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Productivity of Wheat As Affected by Chelated and Nano Zinc Foliar Application and Nitrogen Fertilizer Levels

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ABSTRACT

The most important feature of nanotechnology in the development process of agriculture is Nano fertilizers at the 1-100 nm nanometer scale. Where, the use of nano fertilizers instead of common fertilizers provides plants with nutrients progressively and in a regulated manner, the quality of application increases, contamination decreases and the risk of chemical fertilization decreases. Therefore, Two field studies have been carried out in a private field in Derwatine Village, Nabarouh Center, Governorate of Dakahlia, Egypt, during 2016/2017 and 2017/2018 Seasons to research the impact of foliar application of chelated and nano zinc (without, spraying with chelated zinc at the rate of 2 g/liter and nano zinc at the rate of 200, 400 and 600 mg/L), nitrogen levels (100, 80 and 60 % of the recommended dose *i.e.* 80, 64 and 48 kg N/fed, respectively) as well as their interaction on productivity of wheat Gemmiza 12 cultivar. The experiments were conducted with three replicates in a strip-plot configuration. Five zinc foliar application treatments were given to the vertical-plots. The horizontal-plots were allocated three nitrogen levels.

Keywords: Wheat, treatments for foliar spraying, chelated zinc, nano zinc,N-levels, efficiency.

INTRODUCTION

Wheat (Triticum aestivum L.) is the world's largest food source for human nutrition and the most widely grown crop with its specific protein characteristics and serves as an essential food and energy source (Abedi *et al.*, 2010). In addition to being useful as a livestock feed, it is easily processed into different forms of food such as pizza, macaroni, biscuit, and candy. In Egypt, in the 2018 season, With a planted area of around 3,196 * million fed, wheat was the largest winter cereal crop and overall production exceeded 8,800 million tones with an average of 18,36 ardab / fed (FAO, 2020). Production of wheat in Egypt is not adequate For consumption locally. Therefore, a great attempt has been made to improve the yield of wheat by either growing the field under cultivation or maximizing it.

In order to satisfy continuous demand and to reduce the gap between the output and consumption of wheat, yield per unit area through the use of suitable agronomic practises such as the application of zinc foliar as chelated or nano forms and levels of nitrogen fertiliser.

Zinc has a major impact on fundamental plant life processes, such as metabolism and uptake of nitrogen, protein quality, photosynthesis, chlorophyll synthesis, activity of carbon anhydrase, resistance to abiotic and biotic stresses, and protection against oxidative damage (Cakmak, 2008). Zinc also plays an important role in the production of biomass (Kaya and Higgs, 2002), pollen function and fertilization (Pandey *et al.*, 2006). Foliar nutrition is recognized as an essential fertilization tool among the fertilizer application methods, as foliar nutrients typically penetrate the leaf cuticle or stomata and reach the cells, facilitating simple and rapid nutrient utilization, growing photosynthetic pigments, wheat growth and yield (Kandoliya *et al.*, 2018).

Traditional farming methods use Zn sulphate (ZnSO4) or chelated EDTA-Zn for leaf and soil application. Foliar application of zinc greatly affects plant growth and crop production. In this concern, El-Habbasha *et al.* (2015) reported that Positive foliar application of Zn was positive for significant effect on wheat grain yield and its components. Sultana *et al.* (2016) Foliar application of zinc (zinc sulphate monohydrate, ZnSO4 H2O) at a rate of 0.04 percent has been shown to play a major role in the yield and yield components of wheat at the later growth stages. El-Dahshouri *et al.* (2017) It suggested that the yield and its wheat components were significantly affected by the application of zinc foliar and that, among other forms of fertilisation, the long-term application of zinc foliar had the most beneficial effects on grain yield. Doolittle *et al.* (2018) It concluded that the Zn fertilizers (Zn sulphate and Zn EDTA) used can be used to optimize current fertilization strategies and contribute to the production of more efficient Zn fertilizers for foliar use. Firdous *et al.* (2018) The effect of Zn application was shown to be important on the yields of grain and straw / ha, but had no effect on the length of the spike and the weight of a thousand grains. Khan *et al.* (2019) Maximum plant height, grain weight / spike, 1000-grain weight and grain yield / ha were reported to be registered with foliar zinc application (as a 25 g / L rate of zinc sulphate).

As a modern technology, nanotechnology has solved many difficult problems in various fields of science and industry and has found its place and role in agriculture.

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Plants easily ingest nano-compounds in large quantities, which can have harmful effects on plants and plant products. The highest yield per square metre was 60 g / ha for nano zinc oxide treatment and the lowest yield per square metre for control treatment without foliar zinc oxide. (Afshar *et al.*, 2014). Janmohammadi *et al.* (2016) A major improvement in spike length, grain weight / spike, grain number per spike and grain yield by nano-fertilizer application has been observed. Garcia-Gomez *et al.* (2017) It noted that the effects of ZnO NPs on plants derive from changes in the physical , chemical and biological characteristics and catalytic properties of the materials used as nano-fertilizers. Kandil and Marie (2017) Such substantial increases in plant height , number of spikes/m^2, number of spikes / spike, number of grains / spike, weight of 1000 grains, crop, straw yields / fed using nano-fertilizer + amino acids have been shown. Al-Juthery *et al.* (2018) It was shown that major reactions were observed while spraying wheat plants with Super Micro Plus nano-fertilizer as compared to control and traditional NPK fertilizer treatments in plant height, length of spike and grain yield. Kah *et al.* (2018) Foliar applications of nano-fertilizers have proven to be successful because, compared to traditional fertilisation, they supply nutrients to plants in a gradual and regulated way. Nano-fertilizer application often requires smaller amounts than traditional fertilizer application, as well.

Nitrogen is one of the key nutrients that, if not properly applied, decreases the yield of wheat as it is required for rapid plant growth and high production per unit area. All plant biochemical processes are regulated primarily by nitrogen and its associated compounds, which are important for wheat growth and development. (Kandil *et al.*, 2016 ; Litke *et al.*, 2017 ; Mosanaei *et al.*, 2017 ; Seadh *et al.*, 2017 ; Belete *et al.*, 2018 ; Imdad Ullah *et al.*, 2018 and Liu *et al.*, 2019). Therefore, one of the beneficial factors for growing wheat growth and productivity is the need to apply the required amount of nitrogen. (Ali *et al.*, 2000).

This investigation was therefore developed to determine the impact on growth and grain quality of Gemmiza 12 bread wheat cultivar under the conditions of Dakahlia Governorate , Egypt of zinc foliar application treatments (comparison between chelated and nano zinc forms), nitrogen fertiliser levels.

MATERIALS AND METHODS

During the 2016/2017 and 2017/2018 seasons, two field experiments were carried out in a private field in Derwatine Village, Nabarouh Center, Dakahlia Governorate, Egypt, to research the impact of zinc foliar application treatments (chelated and nano forms), nitrogen fertilizer levels on bread wheat Gemmiza 12 cultivar productivity.

The experiments were conducted with three replicates in a strip-plot configuration. Five zinc foliar application treatments were allocated to the vertical-plots *i.e.* without foliar application (control treatment), foliar application with solution of chelated zinc in the form of Zn-EDTA at the rate of 2 g/liter and foliar application with solution of nano zinc at the rate of 200, 400 and 600 mg/L in each spraying.

- **Synthesis of metal nanoparticles:**

The eco-friendly synthesis of zinc nanoparticles was carried out using the method mentioned by Pattanayak and Nayak (2013) and slightly modified by El-Refai *et al.* (2018). For both solutions, aqueous solutions of zinc sulphate and ascorbic acid were prepared using deionized water with three levels of concentration (200, 400 and 600 ppm).

Every ascorbic acid concentration (20 mL) was applied to the same metal salt solution concentration (20 mL) by To reduce very carefully to stop a rapid reaction causing greater particle size and the formation of precipitate at room temperature under stirring for 2 hours.

The resulting nanoparticles were synthesised according to an equimolar ratio of (1:1) Ibrahim *et al.*, (2019).

- **Nanoparticles characteristic *via* Transmission Electron Microscope (TEM):**

The size, shape , surface area, crystal structure and morphological data of the nanoparticles obtained were characterized by TEM (JEOL TEM-2100) transmission electron microscopy attached to a CCD camera with an acceleration voltage of 200 kV. Every sample of synthesised metal nanoparticles was prepared by suspending on copper-coated carbon grids, the sample and the solvent were able to slowly evaporate until the TEM images were captured. At the Central Laboratory, Electron Microscope Unit, Faculty of Agriculture, Mansoura University, Mansoura, Egypt, TEM measurements were registered.

- **Nanoparticles characteristic *via* Zeta potential:**

Zeta potential analysis is a technique that uses Malvern Instruments Ltd Zeta Potential Ver. 2.3 at the Central Laboratory, Electron Microscope Unit, Faculty of Agriculture, Mansoura University, Mansoura, Egypt, to assess the surface charge of nanoparticles in suspensions.

The volume of the foliar solution was 200 litres / fed and spraying was carried out twice after 35 and 50 days of sowing by hand sprayer (for experimental plots) until saturation point. At 0.02 percent concentration, Tween-20 was used as a wetting agent.

Three nitrogen fertilizer levels were allocated to the horizontal plots, i.e. 100, 80 and 60 percent of the prescribed dose (80, 64 and 48 kg N / fed, respectively). At the above amounts, the nitrogen fertilizer in the form of ammonium nitrate (33.5 percent N) was used as a transmitter in two equivalent doses prior to first and second irrigation.

Each experimental unit was 3 × 3.5 m occupying a 10.5 m2 field (*i.e.* 1/400 feddan). Rice (Oryza sativa L.) in both seasons was the previous summer crop.

Before soil preparation, To test the physical and chemical properties of the soil, soil samples were taken randomly from the experimental field area at a depth of 0-30 cm from the soil surface, as shown in Table 1.

Through two pouching's, Compaction, division and then, as previously described, divided into experimental units with dimensions, the experimental area was well prepared. During soil preparation (after deciding the experimental units) at a rate of 150 kg / fed, calcium super phosphate (15.5 % P2O5) was added.

Table 1. Physical and chemical soil characteristics at the experimental sites during 2016/2017 and 2017/2018 seasons.

Soil analyses		2016/2017	2017/2018
A: Mechanical analysis:			
Coarse sand (%)		3.77	3.72
Fine sand (%)		22.14	23.09
Silt (%)		44.74	43.68
Clay (%)		29.35	29.51
Texture class		Clay loam	Clay loam
B: Chemical analysis:			
E.C. ds. M^{-1} (1 : 5)		1.05	0.93
pH (1 : 2.5)		8.02	7.86
Organic matter (%)		1.55	1.65
S.P. (%)		62.10	62.30
T. $CaCO_3$ (%)		4.23	4.09
Available (mg/kg)	N	46.58	49.60
	P	5.42	5.91
	K	160.50	179.50
Extractable DTPA (ppm)	Zn	0.81	0.86
	Fe	3.01	3.05
	Mn	1.28	1.39

The cultivation took place on 10th and 15th November in the first and second seasons, respectively.

Using the broadcasting Afar process, wheat seeds at the rate of 75 kg / fed were sown. After 25 days of sowing, the first irrigation was applied, and then plants were irrigated every 21 days until the dough level. The potassium fertiliser in the form of potassium sulphate (48% K2O) at 24 kg K2O / fed was transmitted in one dose prior to the first irrigation treatment. Popular agricultural practises for growing wheat, with the exception of the factors under review, have been practised in compliance with the guidelines of the Ministry of Agriculture.

At harvesting, one square meter was randomly selected from each plot to estimate; Plant height (cm) on average of ten plants from the soil surface to the top of the main stem spike, number of spikes / m^2 by counting the number of active tillers per square meter, Spike length (cm) as the average of ten spikes from the base of the main spike to the tip, number of spikelet / spike as the average of ten spikes by counting the number of grains per spike, Amount of grains / spike by weighting whole grains of spike extracted as an average of ten spikes, grain weight / spike (g) by weighting whole grains of spike extracted as an average of ten spikes, 1000-grain weight (g) by weighting 1000 grains of each sample, grain yield / fed by harvesting whole plants in each plot and dry air, then threshed and weighed the grains at 13% moisture in kg and fed by harvesting whole plants in each plot In kg / plot, the sample was weighted, then translated to ton per feddan.

All data are statistically analysed for the strip-plot configuration according to the methodology of variance analysis (ANOVA) as published by Gomez and Gomez (1984) Using the machine programme kit "MSTAT-C".

The Least Significant Difference (LSD) approach was used to measure the variations between the means of treatment at a 5% likelihood level as defined by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1. Nanoparticles characteristic:

1. Nanoparticles characteristic *via* Transmission Electron Microscope (TEM):

Bio-reduced ascorbic acid zinc nanoparticles were characterised by TEM measurements to validate the existence of zinc nanoparticles in order to approximate the structure, aggregation and particle size of synthesised nanoparticles in compliance with TEM measurements. Ibrahim *et al.*, (2019). As shown in Fig. 1, For synthesised nanoparticles, TEM was performed at a (100 nm) magnification value.

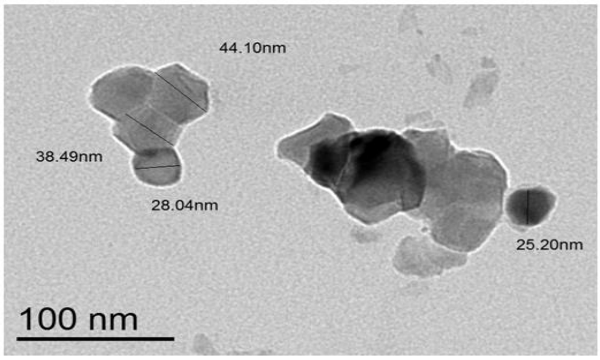

Fig. 1. Zinc nanoparticles shape, aggregation and particles size as characterized by Transmission Electron Microscope (TEM).

The particle size varies from 25.20 to 44.10 nm. For square aggregation, the shape of particles was spherical and fewer figures were tetragonal. Smaller particles produce more surface area, justifying more powerful reactions.

2. Nanoparticles characteristic *via* Zeta potential:

Zeta Potential is an important instrument to consider the condition of the surface of the nanoparticle and to forecast the nanoparticle's long-term stability. Nanoparticles provide a surface charge that pulls a thin layer of opposite-load ions to the surface of the nanoparticle, The Zeta Potential approach has been used to determine the surface charge of nanoparticles. The electrical potential at the boundary of the double layer is known as the Zeta potential of the particles and has values that usually range from +100 mV to -100 mV.

Nanoparticles have double layers of ion travel as it diffuses in the solution. Fig 2 Synthesized zinc nanoparticles using ascorbic acid have been shown to have a Zeta potential value of 0.307 mV, which is extremely stable since nanoparticles with Zeta potential values greater than -25 mV or less than +25 mV usually have high stability levels (Soheyla and Foruhe, 2013).

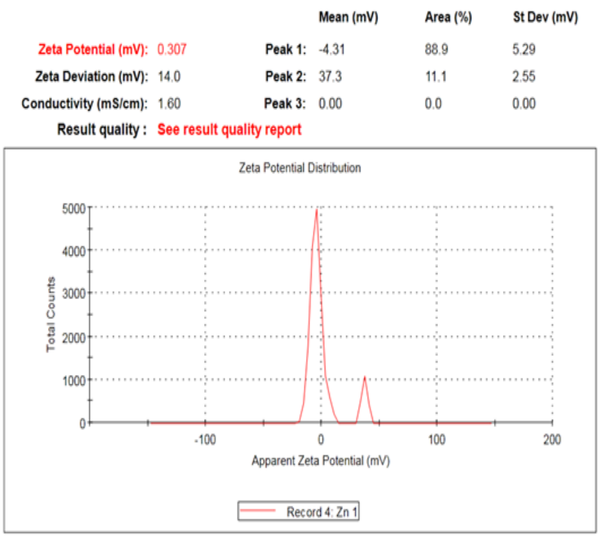

Fig. 2. Zeta potential of zinc nanoparticles .

2. Effect of zinc foliar application treatments:

With regard to the effect of treatment with zinc foliar application (foliar application with chelated zinc solution in the form of Zn-EDTA at a rate of 2 g / litre and foliar application with nano zinc solution at a rate of 200, 400 and 600 mg / L for each spray in additional control treatment , *i.e.* without zinc foliar application) on yield and its characteristics (plant height, number of spikes/m^2, spike length, number of spikelets/spike, number of grains/spike, grains weight/spike, 1000 – grain weight, grain and straw yields/fed), In the two rising seasons, it was necessary (Tables 2 and 3).

It is clear that from the data provided in Tables 2 and 3, the best transaction to increase yield and its characteristics was the foliar spraying of wheat plants twice (after 35 and 50 days after sowing) with nano zinc solution at a rate of 400 mg / L for each spraying, In the two rising seasons, the highest values of any of these characters were reported. Foliar pulverization of wheat plants twice also with nano-zinc solution at a rate of 600 mg / L for each spray, put secondly after the intermediate rate of nano-zinc (400 mg / L) with respect to its yield effect and its characteristics, Foliar spraying is accompanied twice with nano-zinc solution at a rate of 200 mg / L in each spray and then by foliar spraying twice with chelated zinc solution in the form of Zn-EDTA and at a rate of 2 g / litre of water in each spray during The first season and the second. by contrast, control treatment (without zinc foliar application) in both seasons gave the lowest yield values and their attributes.

Table 2. Plant height averages, number of spikes/m^2, spike length , number of spikelet's/ spike and number of grains / spike as influenced by foliar application treatments for zinc (Zn), levels of nitrogen fertilizer (as a combination of prescribed doses) and their association during the seasons of 2016/2017 and 2017/2018.

Characters	Plant height (cm)		Number of spikes/m^2		Spike length (cm)		Number of spikelets / spike		Number of grains / spike	
Treatments	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018
A- Zinc foliar application treatments:										
Without	97.9	100.8	205.8	220.3	11.09	11.95	12.93	13.75	50.33	52.51
Chelated-Zn	106.4	106.6	270.8	290.8	12.66	13.10	16.11	16.82	58.87	60.15
Nano-Zn (200 mg/L)	111.2	111.0	305.5	324.0	13.94	14.45	17.31	17.97	61.10	62.12
Nano-Zn (400 mg/L)	116.9	117.4	362.6	378.2	16.24	16.47	20.97	21.38	76.73	79.40
Nano-Zn (600 mg/L)	115.8	116.0	333.4	350.1	15.76	16.45	19.35	19.72	73.15	74.11
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	0.9	1.1	4.3	3.4	0.27	0.30	0.41	0.40	0.91	0.86
B- Nitrogen fertilizer levels (from recommended doses):										
100% (80 kg N/fed)	112.4	113.3	319.2	335.2	14.79	15.15	18.93	19.68	68.94	70.39
80% (64 kg N/fed)	110.1	110.2	292.6	310.0	13.98	14.53	17.22	17.74	63.76	65.30
60% (48 kg N/fed)	106.4	107.5	275.1	292.8	13.05	13.76	15.86	16.37	59.41	61.28
F. test	*	*	*	*	*	*	*	*	*	*
LSD at 5 %	1.0	1.3	4.5	3.8	0.25	0.20	0.54	0.62	1.04	1.16
C- Interaction (F. test):										
A × B	*	NS	*	*	NS	*	*	*	*	*

Table 3. Grain weight / spike averages, 1000-grain weight, grain and straw yields per feddan as influenced by treatments for zinc (Zn) foliar use, nitrogen fertiliser levels (as a ratio of prescribed doses) and their relationship during the seasons of 2016/2017 and 2017/2018.

Characters Treatments	Grains weight/spike (g)		1000 – grain weight (g)		Grain yield (ardab/fed)		Straw yield (t/fed)	
	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018	2016/ 2017	2017/ 2018
A- Zinc foliar application treatments:								
Without	3.242	3.367	59.74	61.36	11.51	12.49	1.074	1.251
Chelated-Zn	3.996	4.183	65.22	66.40	14.15	14.96	1.352	1.470
Nano-Zn (200 mg/L)	4.629	4.727	68.52	69.65	15.85	16.89	1.482	1.569
Nano-Zn (400 mg/L)	6.121	6.324	74.88	76.07	19.54	19.97	2.021	2.112
Nano-Zn (600 mg/L)	5.713	5.884	72.94	74.46	17.37	17.98	1.660	1.704
F. test	*	*	*	*	*	*	*	*
LSD at 5 %	0.131	0.145	0.73	0.68	0.31	0.34	0.046	0.052
B- Nitrogen fertilizer levels (from recommended doses):								
100% (80 kg N/fed)	5.273	5.475	72.31	73.36	17.15	17.82	1.745	1.847
80% (64 kg N/fed)	4.677	4.882	68.18	69.51	15.52	16.34	1.506	1.591
60% (48 kg N/fed)	4.271	4.335	64.29	65.90	14.38	15.22	1.303	1.426
F. test	*	*	*	*	*	*	*	*
LSD at 5 %	0.117	0.098	0.59	0.45	0.41	0.37	0.037	0.047
C- Interaction (F. test):								
A × B	*	*	*	*				

These results on grain yield per unit area of foliar application therapy with chelated or nano types of zinc may have been attributed to Chelated zinc plays an important role in plant processes such as nitrogen fixation, nitrogen and protein content uptake, photosynthesis, chlorophyll synthesis, activity of carbon anhydrase, resistance to abiotic and biotic stresses and protection against oxidative harm. (Cakmak, 2008). In addition, the application of zinc in nano form instead of the traditional form given to plants progressively and in a regulated manner improves the productivity of the application, lowers emissions and risks. (Naderi *et al.*, 2011). On the basis of the above, early growth improvement, More dry matter accumulation is induced and metabolic products are built, increasing yield per unit area thus. Such findings are partly consistent with those reported by Afshar *et al.* (2014), Janmohammadi *et al.* (2016), Kandil and Marie (2017) and Al-Juthery *et al.* (2018).

3. Effect of nitrogen fertilizer levels:

With relation to the impact of levels of nitrogen fertilizer *i.e.* 100, 80 and 60 % of the recommended dose (80, 64 and 48 kg N/fed) on yield and its attributes (plant height, number of spikes/m^2, spike length, number of spikelets/spike, number of grains/spike, grains weight/spike, 1000 – grain weight, grain and straw yields/fed), It is evident from the findings obtained that any raise in nitrogen fertilizer levels was followed by a substantial increase in all characteristics studied. (Tables 2 and 3).

Mineral wheat fertilization plants with the highest rate of nitrogen fertilizer (100 % of the recommended dose *i.e.* 80 kg N/fed) In the first and second seasons, the highest yield values and their attributes were given (Tables 2 and 3). However, with 80 percent of the prescribed dosage, mineral fertilizing wheat plants *i.e.* 64.0 kg N/fed In terms of its impact on yield and its attributes in the first and second seasons, it ranked second after the maximum level of nitrogen fertilizer levels. Whereas, with 60 percent of the prescribed dosage, mineral fertilizing wheat plants *i.e.* 48.0 kg N/fed provided the lowest values in the first and second seasons of both yields and their attributes.

The rise in grain yield due to increased levels of nitrogen fertilizer up to 80 kg N / fed can easily be attributed to nitrogen, which is known to be one of the key elements of plant nutrition and improves the vegetative cover for plants and forms long-spiked solid plants.

Furthermore, the low soil quality of usable nitrogen (Table 1) compensates for the use of nitrogen fertilisation. In addition, nitrogen stimulates the plant to consume other activating elements, thus improving growth measures and all yield components and grain yields per unit area. Such reports are in clear compliance with those of Kandil *et al.* (2016), Litke *et al.* (2017), Mosanaei *et al.* (2017), Seadh *et al.* (2017), Belete *et al.* (2018), Imdad Ullah *et al.* (2018) and Liu *et al.* (2019).

4. Effect of The interaction:

The findings of this research revealed that there was a major impact on plant height (in the first season), spike length (in the second season), and spike length (in the second season) due to the relationship between the two studied variables (zinc foliar application treatments and nitrogen fertilizer levels) As seen in Tables 2 and 3, number of spikes / m^2, number of spikelets / spike, number of grains / spike, grain weight / spike, 1000-grain weight, grain and straw yields / fed (in both seasons). In both seasons, we only discuss the essential grain and straw yield / fed relationship.

From the achieved results of this study, it could be noticed With 100% of the prescribed dosage, mineral fertilizing wheat plants *i.e.* 80 kg N/fed in addition foliar spraying two times (after 35 and 50 days from sowing) with solution of nano zinc at the intermediate rate (400 mg/L) in each spraying resulted in highest values of grain yield/fed (Fig. 3) and straw yield/fed (Fig. 4) in the first and second seasons. However, Mineral fertilizing wheat plants with 80 percent of the recommended dose (64.0 kg N / fed) were the second best contact procedure, as well as foliar spraying with nano-zinc solution at a rate of 400 mg / L in each spray, followed by mineral fertilizing wheat plants with 100 percent of the recommended dose, i.e. 80 kg N / fed and foliar spraying with nano-zinc solution at a rate of 80 percent of the recommended dose.

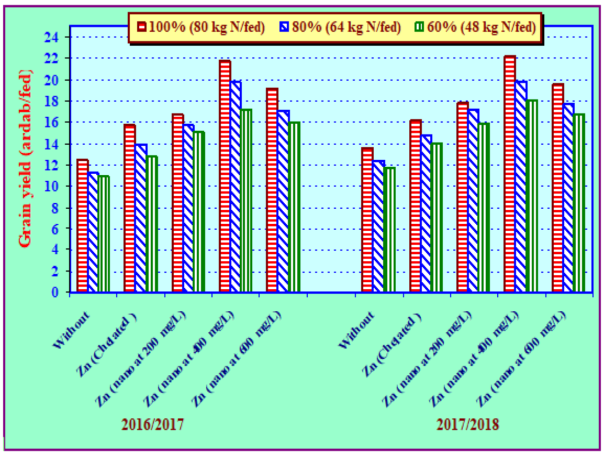

Fig. 3. Grain yield (ardab/fed) as affected by the interaction between zinc (Zn) foliar application treatments and nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

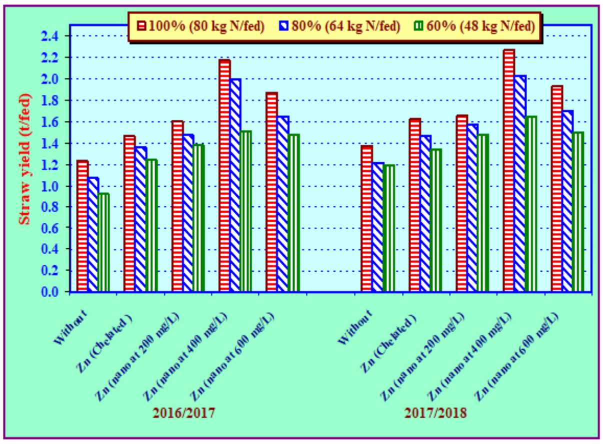

Fig. 4. Straw yield (t/fed) as affected by the interaction between zinc (Zn) foliar application treatments and nitrogen fertilizer levels during 2016/2017 and 2017/2018 seasons.

CONCLUSION

From the accomplished results of this study, it could be concluded that, in addition to mineral fertilization with 80 kg N / fed, the foliar spraying of Gemmiza 12 cultivar wheat twice after 35 and 50 days of sowing with nano zinc solution at a rate of 400 mg / L in each spray produces optimum productivity and efficiency. though retaining high productivity and grain quality though minimizing production costs and environmental emissions, foliar spraying twice with nano zinc solution at a rate of 400 mg / L could be recommended for each spray, in addition to mineral fertilization with 64 kg N / fed under the environmental conditions of Nabarouh Center, Dakahlia Governorate Egypt.

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تأثر إنتاجية القمح بالرش الورقي بالزنك المخلبي والنانو ومستويات السماد النيتروجيني

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أن استخدام الأسمدة النانوية بدلاً من الأسمدة التقليدية يوفر العناصر الغذائية للنبات تدريجياً وبطريقة متحكم فيها، علاوة على زيادة كفاءة التطبيق وتقليل التلوث ومخاطر التسميد الكيميائي، حيث تعد الأسمدة النانوية (من 1 إلى 100 نانومتر) أهم وظيفة لتقنية النانو في مجال الزراعة. لذلك ، تم إجراء تجربتين حقليتين بحقل خاص في قرية الدروتين ، مركز طلخا ، محافظة الدقهلية ، مصر ، خلال موسمي 2017/2016 و 2018/2017 لدراسة تأثير معاملات الرش الورقي بالزنك المخلبى والنانو وهى؛ الرش الورقي بمحلول الزنك المخلّبى على صورة (Zn-EDTA) بمعدل 2 جم / لتر والرش الورقي بمحلول النانو الزنك بمعدلات 200 ، 400 و 600 ملجم / لتر في كل رشة بالإضافة إلى معاملة المقارنة (بدون رش ورقى بالزنك) ومستويات السماد النيتروجيني وهى؛ 100 ، 80 و 60٪ من المعدل الموصى به (80 ، 64 و 48 كجم نيتروجين / فدان) وكذلك التفاعل بينهما على إنتاجية القمح صنف جميزة 12. نفذت كل تجربة في تصميم الشرائح المتعامدة في ثلاثة مكررات. اشتملت الشرائح الرأسية على معاملات للرش الورقي بالزنك المخلبي ومستويات من النانو زنك. أما الشرائح الأفقية فقد احتوت على مستويات من السماد النيتروجيني. أوضحت النتائج أن الرش الرقي لنباتات القمح مرتين (بعد 35 و 50 يومًا من الزراعة) بمحلول النانو زنك بمعدل 400 ملجم / لتر في كل رشة كان أفضل معاملة لزيادة المحصول ومكوناته والتي سجلت أعلى القيم لكل هذه الصفات في كلا موسمي النمو. كما جاء الرش الورقي لنباتات القمح مرتين أيضًا بمحلول النانو زنك بمعدل 600 ملجم / لتر في كل رشة فى المرتبة الثانية بعد المعدل المتوسط للنانو زنك (400 ملجم / لتر) فيما يتعلق بتأثيره على المحصول ومكوناته ، يليه الرش الورقي مرتين أيضًا بمحلول النانو زنك بمعدل 200 ملجم / لتر في كل رشة ثم الرش الورقي مرتين أيضًا بمحلول الزنك المخلّبى بمقدار 2 جم / لتر ماء عند كل رشة في الموسمين الأول والثاني. أدى التسميد المعدني لنباتات القمح بـ 100 % من المعدل الموصى به من النيتروجين (80 كجم نيتروجين / فدان) للحصول على أعلى القيم للمحصول ومكوناته في الموسمين الأول والثاني. أما نباتات القمح المُسَمّدة معدنيا بـ 80 ٪ من المعدل الموصى به (64 كجم نيتروجين / فدان) جاءت فى المرتبة الثانية بعد أعلى معدل من مستويات السماد النيتروجيني فيما يتعلق بتأثيرها على المحصول ومكوناته في الموسمين الأول والثاني. من نتائج هذه الدراسة يمكن استنتاج أن الرش الورقي لنباتات القمح صنف جميزة 12 مرتين الأولى بعد 35 و الثانية بعد 50 يوماً من الزراعة بمحلول النانو زنك بمعدل 400 ملجم / لتر في كل رشة بالإضافة إلى التسميد المعدني بـ 80 كجم نيتروجين / فدان أدى للحصول على أقصى إنتاجية. في حين أنه للحفاظ على إنتاجية عالية للحبوب وفي نفس الوقت تقليل تكاليف الإنتاج والتلوث البيئي ، يمكن التوصية بالرش الورقي مرتين بمحلول النانو زنك بمعدل 400 ملجم / لتر عند كل رشة بالإضافة إلى التسميد المعدني بـ 64 كجم نيتروجين / فدان تحت الظروف البيئية لمركز نبروه ، محافظة الدقهلية ، مصر.