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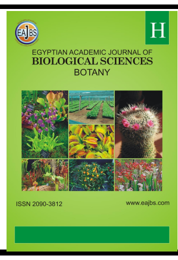

Response of Some Egyptian and Iraqi Wheat Cultivars to Mineral and NanFertilization

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ABSTRACT

Two field experiments were conducted at the Experimental Farm of Faculty of Agriculture (Saba- Basha), Abess Region, Alexandria University, Egypt, during two seasons of 2016/2017 and 2017/2018 to study the response of some wheat cultivars to mineral and nano-fertilization. The experimental design was split- split plot system with three replicates. The main plots were occupied by the three soil mineral fertilizer NPK treatments at the rate of “100, 75, and 50% .”While, sub-plots contain three foliar application of nanofertilizer NPK fertilizer treatments “100, 75 and 50%”. Meanwhile, the four wheat cultivars “Sakha 93, Gemmeiza 11, AL-Rasheed and Abu Ghareb” are distributed at random in sub- subplots. plant height, spike length (cm), number of spikes/m^2, number of spikelets /spike, number of grains/spike, 1000-grains weight (g), grain yield, straw yield (t/ha.), harvest index (HI %) and protein content were recorded in both seasons. The obtained results revealed that fertilized wheat cultivar Sakha 93 by 75 % soil application of mineral fertilization by NPK with foliar application of Nano- fertilizers (NPK) increased yield and its components of the wheat crop under the environmental conditions of Alexandria Governorate.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in the world. It is the main food for more than one-third of the world population; it contributes more calories and protein in the world diet than any other food crops. There is a need to increase wheat grain yield to enhance food security. The government in Egypt aimed to face the human needs. In this respect, it can be increased the wheat production by horizontal and vertical extension. Wheat cultivation in Egypt is about 1.3 million ha and the average yield of wheat reached about 6.6 t/ha. While, the cultivated area in Iraq is about 920 thousand ha

with an average yield about 3.3 t/ha. On the otherwise, the cultivated area in the World reached about 220.1 million ha with an average of 3.4 t/ha (FAO, 2016)

Conventional fertilizers are generally applied on the crops by either spraying or broadcasting. Excess utilizes of fertilizers decrease soil micro-flora lessens nitrogen-fixation. Subsequently, it is important to optimize the utilization of chemical fertilization to full fill the crop nutrient supplement and to reduce the risk of environmental pollution (Tilman *et al.* 2002). In this manner, it is necessary to test the other methods to provide the necessary nutrients for growth and yield of the crop, while keeping the soil structure in the great shape and environment clean (Miransari, 2011).

Use Nano-fertilizer for control of nutrient release could be considered as an effective way to achieving sustainable agriculture and environment. Nanotechnology has provided the feasibility of exploring the nanoscale or nanostructured materials as a fertilizer carrier or controlled - release vector for the building of the so-called smart fertilizers as new facilities to enhance the nutrient use efficiency and reduce the cost of environmental pollution (Chinnamuth and Boopati, 2009). A nano fertilizer alludes to a product in nanometer regime that delivers nutrient to the crops. For, example encapsulation, inside nanomaterials coated with a thin protective polymer film or in the form of particles or emulsions of nanoscale dimensions. Surface coating of nanomaterials on fertilizer particles hold the material more strongly due to the surface tension than the ordinary surfaces and in this way made a difference in the controlled release (Brady and Weil, 1999). Using nano- potash fertilizer as the source of potassium in rice, which resulted in an increasing number of grains/panicle. They conducted that wheat and corn with nano coating fertilizer and slow release of the same to crops has improved yield as well as effective recovery of N fertilizer (Subbarao *et al*., 2013).

An increase in yield due to foliar application of Nano particles640 mg/ha application of foliar application (40ppm concentration) of Nano phosphorus gave 80kg/ha P equivalent yield of Cluster bean and pearl millet under the arid environment (Tarafdar *et al*., 2014). Nano- fertilizers on the growth and yield of selected cereals observed that the full recommended rate of conventional dose Nano fertilizers (FRR-CF+FRR-NF) enhanced the plant height, chlorophyll content, number of reproductive tillers, panicles and spikelet’s in rice (Jyothi *et al.*, 2017). Significant increases in plant height, spikes number/m2, spikelets number/spike, grains number/spike, 1000- kernel weight, grain, straw, and biological yields/fed., as well as harvest index (%) using nano- fertilizer + amino acids during both growing seasons. Meanwhile, the applied mineral fertilizer, alone; gave the lowest mean values of the studied traits. However, “Sids 12” cultivar recorded the highest means values of the studied characters. Spray “Sids 12” cultivar by nano- fertilizer and amino acids; recorded the highest mean values of yield and its components. On the other hand, “Giza 168” cultivar, possessed the lowest ones (Kandil and Marie 2017).

The objective of this investigation is to estimate some wheat cultivars productivity under the effect of mineral and nano-fertilization.

MATERIALS AND METHODS

Two experiments were carried out at the Experimental Farm of Faculty of Agriculture (Saba Basha), Abess Region, Alexandria University, Egypt, during two seasons of 2016/2017 and 2017/2018. This study aimed to investigate the response of four wheat cultivar to mineral and nano- fertilization.

The preceding crop was maize in the two growing seasons. Soil samples of the experimental sites were taken at the depth of (0-30 cm). Physical and chemical analysis are presented in Table (1) and were determined according to the method described by Chapman and Pratt (1978).

Table 1. Some physical and chemical properties of the experimental soil in 2016/2017 and 2017/2018 seasons

Soil properties	Season	
	2016/2017	2017/2018
A) Mechanical analysis:		
Clay %	39.0	38.0
Silt %	32.0	34.0
Sand %	29.0	28.0
Soil texture	Clay loam soil	
B) Chemical properties		
PH (1 : 1)	8.20	8.31
E.C. (ds/m)	3.60	3.70
1) Soluble cations (1:2) (cmol/ kg soil)		
K^+	1.52	1.54
Ca^{++}	9.40	8.70
Mg^{++}	15.00	15.60
Na^{++}	10.50	11.00
2) Soluble anions (1 : 2) (cmol/ kg soil)		
CO_3^{--}+ HCO_3^-	5.20	5.30
Cl^-	18.00	19.00
SO_4^{--}	13.50	12.50
Calcium carbonate (%)	6.50	7.00
Total nitrogen %	1.00	0.91
Available phosphorus (mg/ kg)	3.70	3.55
Organic matter (%)	1.41	1.40

Each experimental design was a split-split plot design with three replicates, the main plots contain three Soil mineral NPK fertilizer treatments “100, 75, and 50%) form the recommended rates. While, sub-plots contain three foliar application of nanofertilizer NPK fertilizer treatments (100, 75 and 50%) form the recommended rates. Meanwhile, the four wheat cultivars “Sakha 93, Gemmeiza 11, AL-Rasheed and Abu Ghareb are distributed at random within the sub- subplots.

Treatments (100, 75 and 50 %) of mineral Nitrogen fertilizer at the rate of 168, 126 and 84 kg N/ha., was added in two doses. The first dose (1/3 of dose from N/ha.) was added with the first irrigation (25 days after sowing), the second dose (2/3 of dose N/ha.) was added with the second irrigation (25 days after the first dose). In the two experiments N- fertilizer was added on the form of urea (46.5 % N). Super phosphate fertilizer (100, 75 and 50%) was applied before sowing at the rates of 60, 45 and 30 kg P_2O_5/ha. Potassium fertilizer treatments (100, 75 and 50 %) were applied before sowing (during seedbed preparation) at rate of 60, 45 and 30 kg K_2O/ha. (100%) in the form of potassium sulphate (48 % K_2O). Foliar application of Nano- fertilizer for NPK was sprayed two times at the rate of (5 kg/ha.).

Each subplot size was 10.50 m^2 (3 m in length and 3.5 m in width). The grains of the tested two Egyptian and two Iraqi wheat cultivars were obtained from wheat Research Section of Agriculture Research Center, Ministry of Agriculture in Egypt and Iraq, respectively.

Sowing dates were $10^{th}$and 5^{th} November in both seasons, respectively, while, seeding rate was 168 kg grains/ha., first irrigation was applied at 25 days after sowing and then plants were irrigated every 25 days till the dough stage.

Table (2). Structure of nano fertilizer (as the foliar application)

Element	Compound name (nano- fertilizer)	
	Potacrystal	Phospho one
K_2O	36 %	28 %
P_2O_5	2 %	40 %
Amino acids	5 %	5 %
Seaweed extracts	-	2 %
Vitamins	1%	1%
Total nitrogen	5%	5%
Micronutrients (Br, Zn, Mn, Co, and Mo)	2%	-

Recorded data include plant height, spike length (cm), number of spikes/m^2, number of spikelets /spike, number of grains/spike, 1000-grains weight (g), grain yield, straw yield (t/ha.), harvest index (HI %) and protein content.

All collected data were subjected to analysis of variance according to **Gomez and Gomez (1984).** All statistical analysis was performed using analysis of variance technique by means of CoStat computer software package **(CoStat, Ver. 6.311., 2005).** The least significant differences (LSD at 0.05) were used to compare the treatment means.

RESULTS AND DISCUSSION

The data in Table (3) reveals the effect of soil application of mineral fertilization (NPK) and foliar application of Nano- fertilizer and their interaction during 2016/2017 and 2017/2018 seasons on plant height (cm), number of spikes/m^2, number of grains/spike and 1000- grain weight (gm) for four wheat cultivars.

The results are shown in Table (3) indicated that the rate (100 %) produced significantly highest values of plant height (84.9 and 95.1cm), number of spikes/m^2 (247.6 and 317.9 spikes), number of grains/spike (61.2 and 62.1 grains) and 1000- grain weight (52.4 and 51.4 gm) in both seasons, respectively. While the lowest ones for plant height (83.9 and 93.9 cm), number of spikes/m^2 (207.4 and 247.3 spikes), number of grains/spike (51.8 and 54.3grains) and 1000- grain weight (54.3 and 46.8 gm) was resulted from 50 % mineral fertilizer in the first and second seasons, respectively**.**

In addition, 75 % nano- fertilizer (NPK) gave the highest values of plant height (89.8 and 100.1 cm), number of spikes/m^2 (252.5 and 305.1 spikes), number of grains/spike (55.7 and 56.7 grains) and 1000- grain weight (50.0 and 49.8 gm) in both seasons, respectively. Meanwhile, the lowest ones for plant height (83.3 and 92.9 cm), number of spikes/m^2 (211.9 and 262.3 spikes), number of grains/spike (55.1 and 56.0 grains) and 1000- grain weight (48.0 and 47.9 gm) was resulted from 50 % mineral fertilizer in the first and second seasons, respectively as shown in (Table 3). Foliar application of micronutrients achieved the significant effect on yield and protein content. They are needed in trace amounts, but their adequate supply improves nutrients availability and positively affects the cell physiological that is reflected in yield (Toyama *et al*., 2001). These results are in agreement with those reported by Subbarao *et al*. (2013); Tarafdar *et al*. (2014); Kandil and Marie (2017) who indicated that using nano- fertilizer increased growth of wheat.

Table (3) indicated that wheat cultivar Sids 12 gave the highest plant height (87.6 and 97.5 cm), number of spikes/m^2 (233.2 and 286.7 spikes), number of grains/spike (57.1 and 58.6 grains) and 1000- grain weight (50.9 and 50.3 gm) in both seasons, respectively. On the other hand, AL-Rasheed cultivar recorded the lowest plant height (83.5 and 92.1 cm), number of spikes/m^2 (227.0 and 278.6 spikes), while Abu- Ghraib cultivar recorded the lowest number of grains/spike (54.1 and 56.6 grains) and 1000- grain weight (45.2 and 45.1 gm) in the first and second seasons, respectively. These differences between wheat cultivars may be due to genetic differences makeup between the three cultivars. Raza *et al.* (2012); Al-Temimi *et al.* (2013); Bakry *et al.* (2013) found highly significant differences between wheat cultivars under their studies for yield and its components.

The first and second order of the interaction were shown in Table (3), as significant or not significant at LSD at 0.05 in both seasons.

Table 3. Plant attributes for four wheat cultivars as affected by the application of soil mineral, foliar nano-fertilizers and their interaction during 2016/2017 and 2017/2018 seasons

Treatments	Plant height (cm)		Number of spikes/m^2		Number of grains/spike		1000- grain weight (gm)	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
Minearl								
100 %	89.1 a	97.2 a	247.6 a	317.9 a	61.2 a	62.1 a	52.4 a	51.4 a
75 %	84.9 b	95.1 b	234.9 b	279.3 b	53.9 b	54.7 b	47.3 b	48.0 b
50 %	83.9 b	93.9 b	207.4 c	247.3 c	51.8 c	54.3 c	46.8b	46.3 b
Nan								
100 %	84.8 b	93.2 b	225.5 b	277.3 b	56.0 a	58.4 a	48.4 b	48.1 b
75 %	89.8 a	100.1 a	252.5 a	305.1 a	55.7 a	56.7 a	50.0 a	49.8 a
50 %	83.3 b	92.9 b	211.9 c	262.3 c	55.1 b	56.0 b	48.0 b	47.9 b
Sids 12	87.6 a	97.5 a	233.2 a	286.7 a	57.1 a	58.6 a	50.9 a	50.3 a
Gemmeiza 11	86.1 a	96.0 a	227.0 b	278.6 b	57.0 a	57.3 a	50.5 a	50.1 a
Al-Rasheed	83.5 b	92.1 b	229.5 b	279.7 b	54.3 b	55.7 b	48.6 b	48.7 b
Abu-Ghraib	86.6 a	96.1 a	233.2 b	281.2 b	54.1 b	56.6 b	45.2 c	45.1 c
A x B	*	*	*	*	*	*	*	*
A x C	ns	ns	*	*	ns	ns	*	*
B x C	ns	ns	*	*	*	ns	*	*
A x B x C	*	*	*	ns	ns	ns	*	*

Means of each factor designated by the same letter are not significantly different at 5% using least significant difference (L.S.D.) ns: Not Significant *: Significant at 0.05 level of probability

The results in Table (4) revealed the effect of soil application of mineral fertilization (NPK) and foliar application of Nano- fertilizer on straw yield (t/ha), grain yield (t/ha), harvest index (HI %) and grain protein % for four wheat cultivars and their interaction during 2016/2017 and 2017/2018 seasons.

Table (4) cleared that the rate 100 % of soil application of mineral NPK produced significantly highest values of straw yield (7.6 and 7.5t/ha), grain yield (5.2 and 5.1t/ha), harvest index (42.6 and 40.5 %) and grain protein (9.8 and 10.1 %)in both seasons, respectively. While the lowest ones for straw yield (7.6 and 7.5 t/ha), grain yield (4.7 and 39.7 t/ha), harvest index (39.7 and 37.6 %) and grain protein (8.1 and 8.4 %)has resulted from 50 % mineral fertilizer in the first and second seasons, respectively**.** Soil application is the ideal method of nutrient supplement use different fertilizers. It could be needed attention when selecting method of fertilizer applications are how long the fertilizer will last in the soil, soil texture, soil salinity and plant sensitive, salt content and pH of the amendment. It is well known that the negative soil particles affect the adsorption of mineral nutrients. The anion exchange capacity of the most agricultural soils is small compared to exchange capacity. Phosphate ions bind to soil particles containing Al or iron because the positively charged Fe^{2+}, Fe^{3+} and Al^{3+} have OH^- group that exchange with phosphate. (Taiz and Zeiger, 2010).

In addition, foliar application of 100 % nano- fertilizer (NPK) gave the highest values of straw yield (7.5 and 7.4 t/ha), grain yield (5.4 and 5.3 t/ha), harvest index (42.1 and 39.5 %) and grain protein (9.9 and 10.1 %) in both seasons, respectively. Meanwhile the lowest ones for straw yield (7.2 and 7.0 t/ha), grain yield (4.9 and 4.8 t/ha), harvest index (40.4 and 38.0 %) and grain protein (8.3 and 8.6 %) was resulted from 50 % mineral fertilizer in the first and second seasons, respectively (Table 4). These results are in harmony with those reported by Subbarao *et al*. (2013); Jyothi *et al.*(2017); Kandil and Marie (2017) who indicated that using nano- fertilizer increased the growth of the crop.

The presented results are shown in Table (4) revealed that wheat cultivars have differed significantly on studied characters in both seasons. Whereas, the cultivar Sids 12 achieved the highest straw yield (7.5 and 7.3 t/ha), grain yield (5.3 and 5.2 t/ha), and harvest index (41.4 and 38.9 %) but Gemmeiza 11 gave highest grain protein (9.5 and 9.8 %)in both seasons, respectively. On the other hand, AL-Rasheed cultivar recorded the lowest straw yield (7.2 and 7.1 t/ha), grain yield (5.0 and 4.9 t/ha), harvest index (40.5 and 38.2 %) and grain protein (9.8 and 10.1 %), while Abu- Ghraib cultivar recorded the lowest straw yield (7.6 and 7.5 t/ha), grain yield (5.2 and 42.6 t/ha), and harvest index (42.6 and 40.5 %) but Al- Rasheed cultivar recorded the lowest value of grain protein (8.9 and 9.2 %) in the first and second seasons, respectively. These findings were in harmony with those obtained by these differences between wheat cultivars may be due to genetic differences make up between the three cultivars. Raza *et al.* (2012); Al-Temimi *et al.* (2013);Bakry *et al.* (2013) found highly significant differences between wheat cultivars under their studies for yield and its components.There were significant differences between the two varieties for most studied characteristics (Abd El-Ghany *et al*., 2013).

Foliar fertilizers sprayed directly on to leaves. It is used for the supply of trace elements. The foliar application can reduce the time lag between application and uptake by the plant during the rapid growth phase. It can also circumvent the problem of restricted uptake of a nutrient from the soil. Uptake of nutrients may be more efficient with this method as compared to soil application where they get absorbed on soil particles and hence are less available to the root system (Taiz and Zeiger, 2010)

The first and second order of the interaction were shown in Table (4), as significant or not significant at LSD at 0.05 in both seasons.

Table 4. Plant attributes for four wheat cultivars as affected by the application of soil mineral, foliar nano- fertilizers and their interaction during 2016/2017 and 2017/2018 seasons.

Treatments	Straw yield (t/ha.)		Grain yield (t/ha.)		Harvest index (%)		Grain protein %	
	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018	2016/2017	2017/2018
100 %	7.6 a	7.5 a	5.2 a	5.1 b	42.6 a	40.5 a	9.8 a	10.1 a
75 %	7.3 a	7.4 a	5.4 a	5.5 a	40.9 b	37.7 b	9.7 a	9.9 a
50 %	7.1 b	6.9 b	4.7 b	4.8 c	39.7 b	37.6 b	8.1 b	8.4 b
100 %	7.5 a	7.4 a	5.4 a	5.3 a	42.1 a	39.5 a	9.9 a	10.1 a
75 %	7.3 a	7.2 a	5.1 b	5.0 b	40.7 b	38.3 b	9.8 a	9.9 a
50 %	7.2 b	7.0 b	4.9 c	4.8 b	40.4 b	38.0 b	8.3 b	8.6 b
Sids 12	7.5 a	7.3 a	5.3 a	5.2 a	41.4 a	38.9 a	9.3 ab	9.6 ab
Gemmeiza 11	7.4 a	7.2 b	5.1 ab	5.1 a	40.9 a	38.5 a	9.5 a	9.8 a
AL-Rasheed	7.3 ab	7.2 b	5.1 ab	5.0 b	41.3 a	38.9 a	9.1 bc	9.4 bc
Abu-Ghraib	7.2 b	7.1 c	5.0 b	4.9 b	40.5 b	38.2 b	8.9 c	9.2 c
A x B	*	*	*	*	*	*	*	*
A x C	*	*	*	*	*	*	*	*
B x C	ns	ns	*	*	*	*	*	*
A x B x C	ns	ns	*	*	*	*	ns	ns

Means of each factor designated by the same letter are not significantly different at 5% using least significant difference (L.S.D.)

ns: Not Significant

*: Significant at 0.05 level of probability**.**

CONCLUSION

It was concluded from the present results that sowing wheat cultivar Sakha 93 with fertilizing 75 % as soil application of mineral fertilization by NPK with foliar application of Nano- fertilizers (NPK) which increased yield and its components of the wheat crop under Alexandria Governorate conditions.

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ARABIC SUMMARY

إستجابة بعض أصناف القمح المصرية والعراقية للتسميد المعدني والنانو

محمود عبد العزيز جمعة – فتحي ابراهيم رضوان – عصام إسماعيل إسماعيل قنديل – محمد عبد الحسين فياض المساري
قسم الإنتاج البناتي- كلية الزراعة (سابا باشا)- جامعة الأسكندرية

أجريت تجربتان حقليتان في مزرعة كلية الزراعة (سابا باشا) جامعة الإسكندرية خلال موسمي ٢٠١٧/٢٠١٦ ، و ٢٠١٨/٢٠١٧ لدراسة استجابة بعض أصناف القمح المصرية والعراقية للتسميد المعدني وأسمدة النانو.

استخدم تصميم القطع المنشقة مرتين في ثلاث مكررات ، حيث وزعت ثلاثة معدلات من المعدل الموصي به (١٠٠ ، ٧٥ ، ٥٠ %) من التسميد المعدني الأرضي (النتروجين والفوسفور والبوتاسيوم) في القطع الرئيسية ،ووزعت ثلاثة معدلات من المعدل الموصي به (١٠٠ ، ٧٥ ، ٥٠ %) من أسمدة النانو المحتوى من النتروجين والفوسفور والبوتاسيوم بالقطع الشقية الأولى ، و بينما وزعت الأربع أصناف من القمح (سخا ٩٣ ، جميزة ١١ ، الرشيد ، أبو غريب) بالقطع الشقية الثانية.

وكانت أهم الصفات المدروسة (ارتفاع النبات ، وعدد السنابل/م^{٢} ، وعدد الحبوب/سنبلة ، ووزن ١٠٠٠ جبة ، ومحصول الحبوب (طن/هكتار) ،ومحصول القش(طن/هكتار) ، ودليل الحصاد % ، ونسبة البروتين في الحبوب).

أوضحت النتائج مايلي:

١- أنه كان هناك تأثيراً معنوياً لعوامل الدراسة الثلاثة على صفات المحصول ومكوناته خلال موسمي الزراعة.

٢- تفوق التسميد المعدني الأرضي بمعدل ١٠٠% من الموصى عن إضافة ٧٥ % أو ٥٠ % في كل من ارتفاع النبات ، وعدد الحبوب في السنبلة ، ووزن الألف حبة ومعامل الحصاد ولم تصل الفروق بين ١٠٠ ، ٧٥% في صفات محصول القش ونسبة البروتين بالحبوب ومحصول الحبوب في الموسم الأول.

٣-تسميد القمح بمعدل ١٠٠% من الرش الورقي أسمدة النانو لنتروجيني والفوسفوري والبوتاسي أعلى محصول ومكوناته والحصول علي أفضل القيم لصفات محصول الحبوب ومعدل الحصاد بينما تفوق ٧٥% من معدل النمو في باقي الصفات تحت الدراسة.

٤-اختلفت الأربعة أصناف المصرية والعراقية اختلافا معنوياً فيما بينهم في صفات المحصول ومكوناته ، حيث حقق تفوقت الأصناف المصرية على الأصناف العراقية في محصول الحبوب ومعامل الحصاد ومحتوى البروتين ووزن الألف حبة وعدد الحبوب/السنبلة.

٥-كان التداخل معنوياً بين معاملات الأسمدة المعدنية والنانوية والأصناف ، حيث حقق تسميد الأصناف المصرية بمعدل١٠٠ ، ٧٥ % من السماد الأرضي النتروجيني والفوسفوري والبوتاسي مع الرش بسماد النانو أعلى محصول ومكوناته الحصول علي أفضل القيم للصفات التي تم دراستها.

يمكن التوصية بزراعة صنف القمح سخا ٩٣ مع أضافة الأرضية للسماد المعدني النتروجيني الفوسفوري والبوتاسي التسميد الورقي بسماد النانو النتروجيني والفوسفوري والبوتاسي حيث أن هذه التوليفة ذات تأثير معنوي على المحصول ومكوناته ومحتوي حبوب من البروتين تحت الظروف البيئية لمنطقة الدراسة.