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Effect of Some Mineral and Bio Fertilization Treatments on Yield and Yield Components of Bread Wheat Under Two Seeding Rates

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ABSTRACT

Two field experiments were carried out during 2013/2014 and 2014/2015 winter seasons at Agric. Res. Stat., Fac. Agric., Cairo Univ. Giza, Egypt to study the effect of two seeding rates i.e.50 and 65 kg seed/ faddan (4200 m^2) and seven treatments of N, P and K fertilizers with or without Cerealin inoculation on wheat growth, grain yield and its components. These seven treatments were T1 (0 - 0 - 0 NPK), T_2 (50 - 30 - 24 NPK), T_3 (65 - 37.5 - 36 NPK), T_4 (80 - 45 - 48 NPK), T_5 (T_2 + Cerealin), T_6 (T_3 + Cerealin), and T_7 (T_4 + Cerealin). A split plot design in randomized complete blocks arrangement with three replications was used. Seeding rates were randomly assigned for the main plots while, fertilizer treatments were randomly arranged for the sub plots. The obtained results showed that seeding rates had no significant effect on all yield attributes except, number of shoots m^{-2}, number of grains spikes^{-1} in 2013/2014 season, number of shoots m^{-2}, number of spikes m^{-2}, straw yield /faddan and harvest index in 2013/2014 season. Mineral NPK fertilizers with bio-fertilizer (Cerealin) had significant effect on yield and its components except, spike length in both seasons. Grain, straw and biological yields and its attributes i.e. plant height, number of shoots m^{-2}, number of spikes m^{-2}, number of grains spike^{-1}, grains weight spike^{-1}, 1000-grain weight were significantly increased by adding bio-fertilizer compared to none adding in both seasons, respectively. Adding 75% of recommended dose of NPK mineral fertilizer combined with Cerealin inoculation resulted in significant increment in plant height, number of shoots m^{-2}, number of spikes m^{-2}, number of grains spike^{-1}, grains weight spike^{-1}, 1000-grain weight, grain, straw and biological yields as well as harvest index compared with other combination treatments. The interaction between seeding rate and fertilizer treatments was significant for all characters under study in both seasons. The highest grain yield (4.31 and 4.07 ton / faddan) in both seasons, respectively was recorded by sowing 65 kg seed faddan^{-1} with adding 65 kg N + 37.5 kg P_2O_5 + 36 kg K_2O + Cerealin inoculation compared with other tested treatments.

INTRODUCTION

Wheat (*Triticum aestivum L.*) is the main cereal crop in Egypt. It provides 37 % of total calories for the people and 40% of the protein in Egyptian diet (Tawfik *et al.*, 2016). It is also represent a major source of chaff for animal feeding. Wheat yield and end–use quality depend upon the environment, genotype, and their interaction (Zecvic *et al.*, 2014). For achieving high yield and quality of wheat grain, it is important to apply all recommended cultural practices on adapted cultivars. Seeding rate is important for the wheat crop since it directly affects the number of ears per unit area. As a consequence other yield components such as the number of grains spike^{-1} and individual grain weight (Ozturuk *et al*., 2006 and Valerio *et al*., 2013). Plant density is an important factor that influences the growth and yield formation in wheat (Hiltburnner *et al*., 2007). Previous studies have focused on identifying the optimal density for wheat cultivation, but the results vary based on the experimental conditions and tested parameters (Lioveras *et al.*, 2004 and Luo *et al*., 2011). In wheat, the number of spikelets spike^{-1} changes under different planting densities (Dornbusch *et al*., 2011). The increase in grain number per spike contributes considerably to improve wheat grain yield potential. On the other hand, many investigators reported that different seeding rates had non-significant effect on wheat yield and its components among them (Kivi *et al*., 2010 and Piekarczyk, 2010).

Maintaining soil fertility and use of plant nutrients in sufficient and balanced amounts is one of the key factors in increasing crop yield (Diacono *et al*., 2013) and added that, nitrogen is the largest agricultural input used by wheat farmers. They generally over apply it because they want to ensure enough nitrogen for crop requirements increase. Increasing and extruding the role of bio-fertilizer can reduce the need for chemical fertilizers and decrease adverse environmental effects. They can play significant role in fixing atmospheric N and production of plant growth promoting substances (Attia and Abd El Salam, 2016). Many studies had addressed the advantageous effects of bacterial inoculation on plant physiology and growth of wheat (Singh *et al*., 2018, Namli *et al.*, 2017 and Khalilzadeh *et al*., 2018). The inoculation with bio-fertilization had significant effect on plant height, grain weight spike^{-1}, number of spikes m^{-2}, number of grains spike^{-1}, 1000-grain weight, grain, straw and biological yields in wheat plants (Namvar and Khandan, 2013 as well as Karimi and Marashi, 2017). Inoculation with *Azospirillum ssp*. resulting in an increase the yield of many cereals in the field by up to 30%, but this increase is still associated with unpredictability and inconsistency which restricts its further development as a commercials inoculation on a large scale (Dobbelaere *et al*., 2002). Under Egyptian conditions, many investigations used *Azospirillum brasilense* under the commercials name Cerealin as a partial substitute for mineral fertilizers or for improving the resistance of some abiotic stresses in wheat and/or maize and they reported that, application of Cerealin combined with mineral fertilizers significantly increased most of growth, physiological character, NPK uptake as well as yield and yield components. On the other hand, they suggested we can save the mineral fertilizers about 20-30% by application of Cerealin along with mineral fertilizers (Ghallab and Salem, 2001; Abd El-Maksoud, 2002; Ibrahim *et al*., 2004; Shaban and Helmy, 2006; El-Garhi *et al*., 2007; Mahmoud, Abeer and Mohammed, Hanaa, 2008; Kabesh *et al*., 2009; El-Gizawy, 2009 as well as Atta and Amein, 2016).

The objective of this study was to elucidate the effect of seeding rates and mineral NPK fertilizers, inoculation of Cerealin and its interactions on yields of wheat and its attributes.

MATERIALS AND METHODS

Two field experiments were carried out during 2013/2014 and 2014/2015 winter seasons at Agric. Res. Sta., at Giza, Fac. Agric., Cairo Univ. to study the effect of two seeding rates, three mineral NPK fertilizer rates with or without Cerealin inoculation and their interactions on wheat grain and straw yields and its attributes. Grains of Seds 13 wheat variety were supplied from Field Crop Institute, Agricultural Research Center (ARC). Two seeding rates, i.e. 50 kg seed faddan^{-1}(~ 300 seed m^{2}) and 65 kg seeds faddan^{-1}(~ 390 seed m^{2}) were drilled manually in rows spaced 20 cm apart on 21th November, 24th November during the two successive seasons of study, respectively. *Azospirillum brasilense* carried on vermiculite (Cerealin) as bacterial fixing nitrogen was obtained from bio-fertilizers unit, General Organization of Agriculture Equalization Fund, ARC at Giza, Egypt. Cerealin was added at a rate of 600g faddan^{1}. Soil inoculation with Cerealin was done at sowing time immediately prior to irrigation.

The tested seven fertilizer treatments (kg faddan^{-1}) could be summarized as follow: T_1 (0 - 0 - 0 NPK), T_2 (50 - 30 - 24 NPK), T_3 (65 - 37.5 - 36 NPK), T_4 (80 - 45 - 48 NPK), T_5 (T_2 + Cerealin), T_6 (T_3 + Cerealin), and T_7 (T_4 + Cerealin). Nitrogen, phosphorus and potassium were applied in the form of ammonium nitrate (33.5% N), calcium superphosphate (15.5% P_2O_5) and potassium sulphate (48.5 % K_2O), respectively. Whole of phosphorus and potassium were applied basally during soil preparation but Nitrogen, was divided into two equal doses and top dressed before the first and second irrigation at 21 and 42 days age, respectively. The preceding summer crop was corn in both seasons. All other agronomic practices were kept normal.

The experiment was laid out in a randomized complete block design with split plot arrangement replicated thrice. Seeding rates were assigned to the main plots, while the tested seven fertilizer treatments were randomly distributed in the sub plots. Each plot contained 15 rows (20 cm apart, 3 m long). The experimental soil type was clay loam in both seasons. Mechanical and chemical properties of the experimental soil site during the two studied seasons are shown in Table 1.

Table 1. Mechanical and chemical properties of experimental site (30 depth) in 2013/2014 and 2014/2015 seasons

Character	Seasons	
	2013/2014	2014/2015
	Mechanical analysis	
Coarse sand (%)	6.0	6.1
Fine sand (%)	34	33
Silt (%)	20	20
Clay (%)	40	41
Soil type	Clay loam	Clay loam
	Chemical analysis	
Available N (kg/fed)	23.3	25.3
Available P (ppm)	1894	1988
Available K (ppm)	3300	3200
Organic matter (%)	1.1	1.9
PH	7.5	7.3
EC (m/mohs/cm)	0.9	0.8

At harvest, six square meter were taken from the middle area of each plot to determine: plant height, number of shoots m^{-2}, number of spikes m^{-2}, spike length (Mean of 10 spikes), number of grains spike^{-1}(Mean of 10 spikes), weight of spikes m^{-} (Mean of 10 spikes), 1000-grain weight, grain yield faddan^{-1}, straw yield faddan^{-1}, biological yield faddan^{-1} and harvest index (%). Data were subjected to analysis of variance according to Steel *et al.*, (1997). Treatment means were compared based on least significant difference (LSD) at probability level of 0.05. Finally, all statistical analysis was carried out using "MSTAT-C" program 1991.

RESULTS AND DISCUSSION

1. Effect of seeding rates

Results in Table 2 show the effect of seeding rates on wheat yields and its attributes during 2013/2014 and 2014/2015 seasons. Seeding rates had no - significant effect on plant height, grains weight spike^{-1}, 1000 grains weight, grain yield faddan^{-1} and biological yield faddan^{-1} in both seasons. Higher seeding rates (65 kg seeds faddan^{-1}) resulted in significant decrease in number of shoots m^{-2} in both seasons. However harvest index was significantly higher with increasing seeding rate from 50 to 65 kg seeds/faddan in 2014/2015 season only. Whereas, number of grains spike^{-1} significantly increased under the application of 65 kg/ faddan seeding rate. Reducing interplant competition related with lower number of shoots m^{-2} generally results in concomitant increases in number of grains spike^{-1}. In other contexts, there is a dynamic yield component compensation to balance among the yield components, which are competing for fixed resource during critical stages of development (Donaldson *et al.*, 2001 and Gooding *et* *al.*, 2002). Across a very wide range of seeds rates, the optimum seeding rate for wheat plant vary greatly from region to region according to climatic conditions, cropping system, weeds, soil, sowing time, winter or spring wheat and varieties. In this connection, Lioveras *et al.* (2004) mentioned that the recommended seeding rates in Belgium and Northern France is 200 seeds m^2 but, In USA the recommended seeding rates ranged from 67 seeds m^2 in dry land plains to 400 seeds m^2 in the eastern regions of the North America, with 200 seeds m^{-2} at the most widely recommended rate in many areas of the USA. This basic rate can be increased by 50% under irrigated cropping system. According to our results there are no differences between both plant densities, so we can recommend by lower stand density as an ideal stand for wheat. Because the risk of lodging and disease infection related to higher plant density also, the lower density would represent a decrease in input of wheat production as saving in seed costs. Kivi et al. (2010), Piekarczyk (2010) and Shemi (2016) reported that seeding rates had on effect on wheat yield and its components.

Table 2. Effect of seeding rates on wheat yields and its attributes in 2013/2014 and 2014/2015 seasons.

Characters	Seeding rates (Kg/fed.)					
	50	65	$LSD_{0.05}$	50	65	$LSD_{0.05}$
	2013/2014			2014/2015		
Plant height (cm)	68.45	68.43	ns	67.44	67.31	ns
No. of shoots m^{-2}	644.48	641.19	2.13	650.71	642.19	1.47
No. of spikes m^{-2}	643.29	640.00	ns	649.76	640.76	1.11
Spike length (cm)	9.49	9.63	ns	9.59	9.52	ns
No. of grains $spike^{-1}$	78.57	80.86	0.95	82.43	83.57	ns
Grains weight $spike^{-1}$(g)	2.07	2.01	ns	1.99	1.96	ns
1000-grains weight (g)	40.23	41.49	ns	41.22	41.59	ns
Grain yield $faddan^{-1}$ (ton)	3.49	3.46	ns	3.42	3.64	ns
Straw yield $faddan^{-1}$ (ton)	3.84	3.75	ns	3.87	3.53	0.15
Biological yield $faddan^{-1}$ (ton)	7.33	7.21	ns	7.30	7.17	ns
Harvest index (%)	47.62	47.99	ns	46.85	50.95	1.45

2. Effect of fertilizer treatments

The effect of mineral NPK, Cerealin and its combination treatments on wheat yields and its attributes during 2013/2014 and 2014/2015 seasons are presented in Table 3. Generally, results showed that except spike length all characters under study were significantly affected by the tested fertilizer treatments in both seasons. In 2013/2014 season, data revealed that the highest values of plant height, grain weight $spike^{-1}$ and yields (grain, straw and biological) $faddan^{-1}$ were obtained by treatment T6 (65 kg N + 37.5 kg P_2O_5 + 36 kg K_2O + Cerealin). However, the highest number of shoots and spikes m^{-2}, number of grains $spike^{-1}$ and 1000-grain weight were achieved with T_7.

In 2014/2015 season, the highest number of shoots and spikes per m^2 were achieved with T_7 (80 kg N + 45 kg P_2O_5 +48 kg K_2O + Cerealin). However, the highest values of plant height, number of grains , grains weight $spike^{-1}$, 1000-grain weight, yields $faddan^{-1}$ of grains, straw and biological were produced with application of T_6 (65 kg N + 37.5 kg P_2O_5 + 36 kg K_2O + Cerealin).

It can be concluded that bio-fertilizers in combination with NPK chemical fertilizer may increase availability and uptake of nutrient for wheat plants. The increment in yield and its components may be due to the increase in vegetative growth of plants and effects of bio-fertilizer on enhancing root growth and dry matter accumulation.

Ghallab and Salem, 2001and Ibrahim *et al*., 2004 as well as Atta and Amein, 2016 reported that the use of bio-fertilizers may have additional benefits such as nitrogen fixation and increasing the endogenous phytohormones i.e. Indole Acetic Acid (IAA), Gibberellins (GA_3) and Cytokines like substances (CKs) which plays an important role in formation a big active root system and hence, increasing water and nutrients uptake, photosynthesis rate and translocation. Results of Attia and Abd El- Salam, 2016 emphasized that bio-fertilization is not a substitute but a partial supplement or the recommended NPK mineral fertilizers which could be ascribed partially to the increased mobility of fixed nutrients like P in the soil or fixing more N which reflected directly on most growth and yield characters of wheat in sandy soils. were results are in harmony with previous findings of Namvar and Khandan, 2013; Namli *et al.* 2017; Karimi and Marashi, 2017; Khalilzadeh *et al*., 2018 and Singh *et al*., 2018.

3. Effect of the interaction

Data presented in Tables 4 and 5 indicated that the interaction between seeding rates and fertilizer treatments were significant on all studied characters in 2013/2014 and 2014/2015 seasons.

Regarding plant height the interaction between seeding rates and fertilizer treatments had a significant effect on plant high in both seasons (Table 4). The longest wheat plants were obtained when plant of wheat received 65 - 37.5 - 36 (NPK) + cerealin under seeding rate 50 kg $faddan^{-1}$.

In terms of number of shoots m^{-2} and number of spikes m^{-2} a significant differences between seeding rates and fertilizer treatments were observed in both seasons (Table 4). The highest number of shoots m^{-2} and number of spikes m^{-2} were recorded with the application of 80 - 45 - 48 (NPK) + cerealin under seeding rate 50 or 65 kg $faddan^{-1}$ without any significant differences between both seeding rates.

Table 3. Effect of chemical-bio fertilizers treatments on wheat yields and its attributes in 2013/2014 and 2014/2015 seasons.

Characters	Fertilizer treatments*							$LSD_{0.05}$
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	
	2013/2014 Season							
Plant height (cm)	66	67	68	69	69	71	69	1.10
No. of shoots m^{-2}	611	615	620	629	656	680	689	3.99
No. of spikes m^{-2}	609	614	619	629	654	678	688	3.35
Spike length (cm)	9.25	9.52	9.45	9.70	9.88	9.70	9.42	ns
No. of grains $spike^{-1}$	71.8	74.7	74.8	78.0	81.5	88.5	88.7	1.79
Grains weight $spike^{-1}$(g)	1.67	1.82	2.02	2.07	2.15	2.30	2.27	0.16
1000-grains weight (g)	37.3	39.4	39.1	40.9	42.6	42.9	43.7	1.05
Grain yield $faddan^{-1}$ (ton)	2.76	3.04	3.35	3.31	3.84	4.16	3.89	0.19
Straw yield $faddan^{-1}$ (ton)	3.00	3.62	3.74	4.40	4.04	3.98	3.80	0.35
Biological yield $faddan^{-1}$ (ton)	5.76	6.66	7.08	7.71	7.88	8.14	7.69	0.26
Harvest index (%)	47.9	45.7	47.4	42.9	48.7	51.3	50.7	3.34
	2014/2015 Season							
Plant height (cm)	65	65	67	67	68	71	71	1.42
No. of shoots m^{-2}	614	621	625	633	663	682	688	2.75
No. of spikes m^{-2}	612	620	624	633	661	680	687	2.08
Spike length (cm)	9.35	9.37	9.67	9.70	9.62	9.70	9.48	ns
No. of grains $spike^{-1}$	74.0	76.5	80.0	86.9	86.5	89.0	88.2	2.14
Grains weight $spike^{-1}$(g)	1.68	1.82	1.90	1.92	2.03	2.25	2.23	0.14
1000-grains weight (g)	38.9	40.1	40.9	41.1	42.8	44.3	41.8	1.73
Grain yield $faddan^{-1}$ (ton)	2.79	3.11	3.39	3.82	3.67	4.01	3.93	0.18
Straw yield $faddan^{-1}$ (ton)	2.71	3.33	3.71	3.95	3.88	4.24	4.12	0.28
Biological yield $faddan^{-1}$ (ton)	5.49	6.44	7.10	7.77	7.55	8.25	8.04	0.27
Harvest index (%)	50.8	48.6	47.9	49.2	48.7	48.7	48.9	2.71

*** T_1: 0 - 0 - 0 (NPK), T_2: 50 - 30 - 24 (NPK), T3: 65 - 37.5 - 36 (NPK), T_4: 80 - 45 - 48 (NPK), T5: T_2 + Cerealin, T_6: T_3 + Cerealin, and T_7: T_4 + Cerealin.**

With regarded to spike length, seeding rates and fertilizer treatments interaction had a significant effect on spike length in the first and second seasons (Table 4). The tallest spike of wheat was produced with the application of 80 - 45 - 48 (NPK) under seeding rate 50 kg $faddan^{-1}$ and 50 – 30 – 24 (NPK) + Cerealin under seeding rate 65 kg $faddan^{-1}$ in the first and second seasons, respectively.

Table 4. Effect of interaction between seeding rates and chemical-bio fertilizer combination treatments on some agronomic characters of wheat in 2013/2014 and 2014/2015 seasons.

Fertilizer* treatments kg $faddan^{-1}$	Seed Rates (Kg /fad.)	Plant height (cm)		No. of shoots m^{-2}		No. of spikes m^{-2}		Spike length (cm)		No. of grains $spike^{-1}$		Grains weight $spike^{-1}$(g)	
		1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
T_1	50	65.8 f	65.7 c	612.3gh	616.0h	611.0gh	615.3i	9.23 b	8.97d	71.0g	72.7g	1.70d	1.77ef
	65	67.0 ef	64.8 c	608.7h	611.7i	607.0h	610.0j	9.27 b	9.73abc	72.7fg	75.3efg	1.63d	1.60f
T_2	50	66.8 ef	65.0 c	616.0fg	622.7g	615.0fg	622.0h	9.60 ab	9.07cd	72.3fg	74.7ef	1.97c	1.93de
	65	67.3 def	65.5 c	614.7g	618.7h	613.7g	617.3i	9.43ab	9.67abcd	77.0cd	78.3e	1.67d	1.70f
T_3	50	68.2 cde	66.3 c	620.3f	624.3g	619.3f	623.7h	9.47ab	9.87ab	74.3ef	77.0ef	2.00bc	1.90de
	65	68.1cde	66.6 c	620.3f	625.0fg	619.3f	624.0h	9.43ab	9.47abcd	75.3de	83.0d	2.03bc	1.90de
T_4	50	68.8 cd	66.2 c	628.7e	638.0e	628.0e	637.3f	9.60ab	10.13a	77.3cd	88.3abc	2.07bc	1.93de
	65	68.2 cde	64.7 c	631.0e	628.7f	629.7e	627.7g	9.80ab	9.27bcd	78.7c	85.3cd	2.07bc	1.90de
T_5	50	69.0 c	66.6 c	665.7c	675.0c	664.7c	672.7d	9.60ab	9.87ab	78.7c	86.7abc	2.13abc	2.03cd
	65	68.1 cde	68.8 b	645.3d	650.7d	643.7d	650.0e	10.17a	9.37bcd	84.3b	86.3bc	2.17abc	2.03cd
T_6	50	71.5 a	71.4 a	679.7b	686.0b	677.7b	685.3b	9.73ab	9.70abc	88.0a	88.3abc	2.30a	2.23ab
	65	70.7 ab	70.6 ab	679.7b	677.0c	679.0b	674.3d	9.67ab	9.70abcd	89.0a	89.7a	2.30a	2.27ab
T_7	50	69.0 c	70.8ab	689.0a	693.0a	687.3a	692.0a	9.20b	9.53abcd	88.3a	89.3ab	2.33a	2.13bc
	65	69.6 bc	70.2 ab	688.7a	683.7b	687.7a	682.0c	9.63ab	9.43abcd	89.0a	87.0abc	2.20ab	2.33a
LSD 0.05		1.6	2.0	5.7	3.9	4.7	3.0	0.90	0.75	2.5	3.0	0.23	0.19

***T_1: 0 - 0 - 0 (NPK), T_2: 50 - 30 - 24 (NPK), T_3: 65 - 37.5 - 36 (NPK), T_4: 80 - 45 - 48 (NPK), T_5: T_2 + Cerealin, T_6: T_3 + Cerealin, and T_7: T_4 + Cerealin.**

With respect to number of grains $spike^{-1}$, there was a significant effect between seeding rates and fertilizer treatments interaction (Table 4). The highest number of grains $spike^{-1}$ resulted from the application of 65 - 37.5 - 36 (NPK) along with Cerealin without a significant difference between the highest and the lowest seeding rate.

For grains weight $spike^{-1}$, the interaction between seeding rates and fertilizer treatments had a significant effect on grains weight $spike^{-1}$ in both seasons (Table 4). The highest value of grains weights $spike^{-1}$ recorded when the plant of wheat received 80 - 45 - 48 (NPK) along with Cerealin under seeding rate 50 and 65kg/ faddan in 2013/2014 and 2014/2015, respectively.

Concerning 1000-grain weight, was significantly affected by the interaction between seeding rates and fertilizer treatments in both seasons (Table 5). The heaviest 1000-grains weigh were produced with T_6 and T_7 in 2013/2014 and 2014/2015, respectively without significant difference between two treatments in both seasons.

Regarding grain yield $faddan^{-1}$, a significant difference between seeding rate and fertilization treatments were observed in both seasons (Table 5). The highest value of grain yield faddan^{-1} was achieved when the plant of wheat received 65 - 37.5 - 36 (NPK) along with Cerealin under 65kg/faddan seeding rate.

With respect to straw yield faddan^{-1} and biological yield faddan^{-1}, there was a significant effect between seeding rate and fertilizer treatments in both seasons (Table 5). The highest yields of straw and biological yield faddan^{-1} produced under fertilizer treatment 65 - 37.5 - 36 (NPK) with 50 kg faddan^{-1} seeding rate.

With regarded to harvest index, the interaction between seeding rates and fertilizer treatments had a significant effect on harvest index in both seasons (Table 5). The highest percentage of harvest index recorded with 65 - 37.5 - 36 (NPK) along with Cerealin in 2013/2014 season and the same treatment alone in 2014/2015 season under 65 kg faddan^{-1} seeding rate in both seasons.

Table 5. Effect of interaction between seeding rates and chemical - bio fertilizer combination treatments on some agronomic characters of wheat in 2014/2014 and 2014/2015 seasons

Fertilizer Treatments*	Seed Rates (Kg /fad.)	1000-grains weight (g)		Grain yield fad.$^{-1}$ (ton)		Straw yield fad.$^{-1}$ (ton)		Biological yield fad^{-1} (ton)		Harvest index (%)	
		1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season	1st Season	2nd Season
T_1	50	37.17i	37.80e	2.76e	2.63f	3.07fg	2.73d	5.83f	5.36g	47.30bcd	49.17cd
	65	37.33hi	39.93de	2.75e	2.94e	2.94g	2.68d	5.69f	5.62g	48.37bcd	52.37abc
T_2	50	38.43ghi	39.67de	3.03d	2.96e	3.51ef	3.78b	6.54e	6.74e	46.43cd	43.93ef
	65	40.43de	40.50cd	3.04d	3.27d	3.73cde	2.87cd	6.77e	6.14f	44.97d	53.17ab
T_3	50	38.80fgh	40.37cd	3.35c	3.05de	4.03bcd	4.26a	7.39d	7.31d	45.40cd	41.73f
	65	39.47efg	41.43bcd	3.34c	3.74bc	3.44ef	3.16c	6.78e	6.90e	49.33bcd	54.20a
T_4	50	40.03ef	41.30bcd	3.56c	3.75bc	4.10bcd	3.97ab	7.66bcd	7.73c	46.50cd	48.57cd
	65	41.73cd	40.93bcd	3.06d	3.89ab	4.70a	3.92ab	7.75bc	7.81c	39.47e	49.83bcd
T_5	50	42.23c	42.97ab	3.84b	3.72bc	4.18bc	3.79b	8.02ab	7.50cd	48.00bcd	49.67bcd
	65	43.00bc	42.67abc	3.84b	3.61c	3.89bcde	3.98ab	7.74bcd	7.59cd	49.70abc	47.63de
T_6	50	42.20c	44.03a	4.02b	3.96ab	4.34ab	4.28a	8.36a	8.25ab	48.23bcd	48.03d
	65	43.73ab	44.50a	4.31a	4.07a	3.62de	4.19a	7.92b	8.26a	54.30a	49.30bcd
T_7	50	42.77bc	42.43abc	3.88b	3.91ab	3.67de	4.31a	7.55cd	8.21ab	51.50ab	47.57de
	65	44.70a	41.17bcd	3.90b	3.94ab	3.93bcde	3.93ab	7.83bc	7.87bc	49.80abc	50.13bcd
LSD 0.05		1.49	2.45	0.27	0.25	0.50	0.40	0.36	0.38	4.72	3.84

***T_1: 0 - 0 - 0 (NPK), T_2: 50 - 30 - 24 (NPK), T_3: 65- 37.5 - 36 (NPK), T_4: 80 - 45 - 48 (NPK), T_5: T_2 + Cerealin, T_6: T_3 + Cerealin, and T_7: T_4 + Cerealin.**

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تأثير بعض معاملات التسميد المعدنى والحيوى على محصول القمح ومكوناته تحت معدلين تقاوى

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أجريت تجربتان حقليتان خلال موسمى الزراعة ٢٠١٤/٢٠١٣ و ٢٠١٥/٢٠١٤ فى محطة التجارب والبحوث الزراعية بالجيزة ، كلية الزراعة ، جامعة القاهرة لدراسة تأثير معدلين تقاوى (٥٠ و ٦٥ كجم /فدان) و سبعة معدلات من الآسمدة المعدنية والحيوية على محصول الحبوب ومكوناته بيانها كالتالى :١ - بدون تسميد (معاملة مقارنة) ٢- ٥٠ كجم نيتروجين+ ٣٠ كجم فوسفور + ٢٤ كجم بوتاسيوم ٣-٦٥ كجم نيتروجين + ٣٧,٥ كجم فوسفور + ٣٦ كجم بوتاسيوم ٤- ٨٠ كجم نيتروجين + ٤٥ كجم فوسفور + ٤٨ كجم بوتاسيوم ٥-٥٠كجم نيتروجين + ٣٠ كجم فوسفور + ٢٤ كجم بوتاسيوم + سيريالين ٦- ٦٥ كجم نيتروجين + ٣٧,٥ كجم فوسفور + ٣٦ كجم بوتاسيوم + سيريالين ٧-٨٠ كجم نيتروجين + ٤٥ كجم فوسفور + ٤٨ كجم بوتاسيوم + سيريالينويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى: لم تظهر أية تأثيرات معنوية بين معدلى التقاوى على صفات طول النبات عند الحصاد وطول السنبلة ووزن الحبوب فى السنبلة وزن الآلف حبة ومحصول الحبوب ومحصول القش والمحصول البيولوجى ودليل الحصاد فى الموسم الأول ٢٠١٤/٢٠١٣ بينما فى الموسم الثانى ٢٠١٥/٢٠١٤ تأثرت صفات المحصول ومكوناته عدا صفة عدد الحبوب فى السنبلة ومحصول الحبوب للفدان لم تتأثرا بالتغير فى معدلا التقاوى. بصفة عامة كان لمعدلات التسميد المعدنى مع إضافة السماد الحيوى تأثيرا معنويا على صفات المحصول ومكوناته فى موسمى الدراسة ٢٠١٤/٢٠١٣ و ٢٠١٥/٢٠١٤ حيث أدت زيادة معدلات التسميد المعدنى مع إضافة السماد الحيوى "السريالين" إلى زيادة معنوية فى طول النبات وعدد الأفرع وعدد السنابل /م٢ وعدد حبوب السنبلة ووزن حبوب السنبلة ووزن الألف حبة ومحصول الحبوب ومحصول القش والمحصول البيووجى ودليل الحصاد. كان أفضل معدل تسميد هو ٦٥ كجم نيتروجين+ ٣٧,٥ كجم فوسفور + ٣٦ كجم بوتاسيوم + إضافة اللقاح البكتيرى سيريالين أعطى أعلى محصول حبوب وأعلى محصول قش وأعلى محصول بيولوجى للفدان فى كلا موسمى الدراسة مقارنة بباقى معدلات التسميد المعدنى و الحيوي. أثر التفاعل بين معدلا التقاوى ومعاملات التسميد المعدنى والحيوى على صفات المحصول ومكوناته خلال موسمى الدراسة. ويمكن الإستنتاج من هذه الدراسة أنه بزراعة الصنف سدس ١٣ بمعدل ٥٠ كجم /فدان وإضافة السماد المعدنى بمعدل ٦٥ كجم نيتروجين + ٣٧,٥ كجم فوسفور + ٣٦ كجم بوتاسيوم مع إضافة اللقاح البكتيرى سيريالين أمكن الحصول على أعلى محصول من الحبوب تحت ظروف التجربه.