J. Plant Production, Mansoura Univ., Vol. 9 (12): 1115 - 1120, 2018

Effect of Foliar Application with Micronutrients under Different Fertilizer Levels on Cotton Cultivar Giza 94

Amal S. Abdel-Aal
Cotton Research Institute, Agricultural Research Center, Giza, Egypt

ABSTRACT

Two field experiments were carried out in Sakha Agricultural Research Station at Kafr El-Sheikh Governorate, Egypt, during the growing seasons 2016 and 2017 to study the effect of foliar application with micronutrients under different NPK fertilizer levels on growth, earliness, yield and its components and fiber traits of cotton on the cotton cultivar (Giza 94) belonging to (*Gossypium barbadense*, L). Each experiment was laid out in a split plot design with four replications. The main plots were allocated to three NPK fertilizer levels i.e., (60 kg N + 37.5 kg P_2O_5 + 48 kg K_2O/fad.), (45 kg N + 22.5 kg P_2O_5 + 36 kg K_2O/fad.), (30 kg N + 15 kg P_2O_5 + 24 kg K_2O/fad.). The sub-plots had to six rates of micronutrients, (without, zinc, iron, calcium, manganese, zinc+iron+ calcium+ manganese). Foliar spraying three times (at squaring, initiation of flowering and two weeks after flowering). The obtained results were as follows:1- The levels of NPK had significant effect on plant height, some earliness parameters, number of open bolls/plant, boll weight and seed cotton yield. While, did not exhibit significant effect on lint percentage and seed index under study in both seasons. 2- The micronutrients had significant effect on growth, some earliness parameters, number of open bolls/plant, boll weight and seed cotton yield/fad. But, had insignificant effect on lint percentage and seed index in both seasons.3- The interaction between treatments had significant effect on plant height, days to the first flower an earliness percentage in 2016 and 2017 seasons. But, insignificantly affected first sympodial node, number of open bolls/plant, boll weight, seed cotton yield/feddan, lint percentage and seed index in both seasons.3- The levels of NPK, micronutrients and interaction between them had a not significant effect on all fiber properties. Therefore, it could be concluded that the highest seed cotton yield/fad. of cotton (Giza 94) was obtained from the high NPK fertilizer level (60 kg N + 37.5 kg P_2O_5 + 48 kg K_2O/fad.) and foliar application with micronutrients fertilizer (Zinc+ Iron+ Calcium+Manganese) three times at squaring, initiation of flowering and two weeks after flowering.

Keywords: Cotton, NPK, Micronutrients, Growth, Yield, Fiber Traits.

INTRODUCTION

In Egypt, nutrition manner is considered as one of the most important factors that affecting cotton growth. Furthermore, NPK forms are the most important plant nutrients limiting plant growth and consequently yield.

The oldest and consecutive traits in this concept were the achievement of the proper fertilizer levels which can maximize cotton productivity specially for the new varieties; i.e. the cotton G94. N is an important constituent of some organic compounds, chlorophyll and amino acids. However, phosphorous is very important for energy carrier (ATP) and active ion uptake. Potassium plays a vital role in carbohydrate metabolism in protein and fat synthesis and in oxidative phosphorylation. Some researchers studied the effect of N, P and K either as a single element or all together on NPK content in cotton leaves Elgahel (1987), on cotton plant growth Abdel-Aal *et al*. (1990) and also on yield and its components El-Sayed and El Menshawy (2005). Concerning the effect of phosphorous fertilizer, Hosny *et al*. (1989) found that application of phosphorous up to 30kg/ fed. caused increase seed cotton yield per feddan.

With regard to potassium fertilization levels, Makram and El-Shihawy (1995) found that potassium had a little effect on plant growth, while it increased yield and its components. El-Sayed *et al*. (2006) found that the plants received the combination of 80kg N + 30kg P2O5 + 48kg K2O/ fed. achieved the greatest value of yield and its components.

In this respect Seadh *et al*., (2012) and Hamoda *et al*., (2014) found that the final plant height, no. of fruiting branches/plant, number of bolls/plant, boll weight, seed index, lint percentage and seed cotton yield/plant and /fad. increased with increasing rates of NPK applied. Elhamamsey *et al*., (2016) and Emara *et al*., (2016) revealed that the high NPK fertilizer level did not exhibit significant effect on seed index, lint presenting and fiber properties. Through cotton agronomy programs, many traits are usually assigned to determine the optimum NPK fertilization levels for new promising cotton genotypes and commercial varieties. In this respect, several studies were done to evaluate the response of cotton plants to different NPK levels, Emara and Abdel-Aal (2017 b and 2017 c) found that the plant height, no. of fruiting branches/plant, number of bolls/plant, boll weight, seed index, seed cotton yield/plant and /fad. increased with increasing rates of NPK applied. Many recent studies have demonstrated positive effects of foliar application of micronutrients on cotton growth, fruit retention, yield and yield components of cotton Kassem *et al*. (2009), Emara (2012), Emara *et al*. (2015), Emara (2016), Emara *et al*. (2016), and Emara and Abdel-Aal (2017a).

Therefore, the main purpose of this study was to investigate the efficiency of effect of foliar application with micronutrients under different NPK fertilizer levels on growth, earliness, yield and its components and fiber traits of cotton.

MATERIALS AND METHODS

A field experiment was carried out at Sakha Agricultural Research Station at Kafr El-Sheikh Governorate, Egypt, during 2016 and 2017 seasons to study the effect of foliar application with micronutrients under different NPK fertilizer levels on growth, earliness, and yield and its components and fiber traits of cotton cultivar Giza 94. Cotton seeds were sown at the last week of March after rice crop in the two seasons.

The experimental design in each experiment was a split plot design with four replications. The main plots were allocated to three NPK fertilizer levels namely i.e.; 1- The recommended NPK rate (100%), i.e. (60 kg N + 37.5 kg P2O5 + 48 kg K2O/fad.), 2- 75% of the recommended NPK rate (45 kg N + 22.5 kg P2O5 + 36 kg K2O/fad.), 3- 50% of the recommended NPK rate (30 kg N + 15 kg P2O5 + 24 kg K2O/fad.). While, the sub-plots were allocated to six micronutrients namely i.e.; (without, Zinc, Iron, Calcium, Manganese, Zn + Fe + Ca + Mn).

The sub-plot size was 19.5 m^2 including six rows (5 m long and 0.65 cm width). The distance between hills was 25 cm. Soil samples was taken in the two seasons before planting cotton to estimate the soil characters using the standard methods as described by Chapman and Parker (1981). The results are shown in Table (1).

Table 1. Mechanical and chemical analysis of the experiment soil in 2016 and 2017 seasons.

Mechanical analysis					
Season	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Organic matter (%)**	**Texture class**
2016	48.8	27.0	20.4	1.80	Clay loam
2017	45.2	25.7	25.1	1.62	Clay loam

Chemical analysis											
Season	pH	EC	HCO_3^-	Bicarbonate	Available element (ppm)						
					N	P	K	Fe	Zn	Ca	Mn
2016	8.38	2.41	0.63	2.00	20.32	12.53	230.0	5.02	0.98	2.08	1.10
2017	7.89	2.49	0.87	2.40	24.08	15.81	247.0	3.02	0.77	1.87	0.92

The soil texture was clay loam, low content of organic matter, low calcium carbonate and non-saline. The soils of the two seasons were low in total N, Extractable-P, and low to medium in available K. Phosphorus in the form of superphosphate, the tested rates incorporated during seed bed preparation. Nitrogen fertilizer in the form of ammonium nitrate at the tested levels was applied in two equal doses immediately before the first and the second irrigation. Potassium in the form of potassium sulphate at the tested rates was side-dressed in a single dose before the second irrigation.

In both seasons, five representative hills (10 plants/sub-main plot) were taken at random in order to study the following traits; plant height at harvest, no. of sympodia/plant, first sympodial position in nodes, days from sowing to the first flower, as well as to the first open boll, earliness percentage, number of open bolls/plant, boll weight, seed cotton yield/plant, no. of plants/fad., lint percentage and seed index. The yield of seed cotton in kentars/fad. was estimated from the three inner ridges. Samples of lint cotton under different treatments were tested at the laboratories of the Cotton Technology Research Division, Cotton Research Institute in Giza to determine fiber properties. Fiber length and uniformity index, fiber strength and Micronaire reading were determined according to A.S.T.M. (2012). Analysis of variance of the obtained data was performed. The measured variables were analyzed by ANOVA using M Stat-C statistical package (Freed, 1991).

RESULTS AND DISCUSSION

A- Growth Traits:

Results presented in Table (2) indicate that levels of NPK had significant effect on plant height and insignificant on no. of sympodia in both seasons. The high level of NPK significantly increased plant height (149.88 and 150.00 cm) in 2016 and 2017 seasons, respectively, as compared with the other two rates. These results are in harmony with those obtained by Elsayed and El-Menshawi (2005) and Emara *et al.,* (2015 and 2016), Emara and Abdel-Aal (2017a) found that plant height and number of fruiting branches were significantly increased by increasing NPK rate. The positive response due to the high NPK rate on growth is mainly related to the followings; N play an important role in synthesis, distributing and accumulating the important substances responsible for growth and reflected greatly Hearn (1981). In photosynthesis and respiration, P plays a major role in energy storage. Phosphorus works on organizing pH in plant cells because a large portion of it found as ions which works on keeping the hydrogen ion concentration at a level which makes the cell more active Ali *et al*. (1996) and Uchida (2000).

Table 2. Cotton growth traits as affected by NPK levels, and micronutrients treatments as well as their interactions during 2016 and 2017 seasons.

Characters		Plant height at harvest (cm)		No. of sympodia/plant	
Treatments: Levels of NPK (A)	Micronutrients (B)	2016	2017	2016	2017
100% (Control)	Without	149.66	149.00	14.16	14.13
	Zinc	153.00	152.00	14.26	14.26
	Iron	149.00	149.00	14.43	14.66
	Calcium	147.00	147.33	14.50	14.53
	Manganese	150.66	151.33	14.50	14.50
	Zn + Fe+Ca + Mn	150.00	151.33	14.10	14.20
Mean		149.88	150.00	14.32	14.38
75%	Without	148.66	149.00	14.10	14.36
	Zinc	149.00	149.00	14.16	14.20
	Iron	148.33	147.66	14.26	14.23
	Calcium	146.00	146.66	14.36	14.26
	Manganese	148.33	149.00	14.50	14.43
	Zn + Fe+Ca + Mn	146.66	147.00	14.06	14.26
Mean		147.83	148.05	14.24	14.29
50%	Without	144.00	144.00	13.93	13.86
	Zinc	142.66	142.00	13.90	13.83
	Iron	144.00	143.33	14.00	13.93
	Calcium	143.00	144.00	13.96	13.80
	Manganese	145.66	144.00	14.00	14.00
	Zn + Fe +Ca +Mn	145.33	143.33	13.96	13.83
Mean		144.11	143.44	13.96	13.87
General of (B)	Without	147.44	147.33	14.06	14.12
	Zinc	148.22	147.66	14.11	14.10
	Iron	147.11	146.66	14.23	14.27
	Calcium	145.33	146.00	14.27	14.20
	Manganese	148.22	148.11	14.33	14.31
	Zn + Fe+Ca + Mn	147.33	147.22	14.04	14.10
L.S.D. at 5%	A	1.59	1.20	0.21	0.09
	B	0.91	1.15	0.16	0.16
	A x B	1.57	1.99	N.S	N.S

Results presented in Table (2) indicate that foliar application with micronutrients treatments had significant effect on plant height and number of sympodia/plant in both seasons. The foliar application with mixture (Zn, Fe, Ca and Mn) significantly increased plant height and no. of sympodia/plant in 2016 and 2017 seasons compared with the other micronutrients treatments. Mixture (Zn, Fe, Ca and Mn) were directly and indirectly involved in many physiological and biochemical processes during plant growth, such as cell elongation and division, cell wall biosynthesis, membrane function, nitrogen metabolism and photosynthesis Blevins and Lukaszewski (1998).

Results presented in Table (2) indicate that NPK levels fertilizer and micronutrients treatments interactions had significant effect on plant height only in 2016 and 2017 seasons. The high level of NPK + foliar feeding with mixture micronutrients significantly increased plant height compared with the other treatments.

B- Earliness Parameters:

The results of earliness as affected by levels of NPK, micronutrients and their interactions during 2016 and 2017 seasons are shown in Table (3). The results show that levels of NPK treatments had a significant effect on days to the first flower, days to the first opened boll and earliness percentage in both seasons and insignificant effect on first sympodial node in both seasons. The only 50% of the recommended NPK rate (30 kg N + 15 kg P_2O_5 + 24 kg K_2O/fad.) significantly decreased days to the first flower (73.33 and 73.51 days) and first open boll (121.43 and 122.08 days) and significantly increased earliness percentage (81.20 and 81.43%) in 2016 and 2017 seasons, respectively as compared with the other treatments. These results are in harmony with those obtained by Emara *et al.,* (2015 and 2016), Emara and Abdel-Aal (2017b) and Abo-Soliman (1990).

Table 3. Earliness parameters as affected by NPK, micronutrients treatments as well as their interactions during 2016 and 2017 seasons.

Characters		First sympodial node		Days to the first flower		Days to the first boll		Earliness (%)	
Treatments	Seasons	2016	2017	2016	2017	2016	2017	2016	2017
Levels of NPK (A)	Micronutrients (B)								
100% Control	Without	6.50	6.50	75.80	76.30	124.06	125.00	76.03	75.60
	Zinc	6.40	6.33	75.80	75.93	124.16	124.63	75.50	75.46
	Iron	6.23	6.30	75.10	75.40	123.70	124.46	76.00	76.20
	Calcium	6.33	6.30	74.46	74.90	123.03	123.70	76.50	76.66
	Manganese	6.50	6.56	75.83	75.90	123.90	124.16	76.36	76.70
	Zn + Fe + Ca + Mn	6.60	6.73	75.13	76.03	123.36	124.43	76.40	76.43
Mean		6.42	6.45	75.35	75.74	123.70	124.40	76.11	76.17
75%	Without	6.36	6.40	74.16	75.16	122.76	123.23	78.90	79.06
	Zinc	6.46	6.56	74.60	74.90	123.16	123.16	78.13	78.40
	Iron	6.63	6.53	74.33	75.36	122.53	123.33	77.46	77.76
	Calcium	6.40	6.50	73.96	74.23	122.76	122.76	77.06	77.16
	Manganese	6.46	6.40	74.33	74.50	122.50	122.90	78.00	78.10
	Zn + Fe + Ca + Mn	6.30	6.23	74.23	74.56	122.33	123.10	77.50	77.66
Mean		6.43	6.43	74.27	74.78	122.67	123.08	77.84	78.02
50%	Without	6.23	6.30	73.60	73.93	121.66	122.40	79.80	80.20
	Zinc	6.40	6.46	73.40	73.76	121.63	122.43	80.83	80.83
	Iron	6.60	6.50	73.50	73.80	121.76	122.40	82.20	82.30
	Calcium	6.56	6.46	73.13	73.20	120.90	121.60	81.63	82.23
	Manganese	6.50	6.46	73.50	73.33	121.30	122.00	81.33	81.26
	Zn + Fe + Ca + Mn	6.53	6.43	72.90	73.06	121.33	121.70	81.43	81.80
Mean		6.47	6.43	73.33	73.51	121.43	122.08	81.20	81.43
General of (B)	Without	6.36	6.40	74.52	75.13	122.83	123.54	78.24	78.28
	Zinc	6.42	6.45	74.60	74.86	122.98	123.41	78.15	78.23
	Iron	6.48	6.44	74.31	74.85	122.66	123.40	78.55	78.75
	Calcium	6.43	6.42	73.85	74.11	122.23	122.68	78.40	78.68
	Manganese	6.48	6.47	74.55	74.57	122.56	123.02	78.56	78.68
	Zn + Fe + Ca + Mn	6.47	6.46	74.08	74.55	122.34	123.07	78.44	78.63
L.S.D. at 5%	A	N.S	N.S	0.27	0.14	0.19	0.14	0.62	0.47
	B	N.S	N.S	0.20	0.18	0.23	0.32	N.S	N.S
	A x B	N.S	N.S	0.35	0.32	0.40	N.S	1.39	1.02

Results presented in Table (3) indicate that foliar application with micronutrients treatments had significant effect on days to the first flower, days to the first opened boll in both seasons. The foliar feeding with mixture (Zn, Fe, Ca and Mn) significantly decreased the days to the first flower (74.08 and 74.55 days) and first open boll (122.34 and 123.07 days) in 2016 and 2017 seasons, respectively and insignificantly effected first sympodial node and earliness percentage in both seasons as compared with the other treatments.

Results indicate that NPK levels fertilizer, micronutrients treatments and their interactions had significant effect on days to the first flower and earliness percentage in both seasons and days to the first opened boll in 2016 season, but insignificantly effected first sympodial node in both seasons.

C- Yield and yield components:

The results of yield and its components as affected by levels of NPK, micronutrients and their interactions during 2016 and 2017 seasons are shown in Table (4). The levels of NPK fertilizer treatments had a significant effect on number of open bolls/plant and boll weight in 2016 and 2017 seasons and seed cotton yield/feddan in 2017 season only. But, the insignificant effect on, seed index and lint percentage in both seasons. The highest values of number of bolls/plant (10.83 and 17.76), boll weight (2.84 and 2.86 gm) were obtained from the high NPK level in 2016 and 2017 seasons, respectively and seed cotton yield/feddan (10.37 kentar) in 2017 season only. The difference in seed cotton yield and the number of open bolls/plant in both season is due to different atmospheric conditions. The positive response to the high NPK level with regard to seed cotton yield might be due to the improvement nutrient availability and increases in nutrients uptake, the role of these two concentrations to increase leaf N, P and K content and consequently increase photosynthesis, assimilates accumulation and plant dry weight and the higher number of open bolls/plant and heavier bolls. The boll weight and seed index increases due to the high NPK level was mainly attributed to increase photosynthetic activity of cotton plants and consequently increase accumulation of metabolites with direct impact on boll weight and seed index. These results are in accordance with those outlined by overall plant growth, fruit retention, seed cotton yield and its components, Seadh *et al.*, (2012), Emara *et al.,* (2015 and 2016), Elhamamsey *et al.,* (2016) and Emara and Abdel-Aal (2017c).

Table 4. Yield and its components as affected by NPK levels, micronutrients as well as their interactions during 2016 and 2017 seasons

Characters		No. of open bolls/plant		Boll weight (g)		Seed cotton yield (Kentar/fad.)		Lint Percentage (%)		Seed index (g)	
Treatments	Seasons	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Levels of NPK (A)	Micronutrients (B)										
100% (Control)	Without	10.63	17.43	2.84	2.85	5.14	10.25	39.86	39.84	11.32	11.30
	Zinc	10.76	17.90	2.84	2.85	6.20	10.31	39.82	39.84	11.34	11.32
	Iron	10.66	17.50	2.84	2.85	6.16	10.37	39.89	39.84	11.40	11.40
	Calcium	11.03	17.80	2.84	2.87	6.23	10.39	39.85	39.89	11.40	11.39
	Manganese	10.66	17.90	2.83	2.87	6.16	10.40	39.85	39.89	11.39	11.38
	Zn + Fe + Ca + Mn	11.23	18.06	2.87	2.89	6.30	10.50	39.91	39.90	11.43	11.42
Mean		10.83	17.76	2.84	2.86	6.03	10.37	39.86	39.86	11.38	11.38
75%	Without	10.46	16.56	2.82	2.84	6.03	9.91	39.83	39.82	11.36	11.36
	Zinc	10.56	16.60	2.83	2.85	6.01	10.14	39.85	39.84	11.38	11.36
	Iron	10.53	16.46	2.82	2.83	6.09	9.95	39.85	39.86	11.35	11.35
	Calcium	10.66	16.53	2.83	2.84	6.14	10.14	39.87	39.88	11.41	11.40
	Manganese	10.60	16.56	2.82	2.85	6.11	10.13	39.84	39.84	11.39	11.39
	Zn + Fe + Ca + Mn	10.70	16.80	2.83	2.86	6.16	10.15	39.88	39.85	11.40	11.41
Mean		10.58	16.58	2.82	2.84	6.10	10.07	39.85	39.85	11.36	11.37
50%	Without	10.26	15.26	2.81	2.82	5.89	9.41	39.84	39.84	11.36	11.36
	Zinc	10.40	15.50	2.81	2.83	5.97	9.48	39.82	39.84	11.32	11.31
	Iron	10.36	15.60	2.81	2.82	5.94	9.42	39.83	39.83	11.34	11.33
	Calcium	10.33	15.56	2.81	2.82	5.95	9.41	39.80	39.85	11.29	11.30
	Manganese	10.36	15.40	2.80	2.82	5.94	9.39	39.81	39.80	11.29	11.28
	Zn + Fe + Ca + Mn	10.53	15.90	2.81	2.84	6.00	9.51	39.84	39.85	11.31	11.27
Mean		10.37	15.53	2.81	2.82	5.95	9.44	39.82	39.83	11.32	11.31
General of (B)	Without	10.45	16.42	2.82	2.84	5.68	9.86	39.84	39.83	11.34	11.34
	Zinc	10.57	16.66	2.83	2.84	6.09	9.98	39.83	39.84	11.34	11.33
	Iron	10.52	16.52	2.82	2.83	6.06	9.91	39.85	39.84	11.36	11.36
	Calcium	10.67	16.63	2.82	2.84	6.10	9.98	39.84	39.87	11.36	11.36
	Manganese	10.54	16.62	2.82	2.84	6.07	9.97	39.83	39.84	11.35	11.35
	Zn + Fe + Ca + Mn	10.82	16.92	2.83	2.86	6.15	10.05	39.88	39.87	11.38	11.36
L.S.D. at 5%	A	0.02	0.15	0.01	0.02	N.S	0.08	N.S	N.S	N.S	N.S
	B	0.06	0.18	0.01	0.01	N.S	0.05	N.S	N.S	N.S	N.S
	A x B	0.12	N.S	N.S	N.S	N.S	0.09	N.S	N.S	N.S	N.S

The micronutrients treatments had a significant effect on number of open bolls/plant and boll weight in 2016 and 2017 seasons and seed cotton yield/feddan in 2017 season only, but the insignificant effect on, seed index and lint percentage in both seasons. The highest values of no. of bolls/plant (10.82 and 16.92), boll weight (2.83 and 2.86 gm) and seed cotton yield/feddan (10.05 kentar) were obtained from the mixture (Zn, Fe, Ca and Mn) in 2016 and 2017 seasons, respectively. These results are in accordance with those outlined by overall plant growth, fruit retention, seed cotton yield and its components.

Results indicate that the interaction between levels of NPK and micronutrients treatments had insignificant effect on boll weight, lint percentage and seed index in 2016 and 2017 seasons, but significantly effected number of open bolls/plant in 2016 season and sead cotton yield in 2017 season. Similar results were obtained by Emara (2012), Emara *et al.* (2015), Emara *et al.* (2016) and Emara and Abdel-Aal (2017 a).

D- Fiber traits:

Data in Table (5) shown effect of levels of NPK and micronutrients treatments and its interaction of cotton during 2016 and 2017 seasons on fiber parameters. The results in Table (5) indicate that levels of NPK + micronutrients treatments and its interaction did not exhibit any significant effect on fiber properties under study in both seasons. This may be attributed to the realization that these characteristics were less affected by the environmental factors. Similar results were obtained by Kassem *et al*. (2009), Emara (2012), Emara *et al.* (2015), and Emara and Abdel-Aal (2017 a).

Table 5. Fiber traits as affected by NPK levels, micronutrients treatments as well as their interactions during 2016 and 2017 seasons.

Characters		Upper half mean		Uniformity index		Fiber strength (Presley units)		Micronaire reading	
Treatments	Seasons	2016	2017	2016	2017	2016	2017	2016	2017
Levels of NPK (A)	Micronutrients (B)								
100% (Control)	Without	33.40	33.73	84.43	83.46	9.70	9.13	4.10	4.23
	Zinc	32.60	33.36	83.53	85.16	9.83	9.33	4.13	4.20
	Iron	33.90	33.63	84.70	84.13	9.56	8.66	4.10	4.36
	Calcium	33.43	33.83	84.56	84.66	9.83	8.80	4.16	4.36
	Manganese	33.46	34.60	84.36	85.66	9.43	9.36	4.26	4.16
	Zn + Fe + Ca + Mn	33.36	32.56	84.36	84.43	9.36	9.56	4.26	4.16
Mean		33.36	33.62	84.32	84.58	9.62	9.14	4.17	4.25
75%	Without	33.73	32.43	85.16	83.53	9.73	9.33	4.03	4.13
	Zinc	32.96	33.10	84.26	84.90	9.56	9.16	4.13	4.26
	Iron	33.16	33.10	84.63	86.06	9.13	9.56	4.23	4.10
	Calcium	32.43	33.13	84.80	85.93	9.30	9.56	4.23	4.13
	Manganese	33.46	33.96	84.93	85.76	9.50	9.43	4.16	4.13
	Zn + Fe + Ca + Mn	32.80	33.90	84.10	84.63	9.40	9.26	4.03	4.06
Mean		33.09	33.27	84.65	85.13	9.43	9.38	4.13	4.13
50%	Without	33.03	33.43	84.80	85.20	9.43	9.33	4.16	4.33
	Zinc	33.60	33.66	84.70	84.53	9.40	9.46	4.16	4.20
	Iron	33.30	34.10	84.06	85.80	9.43	9.53	4.10	4.20
	Calcium	32.70	34.20	83.76	84.93	9.33	9.80	4.03	4.13
	Manganese	33.36	34.46	84.26	85.40	9.10	9.36	4.33	4.20
	Zn + Fe + Ca + Mn	32.43	25.03	84.80	86.10	9.36	9.13	4.33	4.10
Mean		33.07	34.15	84.40	85.32	9.34	9.43	4.18	4.19
General of (B)	Without	33.38	33.20	84.80	84.06	9.62	9.26	4.10	4.23
	Zinc	33.05	33.37	84.16	84.86	9.60	9.32	4.14	4.22
	Iron	33.45	33.61	84.46	85.33	9.37	9.25	4.14	4.22
	Calcium	32.85	33.72	84.37	85.17	9.48	9.38	4.14	4.21
	Manganese	33.43	34.34	84.52	85.61	9.34	9.38	4.25	4.16
	Zn + Fe + Ca + Mn	32.86	33.83	84.42	85.05	9.37	9.32	4.21	4.11
L.S.D. at 5%	A	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	B	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
	A x B	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

CONCLUSION

The results obtained in this study could lead us to a package of recommendations, which seemed to be useful for increasing the cotton yield production and the best fiber quality. It could be concluded that the highest seed cotton yield/fad. was obtained from the high NPK fertilizer level (60 kg N + 37.5 kg P_2O_5 + 48 kg K_2O/fad.) and foliar feeding with micronutrients sprayed three times at squaring, initiation of flowering and two weeks after flowering gave high productivity of the cotton cultivar Giza 94, under this study.

REFERENCES

A.S.T.M. (2012). American Society for Testing and Materials. Designation, (D1447-07).

Ab-Soliman, M.S.M.; M.A. Abou El-Soud and M.H. Hegazy (1990). Preliminary studies on the methods and form of phosphorus fertilizers application on cotton under saline sodic soil conditions. J. Agric. Sci., Tanta Univ., 16(11):150-156.

Abd El-Aal, H.A.; A.I.H. Yasseen and S.M.F. El-Gahel (1990). Effect of NPK on yield and some yield components of Giza 75 cotton variety. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, Egypt, 35(2):709-722.

Ali, S.A.; S.A. Abd El-Aal and A.R. Ahmed (1996). Response of Giza 86 cotton cultivar to phosphors levels. J. Agric. Sci., Mansoura Univ., 21(1): 54-59.

Blevins, D.G. and K.M. Lukaszewski (1998). Boron in plant structure and function. Anu. Rev. Plant Physiol. Plant Mol. Biol., 49: 481 - 500.

Chapman, H.D. and F.P. Parker (1981). Methods of analysis of soil, plants and water. Univ. California, Second Printing.

El-Gahel, S.M. (1987). Studies on overlapping between onion and cotton. Ph.D. Thesis, Fac. Agric., Tanta Univ.

El-Sayed, E.A.; M.E. El-Menshawi and R.R. Abd El-Malik (2006). Effect of different fertilizers doses (NPK) on the yield, yield components and some chemical constituents of the hybred cotton Giza 89X86. Egypt. J. Appl. Sci., 21(4A): 153-166.

El-Sayed, E.A. and M. El-Menshawi (2005). Response of the promising hybrid cotton Giza89X86 to spacing and nitrogen fertilizer level. J. Agric. Sci., Tanta Univ., 31(): 436-456.

Elhamamsey, M.H.; E.A. Ali and M.A. Emara (2016). Effect of some cultural practices on shedding and yield of Egyptian cotton. Assiut J. of Agric. Sci., 47(4): 41 – 51.

Emara M.A. (2016). Influence of potassium fertilization and spraying of zinc and manganese on cotton growth and productivity. J. Plant Prod., Mansoura Univ., 7 (10): 1115 - 1125.

Emara M.A. and Amal S. Abdel-Aal (2017 a). Effect of Different Sources of Phosphorus and Boron on Chemical Composition and Water Relations in Leaves, Growth, Productivity and Quality of Egyptian Cotton. J. Plant Production, Mansoura Univ., 8(2):219 -229.

Emara M.A. and Amal S. Abdel-Aal (2017 b). Effect of nano-fertilizer on productivity of cotton under nutrient stress conditions. Egypt. J. Appl. Sci., 32 (12 B): 445 – 458.

Emara M.A. and Amal S. Abdel-Aal (2017 c). Effect of foliar application with seaweed extract and micronutrients under different npk fertile levels on growth and productivity of promising hybrid cotton Giza (86 X 10229). Egypt. J. Appl. Sci., 32 (12 B): 459 – 473.

Emara M.A.; A.S. Amal and S.A. Hamoda (2015). Effect of water stress and foliar feeding with boron and zinc under NPK fertilizer on growth and yield of the promising cotton genotype (Giza 86 x 10229). Fayoum J. Agric. Res., & Dev., 30 (1): 27 – 48.

Emara M.A.; Amal S. Abdel-Aal and A.E. El-Gabiery (2016). Effect of sowing dates and bio-fertilizer under different NPK fertile levels on growth, yield and fiber of promising hybrid cotton Giza (86 X 10229). Egypt. J. of Appl. Sci., 31 (12): 357 – 376.

Emara, M.A. (2012). Response of cotton growth and productivity to application of potassium and zinc under normal and late sowing dates. J. Plant Prod., Mansoura Univ., 3 (3): 509 - 514.

Freed, R.D. (1991). M Stat-C Microcomputer Statistical Program. Michigan State Univ., East Lansing, Michigan, USA.

Hamoda, S.A.; M.A. Ibrahim and M.A. Emara (2014). Effect of irrigation intervals and NPK fertilizers on growth, yield and quality for new hybrid cotton [Giza 83 (Giza 75 x 5844)] x Giza 80. The 1st International Cotton Conference "Challenges to Sustainable Cotton Production & Guality". Special Issue of Egypt. J. Agric. Res., 92(1): 111 – 123.

Hearn, A.B. (1981). Cotton nutrition. Field Crop Abst., 34(1): 11 - 34.

Hosny, A.A.; H.M.H. Mohamed and W. Kadry (1989). Effect of plant density and phosphorous on yield and yield components of Giza 75 cotton variety. Annals of Agric. Sci., Moshtohor, 27(1): 11-20.

Kassem, M.A.; M.A. Emara and S.A. Hamoda (2009). Growth and productivity of Giza 80 cotton cultivar as affected by foliar feeding with boron and zinc. J. Agric. Sci., Mansoura Univ., 34(2): 967 - 975.

Makram, E.A. and M.I. El-Shihawy (1995). The effect of potassium fertilization on growth and yield of cotton (Giza 76) grown in saline soils. Annals Agric. Sci., Ain Shams Univ., 40(2):621-628.

Seadh, S.E.; M.H. El-Hendi and Shiamaa O. El-Sayed (2012). Effect of NPK rates and humic acid on growth of Egyptian cotton. J. Plant Pro. Mansoura, 3(8): 2287 – 2299.

Uchida, R. (2000). Essential nutrients for plant growth: Nutrient functions and deficiency symptoms. Approaches for tropical and Subtropical Agriculture. Chapter 3: 31 – 55.

تأثير الرش بالعناصر الصغري تحت مستويات مختلفة من التسميد علي صنف القطن جيزة 94

أمل سامي علي عبد العال

معهد بحوث القطن – مركز البحوث الزراعية - جيزة – مصر

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا، محافظة كفر الشيخ علي صنف القطن جيزة 94 وذلك خلال موسمي النمو 2016، 2017 وذلك بهدف دراسة تأثير الرش الورقي بالعناصر الصغري تحت مستويات مختلفة من التسميد علي نمو وانتاجية القطن. أجريت التجربة تحت تصميم القطع المنشقة مرة واحدة فى أربع مكررات حيث وضعت مستويات التسميد بالنتروجين والفوسفور والبوتاسيوم في القطع الرئيسية وكانت كالاتي: (100% من الموصي به من النتروجين والفوسفور والبوتاسيوم)، (75% من الموصي به من النتروجين والفوسفور والبوتاسيوم)، (50% من الموصي به من النتروجين والفوسفور والبوتاسيوم)، في حين وضعت في القطع المنشقة ستة معاملات للرش بالعناصر الصغري كالاتي: (بدون رش عناصر - كنترول، رش زنك منفرد، رش حديد منفرد، رش كالسيوم منفرد، رش منجنيز منفرد، رش مخلوط العناصر زنك-حديد-كالسيوم-منجنيز). وكانت مواعيد الرش ثلاث مرات كالاتي (عند الوسواس + بداية التزهير + بعد التزهير بأسبوعين). وتتلخص أهم النتائج المتحصل عليها فيما يلى:1- كان هناك تأثير معنوي لمستويات التسميد بالازوت والفوسفور والبوتاسيوم علي أرتفاع النباتات عند الحصاد وبعض صفات التبكير وعدد اللوز علي النبات ومتوسط وزن اللوزة أيضاً المحصول بالقنطار للفدان في كلا الموسمين تحت الدارسة، ولكن لم يكن هناك أي تأثيرات معنوية علي تصافي الحليج ومعامل البذرة في كلا الموسمين.2- كان هناك تأثيرات معنوية للرش بالعناصر الصغري علي النمو وبعض صفات التبكير تحت الدراسة وعدد اللوز/نبات ومتوسط وزن اللوزة ومحصول القطن بالقنطار للفدان في كلا الموسمين، ولم يكن هناك ايه تأثيرات معنوية علي تصافي الحليج ومعامل البذرة في كلا الموسمين.3- كانت هناك تأثيرات معنوية للتفاعل بين مستويات المعاملات تحت الدارسة على أرتفاع النباتات عند الحصاد وبعض صفات التبكير في كلا الموسمين ، ولكن لم يكن هناك أي تأثيرات معنوية علي أرتفاع أول فرع ثمري وعدد اللوز/نبات ووزن اللوزة والمحصول بالقنطارللفدان وتصافي الحليج ومعامل البذرة في كلا الموسمين.4- لم يكن هناك تأثيرات معنوية لمستويات التسميد بالازوت والفوسفور والبوتاسيوم وللرش بالعناصر الصغري والتفاعل بين مستويات المعاملات تحت الدارسة على جميع صفات التيلة في كلا الموسمين. عموماً ومن النتائج المتحصل عليها في هذه الدراسة فأنه يمكننا التوصية بالتسميد بالازوت والفوسفور والبوتاسيوم بالمعدل العالي (60 كجم ن + 37.5 كجم فو$_2$أ$_5$ + 48 كجم بو$_2$أ/فدان) بالإضافة للرش بالعناصر الصغري مجتمعة معاً وذلك رشاً ثلاث مرات (عند ظهور الوسواس + بداية التزهير + بعد التزهير بأسبوعين) وذلك لزيادة إنتاجية وجودة محصول القطن للصنف جيزة 94 تحت ظروف الدراسة.