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RESPONSE OF WHEAT TO FERTILIZATION TREATMENTS OF NITROGEN, AZOLLA AND MICRONUTRIENTS.

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ABSTRACT:

Two field experiments were conducted during both growing seasons of 1997/1998 and 1998/1999, at Meet Kenana, Kaluobia Governorate. The main objective of this work aims to identify the response of wheat parameters, i. e., growth, crop yield, different plant components and micronutrients uptake to the applied three rates of ammonium sulphate fertilizer (25, 50 and 75 kg N/fed), Azolla (0, 25 and 50 kg N/fed) and grain coating by micronutrients of Zn, Mn and Fe (0.30, 0.15 and 0.30 g/kg grain).

The data obtained indicated that a significant increase was occurred for all the studied parameters as a result of applying the nitrogen rates up to 75 kg N/fed. Also, all the studied parameters were significantly increased due to the applied Azolla up to 50 kg N/fed, except of grain yield, spike length and 1000 grain weight up to 25 kg N/fed. The treatment of grain coating by micronutrients showed a noticeable increment in all the studied parameters.

The highest grain yield and crude protein were obtained from the treatments of grain coating (75 kg N/fed) and Azolla (25 kg N/fed). While, the highest yields of both straw and micronutrients uptake were obtained from grain coating (75 kg N/fed) and Azolla (50 kg N/fed).

Key Words: Wheat, Nitrogen, Azolla, Meet Kenana soils and Micronutrients uptake in plants.

Wheat is considered the main source of food in the World as well as in Egypt. Raising of wheat production through increasing the productivity of land area unit and the cultivated area, which is the most important national target to minimize the gap between the Egyptian production and consumption. Increasing wheat yield per land area unit can be achieved by chosen the suitable forms and requirements of nitrogen and micronutrient fertilizers throughout plant development to maintain growth.

Nitrogen is one of the major nutrients for plant, it is true that wheat and other cereals in Egypt have a highly response to nitrogen fertilization to produce economic yield. Samir (1992) found that Sakha 69 cultivar received 75 kg of N produced the highest grain, biological and straw yield and other plant components during the successive two seasons. Eissa *et al* (1995) indicated that nitrogen as well as Zn, Mn, Fe and B concentrations in wheat grain were increased with applying N-rates up to 105 kg N/fed.

Azolla-Anabaena has many uses. It can be utilized as a biofertilizer for rice and many other crops. Mahapatra and Sharma (1989) found that the application of Azolla with Sesbania had a beneficial residual effect on subsequent wheat crops, raising grain yield by 56.69 % over controls. Azolla is also beneficial to wheat when applied in a rotating rice-wheat cropping system (Kolhe and Mittra, 1990).

The beneficial effect of micronutrients for plant are represented by their involvement in the redox processes, carbohydrate and nitrogen metabolism. The continuous application of NPK and the intensive agriculture in a limited area cause an imbalance among the available micronutrients in the Egyptian soils and their demands for growing crops. Ghaly et al (1992) showed that the favourable micronutrient balance was found to be 2:1:2 for Zn, Mn and Fe , respectively, where it produced high grain yield associated with high 100 grain weight and characterized by high protein content of wheat. Ibrahim and Shalaby (1994) found that seed coating and soaking with Zn and Cu application were the most effective methods for enhancing plant height, spike length, 1000 grain weight, straw and grain yield/fed of wheat.

The objective of this study is to investigate the response of growth, yield, different components and micronutrients uptake of wheat plants to nitrogen, Azolla and grain coating by micronutrients fertilizers.

MATERIALS AND METHODS:

Two field experiments were conducted at Meet Kenana, Kaluobia Governorate during the two seasons of 1997/1998 and 1998/1999 to study the response of growth, yield, its components and micronutrients uptake by wheat plants to the fertilization with nitrogen, Azolla and grain coating by micronutrients. Soil texture of the experimental site was clay loam, contained 1.49 % organic matter and 0.15 % total nitrogen. Soil pH was 7.9, available Zn, Fe and Mn were 0.86, 4.30 and 4.20 ppm, respectively.

Each experiment included eighteen treatments, representing the in combinations of the ammonium sulphate (20.6 % N, with rates of 25, 50 and 75 kg N/fed), Azolla (with rates of 0, 25 and 50 kg N/fed) and grain coating by micronutrients application (Zn, Mn and Fe at rates of 0.15, 0.30 and 0.30 g/kg grain, respectively, in forms of EDTA for Zn &Mn and EDDHA for Fe), in addition to the untreated one which was used as a control.

The treatments were arranged in split-split plot with four replicates, where the nitrogen rates were arranged at random in the main plots, whereas the Azolla rates were assigned at random in sub-plots and grain coating ones were occupied at random the sub-sub plots. Seeds of wheat variety Sakha 69 at a rate of 60 kg/fed were drilled in rows of 15 cm apart within plots of 3.0x3.5 m. Wheat cultivar was planted on 25 *th* and 27*th* November in the seasons of 1997/1998 and 1998/1999, respectively. Nitrogen was applied in a split application, one half was applied before the first irrigation and the rest before the second one. *Azolla Pinnate* was incorporated two weeks before seeding of wheat at rates of 0, 25 and 50 kg N/fed. The other recommended agronomic practices for wheat growing were applied as followed in the district.

At harvest, 10 plants were randomly taken from each plot to determine the plant height (cm), spike length (cm) and 1000 grain weight. Straw and grain yields were recorded on plot basis and used to estimate their corresponding values per feddan. Crude protein content was determined

according to the methods of A.O.A.C. (1980). Zinc, iron and manganese were determined by Atomic Absorption Spectrophotometric according to Chapman and Pratt (1961). Data and measurements for all studied parameters were recorded and statistically analyzed according to Snedecor and Cochran (1969). The significance differences among means were tested using the least significant difference (L.S.D.) test developed by Waller and Duncan (1969) at the 5% level of significance.

RESULTS AND DISCISSION:

Effect of nitrogen fertilizer:

The effect of nitrogen fertilizer on plant growth, yield, its components and micronutrients uptake are presented in Table (1). Data indicate that the values of plant height, spike length, 1000 grain weight, straw & grain yields, crude protein and nutrients uptake of Zn, Mn and Fe were significantly increased by increasing the rates of nitrogen fertilizer up to 75 kg N/fed. Increasing plant height rates may be attributed to the increment in inter-nodes length that results from the increase of protoplasm to cell wall material proportion and consequently an increase in cell size that manifested in inter-node elongation.

The increment of 1000 grain weight may be due to the increase of mineral uptake, the source capacity of photosynthesis assimilation in building metabolites, its translocation and accumulation in the sink, which increased nitrogen application under this rates. Similar results were recorded by Samir (1992), Eissa *et al* (1995) and Hassanein *et al* (1997).

Effect of Azolla:

The effect of Azolla on plant growth, yield, its components and micronutrients uptake are presented in Table (1). Data obtained showed a significant increment in plant height, crude protein and nutrients uptake of Zn, Mn and Fe by increasing rates of Azolla up to 50 kg N/fed, while there were a significant increment in spike length, 1000 grain weight and grain yield by increasing rates of Azolla up to 25 kg N/fed. These results are in agreement with those obtained by Mahapatra and Sharma (1989) and Kolhe and Mittra (1990).

Effect of grain coating by micronutrients:

Data in Table (1) indicated that the process of the grain coating by micronutrients (Zn, Mn and Fe) leads to a significant increase in plant height, spike length, 1000 grain weight, grain & straw yields, crude protein and nutrients uptake of Zn, Mn and Fe. The increments in these values were due to the application of the trace elements, which enhanced the plant grow well and improve transferring the photosynthesis substances from leaves to grains during synthesis processes because of their effects on the enzymatic group. These results are in harmony with those obtained by Ghaly *et al* (1992), Ghaly *et al* (1993) and Ibrahim and Shalaby (1994).

Table (1): Parameters of plant growth, crop yield, different components and micronutrients uptake as affected by grain coating and different rates of nitrogen and Azolla fertilizers (combined analysis of 1997/98 and 1998/99 seasons).

Rates	Plant height (cm)	Spike length (cm)	1000 grain weight (g)	Grain yield (ton/fed)	Straw yield (ton/fed)	Crude protein %	Nutrient uptake (mg/plant)		
							Zn	Fe	Mn
Ammonium sulphate (kg N/fed)									
25	108.5	9.66	43.9	2.13	4.80	12.3	9.11	47.6	3.74
50	115.5	9.76	46.2	2.52	5.89	13.8	12.43	61.4	5.42
75	120.5	9.86	49.4	2.82	6.66	14.4	14.36	71.4	6.96
L.S.D. 5%	0.90	0.02	0.50	0.08	0.14	0.04	0.85	0.40	0.07
Azolla (kg N/fed)									
0	110.3	9.63	45.0	2.29	5.20	12.7	9.47	51.1	4.02
25	114.8	9.76	47.2	2.57	5.83	13.7	12.12	60.4	5.51
50	119.2	9.79	47.3	2.62	6.32	14.0	14.31	69.0	6.63
L.S.D. 5%	0.50	0.03	0.50	0.07	0.09	0.09	0.59	0.50	0.04
Grain coating									
Un treated	113.2	9.70	45.4	2.38	5.66	13.14	9.17	44.2	4.45
Coating	116.3	9.75	47.6	2.61	5.90	13.79	14.77	76.1	6.32
L.S.D. 5%	0.80	0.03	0.30	0.03	0.11	0.06	0.50	0.30	0.06

Effect of interaction:

Data presented in Tables (2, 3, 4 and 5) showed the significant interaction effects among the three variables under study on yield and micronutrients uptake of wheat plants (combined data) by comparing the highest and the lowest values of each parameter.

Table (2): Effect of interaction among nitrogen fertilizer and Azolla on yield and micronutrients uptake of wheat plants (combined analysis).

Plant parameters	High value	Treatments	Low value	Treatments	L.S.D. 5%
Grain yield (ton/fed)	2.99	$N_3 \times A_2$	1.69	$N_1 \times A_1$	0.11
Straw yield (ton/fed)	6.90	$N_3 \times A_3$	3.97	$N_1 \times A_1$	0.16
Crude protein %	14.70	$N_3 \times A_2$	10.95	$N_1 \times A_1$	0.15
Uptake of Zn (mg/plant)	15.46	$N_3 \times A_3$	6.48	$N_1 \times A_1$	1.03
Uptake of Fe (mg/plant)	75.52	$N_3 \times A_3$	37.72	$N_1 \times A_1$	0.86
Uptake of Mn (mg/plant)	7.78	$N_3 \times A_3$	2.44	$N_1 \times A_1$	0.07

The data obtained in Table (2) evidenced that mineral nitrogen up to 75 kg N/fed and Azolla up to 50 kg N/fed showed a good results in most of the wheat parameters which showed the highest values, except of grain yield and crude protein associated with Azolla up to 25 kg N/fed. While the lowest values of grain and straw yield, crude protein and micronutrients uptake were obtained when mineral nitrogen was applied at a rate of 25 kg N/fed in absence of Azolla. Table (3) shows that wheat plants grown under mineral nitrogen up to 75 kg N/fed by grain coating gave the highest values for all the studied parameters. Whereas, the lowest ones were shown when wheat was grown under mineral nitrogen of 25 kg N/fed in absence of micronutrients.

Table (3): Effect of interaction among nitrogen fertilizer and grain coating by micronutrients on yield and micronutrients uptake of wheat plants (combined analysis).

Plant parameters	High value	Treatments	Low Value	Treatments	L.S.D. 5%
Grain yield (ton/fed)	2.88	$N_3 \times C_2$	1.96	$N_1 \times C_1$	0.05
Straw yield (ton/fed)	6.79	$N_3 \times C_2$	4.66	$N_1 \times C_1$	0.18
Crude protein %	14.70	$N_3 \times C_2$	11.90	$N_1 \times C_1$	0.11
Uptake of Zn (mg/plant)	17.20	$N_3 \times C_2$	6.53	$N_1 \times C_1$	0.81
Uptake of Fe (mg/plant)	88.70	$N_3 \times C_2$	33.46	$N_1 \times C_1$	0.45
Uptake of Mn (mg/plant)	7.94	$N_3 \times C_2$	2.72	$N_1 \times C_1$	0.10

N_1 = 25 kg N/fed N_2 = 50 kg N/fed N_3 = 75 kg N/fed
A_1 = Azolla 0 kg N/fed A_2 = Azolla 25 kg N/fed A_3 = Azolla 50 kg N/fed
C_1 = Untreated C_2 = Grain coating by micronutrients

Table (4): Effect of interaction among Azolla and grain coating by micronutrients on yield and micronutrients uptake of wheat plants (combined analysis).

Plant parameters	High value	Treatments	Low Value	Treatments	L.S.D. 5%
Grain yield (ton/fed)	2.70	$A_3 \times C_2$	2.15	$A_1 \times C_1$	0.05
Straw yield (ton/fed)	6.43	$A_3 \times C_2$	5.07	$A_1 \times C_1$	0.18
Crude protein %	14.30	$A_3 \times C_2$	12.30	$A_1 \times C_1$	0.11
Uptake of Zn (mg/plant)	17.67	$A_3 \times C_2$	7.19	$A_1 \times C_1$	0.81
Uptake of Fe (mg/plant)	86.48	$A_3 \times C_2$	36.60	$A_1 \times C_1$	0.45
Uptake of Mn (mg/plant)	7.44	$A_3 \times C_2$	2.99	$A_1 \times C_1$	0.10

Table (5): Effect of interaction among nitrogen fertilizer, Azolla and grain coating by micronutrients on yield and micronutrients uptake of wheat plants (combined analysis).

Plant parameters	High value	Treatments	Low Value	Treatments	L.S.D. 5%
Grain yield (ton/fed)	3.05	$N_3 \times A_2 \times C_2$	1.53	$N_1 \times A_1 \times C_1$	0.09
Straw yield (ton/fed)	6.98	$N_3 \times A_3 \times C_2$	3.84	$N_1 \times A_1 \times C_1$	0.32
Crude protein %	15.00	$N_3 \times A_2 \times C_2$	10.40	$N_1 \times A_1 \times C_1$	0.18
Uptake of Zn (mg/plant)	19.00	$N_3 \times A_3 \times C_2$	4.06	$N_1 \times A_1 \times C_1$	1.40
Uptake of Fe (mg/plant)	92.96	$N_3 \times A_3 \times C_2$	24.89	$N_1 \times A_1 \times C_1$	0.79
Uptake of Mn (mg/plant)	8.54	$N_3 \times A_3 \times C_2$	1.44	$N_1 \times A_1 \times C_1$	0.18

With respect to the interaction between Azolla and grain coating by micronutrients on grain & straw yields, crude protein and nutrients uptake of Zn, Fe and Mn, data in Table (4) revealed that grain coating had the best effect on their values by using Azolla up to 50 kg N/fed, while the untreated micronutrients had the lowest values under absence of Azolla treatment.

The second order of interaction effects among the mineral nitrogen, Azolla and grain coating by micronutrients on grain & straw yields, crude protein and nutrients uptake of Zn, Fe and Mn were significant as shown in Table (5). These parameters reached the highest values by nitrogen fertilizer up to 75 kg N/fed in combination with grain coating and Azolla up to 50 kg N/fed. It is worthy to mention that grain yield and crude protein exhibited the highest values with Azolla at the rate of 25 kg N/fed, the same parameters had the lowest values by nitrogen fertilizer at 25 kg N/fed in absence of Azolla and micronutrients.

ARABIC SUMMARY:

إستجابة القمح للتسميد النيتروجينى وألآزولا والعناصر الصغرى .

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أقيمت تجربتان حقليتان فى ميت كنانة محافظة القليوبية خلال موسمين متتالين (٩٧/٩٨ ، ٩٨/٩٩) لدراسة أثر إستجابة القمح (صنف سخا ٦٩) للتسميد النيتروجينى بمعدلات مختلفة (٢٥، ٥٠، ٧٥ كجم - نيتروجين فى صورة سلفات نشادر/فدان) والآزولا (صفر، ٢٥، ٥٠ كجم أزوت/فدان) وكذلك عن طريق تغليف الحبوب قبل زراعتها بالعناصر الصغرى (زنك - منجنيز - حديد بمعدلات ٠,٣ ، ٠,١٥ ، ٠,٣ جم/كجم حبوب) على صفات النمو الخضرى وكمية المحصول ومعدل امتصاص العناصر الصغرى .

وتتلخص اهم النتائج المتحصل عليها فيما يلى :-

١- حـدوث زيادة فى كل من قيم إرتفاع النبات وطول السنبلة ووزن الألفاض ومحصولى الحبوب والقش لـلفدان وكذلك كل من الزنك والحديد والمنجنيز الممتص وكذلك محتوى البروتين فى الحبوب، وكانت الزيادة معنوية بزيادة مستويات التسميد النيتروجينى حتى ٧٥ كجم نيتروجين/فدان .

٢- زيادة كل من محصول الحبوب/فدان وطول السنبلة ووزن الألفاض، وكانت الزيادة معنوية بزيادة معدل الأزولا حتى ٢٥ كجم نيتروجين/فدان، بينما زاد كل من ارتفاع النبات ومحصول القش للفدان والمحتوى مـن البروتين فى الحبوب وكذلك كميات الزنك والحديد والمنجنيز الممتصة بزيادة معدل الأزولا حتى ٥٠ كجم نيتروجين/فدان .

٣- أدى تغـليف الحـبوب بالعناصـر الصـغرى قبل الزراعة إلى زيادة معنوية فى كل من الصفات تحت الدراسـة، ولقـد أوضـحت النتائج أن أعلى زيادة أمكن الحصول عليها فى محصول الحبوب للفدان ومحتوى الحبوب من البروتين كانت باستخدام المعاملات المشتركة للتسميد النيتروجينى بمعدل ٧٥ كجم نيتروجين/فدان ، الأزولا بمعدل ٢٥ كجم نيتروجين/فدان وتغليف الحبوب بالعناصر الصغرى.

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