J. Plant Production, Mansoura Univ., Vol. 6 (12): 1991 - 2001,2015

THE ROLE OF DIFFERENT BIO-FERTILIZERS AND NITROGEN RATES IN IMPROVING YIELD AND YIELD COMPONENTS OF WHEAT.

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ABSTRACT

Two filed experiments were carried out at the Exp. Farm, Fac. of Agric., Al-Azhar Univ., Nasr City, Cairo, Egypt, to study the effect of bio-fertilizers i.e. without added (Control), Microbein, Nitrobein and Cerialein and nitrogen fertilizer rates (0, 25, 50, 75 and 100 kg/fad.) and their interaction on yield and yield components of wheat Misr 1 cultivar during the two successive growing winter seasons of 2012/2013 and 2013/2014 seasons. The experimental design was split plot design with four replications. The main plot was devoted to biofertilizer treatments and the sup- plot contained nitrogen rates.

Microbein bio-fertilizer recorded the highest yield and its component, except, spike length, no of grains/spike and 1000-grain weight which found with cerialein in both seasons.

On the other hand, the highest grain yield/fad recorded with the highest nitrogen level in both seasons.

The interaction between bio-fertilizer and N rates proved to be significant for all studied traits. The highest grain yield/ha was found with the interaction between bio-fertilizers and 75 or 100 N/fad in the second season, which were no significant effect between them.

According to these results, rate of 75 kg N/fad and all bio-fertilizer using variety Misr-1 could be recommended for favorable wheat production under the local environmental conditions of this study.

Keywords: Wheat, Cerialein, Microbein, Nitrobein, Nitrogen fertilizer

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop in the world, as well as in Egypt since it is stable food for humans. The total consumption of wheat is about 13 million ton, while the total wheat production is about 8.3 million ton (produced from 1.35 million hectare.) with average grain yield 6 ton/ hectare) in 2013/2014 season (ASBWC, 2014), therefore, there is a gap between the national need and the local wheat production, which means that Egypt still imports about 4.73 million tons annually. Recently, a great attention of several investigations has been directed to increase the productivity of wheat to minimize the gap between the Egyptian production and consumption by increasing the cultivated area and wheat yield per unit area, (Zaki *et al.*, (2007). The increase unit area productivity may be by using optimum nutrient elements to plants, such as nitrogen fertilizer.

It is well known that nitrogen is considered as one of the limiting factors to achieve the high yield of wheat crop. With the steadily increasing prices of nitrogen fertilizers and the pollution problems, the use of atmospheric nitrogen fixing microorganisms might reduce financial costs.

Microbial inoculation or biofertilizer is an important component of organic farming as the microbes help to fix atmospheric nitrogen, solublize and mobilize phosphorous, translocate minor elements like zinc and copper to the plants, produce plant growth promoting hormones, vitamins and amino acids and control plant pathogenic fungi. It improves soil health and increases crop production.

Biofertilizer is defined as a substance which contains living organisms that when applied to seed, plant surface, or soil, colonize the rhizosphere or the interior of plant and promote growth by increasing supply or availability of primary nutrients to the host plant (Vessey, 2003). Biofertilizers are well recognized as an important component of integrated plant nutrient management for sustainable agriculture and hold a great promise to improve crop yield (Narula *et al.* 2005).

Fixation as an alternative or supplementary source of nitrogen for wheat has been the major approach in soil fertility management of nitrogen for wheat. Mahmoud and Mohamed (2008), Badran (2009), El-Gzawy (2009 and 2010), Abd El-Razek and El-Sheshtawy (2013) and Attia and Barsoum (2013) reported that wheat grains inoculated with bio-fertilizers under the commercial name cerialein®, microbein® or nitrobein®, cerialein ® and phospharine®, nitrobein®, microbein® and microbein®, respectively, increased yield and yield components of wheat. Kandil *et al.* (2011) found that biofertilizer treatments (cerialein or microbein) significantly affected plant height (cm), tillers number/m^2, spikes number/m^2 , number of grains/spike, grains weight/spike (g), 1000-grain weight (g), biological yield (ton/ha), grain yield (ton/ha) and straw yield (ton/ha). Using whether cerialein or microbein as bio-fertilizer exerted similar effects on yield and its attributes of wheat.

Yield and yield components increased by increasing nitrogen rates, they have also been reported by (Sharshar *et al.*, 2000; Sushila and Gajendra, 2000 and Saleh, 2002). Atta and Swelam (2006), El-Gzawy (2010) Kandil *et al.* (2011), Abd El-Razek and El-Sheshtawy (2013) and Namvar and Khandan (2013) found that increased nitrogen rates up to N level of 178.5 kg N/ha recorded the highest grain yield of wheat.

The interaction between bio fertilizer and nitrogen levels had significant effect on yield and yield components of wheat (Ali, Nadia *et al.,* 2002., Katiyar *et al.*, 2011., Abd El-Razek and El-Sheshtawy, 2013 and Soleimanzadeh and Gooshchi, 2013). Kandil *et al.* (2011) found that the interaction between bio-fertilizer application and nitrogen levels had favorable effect on spikes number/m^2, grains weight/spike and 1000-grain weight of wheat. The combination of cerialein inoculation and nitrogen level of 178.5 kg N/ha had the superiority over other combinations as spikes number/m^2, grains weight/spike and 1000-grain weight were concerned. Moreover, the interaction between bio-fertilizer treatments and nitrogen levels had significant effect on biological yield, grain yield and straw yield.

Thus, this study aimed to study the effect of bio-fertilizers and mineral nitrogen rates on yield and yield components of wheat.

MATERIALS AND METHODS

The study area:

The present investigation was carried out at the Exp. Farm, Fac. of Agric., Al-Azhar Univ., Nasr City, Cairo, Egypt, during the two successive growing winter seasons of 2012/2013 and 2013/2014, to study the effect of bio-fertilizers and nitrogen rates on yield and yield components of wheat Misr 1 cultivar.

The experimental design and necessary management:

A split plot design with four replicates was used; four bio-fertilizer treatments (without bio-fertilizer and with bio-fertilizer microbein, nitrobein and cerialein were randomly allocated in main plots. The sub-plots were designated to nitrogen rates (0, 25, 50, 75 and 100 kg N/fad). The commercial bio-fertilizers: Cerialein® inoculated a mixture of a non-symbiotic N fixing *Azospirillum lipoferum* and *Bacillus polymxa*, Microbein® inoculated a mixture of *Pseudomonnas* sp., *Azotobacter* sp., *Azospirillum* sp. and *B. megaterium* and Nitrobein ® inoculated a mixture of *Azospirillum brasiliense, Azotobacter chrococcum* and *Azospirillum liboferum*. All bio-fertilizers were produced by Bio-fertilizers Production Unit, General Organization for Agriculture Equalization Fund, Agricultural Research Centre, Ministry of Agriculture and Land Reclamation, Giza, Egypt. The grains inoculation was done before sowing directly. Nitrogen in the form of ammonium nitrate (33.5% N) was added as follows: 1/5 at sowing, 2/5 at 35 days after sowing and 2/5 at 50 days after sowing. In the two seasons, wheat seeds cv. Misr 1 was hand sown at 18^{th} November at the rate of 60 kg/fad. The unit area of experimental plot was 10.5 m^2 (3×3.5 m), having 15 rows in each plot spaced 20 cm apart and 3.5 m in length. The preceeding crop was cowpea of two the seasons. All other cultural practices were followed as recommended in wheat fields. Soil samples were collected pre sowing through the experimental site to determine the mechanical and chemical analysis according to standard methods of Page (1982) and Arnold (1986) are presented in Table 1.

Table 1: Mechanical and chemical analysis of soil at the experimental site in 2012/2013 and 2013/2014 seasons.

SOIL ANALYSIS		
Mechanical Analysis	**Season**	
	2012/2013	**2013/2014**
Clay%	27.66	27.86
Silt %	15.89	16. 29
Sand %	56.45	55.85
Soil Texture	Sandy Clay Loam	Sandy Clay Loam
Chemical Analysis		
PH	7.95	7.93
EC (mmohs/ cm^{-1})	0.91	0.87
Available N (ppm)	19.00	17.85
Available P (ppm)	7.98	7.06
Available K (ppm)	45.12	48.17

Field sampling and data collection:

At harvest one square meter was taken randomly from each sub-plot to determine yield and its components as follows.

- Plant height (cm).
- Spike length (cm).
- Number of grains/spike.
- Number of spikes /m^2.
- 1000-grain weight (g).
- Biological yield (t fad^{-1})
- Straw yield (t fad^{-1})
- Grain yield (t fad^{-1})
- Harvest index

Statistical analysis:

Data were subjected to the proper statistical analysis as the technique of analysis of variance (ANOVA) of split plot design as mentioned by Gomez and Gomez (1984). Treatments means were compared using the Least Significant Difference (LSD) Test as outlined by Waller and Duncan (1969). Computation was done using computer software.

RESULTS AND DISCUSSION

Average plant height, spike length, number of grains/spike, 1000- grain weight, number of spikes/m^2, biological yield, straw yield, grain yield and harvest index of wheat as affected by bio-fertilizers, nitrogen fertilizer rates and their interactions in 2012/2013 and 2013/2014 seasons are shown in Tables 2 and 3.

1-Bio-fertilizer effect:

Results recorded in Tables 2 and 3 show clearly that the effect of bio fertilizer treatments was significant on all studied characters in both seasons. Wheat plants fertilized by cerialein gave the highest values of plant height 98.44 and 100.81 cm, spike length 11.50 and 11.28 cm, number of grains/spike 55.87 and 55.96, 1000- grain weight 42.90 and 43.40 g. While, treated wheat plants with microbein give the highest values of number of spikes/m^2 287.27 and 296.13, biological yield 7.61 and 7.81 tons, straw yield per faddan 4.84 and 4.93 ton, grain yield per faddan 2.77 and 2.88 tons and highest harvest index 36.27 and 36.66 as compared with all other treatments in 2012/2013 and 2013/2014 season, respectively.

The increase in plant height due to cerialein may be attributed to the increase of cell division and enlargement which led to raising plant height, also it gave the tallest spike according to enhancement of dry matter accumulation and stored in spike, therefore gave increase in length of spike. The increase of number of grains/spike may be attributed the increase of spike length which caused by applied cerialein as a bio-fertilizer.

The increase in number of spikes/m^2 owing to applied microbein may be attributed to the increase of bread tillers thus increased number of spikes/m^2. The enhancement of straw yield per faddan according to applied microbein might be due to increasing number of tillers. The increase of grain yield per faddan caused by microbein might be attributed to the increase of number of spikes/m^2 which led to raising grain yield/fad. These results are in harmony with those of Mahgoub, Hayam and Mostafa (2001) they found that wheat plants treated with Microbein biofertilizer significant increased the number of spikes /m^2 and straw yield in the first season. Meanwhile, it had significantly increasing of grain yield in second season. Also, Basha (2004) found that biofertilization (Microbein) was significantly affected on wheat plants and positively of number of spikes /m^2, grain and straw yields /fad, and number of spikes /m^2. On the other hand, Kalboush (2003), in Egypt stated that biofertilizer treatments i.e. cerialein and microbein was significantly increased plant height, harvest index, biological, straw and grain yields of wheat.

2-Nitrogen fertilizer rate effect:

The results presented in Tables 2 and 3 indicated that nitrogen rates had a significant effect on all studied traits in both seasons. Generally the increase of nitrogen rate up to 100 kg N/faddan increased all studied traits in both seasons. These results are in harmony with those of Sharshar *et al.* (2000), Sushila and Gajendra (2000), Saleh (2002), Atta and Swelam (2006), El-Gizawy (2010) Kandil *et al.* (2011), Gul *et al.* (2012), Abd El-Razek and El-Sheshtawy (2013) and Namvar and Khandan (2013).

Wheat plants fertilized by nitrogen at the rate of 100 kg N/faddan increased plant height by 24.08 and 25.33%, spike length by 134.46 and 142.54%, number of grains/spike by 53.26 and 51.30%, 1000-grain weight by 22.07 and 16.75%, number of spikes/m^2 by 48.52 and 55.66%, biological yield by 102.66 and 96.31%, straw yield by 96.64 and 89.01%, grain yield by 113.79 and 109.87% and harvest index by 5.53 and 6.92% as compared with those of the control in 2012/2013 and 2013/2014 seasons, respectively.

The increase of plant height and spike length according to increasing nitrogen fertilizer rate may be due to stimulative effect of nitrogen on plant growth such as increased cell division and cell enlargement which tented to the obtained the tallest plants and spikes. Zhilin *et al.* (1997) stated that plant height significantly increased due to nitrogen application. Pramanik and Bera (2013) found that the increase in plant height was due to various physiological processes including cell division and cell elongation of the plant.

The increase of number of grains per spike and 1000-grain weight might be attributed to the increase of photosynthetic rate and net assimilation rate which led to raising dry matter accumulation, translocated and stored in spike, therefore increased number of fertile flowers, thus increased number of grains per spike as well as decreased the competition among these flowers of nutritive substances which led to gave the heaviest grains. The enhancement of number of spikes/m^2 by increasing nitrogen rate may be due to increasing number of tillers which having spike which led to increasing number of spikes/ m^2. The increase in straw yield per faddan might be attributed to the increase of nitrogen rate increased plant height and number of tillers therefore increased straw yield. The rising of grain yield per faddan owing to increased nitrogen rate may be due to the enhancement of nitrogen on yield components i.e. number of grains/ spike, 1000-grain weight and number of spikes/m^2 therefore increased grain yield per faddan. The increase of harvest index caused by increasing nitrogen rate may be due to increasing grain yield per faddan as a ratio from biological yield per faddan, thus increased harvest index (Sinclair, 1997).

3-Interaction effects:

The obtained results illustrated that the interaction effect between bio-fertilizers and nitrogen rates was significant on all studied characters in both seasons. Similar results found with those obtained by Ali, Nadia *et al.* (2002), Kandil *et al.* (2011), Katiyar *et al.* (2011), Abd El-Razek and El-Sheshtawy (2013) and Soleimanzadeh and Gooshchi (2013).

Wheat plants received cerialein and 100 kg N/faddan nitrogen gave the highest values of plant height 105.83 and 109.70 cm, spike length 15.27 and 15.33 cm, number of grains/spike 67.67 and 67.82 and 1000-grain weight 45.30 and 45.60g as compared with all other this interaction treatments in 2012/2013 and 2013/2014 seasons, respectively. However, wheat plants treated by microbein and 100kg N/faddan gave the highest values of number of spikes/m^2 347.17 and 366.33, biological yield per faddan 9.29 and 9.33 ton, straw yield per faddan 5.84 and 5.82 ton and grain per feddan 3.45 and 3.51 ton as compared with all other this interaction treatments in 2012/2013 and 2013/2014 seasons, respectively. The highest grain yield/fad recorded with the interactions between all bio-fertilizers and 100 kg N/fad in both seasons. But in the second season the interaction between all bio-fertilizer and 75 or 100 kg N/fad recorded the highest grain yield in both seasons, which were no significant difference between them. On the other hand, the interaction between all bio-fertilizers and 75 or 100 kg N/fad gave the highest values of harvest index in both seasons.

2

3

1998

CONCLUSION

From the present results I could be recommended that treated wheat plants c.v Misr 1 by bio-fertilizer i.e. microbein or cerialein and or nitrobein and 75 or 100 kg N/fad enhancing wheat production under the local environmental conditions of this study.

REFERENCES

Abd El-Razek, U.A. and A.A. El-Sheshtawy (2013). Response of some wheat varieties to bio and mineral nitrogen fertilizers. Asian J. of Crop Sci., 5(2):200-208.

Agricultural Statistical Bulletin for Winter Crops (ASBWC), (2014). Economic affairs sector, Ministry of Agriculture and Land Reclamation, Egypt.

Ali, Nadia A.A.; S.D. Darwish and S.M. Mansour (2002). Effect of *Azotobocter chrococcum* and *Azosplrillum brasilense* inoculation and anhydrous ammonium on root colonization, plant growth and yield of wheat plant under saline alkaline conditions. J. Agric. Sci. Mansoura Univ., 27: 5575-5591.

Arnold, K. (1986). Methods of soil analysis, physical methods. Second Ed. American Society of Agron. Inc. Soil Sci. Society of America, Inc. Madison Wisconsin.

Atta, Y.I. and A.A. Swelam (2006). Effect of irrigation number on productivity and some water relations of two bread wheat cultivars under East Delta conditions. Egypt J. of Appl. Sci., 21(6):101-122.

Attia, M.A. and M.S. Barsoum (2013). Effect of supplementary irrigation and bio-fertilization on wheat yield productivity under rainfed conditions. Alex. J. Agric. Res., 58(2): 149 -157.

Badran, M.S.S. (2009). Improving wheat productivity by bionitrogen fertilization under newly planted sandy soils. J. Agric. Sci. Mansoura Univ., 34(3): 1781-1795.

Basha, M.B.I. (2004) Agronomic studies on wheat, M. Sc. Thesis, Fac. Agric., Tanta Univ., Egypt.

El-Gizawy, N.Kh.B. (2009). Effect of planting date and fertilizer application on yield of wheat under no till system. World J. of Agric. Sci., 5 (6): 777-783.

El-Gizawy, N.Kh.B. (2010). Effect of nitrogen, biogas sludge manure and bio-fertilizer on grain nitrogen uptake and yield of wheat (*Triticum aestivum* L.). The international Conference of Agron., 20-22 Sept., 2010, ELArish, Egypt. 1-13.

Gomez, K.A. and A. Gomez (1984). Statistical procedures of agricultural research. John Wiley & Sons, New York, 2nd Ed., 680p.

Gul, H.; B. Saeed; A.Z. Khan; U. Latif; K. Ali; J. Rehman and S. Rehman (2012). Yield and yield contributing traits of wheat cultivars in relation with planting dates and nitrogen fertilization. ARPN J. of Agric. and Bio. Sci., 7(6): 386-395.

Kalboush, F.A.M.H. (2003) Response of wheat plants to some treatments of soil leveling and fertilization wheat with both nitrogen and biological fertilizer. Ph. D. Thesis, Fac. Agric. Mansoura Univ., Egypt.

Kandil, A.A.; M.H. El-Hindi; M.A. Badawi; S.A. El-Moursy and F.A.H.M. Kalboush (2011). Response of wheat to rates of nitrogen, biofertilizers and land leveling. Crop and Environ., 2(1): 46-51.

Katiyar, N.K.; S. Rarawat; R.K. Pathak and A. Kumar (2011). Effect of Azotobacter and nitrogen levels on yield and quality of wheat. Annals of Plant and Soil Res., 13(2):152 -155.

Mahgoub, Hayam S. and A.K. Mostafa (2001). Evaluation of new Egyptian wheat cultivars to biofertilizer under three nitrogen levels in new land. Ann. of Agric. Sci. Moshtohor, 39(2): 857-866.

Mahmoud, A.A. and H.F.Y. Mohamed (2008). Impact of bio-fertilizers application on improving wheat (*Triticum aestivum* L.) resistance to salinity. Res. J. Agric. and Bio. Sci., 4(5): 520-528.

Namvar, A. and T. Khandan (2013). Response of wheat to mineral nitrogen fertilizer and biofertilizer (*Azotobacter* sp. and *Azospirillum* sp.) inoculation under different levels of weed interference. Ekologija, 59(2): 85–94.

Narula, N.; V. Kumar; B. Singh; R. Bhatia, and K. Lakshminarayana (2005). Impact of biofertilizer on grain yield in spring wheat under varying fertility condition and wheat cotton rotation. Archiv. Agron. and Soil Sci., 51(1): 79-89.

Page, A.L. (1982). Chemical and microbiological properties. American Society of Agron., Inc. Soil Sci. Society of America, Inc. Madison Wisconsin.

Pramanik, K. and A.K. Bera (2013). Effect of seedling age and nitrogen fertilizer on growth, chlorophyll. Inter. J. of Agron. and Plant Produc., 4(S): 3489-3499.

Saleh, M.E. (2002). Response of two wheat cultivars to seeding rates and nitrogen levels. Zagazig J. Agric. Res., 29: 1367-1378.

Sharshar, M.S.; M.M. Sobh and Fatina A. Sherif (2000). Effect of some N-Bio-fertilizer sources as supplementary fertilization on wheat yield, yield components and quality under graded levels of N-chemical fertilizer. J. Produc. and Dev., 5: 1-11.

Sinclair, T.R. (1997). Historical changes in harvest index and crop nitrogen accumulation .Crop Sci. of Society American, 38 (3): 638-643.

Soleimanzadeh, H. and F. Gooshchi (2013). Effects of Azotobacter and nitrogen chemical fertilizer on yield and yield components of wheat (*Triticum aestivum* L.).World Appl. Sci. J., 21 (8): 1176-1180.

Sushila, R. and G.R. Gajendra (2000). Influence of farmyard manure, nitrogen and Bio-fertilizers on growth, yield attributes and yield of wheat (*Triticum aestivum* L.) under limited water supply. Indian J. Agron., 45: 590-595.

Vessey, J.K. (2003). Plant growth promoting rhizobacteria as biofertilizer. Plant and Soil, 255: 571-586.

Waller, R.A. and D.B. Duncan (1969). A bays rule for the symmetric multiple comparison problem. Am. Stat. Assoc. J., 1485-1504.

Zaki, N.M.; M.S. Hassanein and K.M. Gamal El-Din (2007). Growth and yield of some wheat cultivars irrigated with saline water in newly cultivated land as affected by biofertilization. J. of Appl. Sci. Res., 3(10): 1121-1126.

Zhilin, L.; R.S. Sarker; S.K. Nayak; I. Ravi and J.L. Li (1997). Physiological effect of nitrogen application on aromatic rice. J. of South China Agric. Univ., 18:13–17.

دور التسميد الحيوي والتسميد الأوزتي في تحسين المحصول ومكوناته في القمح

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أقيمت تجربتان حقليتان بمزرعة كلية الزراعه جامعة الأزهر بمدينة نصر،القاهرة مصر خلال موسمي ٢٠١٣/٢٠١٢ و ٢٠١٤/٢٠١٣ م لدراسة تأثير معاملات مختلفة من التسميد الحيوى مع مستويات من التسميد الازوتى المعدني على محصول القمح صنف (مصر ١). وكان التصميم المستخدم هو تصميم القطع المنشقة مرة واحدة ذات الاربعه مكررات. حيث أحتل التسميد الحيوى القطع الرئيسية (بدون تسميد – ميكروبين – نيتروبين و سريالين) بينما أحتل التسميد النتروجينى القطع الشقية بمستوياته وهى (بدون تسميد ، ٢٥ ، ٥٠ ، ٧٥ و ١٠٠ كجم نيتروجين /فدان).

وقد أوضحت النتائج أن التسميد الحيوى قد سجل معنوية لجميع الصفات المدروسة حيث سجل التسميد بالسماد الحيوى سريالين أعلى القيم لكل من طول النبات، طول السنبلة ، عدد الحبوب فى السنبلة و وزن ١٠٠٠ حبه فى كلا الموسمين ،بينما سجل السماد الحيوى ميكروبين أعلى القيم لكل من عدد السنابل فى المتر المربع، المحصول البيولوجى ، محصول القش ، محصول الحبوب/فدان و دليل الحصاد فى كلا الموسمين.

أدى زيادة مستوى التسميد النيتروجينى المعدنى حتى١٠٠ كجم نيتروجين /الفدان إلى زياده معنويه فى جميع الصفات المدروسة فى كلا الموسمين.

سجل التفاعل بين التسميد الحيوى والتسميد النتروجينى معنوية لجميع الصفات المدروسة فى كلا الموسمين. بينما وجد أن أعلى القيم لمحصول الحبوب معنوية وجدت مع كل من التسميد الحيوى بانواعه المختلفة والتسميد النيروجينى ٧٥ او ١٠٠ كجم نيتروجين /فدان فى الموسم الثانى حيث لم يوجد أى فرق معنوى بينهما.

التوصية

من النتائج المتحصل عليها يمكن التوصية بالتسميد الحيوى بانواعه (ميكروبين أو سريالين أو نتروبين) المستخدمة فى الدراسة مع التسميد النيتروجينى بمعدل ٧٥ كجم نيتروجين معدنى /الفدان وذلك لاعطاء أعلى محصول حبوب ممكن من صنف القمح مصر ١ تحت ظروف منطقة الدراسة .

Table 2: Effect of bio-fertilizers, nitrogen rates and their interaction on plant height, spike length, no. of grains/spike,1000-grain weight and no. of spikes/m^2 of wheat in 2012/2013 and 2013/2014 seasons.

Treatments	Plant height (cm)		Spike length (cm)		No. of grains/Spike		1000-grain weight (g)		No. of spikes/m^2	
	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Bio-fertilizer (B)										
Without (B_1)	92.08	92.79	9.49	9.71	50.78	50.27	38.97	40.13	240.13	262.97
Microbein (B_2)	96.57	99.16	10.76	11.02	54.70	54.76	41.02	42.44	287.27	296.13
Nitrobein (B_3)	97.07	99.48	11.10	10.94	54.27	54.93	42.19	42.82	273.97	292.74
Cerealein (B_4)	98.44	100.81	11.50	11.28	55.87	55.96	42.90	43.40	277.26	287.74
LSD at $_{0.05}$	0.75	0.80	0.25	0.23	1.20	1.22	0.20	0.24	3.37	4.56
Nitrogen rates (N)										
0 kg N/fad (N_1)	83.85	85.11	5.92	5.90	42.34	43.00	35.93	37.78	219.50	223.00
25 kg N/fad (N_2)	93.63	95.29	9.16	9.37	48.18	47.75	41.45	42.06	232.46	262.09
50 kg N/fad (N_3)	97.24	100.02	11.80	11.86	53.55	53.25	42.25	43.03	271.04	285.42
75 kg N/fad (N_4)	101.44	103.22	12.82	12.25	60.56	60.83	42.88	44.03	299.29	306.50
100 kg N/fad (N_5)	104.04	106.67	13.88	14.31	64.89	65.06	43.86	44.11	326.00	347.12
LSD at $_{0.05}$	0.87	0.93	0.29	0.36	1.39	1.41	0.23	0.28	3.92	5.30
Interactions B × N										
$B_1 \times N_1$	79.73	80.44	5.17	5.57	40.71	41.50	35.10	36.70	201.65	209.00
$B_1 \times N_2$	90.60	91.27	8.56	8.83	46.07	45.67	38.50	39.73	212.33	238.33
$B_1 \times N_3$	92.87	93.30	10.50	10.06	51.53	49.00	39.30	40.30	232.33	265.00
$B_1 \times N_4$	96.80	97.21	11.29	11.23	54.40	55.33	40.23	41.60	261.33	285.67
$B_1 \times N_5$	100.40	101.73	11.94	12.84	61.20	59.83	41.71	42.33	293.00	316.83
$B_2 \times N_1$	84.00	86.30	5.95	5.83	42.00	42.83	36.50	38.20	227.67	231.67
$B_2 \times N_2$	94.53	95.21	9.03	9.56	49.33	48.33	41.30	42.41	243.50	267.67
$B_2 \times N_3$	97.93	103.83	12.27	12.35	54.33	54.67	41.70	43.50	292.50	289.00
$B_2 \times N_4$	101.48	104.26	13.13	13.05	63.17	62.67	42.30	44.10	325.50	326.00
$B_2 \times N_5$	104.90	106.20	13.43	14.30	64.67	65.30	43.31	44.00	347.17	366.33
$B_3 \times N_1$	85.67	86.51	6.02	6.00	42.33	43.33	35.20	38.52	225.33	222.67
$B_3 \times N_2$	94.37	96.97	9.50	9.37	48.33	47.67	42.78	42.60	233.17	276.67
$B_3 \times N_3$	98.20	99.28	12.03	12.81	53.67	54.33	43.70	43.60	277.50	294.00
$B_3 \times N_4$	102.10	105.61	13.07	11.75	61.00	62.00	44.17	44.90	298.50	312.67
$B_3 \times N_5$	105.03	109.03	14.86	14.78	66.00	67.30	45.10	44.50	335.33	356.33
$B_4 \times N_1$	86.00	87.18	6.52	6.20	44.33	44.33	36.90	37.70	223.33	228.67
$B_4 \times N_2$	95.03	97.69	9.53	9.70	49.00	49.33	43.20	43.50	240.83	265.67
$B_4 \times N_3$	99.97	103.68	12.40	12.21	54.67	55.00	44.30	44.70	281.83	293.67
$B_4 \times N_4$	105.37	105.78	13.77	12.96	63.67	63.30	44.80	45.50	311.83	301.67
$B_4 \times N_5$	105.83	109.70	15.27	15.33	67.67	67.82	45.30	45.60	328.50	349.00
LSD at $_{0.05}$	1.74	1.86	0.58	0.52	2.79	2.84	0.45	0.56	7.84	10.60

Table 3: Effect of bio-fertilizers, nitrogen rates and their interaction on biological yield, straw yield, grain yield and harvest index of wheat in 2012/2013 and 2013/2014 seasons.

Treatments	Biological yield (t/fad)		Straw yield (t/fad)		Grain yield (t/fad)		Harvest index %	
	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014	2012/2013	2013/2014
Bio-fertilizer (B)								
Without (B_1)	4.97	5.19	3.19	3.33	1.78	1.86	35.59	35.64
Microbein (B_2)	7.61	7.81	4.84	4.93	2.77	2.88	36.27	36.66
Nitrobein (B_3)	7.47	7.56	4.76	4.79	2.71	2.77	36.18	36.52
Cerealein (B_4)	7.54	7.69	4.80	4.86	2.74	2.83	36.22	36.64
LSD at $_{0.05}$	0.20	0.23	0.18	0.22	0.06	0.08	0.33	0.35
Nitrogen rates (N)								
0 kg N/fad (N_1)	4.13	4.34	2.68	2.82	1.45	1.52	35.11	34.96
25 kg N/fad (N_2)	6.20	6.37	3.99	4.07	2.21	2.30	35.62	36.01
50 kg N/fad (N_3)	7.77	7.84	4.97	4.97	2.80	2.87	35.95	36.55
75 kg N/fad (N_4)	8.04	8.24	5.09	5.19	2.94	3.05	36.60	36.93
100 kg N/fad (N_5)	8.37	8.52	5.27	5.33	3.10	3.19	37.05	37.38
LSD at $_{0.05}$	0.23	0.27	0.20	0.26	0.07	0.09	0.38	0.40
Interactions B × N								
$B_1 \times N_1$	3.61	3.75	2.36	2.48	1.25	1.27	34.54	33.89
$B_1 \times N_2$	4.70	4.89	3.07	3.16	1.63	1.73	34.75	35.38
$B_1 \times N_3$	5.16	5.27	3.33	3.39	1.83	1.88	35.51	35.72
$B_1 \times N_4$	5.52	5.76	3.52	3.67	2.00	2.09	36.24	36.27
B1 × N_5	5.86	6.27	3.70	3.96	2.16	2.31	36.91	36.92
$B_2 \times N_1$	4.37	4.66	2.83	3.01	1.54	1.65	35.34	35.46
$B_2 \times N_2$	6.73	6.99	4.31	4.46	2.42	2.53	35.95	36.25
$B_2 \times N_3$	8.72	8.87	5.57	5.60	3.15	3.27	36.14	36.85
$B_2 \times N_4$	8.96	9.19	5.66	5.77	3.30	3.42	36.79	37.19
B2 × N_5	9.29	9.33	5.84	5.82	3.45	3.51	37.14	37.57
$B_3 \times N_1$	4.22	4.41	2.73	2.86	1.49	1.55	35.26	35.23
$B_3 \times N_2$	6.66	6.78	4.27	4.33	2.39	2.45	35.85	36.18
$B_3 \times N_3$	8.57	8.44	5.48	5.34	3.09	3.10	36.06	36.69
$B_3 \times N_4$	8.78	8.91	5.56	5.61	3.22	3.30	36.65	37.04
B3 × N_5	9.13	9.26	5.64	5.77	3.39	3.47	37.08	37.45
$B_4 \times N_1$	4.30	4.52	2.78	2.93	1.52	1.59	35.29	35.24
$B_4 \times N_2$	6.72	6.82	4.30	4.35	2.42	2.47	35.94	36.21
$B_4 \times N_3$	8.61	8.77	5.50	5.53	3.11	3.24	36.10	36.94
$B_4 \times N_4$	8.88	9.09	5.62	5.71	3.26	3.38	36.70	37.21
B4 × N_5	9.19	9.23	5.78	5.76	3.41	3.47	37.07	37.59
LSD at $_{0.05}$	0.46	0.54	0.40	0.52	0.14	0.18	0.76	0.80