag	112.19	141.40	96.66	132.12	23.49	29.79
	Control	111.17	140.15	95.78	130.95	23.27	29.51
L.S.D at 5%		4.5		2.08		0.08	

Yield components

Data in Tables (5&6) reveal the average values of the number of grains / spike, spike length (cm) and weight of 1000 seed as influenced by farmyard manure, NPK-fertilization and bio-inoculation for wheat plants in the two seasons of 200-2009 and 2009-2010.

With regard to the effect of using FYM data at Table (5) showed that there were significant increases in the values of the number of grains / spike, spike length (cm) and weight of 1000 seed due to using FYM than those obtained for the untreated plants.

Table 5: No. of grains/spike, Spike length (cm) and Weight of 1000 seed of wheat plants as affected by FYM, NPK-fertilization and bio-fertilization in the two seasons of 2009 and 2010.

Char. / Treat.	No. of grains/spike	Spike length (cm)	Weight of 1000 seed
First season (pot exp.)			
A- FYM			
Without	38.86	8.77	57.98
With	47.61	10.79	69.38
L.S.D at 5%	**2.60**	**0.85**	**1.35**
B- N, P and K			
0%	32.80	7.43	48.31
50% RD	44.46	10.06	65.48
75% RD	48.00	10.85	70.70
100% RD	47.68	10.78	70.23
L.S.D $_{at\ 5\%}$	**1.50**	**0.08**	**0.08**
C- Bio-fertilization			
Mix	46.23	10.48	68.09
Cerealin	44.48	10.06	65.52
Phosphorene	42.67	9.63	62.85
K-Mag	41.82	9.48	61.60
Control	40.97	9.26	60.35
L.S.D $_{at\ 5\%}$	**1.45**	**1.02**	**1.25**
Second season (field exp.)			
A- FYM			
Without	**48.24**	**14.70**	**74.05**
With	**60.12**	**18.28**	**92.15**
L.S.D $_{at\ 5\%}$	**2.50**	**1.60**	**3.75**
B- N, P and K			
0%	**41.03**	**12.41**	**62.50**
50% RD	**55.57**	**16.81**	**84.64**
75% RD	**58.42**	**17.67**	**88.99**
100% RD	**59.01**	**18.06**	**91.03**
L.S.D $_{at\ 5\%}$	**4.74**	**1.27**	**4.60**
C- Bio-fertilization			
Mix	**57.03**	**17.51**	**88.28**
Cerealin	**55.57**	**16.81**	**84.65**
Phosphorene	**51.40**	**15.54**	**78.31**
K-Mag	**52.28**	**15.81**	**79.64**
Control	**51.25**	**15.50**	**78.07**
L.S.D at 5%	**4.50**	**1.20**	**4.34**

Referring the effect of the single application of NPK fertilizers at the rate of this investigation data at Table (5) show clearly that all above characters were significantly increased with increasing the level of NPK-fertilizer from zero to 75% RD. On the other words; the highest values in the first season; 48.00 , 10.85 & 70.70 for number of grains / spike, spike length (cm) and weight of 1000 seed, respectively were resulted from plants treated with NPK fertilizer at the rate of 75% from RD while the lowest one were realized for the control treatment. The same trend was true during the second season. Moreover, raising the rate of NPK applied from 75% to 100% from RD tended to decrease the average values of the above parameters.

In respect with the effect of single co-inoculation of wheat plants with bio-fertilizers (Cerealin, phosphorin, K-Mag) or their mixture data at Table (5) illustrated that there were a significant differences between all values due to inoculation with biofertilizers in single for/or as a mixture. The highest mean values were resulted from using a mixture of biofertilizer (Cerealin, phosphorin, K-Mag). For example the rate of increases over the uninoculated plants for spike length (cm) were accounted to be 8.64, 3.99, 2.37 &13.17 % in the first season and 8.45, 0.25, 2.00 & 12.97 % in the second season, respectively. The same trend was happened with the other yield components parameters during both seasons of the experiment.

The interaction effect between FYM, bio-inoculation and NPK-fertilization on number of grains / spike, spike length (cm) and weight of 1000 seed was presented in Tale (6). It could be observed that application of NPK fertilizers up to 75% RD and bio-inoculation with mixture of inoculants in presence or absence of farmyard manure significantly increased all parameters. The highest values were 55.58, 12.6 & 80.99 in the first season and 71.10, 21.48 &108.57 in the second season, respectively for number of grains / spike, spike length (cm) and weight of 1000 seed. In this respect, the highest mean values of all treatments under study were connected with the plants treated with FYM + 75% RD NPK + Mixture of biofertilizers during both seasons of 2008-2009 and 2009-2010.

Yield:

Data presented in Tables (7&8) indicated the average values of grain and straw yield as influenced by farmyard manure, NPK-fertilization and bio-inoculation for wheat plants in the two seasons of 2008-2009 and 2009-2010.

Concerning the effect of farmyard manure data at Table (7) showed that the average values of grain and straw yield of wheat plants treated with FYM were more than that obtained for the untreated plants. The differences between these values were significant during both seasons of 2008-2009 and 2009-2010.

Data at the same Table, also reveal that the average values of grain and straw yield of wheat plants were significantly increased with increasing the rate of NPK –fertilizers from zero to 75% from RD. The highest values were 63.46 &109.76 (gm/plant) in the first season and 12.13 (ard /fed) & 6.66 (t/fed) in the second season, respectively.

Table 6: Effect of interaction between FYM, NPK-fertilization and bio-fertilization on No. of grains/spike, Spike length (cm) and Weight of 1000 seed of wheat plants during both seasons of 2009 and 2010.

Tret.	Char.	No. of grains/spike		Spike length (cm)		Weight of 1000 seed	
		0	FYM	0	FYM	0	FYM
First season (pot exp.)							
0%	Mix	32.66	40.01	7.4	9.1	48.73	58.31
	Cerealin	30.96	37.79	7.0	8.6	46.20	55.07
	Phosphorene	28.93	35.45	6.5	8.0	43.16	51.66
	K-Mag	27.91	34.28	6.3	7.8	41.64	49.96
	Control	27.01	32.99	6.1	7.5	40.30	48.08
50% RD	Mix	43.39	53.24	9.8	12.1	64.74	77.58
	Cerealin	41.36	50.78	9.3	11.5	61.71	74.00
	Phosphorene	39.21	47.97	8.8	10.9	58.50	69.91
	K-Mag	38.42	47.03	8.7	10.7	57.32	68.54
	Control	37.29	45.86	8.4	10.4	55.64	66.84
75% RD	Mix	45.43	55.58	10.3	12.6	67.78	80.99
	Cerealin	44.41	53.94	10.0	12.2	66.26	78.60
	Phosphorene	42.60	52.30	9.6	11.8	63.56	76.21
	K-Mag	42.04	51.60	9.5	11.7	62.72	75.19
	Control	41.36	50.78	9.3	11.5	61.71	74.00
100% RD	Mix	44.75	54.76	10.1	12.4	66.77	79.79
	Cerealin	43.39	53.24	9.8	12.1	64.74	77.58
	Phosphorene	42.60	52.30	9.6	11.8	63.56	76.21
	K-Mag	41.92	51.36	9.5	11.6	62.55	74.85
	Control	41.58	50.90	9.4	11.5	62.04	74.17
L.S.D at 5%		0.85		0.10		0.12	
Second season (field exp.)							
0%	Mix	39.85	51.13	12.07	15.45	60.54	78.08
	Cerealin	37.72	48.34	11.42	14.60	57.31	73.81
	Phosphorene	35.33	45.33	10.70	13.70	53.69	69.21
	K-Mag	34.03	43.79	10.30	13.23	51.71	66.87
	Control	32.95	42.26	9.98	12.77	50.06	64.53
50% RD	Mix	52.97	68.10	16.04	20.57	80.49	103.98
	Cerealin	50.43	64.87	15.26	19.60	76.63	99.06
	Phosphorene	47.78	61.33	14.46	18.53	72.61	93.66
	K-Mag	46.54	60.12	14.09	18.16	70.72	91.80
	Control	45.55	58.53	13.79	17.68	69.21	89.38
75% RD	Mix	55.41	71.10	16.78	21.48	84.19	108.57
	Cerealin	53.75	68.89	16.28	20.81	81.67	105.19
	Phosphorene	52.04	50.93	15.75	15.38	79.07	77.77
	K-Mag	51.36	65.93	15.55	19.92	78.05	100.67
	Control	50.43	64.87	15.26	19.60	76.63	99.06
100% RD	Mix	51.50	66.61	16.71	21.14	83.81	107.43
	Cerealin	52.97	68.10	16.04	20.57	80.49	103.98
	Phosphorene	52.04	66.77	15.75	20.17	79.07	101.97
	K-Mag	51.21	65.72	15.50	19.85	77.81	100.35
	Control	50.74	65.13	15.36	19.68	77.10	99.47
L.S.D at 5%		2.75		1.02		0.25	

With regard to the effect of single inoculation of wheat plants with Cerealin, phosphorin, K-Mag or their mixture data at Table (7) reveal that there was a significant increasing due to inoculation wheat plants with a

single or mixture form of biofertilizers. The highest values 61.12 & 105.70 (gm/plant) in the first season and 12.02 (ard/fed) & 6.59 (t/fed) in the second season for grain and straw yield, respectively were realized from the plants treated with the mixture of biofertilizers .

Table 7: Grain yield (gm/plant) and straw yield (gm/plant) of 1000 seed of wheat plants as affected by FYM, NPK-fertilization and bio-fertilization in the two seasons of 2009 and 2010.

Char. / Treat.	Grain yield (gm/plant)	Straw yield (gm/plant)
First season (pot exp.)		
A- FYM		
Without	51.86	89.07
With	62.46	108.64
L.S.D at 5%	**4.75**	**3.25**
B- N, P and K		
0%	43.37	75.00
50% RD	58.77	101.65
75% RD	63.46	109.76
100% RD	63.04	109.02
L.S.D $_{at\ 5\%}$	**0.85**	**0.40**
C- Bio-fertilization		
Mix	61.12	105.70
Cerealin	58.81	101.71
Phosphorene	56.41	97.57
K-Mag	55.29	95.62
Control	54.17	93.68
L.S.D $_{at\ 5\%}$	**1.85**	**0.90**
Char. / Treat.	**Grain yield (ard/fed.)**	**Straw yield (ton/fed.)**
Second season (field exp.)		
A- FYM		
Without	10.07	5.53
With	12.56	6.90
L.S.D $_{at\ 5\%}$	**1.40**	**1.12**
B- N, P and K		
0%	8.52	4.68
50% RD	11.53	6.33
75% RD	12.13	6.66
100% RD	12.39	6.80
L.S.D $_{at\ 5\%}$	**0.55**	**0.30**
C- Bio-fertilization		
Mix	12.02	6.59
Cerealin	11.53	6.33
Phosphorene	10.67	5.86
K-Mag	10.85	5.96
Control	10.64	5.84
L.S.D at 5%	**0.51**	**0.28**

As shown in Table (8) it could be noticed that the values of grain and straw yield were significantly affected by the interaction effect between FYM, bio-inoculation and NPK-fertilization. The level of NPK at 75% from RD +mixture of biofertilizer +FYM were associated with the highest mean values

of grains and straw yields during both seasons of the experimentation. The highest mean values of grain yield were 72.9 g/plant and 14.6 ard/fed in the 1st and 2nd seasons, respectively. Such effect for the straw yield was 126.8 g/plant and 8.03 t/fed in the 1st and 2nd season, respectively.

Table 8: Effect of interaction between FYM, NPK-fertilization and bio-fertilization on grain yield gm/plant and straw yield gm/plant of wheat plants during both seasons of 2009 and 2010.

Char. / Treat.		Grain yield (gm/plant)		Straw yield (gm/plant)	
		0	FYM	0	FYM
First season (pot exp.)					
0%	Mix	43.58	52.50	74.85	91.31
	Cerealin	41.32	49.58	70.97	86.24
	Phosphorene	38.60	46.51	66.30	80.90
	K-Mag	37.25	44.98	63.97	78.23
	Control	36.04	43.29	61.90	75.29
50% RD	Mix	57.91	69.84	99.46	121.49
	Cerealin	55.19	66.62	94.79	115.88
	Phosphorene	52.33	62.94	89.87	109.47
	K-Mag	51.27	61.71	88.06	107.33
	Control	49.76	60.17	85.47	104.66
75% RD	Mix	60.62	72.91	104.12	126.83
	Cerealin	59.26	70.76	101.79	123.09
	Phosphorene	56.85	68.61	97.64	119.35
	K-Mag	56.10	67.69	96.35	117.75
	Control	55.19	66.62	94.79	115.88
100% RD	Mix	59.72	71.84	102.56	124.96
	Cerealin	57.91	69.84	99.46	121.49
	Phosphorene	56.85	68.61	97.64	119.35
	K-Mag	55.95	67.39	96.09	117.21
	Control	55.49	66.77	95.31	116.15
L.S.D at 5%		0.60		0.85	
Char. / Treat.		Grain yield (ard/fed)		Straw yield (ton/fed)	
		0	FYM	0	FYM
Second season (field exp.)					
0%	Mix	8.35	10.52	4.58	5.78
	Cerealin	7.90	9.94	4.34	5.46
	Phosphorene	7.40	9.32	4.06	5.12
	K-Mag	7.13	9.01	3.91	4.95
	Control	6.90	8.69	3.79	4.77
50% RD	Mix	11.09	14.01	6.09	7.69
	Cerealin	10.56	13.34	5.80	7.33
	Phosphorene	10.01	12.62	5.50	6.93
	K-Mag	9.75	12.37	5.35	6.79
	Control	9.54	12.04	5.24	6.61
75% RD	Mix	11.61	14.63	6.37	8.03
	Cerealin	11.26	14.17	6.18	7.78
	Phosphorene	10.90	10.48	5.98	5.75
	K-Mag	10.76	13.56	5.91	7.45
	Control	10.56	13.34	5.80	7.33
100% RD	Mix	11.37	14.53	6.18	7.95
	Cerealin	11.09	14.01	6.09	7.69
	Phosphorene	10.90	13.74	5.98	7.54
	K-Mag	10.73	13.52	5.89	7.42
	Control	10.63	13.40	5.84	7.36
L.S.D at 5%		0.08		0.06	

DISCUSSION

Results mentioned previously can be discussed as follow:

Results revealed that plant growth parameters of wheat were greatly improved by inoculation with the single or mixed bio-fertilizer and the latter exerted a distinct influence. Increasing NPK-applied rate up to 75% RD combined with single or mixed bio fertilizer resulted in heavier fresh and dry weight, as well as plant height, consequently total grain and straw. The highest increase in most of the aforementioned traits was recorded in wheat plants received 75% NPK from RD and bio fertilized with the mixture of biofertilizers in the presence of farmyard manure. These results can be related to the role of the biofertilizers studied on production of phytohormones or improving the availability and acquisition of nutrients or by both, which promoted the vegetative growth to go forward.

In addition, the beneficial effects of Cerealin might be attributed to the importance of Cerealin in fix the atmosphere nitrogen and the role played by Phosphoren and K-mag for increasing the availability of nutrients in soil and consequently enhance the rate of absorption by the roots of the plant.

The improvement of plant growth parameters and consequently increasing yield as a result of biofertilization was also demenostarted by several investigators such as; El-Zeky (2005), Aziz *et al.,* (2007), Abbasdokht (2008), Mohd and Zaki (2009), Nasser and El-Gizawy (2009) and Bddour (2010) who stated that, inoculated tomato seedlings with AZ,PSB,KSB or mixture of them in combination with the investigated rates of NPK fertilizers either with or without FYM addition significantly gave higher magnitudes of plant height, number of leaves and leaves dry weight; gm.plant^{-1} than the uninoculated treatments. The intermediate levels of NPK (50%) + mixture of multi strains inoculants + FYM seemed adequate and was associated with the highest mean values for the previously mentioned traits. Such effect had no significant effect between the mean values of number of branches per plant during both seasons of the experimentation.

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تقليل إستخدام جرعه الأسمده المعدنيه لنبات القمح بإستخدام الأسمده الحيويه: صفات النمو, المحصول والتركيب المحصولى .

زكريا مسعد الصيرفى*, جمال الدين عبد الخالق بدور, إيناس السعيد يوسف*.**
*** قسم الأراضى - كليه الزراعه – جامعه المنصوره.**
**** معهد بحوث الاراضى والمياه والبيئه- مركز البحوث الزراعيه – الجيزه – مصر.**

أجريت تجربه أصص وتجربه حقليه فى المزرعه التجريبيه لكليه الزراعه – جامعه المنصوره خلال موسمى النمو الشتويين 2008-2009 و 2009-2010 على الترتيب لدراسه امكانيه الإحلال الجزئى او الكلى للأسمده الحيويه والعضويه فى زراعه القمح بدلا من الاسمده المعدنيه. اشتملت التجربه على 40 معامله فى تصميم قطع منشقه مرتين وهى تمثل كل التفاعلات الممكنه بين معاملتى تسميد عضوى فى وجود أو عدم وجود سماد المزرعه كقطع رئيسيه و 4 معاملات من التسميد المعدنى NPK بمعدلات صفر, 50 , 75 و 100% من الموصى به بمعرفه وزاره الزراعه واستصلاح الأراضى كقطع منشقه والتلقيح البكتيرى لحبوب القمح فى 5 معاملات من التسميد الحيوى تشتمل على السريالين ، والفوسفورين ، K-mag ومخلوط منهم بنسبه 1:1:1 كقطع تحت منشقه.

وقد اظهرت النتائج أن:

- متوسطات القيم لجميع صفات النمو والمحصول والتركيب المحصولى للنباتات المعامله فى السماد البلدى كانت أعلى من تلك النباتات الغير معامله فى كل من موسمى النمو.
- بالنسبه لجميع الصفات سابقه الذكر فإن متوسطات القيم زادت بزياده معدل التسميد المعدنى من صفر حتى 75% من الموصى به . بينما زيادة معدل التسميد المعدنى من 75 الى 100% من ا لموصى به لم سجل أى فرق معنوى فى الموسمين.
- التلقيح البكتيرى لحبوب القمح بمخلوط الأسمده الحيويه موضوع الدراسه سجل أعلى زياده لمتوسطات القيم لجميع المعاملات ثم تبعه المعامله بالسيريالين ، الفوسفورين ، K-mag وفى النهايه معامله الكنترول.
- وقد اظهرت المعامله بمستوى 75% NPK + مخلوط الأسمده الحيويه + السماد البلدى أعلى متوسطات للقيم لجميع المعاملات السابقه .

الاستنتاج:

وبذلك يمكننا ان نوصى بالتلقيح البكتيرى لحبوب القمح بمخلوط الاسمده الحيويه مع التسميد المعدنى بمعدل 57، 11، 14 كجم/فدان للنيتروجين والفوسفور والبوتاسيوم على الترتيب مع اضافه السماد البلدى بمعدل 20 م^3/فدان وذلك للحصول على أعلى محصول إقتصادى للقمح.

قام بتحكيم البحث

أ.د / احمد عبد القادر طه	**كلية الزراعة – جامعة المنصورة**
أ.د / عادل رزق احمد رزق	**مركز البحوث الزراعية**