السماد البلدي والأسمدة الحيوية كبديل لجزء من السماد النيتروجيني المعدني في تسميد القمح

Farm Yard Manure and Bio-fertilizers to Replace Part of Mineral Nitrogen Fertilizer in Wheat Fields

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المُلَخَّص

أُجريت تجربة حقلية في محطة البحوث الزراعية (بشندويل، محافظة سوهاج، جمهورية مصر العربية)، خلال موسمي الزراعة 2009/2008 و 2010/2009، بهدف تقويم استخدام السماد البلدي وبعض الأسمدة الحيوية كبدائل لجزء من السماد النيتروجيني المعدني في تسميد القمح. اُستخدم تصميم القطع المنشقة مرةً واحدةً في أربعة مكررات وتم التوزيع العشوائي للأصناف (صنف قمح المكرونة سوهاج3 وصنفي قمح الخبز جيزة 168 وسدس1) في القطع الرئيسة ووزعت المعاملات السمادية بالقطع المنشقة وهي: (1) بدون تسميد للمقارنة، (2) إضافة 70 كجم نيتروجين معدني/فدان، وهو الموصى به، (3) إضافة 45 كجم نيتروجين معدني + 20 متر مكعب سماد بلدي/فدان، (4) إضافة 45 كجم نيتروجين معدني + تلقيح الحبوب بالسماد الحيوي ريزوباكترين و (5) إضافة 45 كجم نيتروجين معدني + تلقيح الحبوب بخليط من الأسمدة الحيوية ريزوباكترين وفوسفورين. بينت النتائج أن الفروق في إنتاجية محصول الحبوب كانت ضيقة بين الأصناف الثلاثة، ولكن أعطى الصنف سوهاج 3 أعلى إنتاجية لمحصول الحبوب ونسبة عاليه من البروتين في الحبوب وأعلى وزن ألف حبة، في حين أعطى الصنف سدس 1 أكبر عدد من السنابل في المتر المربع وأعلى محصول بيولوجي، وتميز الصنف جيزة 168 بصفة التبكير في النضج وأكبر عدد من الحبوب في السنبلة. كما أكدت النتائج أن إضافة 45 كجم نيتروجين معدني + 20 متر مكعب سماد عضوي للفدان أدت إلى زيادة معنوية في طول النبات وعدد السنابل في المتر المربع ومحصول الحبوب والمحصول البيولوجي ونسبة البروتين في الحبوب والتأخير في النضج، كما أوضحت النتائج أن إضافة 45 كجم نيتروجين معدني للفدان مع تلقيح التقاوي بخليط من الأسمدة الحيوية ريزوباكترين وفوسفورين قد أدى إلى زيادة عدد الحبوب في السنبلة والمحصول البيولوجي. وبصفة عامة فان النتائج المتحصل عليها تدل على إمكانية الحصول على نفس الإنتاجية ا بإضافة كمية اقل من السماد النيتروجيني الكيميائي مع إضافة السماد البلدي أو تلقيح الحبوب بالأسمدة الحيوية، حيث أن استخدام السماد البلدي والحيوي يساعد على حماية البيئة من التلوث الضار بصحة الإنسان والحيوان.

الكلمات المفتاحية: القمح، التسميد الحيوي، التسميد الآزوتي، الآزوت، ريزوباكترين.

Abstract

A field experiment was carried out during the two growing seasons 2008/09 and 2009/10 at Shandaweel Agric. Res. Station, Sohag Governorate, Egypt, to evaluate the application of farm yard manure and bio-

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fertilizers to substitute part of chemical nitrogen fertilizer in fertilizing wheat crop. The durum wheat cultivar Sohag 3 and the bread wheat cultivars Giza 168 and Sids 1 were treated with: (1) no fertilizers (control), (2) 70 kg of mineral N/faddan (recommended dose), (3) 45 kg of chemical N/fad. + 20 m^3 FYM /fad., (4) 45 kg of mineral N/fad. + seed inoculation with Rhizobacterin, and (5) 45 kg of mineral N/fad. + seed inoculation with mixture of Rhizobacterin and Phosphorin. The experiment was designed in split plot with four replications. Results indicated that the differences in grain yield between cultivars were narrow, where's Sohag 3 gave higher grain yield (18.62 ardab/fad.) and it had heavier 1000 kernel weight and higher grain protein percentage and had taller plants. Giza 168 proved to be earlier in maturity and gave higher number of kernels/spike. Sids 1 produced higher number of spikes/m^2 and higher biological yield. Application of 45 kg N + 20m^3 FYM/fad. resulted in significant increases in plant height, number of spikes/m^2, biological yield, grain yield and grain protein percentage. On the other hand, maturity was delayed when the application of mineral N was combining with FYM. Also, the application of 45 kg N + seed inoculation with mixture of Rhizobacterin and Phosphorin increased number of kernels/spike and 1000 kernel weight. Generally, results indicated that it is possible to minimize the amount of mineral N fertilizer by using FYM and/or bio-fertilizers. Whereas using FYM and bio-fertilizers could prevent the environment from chemical pollution, which is harmful to human bling and animals.

One faddan of land area = 4200 m^2 . **One ardab of wheat grains = 150 Kg.**

Keywords: Wheat, FYM, Bio-fertilizer, Nitrogen, Rhizobactrin, Phospharin.

Introduction

Wheat is one of the most important cereal crops in Egypt. It is known that wheat responds to nitrogen much more than any other nutrient element and it is necessary to apply adequate fertilizer to produce higher grain yield.

Economic use of nitrogen fertilizers is very important issue because using large amount of chemical fertilizers increase production costs as well as environmental pollution, that cause many hazards to human health (Hayam and Mostafa, 2001). That displayed the interest in using organic manure to supply part of plant nutrients need (Saleh and abd-El-Fattah, 1997), as well as bio-fertilization with N2-fixing bacteria (Hayam and Mostafa, 2001).

Organic manures serve two purposes; firstly, supply the soil with macro and micro plant nutrients and secondly, improve its physical properties. The nutrients supplied by FYM are usually more important than physical effect on crops (Cook 1970 and Bhandari et *al*.1989). Soliman et. *al*, (2001) indicated that organic manure can be successfully used for crops fertilization, and a considerable portion of mineral nitrogen requirement could be saved by using bio-fertilizers. Same results have been reported by Eid et *al*, 1986 and Mitkees et. *al*, 1998. Eid et. *al*, (1986) indicated that inoculating wheat seed with N2-fixing bacteria increased its grain yield.

Kotb (1998) showed that the profit from using bio-fertilizers depends on soil properties, characters of N2-fixing bacteria, method of inoculation, planted cultivar, culture practices and climatic conditions. Alagwadi and Gour (1988) studied the effect of phosphate-solublizing bacteria in association with other micro organisms on plant growth and N2-fixing potential. They indicated that inoculation with Rhizobium (N2-fixing bacteria) and Pseudomonas striate or Bacillus Polymyxa (phosphate-solublizers) increased chickpea seed yield, dry matter content and N&P uptake.

This study aimed to evaluate the application of Farm Yard Manure (FYM) and two bio-fertilizers to save part of mineral nitrogen fertilizer in fertilizing wheat crop.

Materials and methods

Afield experiment was carried out at Shandaweel Agricultural Research Station, Sohag Governorate, Egypt during the two growing seasons 2008/2009 and 2009/2010 to evaluate the application of Farm Yard Manure (FYM) and two commercial bio-fertilizers Rhizobacterin (N2 fixing bacteria) and Phosphorin (Phosphate-solubilizer bacteria) to save part of mineral nitrogen fertilizer in fertilizing the two bread wheat cultivars Giza 168 and Sids 1 and the durum one Sohag 3. These cultivars are covering the most cultivated wheat area in Upper Egypt.

The soil in the experimental site was loamy in texture having a pH of 7.6, contains 8.5, 6.0 and 193 ppm available N, P and K, respectively, in the first season and 12, 9 and 273 ppm available N, P and K, respectively, in the second one. The soil contents of organic matter about 1.33 in both seasons. Nitrogen in the experimental soil was determined using Kjeldahl method, soil Phosphorus was calorimetrically determined, soil Potassium was determined using flam photometer (Jackson,1973).

The experiment was arranged in a split plot design with four replications. The main plots were devoted for the three wheat cultivars Sohag 3, Giza 168 and Sids 1, while the sub plots were occupied by the fertilizer treatments: (1) without fertilizers (control) , (2) application of 70 kg mineral N/faddan (recommended dose of fertilizer), (3) application of 45 kg mineral N + 20 m3 FYM/fad., (4) application of 45 kg mineral N + Rhizobacterin bio-fertilizer, and (5) application of 45 kg mineral N + Rhizobacterin and Phosphorin bio-fertilizers, in rate of one litter of the product per faddan.

The experimental plot area was 3 X 3.5 m = 10.5 m^2. Experiment was planted in 15^{th} and 20^{th} of November in the two respective seasons. Seeding rate was 60, 70 kg/fad. for bread and durum wheat cultivar, respectively.

The chemical nitrogen fertilizer was in the form of Ammonium nitrate (33.5% N) and added into two equal doses before of the first and second irrigation. Phosphorus in the rate of 15 kg P_2O_5/faddan. was added in the form of Calcium Super-phosphate (15.5% P) to all plots before planting, except the control. Potassium fertilizer was in the rate of 24 kg K_2O/fad. was added in the form of Potassium-sulphate (48% K) to all plots before planting, except the control. Well-decomposed farm yard manure was added during seed bed preparation in the rate of 20 m^3/fad. Its maturity was detected by narrowing C/N ratio to approximately 19/1. The chemical composition of the FYM is presented in Table 1.

Table 1. Chemical composition of FYM.

pH	N%	P%	K%
7.8	0.52	0.25	2.25

Prior to sowing, seed inoculation was carried out using peat–based inoculants Rhizobacterin containing efficient nitrogen fixing strain. Inoculation performed by mixing seed with appropriate amount of Rhizobacterin using Arabic gum for 30 minutes right before sowing. The same preparation was done for inoculating seeds with mixture of Rhizobacterin and Phosphorin bio-fertilizers. Irrigation was given immediately after sowing. Also, all other recommended cultural practices were applied to the experiment during the growing seasons.

The observations were recorded from each treatment on days to maturity, number of spikes/m^2, number of kernels/spike from ten randomly selected spikes and plant height in cm from five randomly selected plants . At harvest, 2.4 m^2 random harvested samples, from each sub plot, were totally weighted and adjusted to ton/faddan. to indicate biological yield, and then threshed to get grains, which were weighted and adjusted to ardab/faddan.

1000-kernel weights were calculated as an average of three weighted 1000 -kernel samples randomly taken from each sub plot.

Ground grain samples, from each sub plot, were digested to determine grain nitrogen content using the Micro- Kjeldahl method (Jackson, 1973). Protein content in grains was estimated by multiplying N content in grains by 5.7 according to Tkachuk (1966).

The data were subjected to the regular statistical analysis of variance according to Gomez and Gomez (1984), using the statistical program of MSTAT-C.

Results and Discussions

1- Days to maturity:

Data in Table 2 indicated that Giza 168 wheat cultivar had significantly the shortest period to maturity (143.1 days in average) than the other tested cultivars. However the difference between Sohag 3 and Sids 1 was not significant. This trend was true in the two seasons and in combined data. This trend may be attributed to the genetic differences between cultivars in photosynthetic capacity and the time of vegetative growth.

Application of mineral nitrogen fertilizer or the combination of mineral N fertilizer with FYM and/or the combination of mineral N fertilizer with bio-fertilizers significantly increased the days to maturity than the control. This trend was found with the three wheat cultivars, also among fertilizer treatments. However, the significant differences in days to maturity were found between the control of an average of 140.9 days and the other fertilizer treatments.

Application of 45 kg of mineral N + 20 m^3 FYM/faddan had the longest period to maturity, with an average of 148.6 days, especially with Sohag 3 with an average of 150.0 days to maturity.

These results may be due to the sufficient amount of nutrients released from mineral and organic fertilizers and fixed by bio-fertilizers could increase photosynthetic capacity and improved vegetative growth, and then elongate time to maturity. Ahmed (1995) and Sabah (2001) noted that bio-fertilizers increased the rate of plant photosynthesis and accumulation of photosynthesis, which reflected in increasing plant growth and development.

2- Plant height:

The data in Table 2 show that bread wheat cultivar Giza 168 was significantly the shortest one (94.1 cm), even under different fertilizer treatments.

Adding the different fertilizers significantly increased plant height over that of the control. The average plant height of the four nitrogen fertilizer treatments were 97.8, 100.3, 99.4 and 98.5 cm. The differences between the four fertilizer treatments were not significant. This trend was found with all the cultivars in the two growing seasons and in combined data, too. However, the tallest plants (103.5 cm) were found in Sohag 3 when fertilized with 45 kg N + 20 m^3 FYM/faddan.

These results identified the fact that FYM and/or bio-fertilizers could release nutrients in available form, suitable rates and in proper time for the crops, which

Table 2. Effect of wheat cultivar and fertilizer treatment and their interaction on wheat days to maturity and plant height in 08/09 and 09/10 seasons.

Cultivar	Fertilizer treatment	Days to maturity			Plant height (cm)		
		08/09	09/10	Average	08/09	09/10	Average
Sohag3	1	147.5	138.0	**142.6**	95.3	92.3	**93.8**
	2	153.3	146.0	**149.6**	100.8	98.0	**99.4**
	3	153.3	146.8	**150.0**	105.8	101.3	**103.5**
	4	154.5	145.5	**150.0**	103.8	100.8	**102.3**
	5	153.3	146.5	**149.9**	103.0	101.5	**102.3**
Mean		**152.3**	**144.6**	**148.4**	**101.7**	**98.7**	**100.2**
Giza 168	1	141.3	132.8	**137.0**	89.0	87.3	**88.1**
	2	146.3	144.3	**145.3**	95.0	96.5	**95.8**
	3	148.5	143.8	**146.1**	95.3	97.3	**96.3**
	4	143.8	141.0	**142.4**	96.0	94.3	**95.1**
	5	146.8	144.5	**145.6**	96.8	93.3	**95.0**
Mean		**145.3**	**141.3**	**143.3**	**94.4**	**93.2**	**94.1**
Sids 1	1	148.8	137.5	**143.1**	94.8	90.5	**92.7**
	2	153.8	145.0	**149.4**	103.3	93.0	**98.2**
	3	154.3	145.3	**149.8**	107.0	95.3	**101.1**
	4	154.3	142.5	**148.4**	102.0	99.5	**100.8**
	5	153.3	144.8	**149.1**	102.8	93.5	**98.1**
Mean		**152.9**	**143.0**	**148.0**	**102.0**	**94.4**	**98.2**
1-Control		145.8	136.1	**140.9**	93.00	90.3	**91.7**
2-Mineral Nitrogen Fertilizer (MNF)		151.1	145.1	**148.1**	99.7	95.8	**97.8**
3-MNF + FYM		152.0	145.3	**148.6**	102.7	97.9	**100.3**
4-MNF + Rhizobacterin		150.8	143.0	**146.9**	100.6	98.2	**99.4**
5-MNF + Rhiz. + phosphorin		151.2	145.3	**148.2**	100.8	96.1	**98.5**
LSD $_{0.05}$ (cultivars) C		**1.48**	**2.17**	**2.07**	**3.04**	**1.92**	**3.98**
LSD $_{0.05}$ (Fertilizer) F		**1.93**	**1.91**	**2.21**	**2.13**	**2.58**	**2.21**
LSD $_{0.05}$ (Interaction) C x F		**1.92**	**1.95**	**2.00**	**4.03**	**4.88**	**3.28**

can play an active role in building new organs and cell elongation (Mohamed and Gamie, 1999).

3-Number of spikes /m^2:

The data in Table 3 indicate the effect of adding chemical nitrogen fertilizer alone or combined with each of FYM and bio-fertilizers on number of spikes/m^2 of wheat cultivars. It is clear that significant differences were found between cultivars with respect to their number of spikes/m^2. Sids 1 had the highest number of spikes/m^2 (364) as an average of the two seasons. However, no significant difference was observed between the average of number of spikes/m^2 of Sohag 3 (349.4) and Giza 168 (340.1).

The data also revealed that significant differences in number of spike/m^2 were found between control and all other fertilizer treatments. This trend was true during the two growing seasons and the combined data. The highest number of spikes/m^2 (378.8) was found when 45 kg N was combined with 20 m^3 FYM/faddan. However, the lowest number of spikes (335.7) resulted from the fertilizer treatment No. 5. Hussein et *al*.,(1984) reported that adding a befitting nitrogen source to wheat plant should increase the number of fertile tillers, and the number of spike/m^2 could be a reliable index.

The interaction between cultivars and fertilizer treatments significantly affected number of spike/m^2 either in the two seasons or in combined data. The cultivar Sids 1 produced the highest average number of spike/m^2 (395.9) when fertilized by 45 kg N + 20 m^3 FYM/faddan.

4- Number of kernels/spike:

Date in Table 3, revealed that no significant differences were found in number of kernels/spike

Table 3. Effect of wheat cultivar and fertilizer treatment and their interaction on wheat No. of spikes/m^2 and kernels/spikes in 08/09 and 09/10 seasons.

Cultivar	Fertilizer treatment	No. of spikes/m^2			No. of kernels/spikes		
		08/09	09/10	Average	08/09	09/10	Average
Sohag3	1	313.0	302.3	**307.6**	47.25	38.25	**42.75**
	2	352.0	376.0	**364.5**	53.50	50.50	**52.00**
	3	368.0	381.5	**373.0**	61.75	52.25	**57.00**
	4	368.5	339.5	**354.0**	49.24	48.00	**48.63**
	5	339.5	352.0	**346.0**	54.25	42.75	**53.50**
Mean		**348.5**	**350.4**	**349.4**	**53.20**	**48.35**	**50.78**
Giza 168	1	306.0	305.0	**305.5**	43.30	42.50	**43.00**
	2	337.0	367.5	**352.3**	50.25	47.25	**48.75**
	3	360.0	371.0	**365.5**	54.50	52.50	**53.50**
	4	350.3	359.0	**354.6**	60.00	51.50	**55.75**
	5	310.3	334.8	**322.5**	57.50	51.75	**54.63**
Mean		**332.7**	**347.5**	**340.1**	**53.13**	**49.10**	**51.73**
Sids 1	1	339.8	309.5	**324.6**	40.00	40.25	**40.63**
	2	386.5	395.5	**390.0**	48.00	49.25	**48.63**
	3	390.3	401.5	**395.9**	50.50	49.50	**50.00**
	4	368.8	378.0	**373.4**	53.25	47.50	**50.38**
	5	331.0	345.5	**338.5**	59.25	49.00	**54.13**
Mean		**363.4**	**365.6**	**364.5**	**50.40**	**47.10**	**48.75**
1-Control		319.6	305.6	**312.6**	43.92	40.33	**42.13**
2-Mineral Nitrogen Fertilizer (MNF)		358.8	379.0	**368.8**	50.58	49.00	**49.79**
3-MNF + FYM		372.9	384.7	**378.8**	55.58	51.42	**53.50**
4-MNF + Rhizobacterin		362.5	358.8	**360.7**	54.17	49.00	**51.58**
5-MNF + Rhiz. + phosphorin		327.1	344.3	**335.7**	57.00	51.17	**54.08**
LSD $_{0.05}$ C		**23.49**	**14.25**	**11.90**	**NS**	**NS**	**NS**
LSD $_{0.05}$ F		**22.21**	**12.32**	**17.64**	**4.81**	**4.65**	**3.14**
LSD $_{0.05}$ C x F		**24.10**	**23.29**	**22.00**	**9.11**	**NS**	**4.65**

between the three wheat cultivars. This trend was true through the two growing seasons and in combined data. The respective wheat cultivars Sohag 3, Giza 168 and Sids 1 produced 50.78, 51.73 and 48.75 kernels/spike, respectively.

On the other hand, fertilizer treatments significantly affected wheat number of kernels/spike. However, the differences were observed between no fertilizing treatment and other fertilizer treatments. The fertilization treatment of 45 kg N + mixture of Rhizobacterin and Phosphorin bio-fertilizers gave higher number of kernels/spike with an average of 54.08 kernels. Sabah (2006) noted that seed inoculation with bio-fertilizers significantly increased number of kernels/spike for Gemmieza 10 and Sakha 94 bread wheat cultivars.

Results also indicated that significant effects was found due to the interaction between wheat cultivars and fertilizer treatments in the first season and in combined data. The average highest number of kernels/spike (57.0) observed when Sohag 3 was fertilized by 45 kg N + 20 m^3 FYM/faddan.

These results may be attributed to the different responses of wheat cultivars to the fertilizing systems. And also to the well known fact that, adding fertilizer nutrients usually improve plant performance and increase grain yield and yield components.

5- 1000 kernels weight:

The data of 1000-kernel weight in Table 4 show that wheat cultivars significantly varied in their 1000-kernel weight. The significant differences were in the two seasons and in combined data as well. Sohag 3 the durum wheat cultivar gave the heaviest 1000-kernels with an average of 45.62 gm. However, there was no significant difference between the averages of kernel weights of Giza168 (41.38 gm) and Sids 1 (41.77gm).

The significant effect of fertilizer treatments on 1000-kernel weigh were found only between control and the other treatments. However, the differences between the other four treatments did not reach significance level. They gave 1000-kernel weights of 43.90, 42.90, 44.65 and 44.66 gm, respectively, (Table 4).

These results still identifying that FYM and/or bio-fertilizers could release nutrients in available form, and suitable rates in proper time for the crop and play an active role in improving wheat growth performance, which reflected on increasing yield components.

Mohamed and El-Aref (1999) reported that FYM has an active effect on the availability of nutrients and has capacity to supply wheat crop with more than one nutrient during the period of grain filling. Also, Sabah (2001) noted that bio-fertilizers enable bacteria to fix nitrogen in the root media and positively promote growth by increasing plant photosynthetic accumulation.

The effect of the interaction of wheat cultivars and fertilizer treatments on 1000-kernel weight had significant effects in the two season and in combined data. In the two respective seasons, significantly heavier 1000-kernels weight were produced from Sohag 3 when fertilized by 45 kg N + 20 m^3 FYM (51.96 gm) and 45 kg N + Rhizobacterin and Phosphorin (44.75 gm), and when fertilized by 45 kg N + 20 m^3 FYM/faddan (48.24 gm) in combined analysis.

6-Grain yield (ardab/faddan):

The data in Table 4 show the effect of fertilizer treatments on the studied cultivars. Results indicated that there were no significant differences in grain yield between the studied wheat cultivars. However, higher grain yield of 18.62 ardab/faddan produced from Sohag 3 the durum wheat cultivar, followed by Sids 1 (18.05 ardab/faddan) and then Giza 168 of 17.07 ardab/faddan, as an averages of the two seasons. The superiority of Sohag 3 in grain yield may be due to that it had the highest value of 1000-kernel weight.

With respect of fertilizer treatments, in general, adding sources of nitrogen fertilization significantly increased wheat grain yield by about 40% over the control (Table 4). Adding 45 kg N, which is equivalent to almost the half of the recommended nitrogen dose, plus 20 m^3 FYM/faddan significantly increased grain yield to 21.54 ardab/faddan. Adding the recommended nitrogen dose of 70 kg N/faddan ranked the second with an average grain yield of 20.50 ardab/faddan. However, there were no significant differences between adding

Table 4. Effect of wheat cultivar and fertilizer treatment and their interaction on 1000-kernel weight (gm) and grain yield (ardab/faddan) in 08/09 and 09/10 seasons.

Cultivar	Fertilizer treatment	1000-kernel weight			Grain yield		
		08/09	09/10	Average	08/09	09/10	Average
Sohag3	1	44.17	35.45	39.78	7.21	8.83	8.02
	2	48.18	43.27	45.72	23.73	19.07	21.40
	3	51.96	44.53	48.24	23.31	19.49	21.40
	4	51.36	44.30	47.83	23.79	19.46	21.62
	5	48.24	44.75	46.49	22.98	18.33	20.65
Mean		**48.77**	**42.45**	**45.62**	**20.20**	**17.04**	**18.62**
Giza 168	**1**	42.89	34.50	**38.69**	7.09	8.30	**7.70**
	2	45.61	36.68	**41.14**	22.10	18.70	**20.40**
	3	42.41	35.50	**38.95**	23.66	20.84	**22.25**
	4	49.23	38.40	**43.81**	21.45	18.62	**20.03**
	5	46.43	42.21	**44.32**	23.48	15.45	**19.46**
Mean		**45.31**	**37.46**	**41.38**	**19.55**	**16.38**	**17.97**
Sids 1	**1**	41.03	36.24	**38.63**	8.61	9.90	**9.25**
	2	44.09	42.27	**43.18**	22.36	17.04	**19.70**
	3	42.80	40.21	**41.51**	23.60	18.35	**20.98**
	4	45.58	39.08	**42.33**	20.52	18.10	**19.31**
	5	46.48	39.88	**43.18**	22.31	19.76	**21.03**
Mean		**43.99**	**39.54**	**41.77**	**19.48**	**16.63**	**18.05**
1-Control		42.68	35.39	**39.04**	7.63	9.01	**8.32**
2-Mineral Nitrogen Fertilizer (MNF)		45.96	40.74	**43.90**	22.73	18.27	**20.50**
3-MNF + FYM		45.72	40.08	**42.90**	23.52	19.56	**21.54**
4-MNF + Rhizobacterin		48.72	40.59	**44.65**	21.92	18.72	**20.32**
5-MNF + Rhiz. + phosphorin		47.05	42.28	**44.66**	22.92	17.84	**20.35**
$LSD_{0.05}$ C		**2.16**	**2.69**	**2.81**	**NS**	**NS**	**NS**
$LSD_{0.05}$ F		**3.43**	**2.65**	**2.01**	**1.51**	**1.07**	**0.87**
$LSD_{0.05}$ C x F		**5.22**	**5.01**	**3.10**	**2.00**	**2.01**	**1.29**

the recommended nitrogen dose and adding 45 kg N plus seed inoculation with Rhizobacterin and/or Rhizobacterin and Phosphorin. The grain yields were 20.50, 20.32 and 20.35 ardab/faddan, respectively. Kamh et *al.,* (1991), Russel (1973) and Hussein et *al.,* (1984) reported that nitrogen application resulted in significant increase in wheat grain yield. They attributed this increase to the increase in wheat leaf areas, which could increase photosynthetic capacity and/or fertile tillers. Same results have been reported by Hayam and Mostafa (2001), Abd-El-Ghany (2007) and Sabah (2006) noted that applying mineral fertilizer in combinations with FYM or bio-fertilizers to wheat plants increased the grain yield more than that of mineral fertilizer alone.

The interaction between wheat cultivars and fertilizer treatments significantly affected grain yield in the two respective seasons and in combined data. The two cultivars Sohag 3 and Giza 168 responded to the fertilizer treatment of 45 kg N + 20 m^3 FYM/faddan. They gave 23.31 and 23.66 ardab/faddan in the first season and 19.49, respectively and 20.84 ardab/faddan in the second one, respectively. With averages of 21.20 and 22.25 ardab/faddan, respectively. It was also true with Sids 1 in the first season with 23.6 ardab/faddan, while in the second season it produced its highest grain yield of 19.73 ardab/faddan with 45 kg N + Rhizobacterin and Phosphorin bio-fertilizers.

These results are emphasizing the possibility to decrease the dependency on mineral nitrogen fertilizers by using FYM or bio-fertilizers without decreasing grain yield.

7- Biological yield (ton/faddan):

The results in Table 5 shows the superiority of Sids 1 cultivar in producing significantly, the highest average biological yield of 8.18 ton/faddan. The other two cultivars Sohag 3 and Giza 168 did not significantly differed from each other and gave averages of 7.23 and 7.04 ton/faddan, respectively. These trends were also true in the two studied seasons.

This superiority of Sids 1 cultivar may be due to its highest number of spikes/m^2, which expressing the number of tillers per unit area (Table 3). However, Hayam and Mostafa (2001) noted that differences among varieties could be mainly due to their genetic structure.

Generally, adding mineral nitrogen fertilizer alone or in combination with either FYM or bio-fertilizers almost tripled wheat biological yield than that of the control treatment (Table 5). From the results of the respective two seasons and combined analysis, it is clear that adding 45 kg N + 20 m^3 FYM (fertilizer treatment No. 3) significantly gave the highest wheat biological yield of 10.32, 7.78 and 9.05 ton/faddan, respectively. The other three fertilizer treatments, of FYM or bio-fertilizer, averaged 8.68, 8.38 and 8.32 ton/faddan, respectively, but with no significant differences (Table 5).

These results are confirming the use of FYM and/or bio-fertilizers to replace part of mineral nitrogen fertilizer in fertilizing wheat. Hamissa (1959) and Zedan (1982) reported that application of FYM alone or with chemical nitrogenous fertilizer usually increase grain yield of cereals.

The interaction between wheat cultivars and fertilizer treatments significantly affected wheat biological yield (Table 5).

Results of the two respective seasons and combined analysis indicated that the three wheat cultivars responded to the fertilizer treatment of

45 kg N + 20 m^3 FYM/faddan, with one exception of Sids 1 in the second season. The three cultivars produced significantly the highest biological yields/ faddan of 9.78, 7.62, and 8.70 for Sohag 3; 10.18, 7.90 and 9.04 for Giza 168 in the first and second season and in combined analysis; 11.00 and 9.41 for Sids 1 in the first season and in combined analysis. However, in the second season, Sids 1 responded to 70 kg N/faddan and gave 8.10 ton/faddan.

8- The protein content of grains (%):

Result in Table 5 indicated that wheat cultivars significantly differ in their grain protein content. It is clear that Sohag 3, the durum wheat cultivar, had the highest grain protein content of 11.88% as an average of the two growing seasons. However, in comparison of the two bread wheat cultivars, Sids 1 surpassed Giza 168 in grain protein percentage. The respective two cultivars protein content was 11.37 and 10.61%, respectively.

Table 5. Effect of wheat cultivar and fertilizer treatment and their interaction on biological yield (ton/ faddan) and grain protein content (%) in 08/09 and 09/10 seasons.

Cultivar	Fertilizer treatment	Biological yield			Protein content		
		08/09	09/10	Average	08/09	09/10	Average
Sohag3	1	3.54	2.31	**2.92**	9.18	9.21	**9.20**
	2	9.28	7.60	**8.44**	12.58	12.14	**12.36**
	3	9.78	7.62	**8.70**	13.20	12.83	**13.02**
	4	9.18	7.25	**8.12**	12.11	12.65	**12.39**
	5	8.88	6.90	**7.89**	12.40	12.46	**12.43**
Mean		**7.23**	**6.33**	**7.23**	**11.90**	**11.86**	**11.88**
Giza 168	1	3.03	2.57	**2.80**	8.80	8.77	**8.78**
	2	9.60	6.82	**8.21**	10.85	10.80	**10.83**
	3	10.18	7.90	**9.04**	11.20	11.42	**11.31**
	4	8.90	6.60	**7.75**	10.98	11.18	**11.08**
	5	8.48	7.31	**7.89**	11.00	11.07	**11.03**
Mean		**7.04**	**6.24**	**7.04**	**10.57**	**10.65**	**10.61**
Sids 1	1	4.15	3.31	**3.73**	8.95	8.93	**8.94**
	2	10.68	8.10	**9.39**	11.99	12.02	**12.00**
	3	11.00	7.83	**9.41**	12.56	12.29	**12.27**
	4	10.75	7.59	**9.17**	11.57	12.18	**11.88**
	5	10.58	7.81	**9.19**	11.76	11.74	**11.75**
Mean		**9.43**	**6.93**	**8.18**	**11.30**	**11.43**	**11.37**
1-Control		3.57	2.73	**3.15**	8.98	8.97	**8.97**
2-Mineral Nitrogen Fertilizer (MNF)		9.85	7.50	**8.68**	11.81	11.65	**11.73**
3-MNF + FYM		10.32	7.78	**9.05**	12.13	12.18	**12.16**
4-MNF + Rhizobacterin		9.61	7.15	**8.38**	11.25	12.01	**11.78**
5-MNF + Rhiz. + phosphorin		9.31	7.34	**8.32**	11.72	11.76	**11.74**
LSD $_{0.05}$ C		**0.37**	**0.29**	**0.33**	**0.17**	**0.47**	**0.33**
LSD $_{0.05}$ F		**0.53**	**1.01**	**0.61**	**0.21**	**0.39**	**0.18**
LSD $_{0.05}$ C x F		**2.01**	**1.90**	**2.00**	**0.39**	**0.40**	**0.46**

The differences between wheat cultivar in grain protein content could be attributed to the differences in their genetic structure.

The data in Table 5 revealed that application of 45 kg N + 20 m^3 FYM/faddan significantly increased grain protein content than those obtained by the other fertilizer treatments in the two growing seasons (12.13 and 12.18%, respectively) and when data were combined (12.16%). Abd El-Ghany (2007) found that application of FYM combined with mineral nitrogen fertilizer resulted in the highest grain protein content.

The interaction between cultivars and fertilizer treatments significantly affected grain protein content in the two seasons and in combined data (Table 5). The three tested cultivars similarly responded to the fertilizer treatment of 45 kg N + 20 m^3 FYM/faddan, which significantly increased their grain protein percentages to the averages of 13.02% for Sohag 3, 11.31% for Giza 168 and 12.27% for Sids 1.

Conclusion:

From the above results, it could be concluded that application of 45 kg of nitrogen through chemical fertilizer in combination with 20 m^3 of FYM or bio-fertilizers will improve the growth and yield of wheat crop.

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