RESPONSE OF WHEAT CULTIVARS TO FOLIAR APPLICATION OF ZINC AND MANGANESE

BY

Zein, F.I.; M.S. El-Yamani and Asmaa A. El-Basuouny

Soil, Water and Environment Research Institute, ARC, Egypt.

ABSTRACT

Two field trials were conducted at the experimental farm of Sakha Agric. Res. Station Kafr El-Sheikh Governorate during two successive seasons 1998/99 and 1999/2000. The objective of this investigation was to study the influence of foliar application of Zn and Mn in presence of NPK soil application on yield and yield components of six wheat cultivares, Sakha 8 (V_1), Sakha 69(V_2), Sids1(V_3), Baniswaif 1 (V_4), Gemmeiza 3 (V_5) and Gemmeiza 5 (V_6). The experiments were treated statistically using split plot design, with four replicates.

The observed results can be summarized as follows:

- The yield and yield components of wheat cultivares were affected significantly by foliar application of Zn and Mn treatments.
- Baniswaif 1 cultivar generally gave the highest values of grain yield, weight and number of kernels per spike under different foliar application treatments of the two seasons.
- The highest values of straw yield were generally obtained from Gemmeiza 3 under different foliar application of Zn and Mn treatments of the two seasons.
- Sakha 8 and Baniswaif 1 cultivars generally gave the highest values of harvest index under different foliar application treatments of the two seasons.

Kay wards: wheat cultivars, micronutrients, foliar application, Zn and Mn.

INTRODUCTION

Wheat grain is an important agricultural product in Egypt. Wheat bread is the main diet for the Egyptian population and straw of wheat is considered an important feed for livestock. The national production of wheat is not enough and Egypt is importing a substantial amount of its annual consumption of wheat. The main national target is to maximize food production specially wheat production. The Egyptian soils are become deficient in micronutrients as a result of many reasons such as intensive cropping, low percentage of soil organic matter, alkaline conditions of soil

that decreased the availability of some trace elements such as Zn and Mn and precipitation of clay in the front of High Dam. This hypothesis supported by Hamdi (1975). The consequences of these reasons, the addition of micronutrients particularly Zn and Mn to crop plants become a limiting factor (Amberger, 1982). One way of increasing production of wheat is by increasing the efficiency of added NPK fertilization as well as Zn and Mn micronutrient contents of wheat cultivares. El-Kady and Zein (1997) and Abd El-Hadi (1987) reported that grain and straw yield of wheat were positively affected by spraying wheat plants with Mn or Zn solution at tillering and booting stages.

El-Yamani (1994) recorded that potassium and Zinc fertilization were factors contributing in the increase of the efficiency of nitrogen uptake from soil and its utilization by wheat plants.

Wallace and Wallace (1983), El-Fouly *et al.* (1990), Selim (1992) and El-Kady and Zein (1997) indecated that urea increased foliar intake of micronutrients.

The objective of the present investigation was to study the influence of foliar application of Zn or Mn alone or with urea in presence of NPK soil fertilization on yield of six wheat cultivars.

MATERIALS AND METHODS

Two field experiments were conducted at the experimental farm of Sakha Agric. Res. Station during two successive seasons of 1998/99 and 1999/2000 to study the influence of foliar application of Zn and Mn micronutrients in presence of NPK soil application on yield production of wheat. The foliar application treatments were: cont. (T_1); 500 ppm Zn (T_2), 500 ppm Mn (T_3), 500 ppm Zn +1g/L urea (T_4) and 500 ppm Mn+ 1g/L urea (T_5). Six wheat cultivares were experimented; Sakha 8(V_1), Sakha 69(V_2), Sids (V_3), Baniswaif 1(V_4), Gemmeiza 3(V_5) and Gemmeiza 5(V_6). The experiment was conducted in a split plot design with four replicates. The main plots were randomly assigned to foliar application of Zn and Mn treatments, the sub-plot to six wheat cultivares. The area of each plot was 8.4(2.4x3.5) square meter. All plots of the experiment were treated with 15.5 Kg P_2O_5/fed as superphosphate fertilizer (15.5% P_2O_5) and 70 Kg N/fed in the form of urea (46% N) splitted in three doses. The first dose (14 Kg N/fed) was broadcasted together with P-fertilizer and 24 Kg K_2O/fed as potassium sulfate (48% K_2O) at sowing. The second and the third doses of urea 28 Kg N/fed were applied at tillering and booting stages. The foliar application 500 ppm Zn in the form of Zn SO_4, 500 ppm Mn in the form of

Mn SO_4, 500 ppm Zn +1g urea/L and 500 ppm Mn+ 1g urea/L were sprayed at tillering and booting stages. Spraying solution was used at the rate of 200 L/fed.

Wheat grains at rate of 60 Kg/fed were sowing at 10th and 12th of Dec. 1998 and 1999. The wheat plants were harvested at 28th May 1999 and 2000. The grain and straw yields were determined after maturity and weighed at 15% moisture content. Harvest index were also recorded (total grain : total dry matter).

Soil surface samples (0-30 cm) were taken from the experimental sites and analyzed before planting. Available nitrogen was extrected by K-sulfate and determined using the microkjeldahl method according to Jackson (1958).

Available phosphorus was extracted as dercibed by Olsen et al. (1954) and then determined spectro photometrically according to Jackson (1958). Available potassium was determined by flame photometer in the ammonium acetate extract, according to Jackson (1958). Available Zn and Mn were determined by Atomic absorption spectrometry (Berkin Elmer 3300), in the DTPA extract according to Lindsay and Norvell (1978).

The soil characteristics of the experimental locations are presented in Table (1).

The data were subjected to statistical analysis according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Soil analysis: Data in Table (1) showed that the soils of the experimental sites were clayey, i.e., 51.30 and 52.70% clay (in 1999 and 2000) with pH of 7.79 and 8.00. Low organic matter (1.26 and 1.50%) and low available nitrogen (32 and 36 mg N / kg soil). The soil contents of available phosphorus were low (8.00 and 8.50 mg/kg soil in 1999 and 2000 sesons). Their K contents were high (530 and 560 mg/kg soil)and their available Zn and Mn contents were normal (1.04, 1.50 mg/kg soil for Zn and 14.04, 16.80 mg/kg Mn for soil in 1999 and 2000 respecively).

Grain yield: the results in Table (2) and Fig. (1) show that the grain yield of wheat was affected significantly by different foliar application of Zn and Mn treatments and with wheat cultivers. Baniswaif 1 (V_4) gave the highest values of grain yield under T_1, T_3 and T_4 in the two seasons. While Gemmeiza 5(V_6) and Gemmeiza 3(V_5) gave the highest values under (T_2) and (T_5) respectively, in the two seasons. The maximum values of grain yield (3.01 and 3.11 ton/fed in 1999 and 2000) were obtained by

Table (1). Some chemical and physical properties of the soil urface layer (0-30 cm) before planting.

Year	Soil pH* 1:2.5 susp	EC dS/m at 25C°	Soluble cations me/L				Soluble anions mc/L				Available nutrients mg/kg soil					O.M. %	Total carbo-nate %	Partical size %			Texture
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{--}	N	P	K	Zn	Mn			Clay %	Silt %	Sand %	
1998/99	7.79	3.44	18.0	12.0	3.6	0.31	-	6.5	10.0	17.41	32.0	8.0	530	1.04	14.04	1.26	4.12	51.30	24.90	23.8	Clayey
1999/2000	7.80	2.95	14.0	12.0	3.6	0.31	-	6.0	12.0	11.91	36.0	8.5	560	1.50	16.8	1.50	3.73	52.70	25.20	22.10	Clayey

* 1: 2.5 soil : water suspension

Table (2): Effect of foliar application of Zn and Mn micronutrients and six wheat cultivars on grain and straw yields.

Wheat Varieties	Foliar application of Zn and Mn micronutrients											
	1998/99						1999/2000					
	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean
Grain yield (ton/fed)												
Sakha 8(V_1)	2.02b	2.18c	2.12d	2.50b	2.15c	2.19	2.01d	2.25c	2.26c	2.68b	2.31c	2.30
Sakha 69 (V_2)	1.89d	1.98d	2.30c	1.97d	2.29bc	2.09	1.89e	2.22c	2.39c	2.07d	2.41bc	2.20
Sids (V_3)	2.24b	2.11cd	2.55b	2.58b	2.16c	2.33	2.20c	2.28c	2.75b	2.69b	2.56ab	2.50
Baniswaif 1 (V_4)	2.49a	2.60b	3.01a	2.92a	2.15c	2.63	2.49a	2.76b	3.11a	3.08a	2.27c	2.84
Gemmeiza 3(V_5)	2.07c	2.15c	2.56b	2.23c	2.51a	2.30	2.06d	2.31c	2.77b	2.38c	2.66a	2.44
Gemmeiza 5(V_6)	2.36b	2.84a	2.54b	2.35c	2.36b	2.49	2.34b	2.96a	2.70b	2.45c	2.52ab	2.59
Straw yield (ton/fed)												
Sakha 8(V_1)	3.18d	3.78d	3.39e	3.72e	2.72d	3.36	3.62c	3.95c	3.65d	3.94b	3.10c	3.65
Sakha 69 (V_2)	3.37c	4.21b	4.73c	3.93d	4.29b	4.11	3.77bc	4.47b	4.96ab	4.10b	4.57a	4.37
Sids (V_3)	3.94a	3.99c	4.95b	4.81a	4.17b	4.37	4.29a	4.34bc	4.44c	5.03a	4.41a	4.50
Baniswaif 1 (V_4)	3.37c	4.27b	4.23d	4.41c	3.75c	4.01	4.04ab	4.43b	4.48c	4.77a	3.97b	4.34
Gemmeiza 3(V_5)	3.93a	4.33b	5.33a	4.48bc	4.48a	4.51	4.39a	4.54b	5.26a	4.76a	4.77a	4.74
Gemmeiza 5(V_6)	3.70b	4.70a	4.34d	4.58b	3.62c	4.19	4.10ab	5.13a	4.72bc	4.89a	3.91b	4.55

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

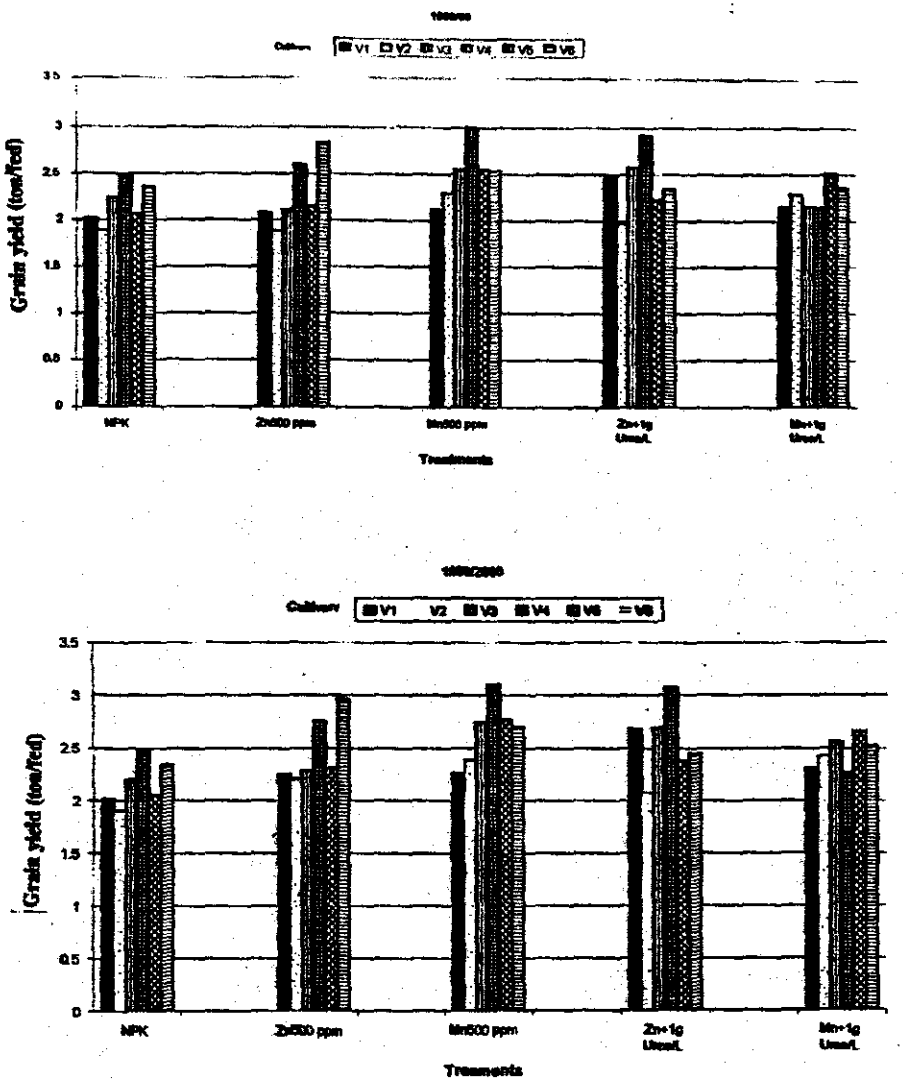

Fig 1. Effect of foliar application of Zn and Mn micronutrients and six wheat cultivars on grain yield.

application of 500 ppm Mn for Baniswaif 1 cultiver in the two seasons. The grain yields were positively increased by about 20.88 and 24.9% in 1999 and 2000 due to foliar application of 500 ppm Mn at tillering and booting stages. These results are in agreement with those published by El-Kady and Zein (1997) , Monged and Basha (1986), Abd El-Hadi (1987) and Dahdoh (1997). They reported that spraying wheat with Mn SO_4 increased grain yield over the control. In general, it could be stated that Baniswaif 1 cultivar gave the highest grain yield under different foliar application of Zn and Mn treatments. The effect of foliar application with Zn on grain yield was more pronounced in the presence of 1g urea/L, while the effect of foliar application of Mn was more efficient in the absence of urea in spraying solution than the other treatments.

Straw yield: The results in Table (2) and Fig.(2) show that straw yield of wheat cultivars were affected significantly with different foliar application of Zn and Mn treatments. Gemmeiza 3 gave the highest values of straw yield under (T_1), (T_3) and (T_5) treatments in the first season and (T_1), (T_3), (T_4) and (T_5) treatments in the second season, while Gemmeiza 5 cultivar gave the maximum values of straw yield under (T_2) treatment in the two seasons. The maximum values of straw yield (5.33 and 5.26 ton/fed in 1999 and 2000) were obtained by application of 500 ppm Mn with Gemmeiza 3 cultivar in the two seasons. The straw yields were increased by about 35.6 and 19.8% over control (T_1) in 1999 and 2000, respectively, due to spraying wheat plants with 500 ppm Mn at tillering and booting stages. These results were supported by the data obtained by Gab-Alla et al. (1985). They reported that an increase in straw yield of wheat was observed when sprayed wheat plants with 0.2% Mn SO_4 at tillering and heading stages. While El-Kady and Zein (1997) found that spraying Zn alone or with urea increased significantly the straw yield of Sakha 69 wheat cultivar. Regarding the effect of foliar nutrients on wheat and straw yields, an increase in grain and straw yields than control treatment were observed, these increments may be due to the fact that applying nitrogen and micronutrients increased the level of indole acetic acid (IAA), chlorophyll content and net assimilation rate (NAR) in leaves and increased the total dry matter accumulation and yield components (Hemantaranjan and Garg, 1984).

Number of heads per square meter : The results in Table (3) show that the number of heads per square meter of wheat cultivars were affected significantly with different foliar application of Zn and Mn treatments. The

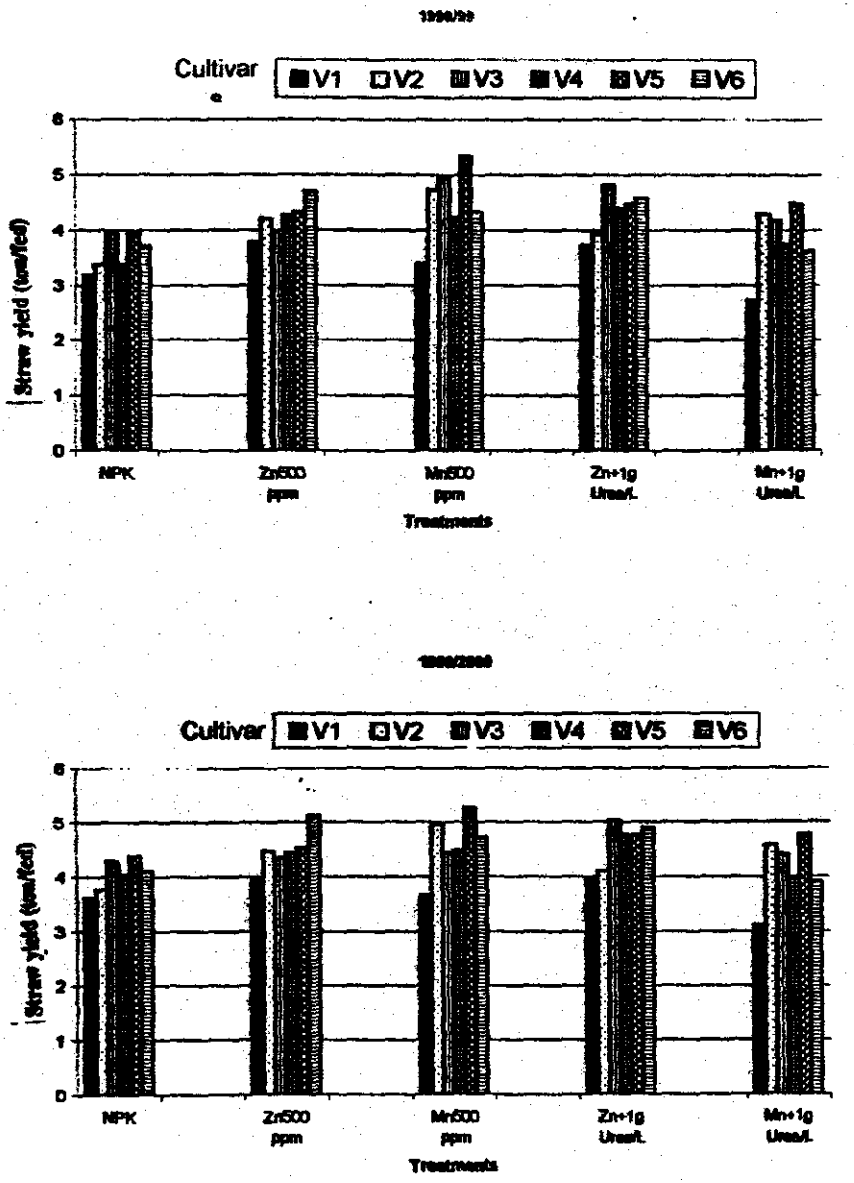

Fig 2. Effect of foliar application of Zn and Mn micronutrients and six wheat cultivars on straw yield.

highest number of heads per square meter (390 and 392 in 1999 and 2000) were obtained under foliar application of 500 ppm Zn and with Banisawif 1 cultivar in the two seasons. The results showed that a pronounced increase in the number of heads per square meter was recorded with sprayed wheat plants with 500 ppm Zn at tillering and booting stages. These results were supported by the data obtained by Gab-Alla et al. (1985). They found that an increase was noticed in the number of heads per square meter when spraying wheat plants with 0.4% Zn SO_4 solution at tillering and booting stages.

The 100-grain weight: The results in Table (3) show that the 100-grain weight of wheat cultivars was affected significantly with different foliar application of Zn and Mn treatments. The highest values of 100-grain weight (4.61 and 4.60 g/100 grains in 1999 and 2000) were obtained when spraying wheat plants with 500 ppm Zn+ 1g urea/L with Sakha 8 in the first season and Sids cultivar in the second season. These results indicated that the effect of Zinc on the 100-grain weight of wheat was generally more pronounced in the presence of urea than without it. These results were supported by the data obtained by Mahrous et al. (1986) and El-Yamani (1994) who found that a slight increase in the 100-grain weight was obtained with Zinc application.

Weight and number of kernels per spike: The results in Table (4) show that weight and number of kernels per spike of wheat cultivars were affected significantly with different foliar application of Zn and Mn treatments. In general Baniswaif 1 cultivar gave the highest values of weight and number of kernels per spike under different foliar application of Zn and Mn treatments. The maximum values of weight kernels per spike (2.14 and 2.27 g/spike in 1999 and 2000) were obtained when spraying wheat plants (Baniswaif 1) with 500 ppm Mn + 1g urea/L in the two seasons. These results indicated that the effect of Mn on weight of kernels was more efficient in the presence of urea than without urea in spraying solution. These results were supported by the data obtained by Gab-Alla et al. (1985). The maximum values of kernels number per spike (51.0 and 51.5 in 1999 and 2000) were obtained when spraying wheat plants (Baniswaif 1) with 500 ppm Mn in the first season and 500 ppm Mn + 1g urea/L in the second season. These results showed that Mn is an important factor contributing in the increase of kernels number per spike. This increase was more pronounced with Baniswaif 1 cultivar. These results were supported by the data obtained by Monged and Basha (1986).

Table (3): Effect of foliar application of Zn and Mn micronutrients and six wheat cultivars on number of heads per square meter and 100-grain weight.

Wheat Varieties	Foliar application of Zn and Mn micronutrients											
	1998/99						1999/2000					
	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean
Number of heads per square meter												
Sakha 8(V_1)	305a	334c	312b	345a	306a	320	301bc	382a	329b	362a	311ab	337
Sakha 69 (V_2)	233e	354b	335a	278c	309a	302	307b	310e	347a	291c	315a	314
Sids (V_3)	266c	346b	336a	326b	308a	316	293cd	347c	349a	341b	315a	329
Baniswaif 1 (V_4)	267c	390a	325ab	346a	284b	322	327a	392a	335b	357a	302b	343
Gemmeiza 3(V_5)	247d	331c	319b	285c	285b	293	285d	324d	330b	299c	314ab	310
Gemmeiza 5(V_6)	284b	384a	316b	340a	285b	322	332a	366b	325b	343b	303ab	328
The 100-grain weight												
Sakha 8(V_1)	3.83ab	3.77d	4.17b	4.61a	4.35a	4.15	3.80b	4.00b	4.33a	4.49ab	4.38a	4.20
Sakha 69 (V_2)	4.0a2	3.47e	4.45a	4.29b	4.32a	4.12	4.01ab	3.63c	4.30a	4.43ab	4.42a	4.16
Sids (V_3)	3.83ab	4.02c	4.27ab	4.45ab	4.34a	4.18	3.94ab	4.06b	4.41a	4.60a	4.37a	4.28
Baniswaif 1 (V_4)	3.73b	4.31a	4.31ab	4.47ab	4.55a	4.27	4.10a	4.34a	4.42a	4.28b	4.45a	4.32
Gemmeiza 3(V_5)	3.92ab	3.88cd	4.33ab	4.52ab	4.39a	4.21	3.96ab	4.28ab	4.38a	4.50ab	4.47a	4.32
Gemmeiza 5(V_6)	3.82ab	4.19ab	4.49a	4.42ab	4.58a	4.30	4.03ab	4.30ab	4.43a	4.51ab	4.36a	4.33

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Table (4): Effect of foliar application of Zn and Mn micronutrients and six wheat cultivars on weight and number of kernels per spike.

Wheat Varieties	Foliar application of Zn and Mn micronutrients											
	1998/99						1999/2000					
	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean
Weight of kernels per spike												
Sakha 8(V_1)	1.44b	1.42bc	1.67c	1.75b	1.70b	1.60	1.40c	1.50bc	1.69c	1.75c	1.72c	1.61
Sakha 69 (V_2)	1.54ab	1.30c	1.75bc	1.56c	1.80b	1.59	1.52b	1.31d	1.67c	1.64d	1.81bc	1.59
Sids (V_3)	1.55ab	1.51b	1.73bc	1.87b	1.78b	1.69	1.56b	1.46c	1.81b	1.89ab	1.83bc	1.71
Baniswaif 1 (V_4)	1.66a	1.60ab	1.96a	2.06a	2.14a	1.88	1.79a	1.61b	2.21a	1.97a	2.27a	1.97
Gemmeiza 3(V_5)	1.67a	1.54ab	1.86ab	1.76b	1.76b	1.72	1.63b	1.58b	1.89b	1.84bc	1.79c	1.75
Gemmeiza 5(V_6)	1.58ab	1.72a	1.84abc	1.77b	1.88b	1.76	1.61b	1.76a	1.82b	1.76c	1.92b	1.77
Number of kernels per spike												
Sakha 8(V_1)	33.8d	37.3b	39.5c	38.3c	39.5b	37.7	34.0c	37.5b	39.5c	39.3cd	39.5d	38.00
Sakha 69 (V_2)	34.5cd	37.9b	39.3c	37.5c	41.3b	38.0	36.5b	36.5b	39.5c	37.5d	41.5cd	38.30
Sids (V_3)	36.5bcd	37.5b	40.5bc	42.5b	41.3b	39.7	36.7b	36.5b	41.5bc	43.5b	42.5bc	40.10
Baniswaif 1 (V_4)	40.1a	37.3b	51.0a	46.8a	47.5a	44.5	40.1a	37.3b	50.5a	46.5a	51.5a	45.20
Gemmeiza 3(V_5)	38.3ab	37.5b	43.5b	39.5bc	42.0b	40.2	37.4b	37.5b	43.3b	41.5bc	40.0d	40.00
Gemmeiza 5(V_6)	37.2bc	41.0a	41.5bc	40.3bc	41.8b	40.4	36.5b	41.3a	41.5bc	39.3cd	44.5b	40.60

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Table (5): Effect of foliar application of Zn and Mn micronutrients and six wheat cultivars on harvect index of wheat.

Wheat Varieties	Foliar application of Zn and Mn micronutrients											
	1998/99						1999/2000					
	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean	NPK cont (T_1)	Zn 500 ppm (T_2)	Mn 500 ppm (T_3)	Zn +1g urea/L (T_4)	Mn +1g urea/L (T_5)	Mean
Harvest index of wheat crop												
Sakha 8(V_1)	0.37b	0.37b	0.39b	0.40a	0.44a	0.39	0.36c	0.36b	0.39b	0.41a	0.43a	0.39
Sakha 69 (V_2)	0.33cd	0.32d	0.33e	0.34c	0.35d	0.33	0.34d	0.33e	0.33e	0.34d	0.35c	0.33
Sids (V_3)	0.34c	0.35c	0.34d	0.35b	0.34d	0.34	0.34d	0.34d	0.35d	0.35c	0.34e	0.34
Baniswaif 1 (V_4)	0.39a	0.38a	.042a	0.40a	0.37c	0.39	0.38a	0.39a	0.41a	0.39b	0.37c	0.39
Gemmeiza 3(V_5)	0.32d	0.33d	0.33e	0.33c	0.36c	0.33	0.32c	0.35c	0.35d	0.33d	0.36d	0.34
Gemmeiza 5(V_6)	0.36b	0.37b	0.37c	0.34c	0.39b	0.37	0.37b	0.37b	0.37c	0.33d	0.39b	0.36

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

Harvest index: Total grain/total dry mater: Data in Table (5) showed that harvest index of wheat cultivars were affected significantly with foliar application of Zn and Mn treatments. The results showed that the harvest index was much higher with Sakha 8 and Baniswaif 1 cultivars than the other studied cultivars. The maximum harvest index (0.44 and 0.43 in 1999 and 2000) were obtained with Sakha 8 cultivar when spraying wheat plants with 500 ppm Mn + 1g urea/L. These results indicated that the effect of Mn on harvest index was much higher in the presence of urea than at its absence in spraying solution.

It can be concluded that spraying wheat plants with Zn and Mn micronutrients at tillering and booting stages resulted in higher grain and straw yields, weight and number of kernels per spike and harvest index. These main yield components were more pronounced with Baniswaif 1 cultivar which gave the highest grain yield associated with high number of heads per square meter, weight and number of kernels per spike.

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الملخص العربى

استجابة أصناف القمح للرش بعناصر الزنك والمنجنيز

فاروق ابراهيم زين – محمد صابر اليمانى – أسماء أحمد البسيونى

مصر – الجيزة – مركز البحوث الزراعية – معهد بحوث الأراضى والمياة والبيئة

أجريت تجربتين حقليتين فى المزرعة لبحثية – محطة البحوث الزراعية بسخا – محافظة كفر الشيخ خلال الموسمين المتعاقبين ١٩٩٩/٩٨ ، ٢٠٠٠/٩٩م

الهدف من البحث دراسة تأثير التسميد بالرش الزنك والمنجنيز فى وجود التسميد الأرضى بالنيتروجين والفوسفور والبوتاسيوم على المحصول ومكوناته لستة أصناف من القمح سخا ٨ ، سخا ٦٩ ، سدس ، بنى سويف ١ ، جميزة ٣ ، جميزة ٥ بهدف تعظيم انتاج محصول القمح . وقد أقيمت التجربتين فى تصميم قطع منشقة مرة واحدة مع أربعة مكررات.

ويمكن تلخيص النتائج المتحصل عليها كما يلى:

- المحصول ومكوناته لأصناف القمح تأثرت معنويا بمعاملات التسميد بالرش بالزنك والمنجنيز.
- أعطى الصنف بنى سويف ١ أعلى قيم لمحصول الحبوب ووزن وعد الحبوب فى السنبلة تحت مختلف معاملات التسميد بالرش خلال الموسمين.
- أعطى الصنف جميزة ٣ أعلى قيم لمحصول القش تحت مختلف معاملات التسميد بالرش بالزنك والمنجنيز خلال الموسمين.
- أعطى الصنفين سخا ٨ ، بنى سويف ١ أعلى قيم دليل الحصاد تحت مختلف معاملات التسميد بالرش خلال الموسمين.