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INTEGRATED USE OF MINERAL AND ORGANIC FERTILIZERS, GAMMA IRRADIATION AND MAGNETITE IMPACT ON WHEAT PRODUCTIVITY

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ABSTRACT

A field experiment was carried out in an Experimental field, Abu-Hammad District, Sharkia Governorate, Egypt, during two successive winter seasons (2012/2013 and 2013/2014) to study the impact of six fertilization regimes and seven treatments of gamma irradiation and their combinations with magnetite on grain and straw yields and their components of wheat cultivar “Misr 1”. The most important results could be summarized as follows: the application of F_1 [NPK (90 Kg N + 15.5 Kg P_2O_5 + 25 Kg K_2O)/fad.] and F_4 [Organic manure (3 tonnes compost /fad.) + ½ NPK] fertilization regimes resulted in the highest averages for all studied traits *i.e*. No. of grains/spike, grain weight/spike (g), 1000- grain weight (g), No. of spikes /m^2, grain yield (ardab/fad.) and straw yield (tonne /fad.). These results are in favour of F_4 fertilization regime, which reduced production costs and pollution in addition to sustaining soil fertility through the favourable effect of organic matter on the physical, chemical and biological properties of soil. With regard to gamma irradiation and magnetite effects, irradiated grains with 10 Gy gamma irradiation, produced the highest average for each of No. of grains/spike, grain weight/spike and No. of spikes/m^2, in addition to grain yield. Meanwhile, grain irradiation with gamma dose 20 Gy with 150 kg magnetite/fad., or without magnetite addition produced the highest straw yield. The interaction between the two studied factors did not reach the level of significance regarding grain and straw yields/fad., and their components during the two growing seasons and their combined data, therefore the addition of 3 tonnes compost/fad. + half of the recommended dose of NPK could be recommended to maximize yield and reduce environmental pollution.

Key words: Fertilization regimes, gamma irradiation, magnetite, wheat.

INTRODUCTION

Wheat (*Triticum aestivum*, L.) is one of the most important cereal crops in Egypt and over all the world. Wheat provides 37 % of the total human calories and 40 % of the protein in the Egyptian diet (Zaki *et al*., 2007). The total consumption of wheat in Egypt is estimated at about 13 million tonnes, while total wheat production hardly reached 9,460,200 tonnes (produced from harvested area of 3,376,525 fad., in 2012/2013 winter season (FAOSTAT, 2014). So, Egypt vitally needs sustained agricultural development to suit with the social and economic obligations that are the normal consequences of the continued high rates of population growth. This urgent need requires continuous scientifically based implementation of effective agricultural practices.

The use of mineral fertilizers has been doubled during the last two decades (EEAA, 1992). Thus the coincident application of organic manure is frequently recommended for improving biological, physical and chemical properties of soil and to get agriculture products with good quality and pollutants free. Under such conditions integrated use of mineral and organic fertilizers can play an important role to sustain soil fertility and crop productivity (Tandon, 1998; Lampe, 2000). Many authers studied the effect of integrated use of mineral

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and organic fertilizers on yield and yield attributes of wheat. While, the best results for number of grains/spike, 1000-grain weight, number of spikes/m^2 as well as grain and straw yields were obtained from adding 25% of recommended dose of bio-organic fertilizer (10 m^3 chicken manure and cerealine) + 75% of recommended dose of NPK *i.e.* 75kg N: 31 kg P_2O_5: 48 kg K_2O/fad., (Kabesh *et al*., 2009). Zeidan *et al.* (2009) found that nitrogen fertilization with or without addition of compost significantly affected number of grains/spike, grain weight /spike, 1000-grain weight, number of spikes/m^2 as well as grain and straw yields/fad. Raising nitrogen fertilizer level (with or without addition of compost) from 60 to 90 and up to120 kg N/fad, led to gradual increase in the abovementioned traits. On the contrary, Zaki *et al*. (2012) revealed that the addition of mineral and organic fertilizer at rate of 100% mineral fertilizer resulted in a significant increment in number of grains/spike, grain weight/spike, 1000-grain weight, number of spikes/ m^2 as well as grain and straw yields/fad.

Immense applications of gamma radiation in agriculture have been recommended for reducing post-harvest losses by suppressing sprouting and contamination, eradication or control of insect pests, reduction of food-borne diseases and extension of shelf life, and for breeding of high-performance well adapted and disease resistant agricultural crop varieties (Andress *et al*.,1994 ; Emovon, 1996). However, at low dose of gamma irradiation (less than 1 KGy), most research studies indicated no substantial change at genetic level (Dogbevi *et al*., 2000; Wu *et al*., 2002). Many works noticed the stimulated effect of low gamma irradiation doses on growth, yield and yield attributes of wheat such like (Sharabash *et al*., 1988; Arain *et al*., 1999; Singh and Datta, 2010 a and b). Meanwhile, Farag and El-Khawaga (2013) demonstrated that wheat grains irradiated with low dose of gamma radiation (10 Gy) surpassed the other two irradiation doses (20 and 30 Gy) in each of number of spikletes/spike, number of grains /spikelet, grain weight /spike, 1000- grain weight, number of spikes/m^2 as well as grain and straw yields/fad. Also, Grover and Sardar Khan (2014) revealed that irradiation treatment, in general, caused an improvement in grain yield.

Using magnetite (magnetic iron) is one of the most important factors affecting plant growth; magnetite is a natural row rock that has very high iron content, magnetite has a black or brownish-red, it has a hardness of about 6 on the Mohs hardness scale. It is one of the natural row rocks in the world that is naturally magnetic (Mansour, 2007). A few investigators studied the impact of magnetite on fruit, vegetable and field crops as well as the chemical properties and available nutrients of soils. On rosella plants, Ahmed *et al.,* (2011) noticed that the highest values of plant height, stem diameter, fresh and dry weight of leaves and branches/plant were obtained when magnetic iron was added to the soil compared to the control treatment. Moreover, Ramadan (2012) studied the effect of three magnetite levels (0,100 and 200 kg/fad.) on growth and yield of cabbage plants as well as the chemical properties and available nutrients of the soil. Results indicated that increasing magnetite levels led to increasing vegetative growth and chemical characteristics, *i.e*., N, P, K, Ca, S and Fe in leaves and heads. However, Na, Cl and Mg in leaves and heads were decreased with increasing magnetite levels. Also, there were gradual increments in EC and available N, P, K, Ca and Fe, meanwhile pH, Na, Cl and available of Mg in the soil were decreased with increasing the magnetite levels.

The aim of this investigation was to study the effect of integrated use of mineral and organic fertilizers, gamma irradiation and magnetite on yield and some wheat yield attributes.

MATERIALS AND METHODS

A field experiment was carried out in an experimental field, Abu-Hammad District, Sharkia Governorate, Egypt, during two successive winter seasons of (2012/ 2013) and (2013/ 2014) to study the effect of six fertilization regimes and seven treatments of gamma irradiation and their combinations with magnetite on grain and straw yields and their attributes of wheat cultivar “Misr 1”. Wheat was preceded by rice in both seasons. The experimental field soil was sandy clay and sandy loam in texture in the 1^{st} and the 2^{nd} seasons, respectively. Table 1 show the soil physical and chemical analyses of the experimental

Table 1. Soil physical and chemical analyses of the experimental site (30 cm depth)

Properties	2012/2013	2013/2014
Physical analysis		
Sand (%)	50.35	56.85
Silt (%)	9.05	25.25
Clay (%)	40.60	17.90
Texture class	Sandy clay	Sandy loam
Organic matter (%)	4.59	4.59
Chemical analysis		
pH	7.70	7.00
Ec (mmoh/cm)	2.90	2.40
Soluble cations and anions (meqi/100 g soil)		
Ca^{++}	0.50	0.83
Mg^{++}	0.92	0.66
Na^{+}	1.01	1.20
K^{+}	0.06	0.06
$Co_3^{=}$	Zero	Zero
Hco_3^{-}	1.00	0.38
Cl^{-}	0.55	0.69
$So_4^{=}$	0.92	1.68
Total nitrogen (%)	0.05	0.07
Available phosphorus (ppm)	31.25	34.72
Available potassium (ppm)	31.61	27.20

Source: Central laboratory, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

site. A split plot design with three replicates was used. Fertilization regimes were assigned to the main plots as follows:

F_1: Recommended dose of mineral fertilizers NPK (90 kg N+ 15.5 kg P_2O_5+ 25 kg K_2O)/fad.), F_2: Organic manure (3 tonnes compost /fad.), F_3: Mixed mineral ore (300 kg/fad.), F_4: Organic manure + ½ NPK (½ F_1), F_5: Mixed mineral ore + ½ NPK (½ F_1) and F_6: Organic manure + mixed mineral ore + ¼ NPK *i.e.* (F_2 + F_3+¼ F_1).

While gamma irradiation and its combinations with magnetite were randomly distributed in the sub plots as follows:

GM_1 = Control, GM_2= 10 Gy, GM_3= 20 Gy, GM_4 = 10 Gy + 75 kg magnetite/fad., GM_5=10 Gy + 150 kg magnetite / fad., GM_6 = 20 Gy + 75 kg magnetite/fad., and GM_7 = 20 Gy + 150 kg magnetite/fad., the sub plot area was 10.5m^2 (3×3.5 m), which included 15 rows, 20 cm apart.

Compost was used as organic fertilizer at the level of 3 tonnes/fad., Table 2 show the physical and chemical properties of the compost used in the two growing seasons. With regard to the mixed mineral ore, Table 3 show the chemical analysis for mixed mineral ore used. All P, K, compost and mixed mineral ore fertilizers were applied before sowing, while N fertilizer was applied in two splits, 40% at 1st irrigation and 60% at 2nd irrigation (30 and 60 days after sowing), respectively.

Table 2. Physical and chemical properties of the compost used in the two growing seasons

Properties	2012/2013	2013/2014
pH	8.54	7.12
EC (1-10 ds/m)	2.64	7.60
Organic matter (%)	30	18.08
C/N Ratio	18.31:1	18.39:1
Total nitrogen (%)	0.95	0.57
Total phosphorus (%)	0.35	0.03
Total potassium (%)	0.96	0.70

Source: Central laboratory, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Table 3. The chemical analysis for mixed mineral ore used

Item	Percentage (%)
SiO_2	38.56 - 40.15
TiO_2	0.76 - 0.85
Al_2O_3	7.80 - 7.55
Fe_2O_3	3.58 - 4.52
MnO	0.61 - 0.74
MgO	2.47 - 3.92
CaO	13.45 - 16.69
Na_2O	1.32 - 2.19
K_2O	3.97 - 4.51
P_2O_5	6.14 - 8.52
SO_3	5.38 - 6.28
L.O.I	7.01- 9.14

Source: El- Ahram company for mining and natural fertilizers (ECMNF), Giza, Egypt.

Pure dry grains of wheat cultivar "Misr 1" were irradiated with dose levels of 10 and 20 Gy in National Centre for Radiation Research and Technology (NCRRT), Naser City, Cairo, Egypt. Irradiation facility used was Indian Gamma Cell Research Irradiator (^{60}Co). Also, non-irradiated grains were used as a control treatment.

Magnetite (Magnetic iron ore), contained 48.8% Fe_3O_4, 17.3% Fe O, 26.7% Fe_2O_3, 2.6% MgO, 4.3% SiO_2 and 0.3% CaO, obtained from "El- Ahram company for mining and natural fertilizers" (ECMNF), Giza, Egypt. Magnetite was incorporated with soil before sowing.

Sowing took place on the 3rd week of November in the two seasons (2012/2013; 2013/ 2014) using seeding rate of 70 kg/fad., flood irrigation was monthly practiced and was withheld one month before harvest which was done during the last week of April in the both seasons.

Recorded Data

At harvest, ten guarded plants were randomly selected from each sub plot to estimate number of grains/spike, grain weight/spike (g) and 1000-grain weight (g).

At harvest, plants of one guarded square meter were harvested from each sub plot to estimate the following characters:

1. Number of spikes /m^2: number of fertile tillers/m^2 were calculated by counting all spikes per square meter.
2. Grain yield (ardab/fad.): determined from the harvested area of each sub plot in terms of kg/m^2 and converted to ardab/fad.
3. Straw yield (tonne /fad.): determined from the harvested area of each sub plot in terms of kg/m^2 and converted to tonne/fad.

The data obtained from each trial were subjected to the analysis of variance of split plot design using computer program MSTAT-C. (1989) as described by Snedecor and Cochran (1967). Then, a combined analysis was made for data of the two seasons. The differences among treatments were compared using Duncan's multiple range test (Duncan, 1955), where means denoted with the different letters are statistically significant. In the interaction tables, capital and small letters were used to compare between means in rows and columns, respectively.

RESULTS AND DISCUSSION

Number of Grains/Spike and Grain Weight/ Spike

Fertilization regime effect

The results in second season and combined analysis presented in Table 4 show highly significant differences among fertilization regimes on No. of grains/spike and grain weight/ spike (g). The combined analysis revealed that application any of F_1(recommended dose of mineral fertilizers NPK; 90 kg N+15.5 kg P_2O_5+ 25 kg K_2O/fad.), F_4(organic manure + ½ NPK), F_5 (mixed mineral ore+½ NPK) and F_6 (organic manure + mixed mineral ore+¼ NPK) produced significant increments in both of No. of grains/ spike and grain weight/spike (g) compared with F_2 and F_3 fertilization regimes, taking in care that the differences among F_1, F_4, F_5 and F_6 were insignificant. Meanwhile F_2 and F_3 fertilization regimes, *i.e.* sole application for each of organic manure and mixed mineral ore, respectively, had the lowest averages for the abovementioned traits. These results might be due to the well utilization of wheat plants to NPK elements and the role of nitrogen in delaying heading and increasing spike initiation period which increased No. of spikelets and grains/spike. These results are in harmony with those obtained by Zaki *et al.* (2012).

Gamma irradiation and magnetite effects

It is obvious from the second season and the combined analysis in Table 4 that the differences between GM_2 treatment (10 Gy) and the other treatments did not reach the level of significance except GM_7 (20 Gy + 150 kg magnetite/fad.) for No. of grains/spike, and GM_1 (control) as well as GM_7 (20 Gy + 150 kg magnetite/fad.) for grain weight/ spike (g) which produced the lowest averages. These results are in agreement with those obtained by Farag and El-Khawaga (2013).

Interaction effect

Data in Table 4-a show significant interaction effect between fertilization regimes and co-application of gamma irradiation and magnetite on grain weight/spike (g). It is clear from the obtained results that, the application of F_1 fertilization regime and irradiated grains with 10 Gy (GM_2) gave the highest grain weight/spike (g). Meanwhile, using F_2 and F_3 fertilization regimes with any gamma irradiation and magnetite treatment mostly gave the lowest grain weight/spike (g).

1000-Grain Weight (g) and Number of Spikes/m^2

Fertilization regime effect

Data presented in Table 5 show that the differences in 1000-grain weight among the six fertilization regimes were significant in the 2nd season only, while the differences regarding to No. of spikes/m^2 were significant in the first season

Table 4. Number of grains/spike and grain weight/spike (g) of wheat as affected by fertilization regimes and co-application of gamma irradiation and magnetite during (2012/2013) and (2013/2014) seasons and their combined data

Main effects and interaction	No. of grains/spike			Grain weight/spike (g)		
	2012/ 2013	2013/ 2014	Com.	2012/ 2013	2013/ 2014	Com.
Fertilization regimes (F)						
F_1: NPK (90 Kg N + 15.5 Kg P_2O_5 + 25 Kg K_2O) /fad.	58.78	53.08a	55.93a	2.72	2.39a	2.56a
F_2: Organic manure (3 Tonnes compost) /fad.	60.17	23.52c	41.85b	2.70	0.93c	1.82b
F_3: Mixed mineral ore (300 kg)/fad.	56.86	27.92c	42.39b	2.62	1.08c	1.85b
F_4: Organic manure + ½ NPK.	62.10	40.22b	51.16a	2.85	1.69b	2.27ab
F_5: Mixed mineral ore + ½ NPK.	56.86	41.87b	49.37ab	2.64	1.71b	2.18ab
F_6: Organic manure + Mixed mineral ore +¼ NPK.	60.33	42.95b	51.64a	2.79	1.76b	2.28ab
F. test	NS	**	**	NS	**	**
Gamma irradiation and Magnetite (GM)						
GM_1. Control.	58.60	37.62ab	48.11ab	2.69ab	1.48b	2.09b
GM_2. 10 Gy.	60.85	40.91a	50.88a	2.81a	1.71a	2.26a
GM_3. 20 Gy.	60.13	38.33ab	49.23ab	2.78ab	1.57b	2.18ab
GM_4. 10 Gy + 75 kg magnetite / fad.	59.16	38.96ab	49.06ab	2.72ab	1.67ab	2.20ab
GM_5. 10 Gy + 150 kg magnetite / fad.	59.68	37.81ab	48.75ab	2.73ab	1.57b	2.15ab
GM_6. 20 Gy + 75 kg magnetite / fad.	58.19	37.67ab	47.93ab	2.66b	1.61ab	2.14ab
GM_7. 20 Gy + 150 kg magnetite / fad.	57.68	36.52b	47.10b	2.65b	1.55b	2.10b
F. test	NS	*	*	*	*	**
Interaction						
F x GM	NS	NS	NS	NS	*	*

*, ** Indicate significant at 5% and 1% levels of probability NS = Not significant

Table 4-a. Wheat grain weight/spike (g) as affected by the interaction between fertilization regimes and co-application of gamma irradiation and magnetite (combined data)

Gamma irradiation and Magnetite	Fertilization regimes					
	F_1	**F_2**	**F_3**	**F_4**	**F_5**	**F_6**
	A	C	BC	B	AB	AB
GM_1	2.43 b	1.77 a	1.86 a	2.09 b	2.13 a	2.24 ab
	A	C	C	B	BC	AB
GM_2	2.76 a	1.81 a	1.92 a	2.37 ab	2.20 a	2.51 a
	A	C	C	AB	BC	BC
GM_3	2.57 ab	1.90 a	1.89 a	2.39 ab	2.11 a	2.20 ab
	A	C	C	B	B	B
GM_4	2.69 ab	1.79 a	1.87 a	2.33 ab	2.22 a	2.29 ab
	A	BC	C	B	AB	AB
GM_5	2.55 ab	1.87 a	1.80 a	2.13 ab	2.25 a	2.29 ab
	A	C	C	B	B	B
GM_6	2.64 ab	1.81 a	1.82 a	2.15 ab	2.22 a	2.18 b
	AB	C	BC	A	B	AB
GM_7	2.25 b	1.78 a	1.81 a	2.44 a	2.10 a	2.22 ab

Table 5. 1000-grain weight (g) and No. of spikes/m^2 of wheat as affected by fertilization regimes and co-application of gamma irradiation and magnetite during (2012/2013) and (2013/2014) seasons and their combined data

Main effects and interaction	1000-grain weight (g)			No. of spikes/m^2		
	2012/ 2013	2013/ 2014	Com.	2012/ 2013	2013/ 2014	Com.
Fertilization regimes (F)						
F_1: NPK (90 Kg N + 15.5 Kg P_2O_5 + 25 Kg K_2O)/fad.	46.08	44.93a	45.51	351.33a	355.71	353.52
F_2: Organic manure (3 Tonnes compost) /fad.	45.01	39.89ab	42.45	254.19b	381.05	317.62
F_3: Mixed mineral ore (300 kg)/fad.	46.01	39.02b	42.52	293.33ab	346.19	319.76
F_4: Organic manure + ½ NPK.	46.05	42.29ab	44.17	341.05a	417.33	379.19
F_5: Mixed mineral ore + ½ NPK.	46.14	40.93ab	43.54	316.86ab	340.14	328.50
F_6: Organic manure + Mixed mineral ore +¼ NPK.	45.75	41.24ab	43.50	294.19ab	353.15	323.67
F. test	NS	*	NS	*	NS	NS
Gamma irradiation and Magnetite (GM)						
GM_1. Control.	46.02	39.32b	42.67	301.66ab	342.00	321.83
GM_2. 10 Gy.	45.47	41.34ab	43.41	316.89ab	390.33	353.61
GM_3. 20 Gy.	46.27	41.06ab	43.67	315.78ab	365.72	340.75
GM_4. 10 Gy + 75 kg magnetite / fad.	46.00	42.67a	44.34	291.66b	375.88	333.77
GM_5. 10 Gy + 150 kg magnetite / fad.	45.89	40.70ab	43.30	287.77b	375.89	331.83
GM_6. 20 Gy + 75 kg magnetite / fad.	45.74	42.59a	44.17	307.23ab	342.77	325.00
GM_7. 20 Gy + 150 kg magnetite / fad.	45.49	42.01a	43.75	338.44a	366.56	352.50
F. test	NS	*	NS	*	NS	NS
Interaction						
F x GM	NS	NS	NS	NS	NS	NS

*, ** Indicate significant at 5% and 1% levels of probability NS = Not significant

only. Combined analysis of both pastmentioned traits exhibited insignificant response to the various fertilization regimes. It was paramount result to produce at par seed index and No. of spikes/m^2 under different fertilization regimes, because of the possibility of using fertilization regimes possess less pollution effect and low coast such as F_2: organic manure (3 tonnes compost /fad.)., F_3: mixed mineral ore (300 kg/fad.), F_4, F_5 and F_6. Contrary results were recorded by Kabesh *et al*. (2009), Zeidan *et al*. (2009) and Zaki *et al*. (2012).

Gamma irradiation and magnetite effects

Table 5 indicate that gamma irradiation and magnetite treatments did not differ significantly in both of 1000-grain weight (g) and No. of spikes/m^2 as shown in combined analysis data. The interaction between the two studied factors did not reach the level of significance respecting to 1000-grain weight (g) and No. of spikes/m^2.

Interaction effect

The interaction between factors under study regarding 1000-grain weight and No. of spikes/m^2 did not reach the level of significance in both seasons and their combined (Table 5).

Grain and Straw Yields

Fertilization regime effect

Data of combined analysis in Table 6 indicate highly significant differences among fertilization regimes for grain yield (ardab/fad.). F_4 fertilization regime gave the highest grain yield/fad. (16.77 ardab/fad.), without significant increase than F_1 fertilization regime, while F_2 and F_3 fertilization regimes produced the lowest grain yields. These results could be attributed to F_4 and F_1 fertilization regimes which had favourable effects on No. of grains /spike, grain weight /spike (g), 1000-grain weight (g) and No.

Table 6. Grain yield (ardab/fad.) and straw yield (tonne/fad.) of wheat as affected by fertilization regimes and co-application of gamma irradiation and magnetite during (2012/2013) and (2013/2014) seasons and their combined data.

Main effects and interaction	Grain yield (ardab† /fad.)			Straw yield (tonne/fad.)		
	2012/ 2013	2013/ 2014	Com.	2012/ 2013	2013/ 2014	Com.
Fertilization regimes (F)						
F_1: NPK (90 Kg N + 15.5 Kg P_2O_5 + 25 Kg K_2O)/fad.	20.96a	12.22ab	16.59a	5.73ab	2.69a	4.21
F_2: Organic manure (3 Tonnes compost) /fad.	14.86b	10.28b	12.57b	4.49b	2.33ab	3.41
F_3: Mixed mineral ore (300 kg)/fad.	16.64ab	9.04b	12.84b	5.30ab	2.04b	3.67
F_4: Organic manure + ½ NPK.	21.08a	12.46a	16.77a	6.15a	2.65ab	4.40
F_5: Mixed mineral ore + ½ NPK.	19.22ab	10.68ab	14.95ab	4.93ab	2.25b	3.59
F_6: Organic manure + Mixed mineral ore +¼ NPK.	18.81ab	10.71ab	14.76ab	5.19ab	2.27ab	3.73
F. test	*	*	**	*	*	NS
Gamma irradiation and Magnetite (GM)						
GM_1. Control.	18.48ab	10.74	14.61	5.56	2.28	3.92
GM_2. 10 Gy.	19.50ab	11.06	15.28	5.21	2.43	3.82
GM_3. 20 Gy.	18.74ab	10.80	14.77	5.69	2.35	4.02
GM_4. 10 Gy + 75 kg magnetite / fad.	18.06ab	11.32	14.69	5.01	2.43	3.72
GM_5. 10 Gy + 150 kg magnetite / fad.	17.36b	11.02	14.19	4.81	2.41	3.61
GM_6. 20 Gy + 75 kg magnetite / fad.	18.09ab	10.61	14.35	5.10	2.40	3.75
GM_7. 20 Gy + 150 kg magnetite / fad.	19.94a	10.72	15.33	5.73	2.31	4.02
F. test	*	NS	NS	NS	NS	NS
Interaction						
F x GM	NS	NS	NS	NS	NS	NS

* , ** Indicate significant at 5% and 1% levels of probability NS = Not significant † : Ardab = 150 kg.

of spikes/m^2. With regard to straw yield (tonne/ fad.), differences among fertilization regimes did not reach the level of significance (combined data). Moreover, F_4 fertilization regime tended to produce the highest value for straw yield (tonne/fad.) followed by F_1 fertilization regime. These results are in agreement with those obtained by Zaki *et al*. (2007).

Gamma irradiation and magnetite effects

Table 6 show that gamma irradiation and magnetite and their combinations had no significant effects on grain and straw yields/fad., that was true in second season and combined analysis for grain yield/fad., while the insignificant effects on straw yield were assured in both seasons and their combined analysis. On the other hand, Farag and El-Khawaga (2013) found that wheat grains irradiated with 10 Gy surpassed the other two irradiation doses (20 and 30 Gy) in grain and straw yields/fad.

Interaction Effect

The interaction between the two studied factors did not reach the level of significance regarding grain and straw yields/fad indicating that their main effects dominated their interactions as aforementioned regarding the two main grain yield components *i.e.* number of spikes/m^2 and No. of grains/ spike.

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تأثير الاستخدام المتكامل للأسمدة المعدنية والعضوية، الإشعاع الجامى والحديد المغناطيسى على إنتاجية القمح

عبدالله محمد السنطاوى - عبدالستار عبدالقادر حسن الخواجه
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أجريت تجربة حقلية بحقل تجريبى بمركز أبو حماد – محافظة الشرقية خلال الموسمين الشتويين (٢٠١٢/٢٠١٣)، (٢٠١٣/٢٠١٤) لدراسة تأثير ستة نظم سمادية وسبع معاملات للتشعيع بأشعة جاما وتوليفاتها مع الحديد المغناطيسى على محصولى الحبوب والقش ومكوناتهما لصنف القمح مصر ١، يمكن تلخيص أهم النتائج كما يلى: أنتج النظام السمادى الأول {إضافة الأسمدة الكيماوية الموصى بها (٩٠ كجم ن + ١٥.٥ كجم فو$_{٢}$أ$_{٥}$ + ٢٥ كجم بو$_{٢}$أ/ فدان)} والنظام السمادى الرابع {إضافة الأسمدة العضوية (٣ طن كمبوست/فدان + نصف كمية الأسمدة الكيماوية الموصى بها فى النظام السمادى الأول} أعلى القيم للصفات موضع الدراسة وهي: عدد حبوب السنبلة، وزن حبوب السنبلة (جم)، وزن الـ ١٠٠٠ حبة (جم)، محصول الحبوب (أردب /فدان) و محصول القش (طن/فدان)، وتظهر هذه النتائج أهمية إضافة النظام السمادى الرابع فى زيادة الإنتاجية، خفض تكاليف الإنتاج والتلوث والحفاظ على خصوبة التربة من خلال تأثير المادة العضوية على الخواص الطبيعية، الكيماوية والحيوية للتربة، ولقد حقق التشعيع بمستوى ١٠ جراى أعلى القيم لصفات عدد حبوب السنبلة، وزن حبوب السنبلة (جم)، عدد السنابل/م^{٢} ومحصول الحبوب (أردب/فدان)، بينما حقق التشعيع بمستوى ٢٠ جراى مع إضافة ١٥٠ كجم حديد مغناطيسى أو عدم الإضافة أعلى محصول للقش (طن/فدان). ولم يكن للتفاعل بين عاملى الدراسة تأثيراً معنوياً على محصولى الحبوب والقش/ فدان ومكوناتهما خلال موسمى الدراسة أو التحليل التجميعى لهما ومن ثم فإنه يمكن التوصية بإضافة الكمبوست (٣ طن/فدان) عند الزراعة بالإضافة إلى نصف الجرعة السمادية المعتاد التوصية بها وذلك لمعظمة المحصول مع الحد من التلوث البيئى المحتمل عند الاستخدام الكامل للأسمدة المعدنية بالمعدلات المشار إليها عالياً.

المحكمـــون:

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