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Impact of Integrated Mineral and Organic Fertilization and Foliar Spraying of some Micronutrints on Cotton Productvity

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ABSTRACT

Two field experiments were conducted at Sids Agricultural Research Station, Beni - Suef Governorate, Egypt in 2015 and 2016 seasons to study the effect of the integrated inorganic NPK fertilizers in combined with organic manure as well as foliar spraying of micronutrients on some growth parameters (plant height, first fruiting branch, number of fruiting branches, number of green branches and total bolls/plant), seed cotton yield and its components (number of open polls/plant, boll weight, yield/plant, lint percentage and seed cotton yield/fed) as well as some soil properties. The experimental design was split plot in four replication, where the inorganic – organic treatments, i.e.,100 % NPK (100 RDF), 75 % NPK (75 % RDF) + 5 t FYM /fed and 50 % NPK (50 % RDF) + 10 t FYM /fed were located in main plots and micronutrient treatments (without micronutrients, Fe, Mn, Zn, Fe + Mn, Fe + Zn, Mn + Zn and Fe + Mn + Zn) were set up in sub plots. The statistical analysis showed that, in general, 50 % RDF+ l0 t FYM / fed produced tallest plant, greatest number of fruiting branches and best node number of first fruiting branches, while 100 % RDF recorded higher number of green branches and number of total bolls / plant. Meanwhile, 75 % RDF + 5t FYM /fed showed the best seed cotton yield and its attributes, except lint % which did not affect. Foliar spraying of Fe, Zn, Fe + Zn and Mn + Zn found to have the best treatment for growth and yield attributes as well as seed cotton yield. The interaction between treatments indicated that 75 % RDF + 5t FYM /fed + foliar spraying of Fe, Zn, Fe + Zn or Mn + Zn found to be the best treatments for cotton production. FYM application improved soil properties, except soil salinity, which increased due to organic manure.

Keywords : Cotton, inorganic fertilizer, FYM, Fe, Mn, Zn, growth, yield and its components.

INTRODUCTION

Cotton crop has been associated with ancient civilization, which has been contributed greatly to the industrial and economic development of many countries. Cotton seed contain 15 - 20 % oil; the left over cake, a byproduct of cotton mill is very important feed for livestock. It can also be used as manure as it contain 6.4 % N, 2.9 % P and 2.2 % K (Khambalkar *et al*, 2017).

Fertilizer is an organic or inorganic materials, containing one or more essential nutrients, which used to provide nutrients for the growth of crops and increasing productivity and quality of agricultural products (Zhang *et al*, 2010). On the other hand, poor management of fertilizer has key to play in obtaining low yield productivity, so in order to achieve optimum crop productivity management of nutrients through judicious application of inorganic and organic sources and micronutrients are required (Ghaffari *et al*, 2011). Furthermore, the fertilizer management is very important factor that effect the growth and yield of cotton crop.

In fact, organic nutrients not only provide plant with nutrients but also enhance and / or sustain the soil health. The micronutrients content in organic fertilizer may be sufficient enough to meet the plant requirement, but problem of soil low fertility is one of the obstacles to mention and sustain agricultural management and productivity (Ahmad *et al*, 2011 and Kannan *et al*, 2013).

Integrated nutrient management (INM) is a judicious use of organic and inorganic sources of nutrient to crop fields for sustaining and maintaining soil productivity. However, the use of appropriate and conjunctive use of application of suitable nutrients through organic and inorganic solely or in combination can provide the solution to the problems such as increase in the price of inorganic fertilizers and deterioration effect of soil fertility and productivity (Wailare and Kesarwani, 2017).

Soil application of micronutrients on soil with high pH value as in case of the most alluvial Egyptian soil is less efficient, as these nutrients remain inaccessible to plant roots due to the higher pH (Rashid and Rayan, 2004 and Sajid *et al*, 2008). However, an alternative approach under such circumstances is foliar application of nutrients (Rab and Hag, 2012) primarily for two reasons; first, it eliminates the effects of soil pH on nutrients availability (Ali, 2012). Second, it is more effective and less costly (Ali *et al*, 2007).

The present investigation was conducted with the objective to develop the appropriate fertilizer formulation (inorganic and organic as well as foliar application of iron, manganese and zinc) that is specific to cotton productivity.

MATERIALS AND METHODS

Two field experiments were conducted during the two successive seasons of 2015 and 2016 at Sids Agricultural Research Station, ARC, Beni-Suif governorate, Egypt to study the effect of integrated inorganic and organic nutrients as will as micronutrients on growth, yield components and yield of Giza 95 cotton cultivar (Gossypium barbadense L.) Some physical and chemical properties of the experimental site (0–30 cm depth) were determined according to Klute (1986) and Page *et al* (1982), respectively and listed in Table (1). Also, soil sample were taken from each plots after harvest to determine some soil properties according to Page *et al* (1992).

Table 1. Some physical and chemical properties of the studied experimental soil.

Soil properties	First season	Second season
Physical properties		
Partical size distribution		
Sand %	14.7	11.9
Silt %	30.2	33.5
Clay %	55.1	54.6
Texture grade	Clay	Clay
Chemical properties		
pH (1: 2.5 soil- water supspension)	8.0	7.9
EC, soil paste (dSm^{-1})	1.31	1.25
Organic matter %	1.11	1.22
Available N (ugg^{-1})	21.5	25.6
Available P(ugg^{-1})	13.7	13.1
Available K (ugg^{-1})	142	156
DTPA – extractable Fe (ugg^{-1})	2.1	2.7
DTPA – extractable Mn (ugg^{-1})	1.7	1.8
DTPA – extractable Zn (ugg^{-1})	0.46	0.41

Table 2. Chemical composition of farmyard manure used in the experiment

Characteristic	First season	Second season
pH	7.6	7.7
EC	7.5	7.7
Organic matter %	28.9	26.7
Total nitrogen %	1.45	1.57
Total phosphorus %	0.33	0.39
Total potassium	1.38	1.45
DTPA – extractable Fe (ppm)	5.16	6.39
DTPA – extractable Mn (ppm)	3.25	3.69
DTPA – extractable Zn (ppm)	1.73	1.80

Also, sample of farmyard manure (FYM) used in the experiment was dried at 60 C° and ground to pass through 2mm sieve, chemical properties were determined (Table,2) as follows.

Organic matter content was determined using the Walkley and Black method (Page *et al*, 1982).

Total N, P and K were determined according to the methods described by Chapman and Pratt (1978).

Available Fe, Mn and Zn were extracted by DTPA according to Lindsay and Norvell (1978) and determined using Perkin-Elmer Emission Spectrophotometer.

The experimental design was split plot design in four replications, the first factor is the integrated inorganic and organic fertilizers, i.e., full recommended NPK rates 100% RDF for cotton (70, 30 and 24 kg N, P2O5 and K2O /fed, respectively), 75% from the recommended NPK rates (75% RDF) + 5 t farmyard manure (FYM) /fed) and 50% from the recommended NPK rates (50% RDF) +10 t /fed FYM) /fed). The second factor is foliar spraying of micronutrients (Fe, Mn, Zn, Fe + Mn, Fe + Zn, Mn + Zn and Fe + Mn + Zn).

The organic fertilizer was added befor sowing during land preparation, while inorganic nitrogen and potassium fertilizers were added as ammonium nitrate (33.5% N) at two equal doses and potassium sulphate (48% K2O) , the first before the second irrigation and the second before the third irrigation. The phosphorus fertilizer was added as supperphosphate (15.5%P2O5) before sowing. On the other hand, foliar spraying of micronutrients were done twice after one mounth from sowing and the other at one mounth later at rates of 0.6, 0.3 and 0.3% for Fe, Mn, and Zn, as sulphate salts.

The inorganic – organic treatments were located in main plots, while micronutrients treatments were tock place in sub plots. The experimental plot was 13 m² (1/323 fed), five ridges (4m long and 0.65m width with distance of 0.30 m between hills). The preceding crop is maize (Zea maize) for the two seasons. Cotton seeds were sown 1 and 3 April in the two seasons, respectively. Hills were thinned after five weeks from planting to two plants. Other cultural practices were done as recommended for cotton in district.

At harvesting, five hill plants were taken randomly from each plots to determine the following parameters : –

Growth parameters

1 – Plant height (cm).
2 –Node number of first fruiting branch.
3 –No of fruiting branches / plant.
4 – No of green branches / plant.
5 –No of total bolls / plant.

Yield and yield components

1 – No of open bolls / plant.
2 – Boll weight (g).
3 – Yield / plant (g).
4 – Lint %.
5 – Yield /fed (kentar).

Analysis of variance was performed on all collected data according to Snedecor and Cochran (1980) and the treatment averages were compared at level of probability using L.S.D.

RESULTS AND DISCUSSION

Growth parameters

Data in Table (3) represent the response of some growth parameters of cotton to inorganic and organic fertilizers (A). The results reveal that all studied growth parameters were significantly affected by inorganic and organic treatments. Half recommended rates of NPK plus 10 ton farmyard manure per feddan produced highest values of plant height and number of fruiting branches which may be due the improvement of fertility status, microbial activity and physical properties caused by FYM application (Abd El-Hafeez, 2009). Similar results were obtained by Reddy *et al* (2007) and Khambalkar *et al* (2017) who stated that cotton growth parameters were increased due to organic manure application.. Also, this treatment improved the node number of first fruiting branches. On the other hand, number of green branches and number of total bolls were significantly responded to 100 % recommended NPK rates and then decreased as inorganic NPK fertilizer rates decreased.

As for foliar spraying (B), the data in Table (4) clearly show that micronutrients application was significantly affected all studied growth parameters. In general, it could be notice that spraying cotton plant with Fe, Mn or Zn in single form or in its combination, except Fe + Mn + Zn treatment were improved all studied growth parameters than without micronutrients or mixed the three studied micronutrient treatment (Fe + Mn + Zn). The increase in cotton growth due to micronutrients might be due to manganese acts as an activator for many enzymes which promote plant growth and flower production (Ohki, 1973). Also, it effects on stem elongation (Marschner, 1995).As for iron, it act on photosynthesis and other light dependant processes (Amberger, 1974). Concerning the effect of zinc, it is it is involved in many enzymatic activaros, it is important in the synthesis of tryptophane, a component of protein and compound needed for the production of growth hormones like indole acetic acid (Mengle *et al*, 2001). Moreover, one of these most reasons is high pH value of Egyptian soils, which hiders the utilization of these nutrients by plants. Another one is the deprived of the Egyptian soils from the humus coming from upper regions with Nile water as a side effect of High Dam. However, the negative effect of combined the three micronutrients (Fe + Mn + Zn) on cotton growth is mainly due to the antagonistic effect among these nutrients. In this concern, Jones *et al* (1991) mentioned that high zinc will induce a Fe deficiency in many plants. Many authors reported that Fe and Mn are interrelated in their metabolic functions, with the effectiveness of one determined by the proportional presence of the other (Mortvedt *et al*, 1972).

Table 3. The main effect of mineral NPK fertilization in combined with organic manure on some growth parameters of cotton (A).

Integrated macronutrients 2015 season	Plant height (cm)	Node number of first fruiting branch	No of fruiting branch/plant	No of green branch/plant	No of total bolls /plant
	2015	2015	2015	2015	2015
100% mineral NPK	125.1	8.3	12.8	1.4	21.1
75 % mineral NPK + 5 t FYM /fed	125.7	8.2	13.0	1.3	20.3
50 % mineral NPK + 10 t FYM /fed	126.9	8.1	13.1	1.2	19.3
L.S.D at 0.05	0.5	0.04	0.07	0.03	0.09
Integrated macronutrients 2016 season	Plant height (cm)	Node number of first fruiting branch	No of fruiting branch/plant	No of green branch/plant	No of total bolls/plant
	2016	2016	2016	2016	2016
100% mineral NPK	126.5	8.3	12.8	1.4	21.1
75 % mineral NPK +5 t FYM /fed	127.2	8.2	13.0	1.3	20.4
50 % mineral NPK +10 t F YM /fed	126.0	8.2	13.2	1.2	19.4
L.S.D at 0.05	0.60	0.05	0.08	0.04	0.10

Table 4. The main effect of micronutrients on some growth parameters of cotton (B) 2015 and 2016 seasons.

Micronutrients	Plant height (cm)		Node number of first fruiting branch		No of fruiting branches /plant		No of green branches /plant		No of total bolls/plant	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Without	125.5	127.8	8.1	8.2	12.4	12.5	1.4	1.4	19.7	19.8
Fe	126.7	129.7	8.2	8.3	13.0	13.0	1.5	1.0	20.8	20.8
Mn	126.0	127.6	8.1	8.2	12.8	12.9	1.5	1.5	19.8	19.9
Zn	125.4	127.3	8.3	8.4	13.6	13.5	1.4	1.4	20.1	20.2
Fe + Mn	126.1	126.9	8.3	8.3	13.0	13.0	1.0	1.0	20.2	20.3
Fe + Zn	127.6	128.1	8.1	8.2	13.3	13.2	1.3	1.3	20.4	20.4
Mn + Zn	127.2	127.2	8.1	8.1	12.9	12.8	1.3	1.3	20.8	20.9
Fe + Mn + Zn	122.6	123.7	8.2	8.3	12.7	12.7	1.4	1.4	19.9	20.1
L.S.D at 0.05	0.5	0.5	0.04	0.04	0.07	0.08	0.03	0.03	0.11	0.10

Data in Table (5) show the response of some growth parameters of cotton to the interaction between inorganic – organic fertilizers and micronutrients application on cotton growth. The results clearly show that, the plant height was only affected by the interaction between treatments, where in the absence of micronutrients, the plant height was increased as increasing organic manure rates in both seasons. This may be due to the studied FYM fertilizer contain some amounts of micronutrients (Table, 2). In this respect, Gary *et al* (2001) reported that organic manure is considered a source of plant nutrients. Furthermore organic manure play on important role to enhance the nutrients availability such as micronutrients (Mohanty *et al*, 2006).

Table 5. Effect of the interaction between macronutrients and micronutrients on some growth parameters of cotton (A×B).

season 2015

Micronutrients	Plant height (cm)			Node number of first fruiting branch			No of fruiting branches/plant			No of green branches/plant			No of total bolls / plant		
	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK +5 t FYM /fed
Without	122.3	126.0	128.3	8.1	8.2	8.1	12.4	12.5	12.4	1.9	1.4	1.0	21.6	12.6	18.0
Fe	126.5	126.4	127.3	8.5	8.1	8.2	12.8	12.9	13.3	1.0	1.1	1.2	21.4	20.8	20.1
Mn	124.8	123.3	130.0	8.3	8.1	8.1	12.7	12.8	13.0	1.5	1.5	1.5	19.2	21.0	19.3
Zn	123.5	127.3	125.5	8.3	8.3	8.4	13.4	13.5	13.8	2.1	1.3	0.9	20.1	20.6	19.6
Fe+Mn	125.4	128.5	124.5	8.5	8.2	8.2	12.7	13.3	12.9	1.1	1.0	1.0	22.2	19.6	18.7
Fe+Zn	127.3	127.5	128.0	8.1	8.1	8.1	12.8	13.8	13.2	1.0	1.2	1.8	21.7	19.9	19.6
Mn+Zn	125.8	125.5	130.4	8.1	8.2	8.0	12.6	12.6	13.5	1.6	1.3	1.0	21.6	20.1	20.6
Fe+Mn+Zn	125.1	121.4	121.4	8.4	8.2	8.2	12.6	17.5	12.9	1.4	1.5	1.3	20.4	20.2	18.4
L.S.D at 0.05	0.71			NS			NS			NS			NS		

Season 2016

Micronutirents	Plant height (cm)			Node number of first fruiting branch			No of fruiting branches / plant			No of green branches / plant			No of total bolls / plant		
	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 5 t FYM /fed
Without	124.7	127.9	129.3	8.1	8.3	8.1	12.5	12.5	12.6	1.9	1.4	1.0	21.7	19.7	16.1
Fe	128.9	129.4	130.8	8.5	8.1	8.2	12.8	12.9	13.4	1.0	1.0	1.1	21.5	20.9	20.1
Mn	125.9	125.8	131.2	8.3	8.1	8.1	12.8	12.9	13.1	1.4	1.5	1.4	19.3	21.0	19.3
Zn	125.5	128.6	127.7	8.4	8.3	8.5	13.4	13.5	13.7	2.0	1.3	0.9	20.1	20.7	19.7
Fe+Mn	126.6	128.9	125.1	8.5	8.3	8.3	12.6	13.2	13.1	1.0	0.9	0.9	22.3	19.7	18.9
Fe+Zn	127.9	128.1	128.3	8.1	8.2	8.2	12.8	13.6	13.3	1.0	1.1	1.8	21.7	19.9	19.6
Mn+Zn	126.7	126.3	128.7	8.1	8.2	8.0	12.5	12.7	13.3	1.5	1.3	0.9	21.7	20.2	20.8
Fe+Mn+Zn	125.9	122.5	122.6	8.5	8.3	8.1	12.6	12.6	12.9	1.4	1.5	1.3	20.4	21.2	18.5
L.S.D at 0.05	0.73			NS			NS			NS			NS		

Yield and its components : –

The results listed in Table (6) represent the main effect of inorganic and organic fertilization (A) on seed cotton yield and its components. The results clearly show that the yield and its components were significantly affected by inorganic and/or organic fertilizer treatments in both seasons, except lint percentage, which not affected. It could be arranged the effect of inorganic – organic fertilization on cotton yield and its components on the descending order as follow : 75 % RDF + 5 t FYM / fed > 100 % RDF > 50 % RDF + 10 t FYM /fed. The relative increasing in seed cotton yield caused by 75 % NPK + 5 t FYM /fed treatment reached to 3.62 and 1.24 % when compared with 100 % NPK and 50 % NPK + 10 t FYM /fed, respectively in the first season. The corresponding increasing in the second season were 5.7 and 1.22 % in the same respect. The treatment of 75 % RDT + 5 t FYM /fed found to be produced more number of open bolls / plant, heaviest boll weight, and greatest yield / plant or fed. These results may be due to added 5 t FYM improved chemical, microbial and physical properties of soil. These results are in line with those obtained by Reddy *et al* (2007) and Khambalker *et al* (2017) who stated that combined organic manure with inorganic fertilizers enhanced the cotton yield and its components than inorganic fertilizer alone.

With respect to micronutrients, the data in Table (7) clearly show that micronutrient treatments (B) had significant effects on yield and its components of cotton, except lint percentage in both seasons. All studied micronutrients enhanced number of open polls, / plant, boll weight, yield / plant and yield /fed than without micronutrients. In general, foliar spraying of Fe, Zn, Fe + Mn, Fe + Zn and Mn + Zn yielded the highest values of yield and yields components parameters than others. Fe or Mn + Zn could be provid the best treatments for cotton productivity. It is obvious to observe that the treatment of combined Fe plus Mn and Zn exerted the lowest productivity of cotton than single or dual application of micronutrients, which is mainly due to the antagonistic effect among micronutrients, especially between Fe and Mn (Jones, *et al*, 1991). These results are in harmony with those obtained by Eleyan *et al* (2014).

Table 6. The main effect of mineral NPK fertilization in combined with organic manure on seed cotton yield and its components (A).

Season 2015					
Integrated macronutrients	**No of open poll / plant**	**Boll weight (g)**	**Yield / plant (g)**	**Lint %**	**Yield /fed (kentar)**
100% mineral NPK	16.5	2.44	40.06	41.79	12.46
75 % mineral NPK +5 t FYM /fed	16.7	2.53	42.01	41.68	13.17
50 % mineral NPK + 10 t FYM /fed	16.6	2.52	41.5	41.58	12.97
L.S.D at 0.05	0.08	0.03	0.25	NS	0.07
Season 2016					
Integrated macronutrients	No of open poll / plant	Boll weight (g)	Yield / plant (g)	Lint %	Yield /fed (kentar)
100% mineral NPK	16.5	2.49	40.83	41.77	12.54
75 % mineral NPK +5 t FYM /fed	17.0	2.55	42.17	41.66	13.26
50 % mineral NPK + 10 t FYM /fed	16.6	2.54	41.56	4161	13.10
L.S.D at 0.05	0.07	0.03	0.26	NS	0.06

Table 7. The main effect of micronutrients on seed cotton yield and its Components (B).

Season 2015					
Components	**No of open bolls / plant**	**Boll weight (g)**	**Yield / plant (g)**	**Lint %**	**Yield /fed (kentar)**
Without	16.1	2.40	38.39	41.96	11.81
Fe	17.0	2.51	42.52	41.60	13.25
Mn	16.5	2.51	41.02	41.70	12.78
Zn	16.5	2.51	41.44	41.67	12.91
Fe + Mn	16.5	2.51	41.39	41.63	12.98
Fe + Zn	16.6	2.52	41.85	41.66	13.12
Mn + Zn	17.0	2.55	42.75	41.67	13.31
Fe + Mn + Zn	16.2	2.47	40.15	41.57	12.81
L.S.D at 0.05	0.07	0.03	0.21	NS	0.07
Season 2016					
Components	No of open bolls /plant	Boll Weight (g)	Yield / plant (g)	Lint %	Yield /fed (kentar)
Without	16.0	2.50	38.11	41.98	11.86
Fe	17.5	2.54	42.58	41.57	13.35
Mn	16.7	2.51	41.35	41.72	12.85
Zn	17.3	2.52	41.73	41.64	13.02
Fe + Mn	16.4	2.53	41.49	41.66	13.12
Fe + Zn	16.8	2.54	42.02	41.63	13.24
Mn + Zn	17.1	2.55	42.87	41.64	13.37
Fe + Mn + Zn	16.4	2.49	40.43	41.61	12.93
L.S.D at 0.05	0.06	0.03	0.24	NS	0.06

The data in Table (8) show the effect of the interaction between inorganic – organic and micronutrient treatments on the studied yield of cotton and its components. The data clearly indicate that all studied yield and yield components did not respond to the interaction between the two studied factors. This means that, in general, the highest cotton productivity were recorded under Fe + Zn or Mn + Zn when combined with 75 % RDF + 5 t FYM /fed (13.67 or 13.86 kentar /fed, respectively), or Fe + 50 % RDF + 10 t FYM /fed (13.73 kentar /fed). Similar trends were obtained for the second season. On the other hand, the treatment of 100 % RDF in absence of micronutrients recorded the lowest values of seed cotton yield and its components. (11.67 and 11.72 kentar /fed in both seasons, respectively).

Soil properties : –

Results of the effect of the treating the tested soil with integrated NPK inorganic and organic manure, foliar spraying of some micronutrients and their interaction are given in Tables 9, 10 and 11. The obtained data clearly reveal that pH, E.C, soil organic matter as well as soil available N, P and K in soil after harvest were only responded to FYM application, while mineral N, P and K and micronutrients application as well as the interaction between treatments did not effect

the studied soil properties. It is obvious to notice that added organic manure increased E.C, O.M% and soil available NPK, while it reduced soil reaction in both seasons. The effect of organic manure was more pronounced as increasing FYM from 5 to 10 t / fed. The decrease in pH value due to FYM application could be ascribed to the acidifying effect of organic acids produced during the course of continuous decomposition of applied manure (Hizal, 1993). Similar results were obtained by Ali (2010). The increase in EC value due to FYM application is mainly due to its high salinity content (Table, 2). These results are in line with those obtained by Sayed (2009). The positive affect of FYM on increasing soil organic matter and soil NPPK after harvest is mostly due to the high content of the FYM of organic carbon and total N, P and K. These results agree with those obtained by Wong *et al* (1999) and Abd-El-lattif (2012).

Table 8. Effect of the interaction between macronutrients and micronutrients on seed cotton yield and its components of cotton (A×B).

season 2015

Micronutirents	No of open bolls / plant			Boll weight (g)			yield / plant (g)			Lint %			Seed cotton yield/fed (kentar)		
	100% NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed
Without	16.7	16.5	15.9	2.36	2.40	2.45	36.75	39.47	38.95	42.75	41.77	41.36	11.67	11.96	11.80
Fe	17.1	16.7	17.2	2.44	2.55	2.53	41.60	42.45	43.50	41.63	41.60	41.58	12.81	13.22	13.73
Mn	16.1	16.7	16.6	2.39	2.55	2.58	38.26	42.09	42.70	41.79	41.72	41.58	11.63	13.30	13.42
Zn	16.3	16.8	16.4	2.40	2.55	2.59	39.18	42.83	42.32	41.61	41.60	41.79	11.97	13.34	13.43
Fe+Mn	16.7	16.8	16.1	2.49	2.58	2.46	41.44	43.13	39.61	41.63	41.72	41.55	13.31	13.52	12.12
Fe+Zn	16.2	16.8	16.9	2.49	2.57	2.50	40.42	42.81	42.27	41.75	41.65	41.57	12.37	13.67	13.33
Mn+Zn	16.6	17.0	17.4	2.49	2.58	2.57	41.39	43.70	43.16	41.49	41.76	41.77	12.56	13.86	13.51
Fe+Mn+Zn	16.7	16.0	16.0	2.48	2.47	2.47	41.40	39.59	39.59	41.66	41.59	41.47	13.38	12.51	12.55
L.S.D at 0.05	NS			NS			NS			NS			NS		

Season 2016

Micronutirents	No of open bolls / plant			Boll weight (g)			yield / plant (g)			Lint %			Seed cotton yield / fed (kentar)		
	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed	100 % NPK	75% NPK + 5 t FYM /fed	50% NPK + 10 t FYM /fed
Without	15.4	16.6	15.9	2.59	2.44	2.47	38.79	39.51	39.03	42.77	41.69	41.47	11.72	12.01	11.85
Fe	17.4	17.8	17.3	2.46	2.58	2.59	41.69	42.51	43.55	41.56	41.61	41.55	12.89	13.31	13.85
Mn	16.4	16.9	16.7	2.41	2.55	2.58	39.31	42.10	42.65	41.75	41.72	41.62	11.71	13.33	13.50
Zn	16.5	16.9	16.5	2.41	2.56	2.60	40.01	42.88	42.29	41.63	41.60	41.69	12.05	13.50	13.52
Fe+Mn	16.0	16.9	16.2	2.51	2.58	2.49	41.53	43.26	39.79	41.64	41.70	41.65	13.40	13.58	12.37
Fe+Zn	16.4	17.1	16.9	2.51	2.58	2.54	40.56	43.10	42.41	41.69	41.62	41.57	12.46	13.73	13.52
Mn+Zn	16.7	17.5	17.2	2.50	2.58	2.57	41.47	43.88	43.25	41.50	41.70	41.72	12.66	13.32	11.54
Fe+Mn+Zn	16.8	16.2	16.2	2.50	2.49	2.48	41.55	40.12	39.63	41.65	41.62	41.57	13.42	12.71	12.67
L.S.D at 0.05	NS			NS			NS			NS			NS		

Table 9. The main effect of mineral NPK fertilization in combined with organic manure on soil properties.

Integrated macronutrients	pH		E.C		O.M%		Soil available N (ugg^{-1})		Soil available P (ugg^{-1})		Soil available K (ugg^{-1})	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
100 % minral NPK	8.01	7.92	1.32	1.26	1.13	1.21	22.1	25.5	13.6	13.2	140	151
75 % minral NPK + 5 t FYM / fed	7.91	7.81	1.054	1.55	1.33	1.42	26.6	29.2	15.2	15.3	170	182
50 % minral NPK + 10 t FYM / fed	7.84	7.78	1.75	1.72	1.51	1.59	29.3	32.3	16.6	17.3	195	201
L.S.D at 0.05	0.06	0.05	0.11	0.12	0.10	0.11	1.03	1.04	0.65	0.71	2.56	2.66

Table 10. The main effect of micronutrients on some soil properties.

Micronutrients	pH		E.C		O.M%		Soil available N (ugg^{-1})		Soil available P (ugg^{-1})		Soil available K (ugg^{-1})	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Without	7.93	7.82	1.54	1.51	1.33	1.40	26.0	29.0	15.1	15.2	168	177
Fe	7.92	7.83	1.54	1.51	1.32	1.40	26.0	29.1	15.1	15.2	168	178
Mn	7.91	7.84	1.55	1.52	1.31	1.41	26.0	29.0	15.2	15.2	168	179
Zn	7.92	7.84	1.54	1.50	1.31	1.40	25.9	29.1	15.1	15.2	168	178
Fe + Mn	7.92	7.85	1.54	1.51	1.32	1.41	26.0	29.0	15.1	15.2	168	178
Fe + Zn	7.93	7.84	1.54	1.51	1.32	1.42	26.0	29.2	15.1	15.4	169	178
Mn + Zn	7.91	7.84	1.53	1.51	1.32	1.41	25.9	29.0	15.1	15.4	169	178
Fe + Mn + Zn	7.91	7.85	1.54	1.51	1.33	1.41	26.0	28.9	15.1	15.4	167	180
L.S.d at 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 11. Effect of the interaction between macronutrients and micronutrients on some soil properties.

Micronutrients	pH			E.C			O.M%			Soil available N (ugg^{-1})			Soil available P (ugg^{-1})			Soil available K (ugg^{-1})		
	100 % minral NPK	75 % minral NPK + 5 t FYM / fed	50 % minral NPK + 10 t FYM / fed	100 % minral NPK	75 % minral NPK + 5 t FYM / fed	50 % minral NPK + 10 t FYM / fed	100 % minral NPK	75 % minral NPK + 5 t FYM / fed	50 % minral NPK + 10 t FYM / fed	100 % minral NPK	75 % minral NPK + 5 t FYM / fed	50 % minral NPK + 10 t FYM / fed	100 % minral NPK	75 % minral NPK + 5 t FYM / fed	50 % minral NPK + 10 t FYM / fed	100 % minral NPK	75 % minral NPK + 5 t FYM / fed	50 % minral NPK + 10 t FYM / fed
Season 2015																		
Without	8.01	7.92	7.86	1.33	1.54	1.75	1.13	1.34	1.51	22.1	26.6	29.3	13.6	15.1	16.7	140	170	195
Fe	8.01	7.91	7.85	1.32	1.55	1.74	1.13	1.33	1.50	22.1	26.7	29.2	13.5	15.2	16.7	138	171	196
Mn	8.00	7.90	7.83	1.33	1.54	1.77	1.12	1.32	1.50	22.0	26.6	29.3	13.6	15.2	16.8	139	169	196
Zn	8.01	7.91	7.85	1.32	1.54	1.75	1.11	1.33	1.50	22.1	26.5	29.2	13.5	15.2	16.6	141	169	195
Fe + Mn	8.01	7.93	7.83	1.31	1.54	1.76	1.13	1.33	1.51	22.1	26.6	29.3	13.6	15.1	16.5	140	170	194
Fe + Zn	8.01	7.93	7.84	1.33	1.55	1.73	1.12	1.32	1.51	22.1	26.6	29.2	13.6	15.1	16.6	141	170	195
Mn + Zn	8.02	7.91	7.83	1.32	1.54	1.74	1.14	1.32	1.51	22.0	26.5	29.3	13.5	15.2	16.5	139	172	195
Fe + Mn + Zn	8.01	7.90	7.83	1.31	1.55	1.75	1.13	1.33	1.52	22.2	26.5	29.2	13.5	15.2	16.6	138	170	193
L.S D at 0.05		NS			NS			NS			NS			NS			NS	
Season 2016																		
Without	7.91	7.81	7.74	1.27	1.55	1.70	1.21	1.40	1.60	25.6	29.0	32.3	13.1	15.4	17.1	152	180	200
Fe	7.91	7.82	7.77	1.26	1.55	1.71	1.22	1.40	1.58	25.6	29.0	32.6	13.1	15.3	17.2	151	181	201
Mn	7.93	7.82	7.77	1.26	1.56	1.73	1.21	1.43	1.58	25.7	29.1	32.1	13.2	15.3	17.1	151	183	202
Zn	7.92	7.83	7.78	1.25	1.55	1.70	1.21	1.44	1.59	25.5	29.3	32.5	13.2	15.1	17.3	152	180	202
Fe + Mn	7.94	7.81	7.79	1.27	1.53	1.72	1.21	1.41	1.60	25.6	29.1	32.2	13.1	15.3	17.1	150	181	203
Fe + Zn	7.93	7.81	7.78	1.27	1.54	1.72	1.22	1.43	1.61	25.4	29.4	32.7	13.3	15.5	17.3	150	183	200
Mn + Zn	7.92	7.82	7.78	1.25	1.55	1.73	1.21	1.44	1.59	25.3	29.5	32.2	13.3	15.3	17.6	151	181	201
Fe + Mn + Zn	7.93	7.82	7.80	1.26	1.54	1.72	1.20	1.44	1.58	25.6	29.1	32.1	13.4	15.1	17.7	153	185	202
L.S D at 0.05		NS			NS			NS			NS			NS			NS	

CONCLUSION

It could be concluded that fertilized cotton plants with 75 % RDF + 5 t FYM /fed under foliar spraying of Fe, Zn, Fe + Zn or Mn + Zn resulted maximum productivity of cotton as well as improving soil properties. Furthermore, it could be recommended to avoid spraying cotton plants with the mixture of Fe, Mn and Zn to prevent the antagonistic effect between these nutrients under clay alluvial soil in Middle Egypt.

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تأثير التسميد التكاملى المعدنى والعضوى مع استخدام الرش ببعض العناصر الصغرى على محصول القطن.

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اقيمت تجربتان حقليتان بمحطة البحوث الزراعية بسدس – مركز البحوث الزراعية – محافظة بنى سويف خلال موسمى النمو 2015 , 2016 لدراسة تأثير التسميد المتكامل على انتاجية القطن تحت ظروف الاراضى الطينية الرسوبية بمصر الوسطى وكذلك تأثيرها على بعض خواص التربة بعد الحصاد , واجريت التجربة فى قطاعات منشقة , حيث اضيفت اسمدة النيتروجين والفسفور والبوتاسيوم المعدنية الموصى بها وكذلك السماد البلدى فى القطع الرئيسية (100 % من الموصى به من اسمدة النيتروجين والفسفور والبوتاسيوم , 75 % من اسمدة النيتروجين والفسفور والبوتاسيوم الموصى بها + 5 طن سماد بلدى / فدان , 50 % من اسمدة النيتروجين والفسفور والبوتاسيوم الموصى بها + 10 طن سماد بلدى / فدان) بينما اضيفت معاملات رش العناصر فى القطع المنشقة (حديد , منجنيز , زنك , حديد + منجنيز , حديد + زنك , منجنيز + زنك , حديد + منجنيز + زنك). وكانت اهم النتائج المتحصل عليها كما يلى : – - أدت معاملة 50 % من الموصى به من اسمدة النيتروجين والفوسفور والبوتاسيم + 10 طن سماد بلدى / فدان إلى أعلى قيم لطول النبات ,عدد الافرع الثمرية , واقل ارتفاع لأول فرع ثمرى , بينما ادت معاملة 100 % من الموصى به لعناصر النيتروجين والفسفور والبوتاسيوم إلى اكبر عدد للفروع الخضرية وعدد اللوز الكلى. - أدت معاملة 75 % من الموصى به من اسمدة النيتروجين والفوسفور والبوتاسيم + 5 طن سماد بلدى / فدان إلى أعلى قيم لمحصول القطن وخصائص المحصول ما عدا النسبة المئوية لتصافى الحليج التى لم تتأثر. - أدى رش نباتات القطن بالحديد او الزنك أو الحديد + الزنك أو المنجنيز + الزنك إلى أعلى قيم لخصائص النمو والمحصول ومكوناته. - أدى إضافة السماد البلدى إلى انخفاض حموضة التربة وزيادة محتواها من المادة العضوية وزيادة صلاحية عناصر النتروجين والفسفور والبوتاسيوم فى التربة بعد الحصاد , ومن ناحية اخرى زادت ملوحة التربة باضافة المادة العضوية مقارنا بالمعاملات الاخرى. - من نتائج التداخل بين التسميد المعدنى والعضوى من ناحية والرش بالعناصر الصغرى من ناحية اخرى فأنه عموما يمكن الحصول على أعلى انتاجية للقطن عند تسميدة 75 % من المعدل الموصى به من عناصر النيتروجين والفوسفور والبوتاسيم + 5 طن سماد بلدى / فدان + رش عناصر الحديد أو الزنك أو الحديد + الزنك أو المنجنيز + الزنك , كما يمكن التوصية بعدم رش الثلاث عناصر مجتمعة معاً (حديد + منجنيز + زنك) لتأثيرهم السلبى على نمو وإنتاجية القطن نتيجة ظاهرة التضاد بينهم.