Assiut J. Agric. Sci., (48) No. (1-1) 2017 (229-250) *ISSN: 1110-0486*
Website: http://www.aun.edu.eg/faculty_agriculture *E-mail: ajas@aun.edu.eg*

Use of Some Organic and Bio Fertilizers as a Partial Substitution of the Mineral Nitrogen Fertilization for Corn
1-The Effect on Corn Yield and N, P and K uptake.

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Received on: 19/10/2016 **Accepted for publication on:** 1/11/2016

Abstract

A field experiment was conducted at Shandweel Agricultural Research Stations, Sohag Governorate, during each of the two successive summer seasons 2014 and 2015 to study the effects of organic and bio fertilizers as a partial substitution of the mineral nitrogen fertilization and their effects on yield, (N,P and K uptake) and protein content in grains for the TWC 310 maize cultivar. The used soil was clay loam in texture, having pH 7.7, O.M 1.27%. The experiments were laid down in split-split plot design with four replications. The experiments included 27 treatments, which were the combination of 3 nitrogen levels (60,90 and 120 kg N fed^{-1}), 3 treatments of organic and bio fertilizer (without organic and bio fertilizer, 10m^3 FYM fed^{-1} and microbein inoculume) and 3 treatments of humic acid (water spraying, humic and fulvic acid spraying) at a rate (2% v/v) at two times (30 and 45 days from planting). The obtained results revealed that a significant and gradual increase in grain yield, N, P and K uptake and protein content were found by increasing nitrogen fertilizer levels from 60 to 120 kg N fed^{-1} during the two seasons of the study. The results also revealed significant improvements in grain yield and N, P and K uptake and protein content due to the applications of farm yard manure or (Microbein) compared with the control (without organic and bio fertilizers) in both seasons. The effect of spraying humic acid was significant for all studied traits. The interaction effects of all factors under study were significant for all studied traits. The highest values in grain yield were (29.078 and 28.735 ard. fed^{-1}) and were obtained by adding 90 kg N fed^{-1}. combined with 10m3 FYM fed^{-1}. and sprayed with F.A during 2014 and 2015 seasons respectively. It can be recommended that the possibility to minimize the application of chemical fertilizer and in the same time increasing maize production in quantity and quality was true by adding organic and/or bio fertilizers.

Keywords: *Nitrogen fertilizer, FYM Bio-fertilizer, Humic acids, Nutrient content, corn*

Introduction

Corn (*Zea mays* L.) is one of the main cultivated cereals all around the world. It is one of the important crops principally during the summer season in Egypt(1,724,000 faddan for white maize and 415,245 faddan for yellow maize one faddan =0.42ha). Egypt produces about 5.8 million tons of white corn and 1.3 million tons of yellow corn annually (Haggag 2013). Maize grain is used for human consumption, animal and poultry and industrial purposes. The total production is insufficient to meet local consumption due to low productivity per area unit and limited cultivated area. During the last few decades the food demand sharply increased across the world, therefore, there are a large extensive agricultural lands has been shifted to intensive agriculture, it put the natural resources, including the land, under a high pressure. Many kinds of soils became incapable of supplying the high yield by their micronutrient requirements. With intensive cropping the best natively fertile soils, stress eventually occurs in the proper procedures are not followed to replace crop- removed nutrient elements and to maintain the proper nutrient element balance for optimum plant growth (Jones 2001). For many years agricultural research has aimed at improving crop yields, while placing little importance on the quality of the products or environmental protection. More recently, the environmental impact of production methods, high production costs and the need to reduce chemical substances in the soil have become important agricultural objectives (Gastal and Limaire 2002). To promote efficient plant absorption of nutrients and reduce environmental pollution, a number of chemical molecules have been studied (Ertani *et al.,* 2009 and 2011). Nitrogen contributes 1-4% of dry matter production of the plants., Nitrogen deficiency causes stunted growth, delayed maturity and pale green or yellow color (chlorosis) of the leaves (Haque *et al.,* 2001). Increasing grain yield due to application of nitrogen fertilizer inorganic combined with FYM over the control may be due to the effect of FYM in improving the physical and chemical properties of the soil. As well as, organic manures plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization, (Abou El-Magd *et al*., 2006). Inoculation with *Bacillus megaterium* increased significantly nutrient content (N,P and K) in maize compared with control, (Hauka, 2000). N content in maize plant significantly increased by the synergistic effect mainly between both N-fixing bacteria and P-solubilizers microorganism, (El-Sawah, 2000). These compounds are defined as bio stimulants such as humic substances (HS). Humic acid is one of the major components of humic substances. Humic matter is formed through the chemical and biological humification of plant and animal matter and through the biological activities of microorganisms (Anonymous 2010). Humic substances have an important ability to be chelating –agents, they are in fact excellent in this role as strong enough to protect the micronutrients from leaching, but weak enough to release micronutrients to plants when required. The cationic micronutrients are most likely deficient on calcareous soils or soil high in organic matter where strong chelating decreases availability (Tan 1998 and Garcia *et al.* 2004). Yield and yield components of maize were maximum when applying 3 kg HA ha-1 and 160 kg N ha-1, (Kamran *et al*., 2014).

Materials and Methods

Field experiments were conducted at Shandweel Agricultural Research Stations, Sohag Governorate, during two successive summer seasons (2014 and 2015) to study the effect of organic and bio fertilizer as a partial substitution of the mineral nitrogen fertilization and their effects on yield and N,P and K uptake and protein content for the TWC 310 maize cultivar. The experimental design was split-split plot with four replication. Nitrogen levels were assigned to the main plots, applications of farm yard manure (FYM) and bio-fertilizer to the sub-plots and applications of Humic acid to the sub-sub-plots.

The treatments were as follows:

A- Main plots: Nitrogen fertilizer levels.

a1- 60 Kg N $fed.^{-1}$ (Control).

a2- 90 Kg N $fed.^{-1}$.

a3- 120 Kg N $fed.^{-1}$.

B- Sub-plots: organic and bio-fertilizers.

b1-Without organic and bio-fertilizers.

b2-Adding $10m^3$ FYM $fed.^{-1}$.

b3-Adding bio-fertilizer (Microbein).

C- Sub-sub-plots: Foliar application of Humic & Fulvic acid.

c1- Water spraying.

c2- Humic acid spraying.

c3- Fulvic acid spraying.

The preceded crop in the farm was wheat in both seasons. Each experimental plot consisted of five rows, three meters long and 70 cm apart. Planting was done in hills 30 cm apart, seeding rate was 15 kg/fed.. TWC 310 maize cultivar was planted on June 1st in 2014 and on June 3rd in 2015 seasons. Thinning was done before first irrigation (21 days from planting) to one plant/hill Which gave a population nearly of 20.000 plants/fed. The plants were harvested at maturity (120 days after planting in both seasons). Nitrogen fertilizer was applied in the form of urea (46.5% N) in two equal doses, the first dose was added before the first irrigation and other one was before the second irrigation. potassium fertilizer was added in the form of potassium sulphate (48% K_2O) to all plots of the experiment at the rate of 24 kg K_2O/fed. (50kg potassium sulphate) at planting. Super-phosphate (15 % P_2O_5) was added at the rate of 15 kg P_2O_5/fed. (100kg super-phosphate) during land preparation. Farm yard manure (FYM) was added at the rate of $10m^3$ FYM/fed. during land preparation. Bio-fertilizer (Microbein) was added as a soil application before the first irrigation. Foliar application of Humic acid (H.A) and Fulvic acid (F.A) were sprayed at a rate 4 liters/200 liters water per fed. in two times at 30 and 45 days after planting.

Soil characterization for the two experimental sites during the seasons 2014 and 2015 are listed in Table 1. The elements composition and chemical properties of the applied farm yard manure (FYM) during the seasons 2014 and 2015 are listed in Table 2,

Table 1. Some physical and chemical properties of the experimental soils.

Properties	Values	
	2014	2015
Physical analysis		
Particle size distribution (%):		
Sand	24.00	22.40
Silt	38.20	39.50
Clay	37.80	38.10
Textural class:	clay loam	clay loam
Chemical analysis		
Organic matter (%)	1.22	1.32
pH (1:2.5soil water susp.)	7.55	7.76
EC (dSm^{-1}, soil paste ext.)	0.87	0.92
$CaCo_3$ (%)	1.80	1.75
Soluble ions (meq/100g):		
Ca^{2+}	4.53	6.53
Mg^{2+}	3.17	2.38
Na^{+}	2.33	2.88
K^{+}	0.22	0.25
HCO_3^{-}	3.83	3.63
Cl^{-}	1.67	2.85
SO_4^{2-}	4.75	5.56
Available macronutrients (mgkg^{-1}):		
N	17.20	18.70
P	10.00	9.50
K	178	170

Table 2. Chemical properties of the applied farm yard manure (FYM) during the seasons 2014 and 2015.

Seasons	properties									
	pH	E.C dsm^{-1}	N (%)	P (%)	K (%)	O.M (%)	O.C (%)	C/N ratue	weight of 1 m^3 (kg)	moisture content (%)
(FYM) 2014	7.35	6.19	0.78	0.39	2.95	25.87	13.44	17.23	644	10.60
(FYM) 2015	7.13	6.38	0.67	0.50	2.90	23.99	12.48	18.63	610	8.35
pH and EC of the FYM were measured in 1:5 extract.										

The following characters were studied:

- **A- Yield:** Grain yield (ardab/fed.) at 15.5% moisture content.
- **B- Chemical composition:**
  1. N, P and K uptake in grains.
  2. Protein content in grains.

Nutrients determination:

Plant sample was taken at the harvest time from the grains of each plot. The grains samples were ground and kept for chemical analysis. Plant materials were digested using a mixture of concentrated H_2SO_4 and H_2O_2 30% (Jackson, 1973). Total nitrogen determined by using micro-Kjeldahl methody, as described by A.O.A.C (1980),. Phosphorus concentration in grains was determined colorimetric method using chlorostannous-phospholybdic acid using a spectrophotometer according to Jackson (1958). Potassium concentration in grains was determined using a flamphotometer according to Jackson (1973). The nutrient uptake was computed by multiplying the respective grains yield with nutrient contents and expressed as Kg/fed. Crude protein content was calculated by multiplying the value of nitrogen % by 5.9 according to Drk (1984).

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Statistical Analysis

The obtained data were subjected to proper statistical analysis of variance and (L.S.D.) test was used to compare the treatment means according to the procedures outlined by Sendecor and Cochran (1980).

Results and Discussion

As a general, the effect of the main factor (Nitrogen fertilization) on grain yield, N uptake, P uptake, K uptake and protein content was highly significant in both season. Similarly sub factor (Organic and bio fertilizers) was highly significant except for Potassium uptake in 2015 season which was just significant. The effect sub-sub factor (Humic and Fulvic acid spraying) was highly significant for all studied traits except Potassium uptake in 2014 season which was just significant., Table (3).

Table 3. Analysis of variance

Key Value	Source .V	Degrees of Freedom	Grain yield	N. uptake	P. uptake	K. uptake	Protein content	Grain yield	N. uptake	P. uptake	K. uptake	Protein content
			Mean Square									
			2014 season					2015 season				
1	Replication	3	0.071	0.070	0.033	0.319	0.024	0.147	0.354	0.067	0.313	0.013
2	Factor A	2	365.995**	4739.917**	190.947**	267.204**	22.188**	273.037**	4571.742**	190.062**	220.637**	29.704**
-3	Error	6	0.086	1.633	0.023	0.120	0.041	0.125	2.936	0.065	0.211	0.075
4	Factor B	2	24.506**	417.483**	16.866**	7.021**	2.177**	9.064**	241.945**	8.833**	1.051*	1.916**
6	AB	4	1.516**	20.085**	0.539**	2.053**	0.690**	1.613**	40.732**	3.436**	1.351**	0.878**
-7	Error	18	0.136	2.308	0.057	0.049	0.041	0.158	2.521	0.091	0.264	0.031
8	Factor C	2	4.461**	176.731**	4.212**	0.539*	2.331**	10.484**	218.084**	13.640**	1.782**	1.564**
10	AC	4	0.812**	9.743**	1.534**	0.707**	0.457**	0.924**	5.680n.s	3.422**	3.246**	0.167**
12	BC	4	0.153n.s	4.334n.s	0.959**	1.542**	0.184**	0.590*	9.779**	1.398**	0.791**	0.211**
14	ABC	8	0.694**	18.190**	1.500**	1.238**	0.233**	0.699**	20.490**	1.079**	0.818**	0.333**
-15	Error	54	0.158	2.521	0.099	0.165	0.039	0.179	2.346	0.099	0.146	0.039
	Total	107										

**, * and ns mean significant at 1% and 5% probability levels and not significant, respectively.

The interaction effect of factor A (Nitrogen fertilization) and factor B (Organic and bio fertilizers) was highly significant for all studied traits in both seasons. The interaction effect of factor A (Nitrogen fertilization) and factor C (Humic and Fulvic acid spraying) was highly significant except for Nitrogen uptake in 2015 season which was not significant. The interaction effect of factor B (Organic and bio fertilizers) and factor C (Humic and Fulvic acid spraying) was highly significant except for grain yield in 2015 season which was just significant. Also that grain yield and Nitrogen uptake in 2014 season which were not significant. The interaction effect of all the factor under study was highly significant for all studied traits during the two seasons under study., Table (3).

Table 4. **Effect of some organic and bio fertilizer as a Partial substitution of the mineral nitrogen fertilization on the grain yield (ard./fed.) in 2014 and 2015 seasons.**

Treatment		2014				2015			
		Foliar application of Humic & Fulvic acid (C)							
N mineral fertilizer (A)	organic & bio fertilizer (B)	water spray	Humic spray	Fulvic spray	Average	water spray	Humic spray	Fulvic spray	Average
(60kg N/F) (Control)	(without)	20.495	21.243	21.205	20.981	21.380	22.533	22.668	22.193
	10m^{3}FYM/F	22.555	23.648	22.785	22.996	21.513	23.585	23.355	22.818
	(Microben)	22.100	22.515	22.473	22.363	22.718	23.520	23.458	23.232
Average		21.717	22.468	22.154	22.113	21.870	23.213	23.160	22.748
(90kg N/F)	(without)	25.913	27.875	26.448	26.745	25.515	27.760	27.198	26.824
	10m^{3}FYM/F	28.413	28.713	29.078	28.734	27.965	28.493	28.735	28.398
	(Microben)	27.183	28.428	27.113	27.574	27.425	28.188	27.500	27.704
Average		27.169	28.338	27.546	27.684	26.968	28.147	27.811	27.642
(120kg N/F)	(without)	27.127	27.213	27.180	27.173	26.490	27.036	27.240	27.072
	10m^{3}FYM/F	27.973	28.339	28.046	28.119	27.308	28.318	27.703	27.776
	(Microben)	27.391	27.491	27.512	27.465	27.079	27.677	27.143	27.299
Average		27.479	27.681	27.579	27.586	27.109	27.677	27.362	27.382
Average for organic & bio-fertilizer	(without)	24.512	25.443	24.944	24.966	24.612	25.776	25.702	25.363
	10m^{3}FYM/F	26.313	26.900	26.636	26.616	25.595	26.798	26.598	26.330
	(Microben)	25.558	26.144	25.699	25.800	25.740	26.461	26.033	26.078
Average		25.461	26.162	25.760		25.316	26.365	26.111	

$L.S.D_{0.05}$	2014	2015
	A=0.169	A=0.204
	B=0.182	B=0.197
	AB=0.316	AB=0.341
	C=0.187	C=0.200
	AC=0.325	AC=0.346
	BC=N.S	BC=0.346
	ABC=0.562	ABC=0.599

I. Grain yield of maize as affected by inorganic, organic nitrogen fertilizers and activators (H.A and F.A).

As shown in Tables 3 and 4, it is clear that there is a significant and gradual increase in grain yield was found by increasing nitrogen fertilizer levels from 60 to 120 kg N fed.$^{-1}$ during the two seasons of the study. The highest values were obtained by adding 90 kg N fed.$^{-1}$ (27.684 and 27.642 ard. Fed.$^{-1}$) in 2014 and 2015 seasons, respectively. Nitrogen is the key element in increasing grain yield and quality of maize. Nitrogen contributes 1-4% of dry matter production of the plants., Nitrogen deficiency causes stunted growth, delayed maturity and pale green or yellow color (chlorosis) of the leaves (Haque *et al.*, 2001). The results are in agreement with Ortiz Monasterio *et al*. (1997), Derby *et al.,* (2004), El-sheikh, 1998; Samira *et al.,* 1998, Zeidan and Amany (2006) and (Singh, 1985).

Data given in Tables 3 and 4 indicated a significant improvement in grain yield was found due to the application of farm yard manure or bio-fertilizer (Microbein) more than the control (without organic fertilizers). The highest grain yield was obtained by application of 10m3 FYM fed.$^{-1}$ at land preparation during 2014 and 2015 seasons (26.616 and 26.330 ard. Fed.$^{-1}$, respectively). The increase of growth and yield components may be due to carry-over effect of applied nutrients to the preceding maize crop and higher availability of macro and micronutrients with the addition of FYM. This is in conformity with the findings of Ahmed and Thakur, (1998). The obtained results are in agreement with those reported by Munda *et.al*., (2007). Mokidul *et.al.,* (2012) reported that an increase in maize grain yield owing to adding green leaf manure and FYM incorporation may be attributed to release of nutrients to soil slowly for longer duration after decomposition resulting in better plant growth and yield attributing characters.

The data listed in Tables 3 and 4 showed that application of Humic acid or Fulvic acid (H.A or F.A) as a foliar spraying gave significantly increasing in grain yield in seasons 2014 and 2015. The highest grain yield was obtained by spraying (H.A) during 2014 and 2015 seasons (26.162 and 26.365 ard. fed.$^{-1}$, respectively). This may be attributed that humic acid affected plant physiology positively, including enhancement of biomass yields, induction of lateral roots emergence, increase of cell respiration and membrane uptake of nutrients and exertion of hormone-like activities Puglisi., *et.al.,*(2009). Celik *et al*. (2010) explained that humus had beneficial effects on nutrient uptake, transport and availability to maize plant that enhances the maize plant growth and increases maize yield. The ability of HA to release the nutrient slowly due to the decomposition of residue for a longer time could be the possible explanation for improved grain yield due HA application (Dev and Bhardwaj, 1995) These results are in agreement with Sharif *et al.* (2002) and (Kamran *et.al.,* 2014).

By examining the data obtained in Tables 3 and 4 it is clear that the interaction between nitrogen fertilizer levels and FYM or Microbein led to a significant increase in grain yield in both seasons. It was found that the application of 90 kg N fed.$^{-1}$ combined with 10m3 FYM/fed. gave the highest values of grain yield (28.734 and 28.398 ard. fed.$^{-1}$) in 2014 and 2015 seasons, respectively. Increasing grain yield due to application of nitrogen fertilizer levels combined with FYM over the control may be due to the effect of FYM in improving the physical and chemical properties of the soil. As well as, organic manures plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization, Abou El-Magd *et.al.,* (2006) and Chung *et. al.,* (2000) showed that application of organic manures with an adequate amount of chemical N fertilizer gave higher dry matter yield of maize. The results are in consistent with the findings of a number of workers (Mishra *et.al.,* 1995; Al-Abdulsalam, 1997; Pandey *et al.,* 1998; Radwan, 1998 and Wu *et. al.,* 2005). They demonstrated that under certain environmental and soil conditions, application of FYM and inoculation with *Azotobacter* improved crop yield.

Results in Tables 3 and 4 showed that the interaction between nitrogen fertilizers levels with the studied activators (H.A and F.A) gave significant and positive increases more than those without (H.A and F.A) in grain yield during the two seasons. The highest grain yield values (28.338 and 28.147 ard./fed.) were found in 2014 and 2015 seasons by adding 90 kg N/fed. with spraying of (H.A). Similar results were also reported by Sharif *et. al.* (2002) who recorded that 20 -23 % highest maize shoot dry weight and grain yield over control were found with application of humic acid in combination with recommended dose of NPK. These results are in agreement with Muhammad. W., *et.al.,* (2014), who reported that the higher grain yield due to HA application in this research corroborates the findings of David and Samule, (2002); Thenmozhi *et.al.* (2004); Albayrak, (2005); Khan *et.al.* (2010); Vanitha and Mohandass, (2014); Almarshadi and Ismail, (2014).

The data in Tables 3 and 4 indicated that the interaction effect between adding FYM or Microbein with spraying of H.A or F.A did not reach significancy on grain yield during 2014 season but there effect was significant during 2015 season. The highest value was obtained by adding $10m^3$ FYM fed^{-1} with spraying of H.A (26.798 ard./fed.). These results are in agreement with found by (Wiqar. A., *et.al.,* 2013).

Tables 3 and 4 showed that interaction between the different factors under study led to significant increases in grain yield of maize in 2014 and 2015 seasons. It was found that the highest grain yield (29.078 and 28.735 ard./fed.) were obtained by adding 90 kg N/fed. and 10m3 FYM/fed. with spraying (F.A) during 2014 and 2015 seasons respectively. These results were in harmony with the findings of by Chung *et. al.,* (2000); Abou El-Magd *et.al.*, (2006) and Wiqar. A., *et.al.,* (2013).

Π. N, P and K uptake of maize as affected by inorganic, organic nitrogen fertilizers and activators (H.A and F.A).

i. N uptake in grains (kg/fed.):

Data given in Tables 3 and 5 indicated that there is a significant and gradual increase in nitrogen uptake were found by adding nitrogen fertilizer from 60 up to 120 kg N/fed. during the two seasons under study. The highest values were obtained by adding 120 kg N/fed. (71.047 and 70.600 kg/fed) in 2014 and 2015 seasons, respectively. These results are in agreement with those obtained by Derby *et al.,* (2004) and Hussaini *et al.,* (2008). Who reported that the addition/supply of N enhances the production of small roots and root hairs of maize, which in turn facilitates the high absorbing capacity per unit of dry matter, and influence the uptake by the plant of soil. The same results was found by Dordas (2009) in wheat. The present results are in good agreement with those obtained by Epimaque *et al.,* (2014) and Haque *et al.,* (2001), they reported that Nitrogen uptake in grain of maize enhanced significantly with the application of higher levels of N as compared with lower doses of N.

Results in Tables 3 and 5 showed that application of FYM or Microbein gave significant increases in nitrogen uptake during 2014 and 2015 seasons. The highest values of nitrogen uptake were obtained by adding 10m3 FYM/fed. in 2014 and 2015 seasons (64.869 and 63.555 kg/fed., respectively). Saleh and Abd El-Fattah (1997) reported that N uptake by plant increased by adding organic manure. Also Mohamed *et al.,* (2008) and Mohamed *et al.,* (2009) found the same results.

The data listed in Tables 3 and 5 indicated that spraying the studied activators (H.A and F.A) gave significant increases in nitrogen uptake more than the control (spray water) during the two seasons under study. The highest values N uptake were found by spraying of H.A (63.403 and 62.977 kg/fed. in 2014 and 2015 seasons respectively). Celik *et al.* (2010) explained that humus had beneficial effects on nutrient uptake, transport and availability to maize plant that enhances the maize plant growth. Tahir *et.al.,* (2011), Puglisi., *et. al.,*(2009). Baris and Ali, (2013), also noted that potassium humate as product of HA increases the release of primary macronutrients (N, P and K). This may be attributed that humic acid affected plant physiology positively, including enhancement of induction of lateral roots emergence, increase of cell respiration and membrane uptake of nutrients and exertion of hormone- like activities.

Tables 3 and 5 showed that interactions between nitrogen fertilizer levels and FYM or Microbein led to significant and positive increases in N uptake more than those obtained by control in 2014 and 2015 seasons. Adding 120 kg N/fed. with 10m3 FYM/fed. Obtained the highest values of nitrogen uptake (75.752 and 74.944 kg/fed.) in 2014 and 2015 seasons, respectively. Abou El-Magd *et. al.,* (2006), reported that FYM improves the physical and chemical properties of the soil. As well as, organic manures plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization. Saleh and Abd El-Fattah (1997), reported that N uptake by plant increased by adding organic manure. Hauka, (2000) noted that inoculation with *Bacillus megaterium* increased significantly nutrient content (N,P and K) in maize compared with control. El-Sawah, (2000). also noted that N content in maize plant significantly increased by the synergistic effect mainly between both N-fixing bacteria and P-solubilizers microorganism.

Table 5. Effect of some organic and bio fertilizer as a Partial substitution of the mineral nitrogen fertilization on N uptake (kg/fed.) in grains of maize in 2014 and 2015 seasons.

Treatment		2014				2015			
N mineral fertilizer (A)	organic & bio fertilizer (B)	Foliar application of Humic & Fulvic acid (C)							
		water spray	Humic spray	Fulvic spray	Average	water spray	Humic spray	Fulvic spray	Average
(60kg N/F) (Control)	(without)	41.114	46.651	46.543	44.769	43.788	46.623	47.857	46.089
	$10m^3$FYM/F	49.029	54.619	50.952	51.533	44.965	49.778	53.200	49.314
	(Microben)	45.940	51.534	53.080	50.184	48.190	53.578	51.732	51.167
Average		45.361	50.934	50.191	48.829	45.647	49.993	50.930	48.857
(90kg N/F)	(without)	60.147	65.370	61.161	62.226	59.340	65.269	63.465	62.691
	$10m^3$FYM/F	66.039	67.337	68.594	67.323	64.981	66.624	67.614	66.406
	(Microben)	63.857	67.338	64.378	65.191	63.271	66.676	66.559	65.502
Average		63.347	66.682	64.711	64.913	62.531	66.190	65.879	64.867
(120kg N/F)	(without)	66.842	66.862	67.964	67.223	66.225	66.304	68.037	66.865
	$10m^3$FYM/F	71.079	80.121	76.055	75.752	68.879	80.539	75.414	74.944
	(Microben)	68.073	70.797	71.632	70.167	67.753	71.400	70.821	69.991
Average		68.665	72.593	71.884	71.047	67.629	72.748	71.424	70.600
Average for organic & bio-fertilizer	(without)	56.034	59.628	58.556	58.073	56.461	59.399	59.786	58.549
	$10m^3$FYM/F	62.049	67.359	65.200	64.869	59.608	65.647	65.409	63.555
	(Microben)	59.290	63.223	63.030	61.848	59.738	63.885	63.037	62.220
Average		59.124	63.403	62.262		58.602	62.977	62.744	

	2014	2015
$L.S.D_{0.05}$	**A=0.738**	**A=0.990**
	B=0.752	**B=0.786**
	AB=1.302	**AB=1.361**
	C=0.748	**C=0.722**
	AC=1.296	**AC= N.S**
	BC=N.S	**BC=1.251**
	ABC=2.245	**ABC=2.166**

Examining the data in Tables 3 and 5, it is clear that the interaction between nitrogen fertilizer levels and spraying of H.A or F.A gave significant increase in nitrogen uptake in 2014 seasons. In 2015 season the increases did not reach significantcy. The highest values was obtained by applying 120 kg N fed.$^{-1}$ with spraying of H.A (72.593 kg fed.$^{-1}$) in 2014 season. Pinton et al. (1999) suggest that humic substances play a role in the modulation of nitrate uptake and therefore increase N uptake in plant via an interaction with plasma membrane H+ -ATPase. In their study the contemporary presence of nitrate and humic substances caused stimulation of the nitrate uptake capacity and of the plasma membrane H+ -ATPase activity with the same pattern observed for nitrate uptake. The stimulation of plasma membrane H+ -ATPase activity was also reported by several other authors (Eyheraguibel, 2004; Canellas *et al.,* 2002) and (Hartwigsen and Evans, 2000).

The data in Tables 3 and 5, indicated that the interaction effects between adding FYM or Microbein with spraying of (H.A or F.A) was not significant on increasing nitrogen uptake in 2014 season, but in 2015 season it was highly significant. The highest value in nitrogen uptake was obtained by adding 10m3 FYM/fed. with spraying H.A in 2015 season (65.647 kg/fed.). Saleh and Abd El-Fattah (1997) reported similar results and noted that N uptake by plant increased by adding organic manure. Inoculation with *Bacillus megatherium* increased significantly nutrient content (N,P and K) in maize as compared with control. Also Hauka, (2000), declined that N content in maize plant significantly increased by the synergistic effect mainly between both N-fixing bacteria and P-solubilizers microorganism, El-Sawah, (2000). The results are in agreement with Abou El-Magd *et al*., (2006) and Mohamed *et al*., (2009).

Tables 3 and 5, showed that the interaction between the different factors under study led to significant increases in nitrogen uptake more than the control in 2014 and 2015 seasons. It was found that the application of 120 kg N/fed. combined with 10m3 FYM/fed. with spraying H.A gave maximum values of nitrogen uptake (80.121 and 80.539 kg/fed.) in 2014 and 2015 seasons respectively. This may be to the fact that mineralized nutrients released by FYM are easily taken up by the plants and result in higher N uptake by grain. Similar results were, also, reported by Steinbach *et al.* (2004), (Hauka, 2000); (El-Sawah, 2000) and (Meena *et al*., 2013).

ii. *P uptake in grains (kg/fed.):*

The data listed in Tables 3 and 6 indicated that application of nitrogen fertilizer levels, significantly increase the phosphorus uptake of maize, over the control in both seasons. The highest phosphorus uptake were found by adding 120 kg N/fed. (17.039 and 17.390 kg/fed.) in 2014 and 2015 seasons respectively. Hussaini *et al*., (2008) in maize reported that the addition/supply of N enhances the production of small roots and root hairs, which in turn facilitates the high absorbing capacity per unit of dry matter, and influence the uptake by the plant of soil. The results are in good agreement with those obtained by Dordas (2009) and Epimaque *et al*., (2014).

Application of FYM or Microbein significantly increase the phosphorus uptake as compared to the control (without organic or bio-fertilizers) during 2014 and 2015 seasons. It was found that the highest value of phosphorus uptake was obtained by adding 10m^3 FYM/fed. (15.937 and 16.229 kg/fed.) in 2014 and 2015 seasons, respectively. This finding is in tha same side of results obtained by Hauka., (2000); Mohamed *et al*., 2008; Mohamed *et al*., (2009) and Meena *et al*., (2013).

Spraying of H.A or F.A had positive and significant effects on phosphorus uptake by maize during 2014 and 2015 seasons in (Tables 3 and 6). The highest phosphorus uptake values (15.836 and 16.271 kg/fed.) were found by spraying of H.A in 2014 and 2015 seasons, respectively. Similar results was obtained by Puglisi., *et al*.,(2009); Celik *et al.* (2010) and Tahir *et al.,* (2011). They indicated that potassium humate as product of HA increases the release of primary macronutrients (N, P and K). Baris and Ali, (2013) explained that humic acid affected plant physiology positively, including enhancement of induction of lateral roots emergence.

Data in Tables 3 and 6 showed that the interaction effects between nitrogen fertilizer levels and FYM or Microbein gave significant increases in phosphorus uptake in grains more than those obtained by control in both 2014 and 2015 seasons. The highest value of phosphorus uptake (17.661 kg/fed) was found by adding 120 kg N/fed. combined with 10m^3

FYM/fed. in 2014 season, but in 2015 season the highest value was 17.592 kg/fed. by adding 90 kg N/fed. combined with $10m^3$ FYM/fed. These results are in agreement with those obtained by Hauka, (2000); El-Sawah, (2000); Mokidul *et al*., (2012) and Meena *et al.,* (2013).

Table 6. Effect of some organic and bio fertilizer as a Partial substitution of the mineral nitrogen fertilization on P uptake (kg/fed.) in grains of maize in 2014 and 2015 seasons.

Treatment		2014				2015			
N mineral fertilizer (A)	organic & bio fertilizer (B)	Foliar application of Humic & Fulvic acid (C)							
		water spray	Humic spray	Fulvic spray	Average	water spray	Humic spray	Fulvic spray	Average
(60kg N/F) (Control)	(without)	11.372	11.925	12.439	**11.912**	11.693	12.618	13.352	**12.554**
	$10m^3$FYM/F	12.566	14.103	13.222	**13.297**	12.672	14.594	14.208	**13.824**
	(Microben)	12.684	13.609	13.551	**13.282**	12.216	13.550	13.514	**13.093**
Average		**12.207**	**13.213**	**13.071**	**12.830**	**12.193**	**13.587**	**13.691**	**13.157**
(90kg N/F)	(without)	15.209	17.446	15.430	**16.028**	13.790	16.422	17.098	**15.770**
	$10m^3$FYM/F	16.955	16.476	17.127	**16.853**	17.108	17.998	17.670	**17.592**
	(Microben)	16.307	17.601	16.444	**16.784**	16.337	17.970	17.018	**17.108**
Average		**16.157**	**17.174**	**16.334**	**16.555**	**15.745**	**17.463**	**17.262**	**16.823**
(120kg N/F)	(without)	15.686	16.267	16.422	**16.125**	17.417	17.638	17.250	**17.435**
	$10m^3$FYM/F	18.093	17.416	17.473	**17.661**	17.310	18.028	16.471	**17.270**
	(Microben)	17.525	17.676	16.796	**17.333**	17.326	17.619	17.451	**17.465**
Average		**17.101**	**17.120**	**16.897**	**17.039**	**17.351**	**17.762**	**17.058**	**17.390**
Average for organic & bio-fertilizer	(without)	14.089	15.213	14.764	**14.688**	14.300	15.559	15.900	**15.253**
	$10m^3$FYM/F	15.871	15.998	15.941	**15.937**	15.697	16.873	16.116	**16.229**
	(Microben)	15.505	16.296	15.597	**15.799**	15.293	16.380	15.994	**15.889**
Average		**15.155**	**15.836**	**15.434**		**15.096**	**16.271**	**16.004**	

	2014	2015
$L.S.D_{0.05}$	**A=0.088**	**A=0.147**
	B=0.118	**B=0.149**
	AB=0.204	**AB=0.258**
	C=0.149	**C=0.148**
	AC=0.257	**AC=0.257**
	BC=0.257	**BC=0.257**
	ABC=0.446	**ABC=0.444**

Examining the data obtained Tables 3 and 6 it is clear that the interaction between nitrogen fertilizer levels and the studied activators (H.A or F.A) had significant effects increases phosphorus uptake in both seasons. It was found that the highest value of P uptake in 2014 season was (17.174 kg/fed.) which obtained by adding 90 kg N/fed. with spraying (H.A)., In 2015 season the highest value (17.762 kg/fed.) of P uptake was obtained by adding 120 kg N/fed. with spraying (H.A). This finding is consistent with studies conducted by Celik *et al.* (2010) explained that humus had beneficial effects on nutrient uptake, transport and availability to maize plant that enhances the maize plant growth.

Tables 3 and 6 showed that application of FYM or Microbein combined with studied activators (H.A or F.A) had a significant effects on increasing phosphorus uptake in grains in both seasons under study. The highest phosphorus uptake value in 2014 season (16.296 kg/fed.) was obtained by adding Microbein with spraying H.A., but in 2015 season the highest value (16.873 kg/fed.) was obtained by adding $10m^3$ FYM/fed. with spraying (H.A). Results of the present investigation to some extant corroborate the findings of Mohamed *et al*., (2009) and Aisha *et al*., (2014).

The data in Tables 3 and 6 clear that the interactions between all factors under study led to significant increases in phosphorus uptake more than the control (60 kg N/fed.) during the two seasons under study. The highest value of P uptake (18.093 kg/fed.), in 2014 season, was obtained by adding 120 kg N/fed. combined with 10m^3 FYM/fed., but in 2015 season the highest value (18.028 kg/fed.) was obtained by adding 120 kg N/fed. combined with both 10m^3 FYM/fed. and spraying (H.A). Similar results was obtained by Hauka, (2000); El-Sawah, (2000); Mokidul et al.,(2012**)** and (Meena *et al.,*(2013).

i. K uptake in grains (kg/fed.):

Regarding the data in Tables 3 and 7 it is clear that there is a significant and gradual increase in potassium uptake were found by adding nitrogen fertilizer levels from 60 to 120 kg N/fed. during the two seasons of the study. The highest values (20.406 and 20.338 kg/fed) were obtained by adding 120 kg N/fed. in 2014 and 2015 seasons, respectively. Results of present investigation corroborate the findings of Haque *et al.,* (2001).

Results in Tables 3 and 7 showed that application of FYM or Microbein gave significant increases in potassium uptake in grains during 2014 and 2015 seasons. The highest values potassium uptake (19.155 and 19.075 kg/fed.) were found by adding 10m^3 FYM/fed. in 2014 and 2015 seasons, respectively. This finding is consistent with studies conducted by Hauka, (2000); Mohamed *et al*., (2008) and Meena *et al*.,(2013).

Results presented in Tables 3 and 7 indicate that potassium uptake in maize grains was significantly affected by studied activators (H.A or F.A) in 2014 and 2015 seasons. It was found that the highest K uptake (18.817 and 19.102 kg/fed.) were obtained by spraying H.A in 2014 and 2015 seasons, respectively. Similar results was obtained by Puglisi., *et al*.,(2009); Celik *et al*. (2010). Tahir *et al.,* (2011) and Baris and Ali (2013) reported that potassium humate as product of HA increases the release of primary macronutrients (N, P and K). This may be attributed that humic acid affected plant physiology positively, including enhancement of induction of lateral roots emergence.

From data in Tables 3 and 7 it could be noticed that the interactions between nitrogen fertilizer levels with FYM or Microbein significantly increased potassium uptake over the control in the two seasons. The highest K uptake (20.746 and 20.874 kg/fed.) were obtained by adding 90 kg N/fed. combined with 10m^3 FYM/fed., in 2014 and 2015 seasons., respectively. Similar results were obtained by Hauka, (2000); El-Sawah, (2000); Mokidul *et al.,*(2012**)** and Meena *et al.,* (2013).

The interaction between nitrogen fertilizer levels and studied activators H.A and F.A affected potassium uptake in maize grains positively and significantly during 2014 and 2015 seasons. The highest values of K uptake (20.477 and 20.539 kg/fed.) were found by adding 120 kg N/fed., with spraying H.A in 2014 and 2015 seasons, respectively. This finding is consistent with those obtained by Celik *et al.* (2010), who explained that humus had beneficial effects on nutrient uptake.

Data reported in Table 3 and 7 revealed that the interaction effects between FYM or Microbein and studied activators H.A or F.A on K uptake were significant in both seasons 2014 and 2015 seasons,. The highest value of K uptake (19.342 kg/fed.) was obtained by adding 10m^3 FYM/fed. alone in 2014 season, while in 2015 season the highest value of K uptake in grains was obtained by 10m^3 FYM fed.$^{-1}$ beside spraying of F.A (19.361 kg fed.$^{-1}$),. These results are agreement whit those obtained by Mohamed *et al.*, (2009).

Interactions between all studied factors affected significantly potassium uptake in both seasons under study. The highest K uptake (21.362 kg/fed.) was found in 2014 season by adding 90 kg N/fed. combined with 10m^3 FYM/fed., while in 2015 season the highest K uptake was obtained by 120 kg N/fed. alone (21.226 kg/fed.). This results is in agreement with studies conducted by (Hauka, 2000); (El-Sawah, 2000); (Mokidul *et al.*, 2012) and (Meena *et al.*, 2013).

Table 7. Effect of some organic and bio fertilizer as a Partial substitution of the mineral nitrogen fertilization on K uptake(kg/fed.) in grains of maize in 2014 and 2015 seasons.

Treatment		2014				2015			
N mineral fertilizer (A)	organic & bio fertilizer (B)	Foliar application of Humic & Fulvic acid (C)							
		water spray	Humic spray	Fulvic spray	Average	water spray	Humic spray	Fulvic spray	Average
(60kg N/F) (Control)	(without)	14.625	14.749	14.651	14.675	15.415	16.245	15.988	15.882
	10m^{3}FYM/F	15.948	15.958	16.269	16.058	15.029	16.101	17.142	16.091
	(Microben)	15.401	16.202	16.233	15.945	15.512	16.503	16.244	16.086
Average		15.325	15.636	15.718	15.560	15.319	16.283	16.458	16.020
(90kg N/F)	(without)	18.982	20.419	20.385	19.929	19.280	19.887	20.552	19.906
	10m^{3}FYM/F	21.362	19.849	21.026	20.746	20.757	20.896	20.969	20.874
	(Microben)	19.131	20.747	19.348	19.742	19.848	20.669	19.635	20.051
Average		19.825	20.339	20.253	20.139	19.961	20.484	20.386	20.277
(120kg N/F)	(without)	20.405	20.306	19.929	20.213	21.226	20.619	19.726	20.524
	10m^{3}FYM/F	20.717	20.680	20.584	20.660	20.118	20.694	19.971	20.261
	(Microben)	20.592	20.447	19.998	20.345	20.729	20.304	19.654	20.229
Average		20.571	20.477	20.170	20.406	20.691	20.539	19.784	20.338
Average for organic & bio-fertilizer	(without)	18.004	18.491	18.322	18.272	18.640	18.917	18.755	18.771
	10m^{3}FYM/F	19.342	18.829	19.293	19.155	18.635	19.230	19.361	19.075
	(Microben)	18.375	19.132	18.526	18.678	18.696	19.159	18.511	18.789
Average		18.574	18.817	18.714		18.657	19.102	18.876	

$L.S.D_{0.05}$	2014	2015
	A=0.200	A=0.265
	B=0.110	B=0.254
	AB=0.190	AB=0.440
	C=192	C=0.180
	AC=0.332	AC=0.311
	BC=0.332	BC=0.311
	ABC=0.575	ABC=0.539

ΠΙ. Protein content in grain of maize as affected by inorganic, organic nitrogen fertilizers and activators (H.A and F.A).

The effect of nitrogen fertilizer levels on Protein content in grains, Tables 3 and 8 was positive, gradual and significant increase, in both seasons under study. The highest Protein content (10.847 and 10.859 %) were found by adding 120 kg N/fed. in 2014 and 2015 seasons, respectively.

This effect may be due to the highest N concentration in grains under this treatment. These improvement effects were, also, found by Hussaini *et al.,* (2008) in maize and Dordas (2009) in wheat. This results are in good agreement with those obtained by Epimaque *et al*., (2014).

The data listed in Tables 3 and 8 indicated that application of FYM or Microbein gave significant increasing in Protein content during 2014 and 2015 seasons. It was found that the highest Protein content (10.221 and 10.106 %) were obtained by adding 10m^3 FYM/fed. in 2014 and 2015 seasons, respectively. This finding is in the same direction of those obtained by Meena *et al*.,(2013).

Examining the data obtained in Tables 3 and 8, it is cleared that the studied activators (H.A and F.A) led to significant increases in Protein content as compared to the control (spray water) in 2014 and 2015 seasons. The highest value of Protein content (10.167 %) was found in 2014 season by spraying H.A, while in 2015 the highest value of protein content (10.082 %) was obtained by spraying (F.A). This increase in protein content may be attributed to the effect of humic acid which may have various biochemical effects either at cell wall, membrane level or in the cytoplasm, including increased photosynthesis and respiration rates in plants, enhanced protein synthesis and plant hormone-like activity, Chen *et al*., (1999). Similar results was obtained by Hoda *et al.,* (2014).

Table 8. Effect of some organic and bio fertilizer as a Partial substitution of the mineral nitrogen fertilization on Protein content (%) in maize grains in 2014 and 2015 seasons.

Treatment		2014				2015			
N mineral fertilizer (A)	organic & bio fertilizer (B)	Foliar application of Humic & Fulvic acid (C)							
		water spray	Humic spray	Fulvic spray	Average	water spray	Humic spray	Fulvic spray	Average
(60kg N/F) (Control)	(without)	8.455	9.250	9.250	**8.985**	8.632	8.720	8.897	**8.750**
	10m^{3}FYM/F	9.161	9.734	9.424	**9.440**	8.809	8.896	9.601	**9.102**
	(Microben)	8.760	9.645	9.953	**9.453**	8.940	9.601	9.294	**9.278**
Average		**8.792**	**9.543**	**9.542**	**9.292**	**8.793**	**9.072**	**9.264**	**9.043**
(90kg N/F)	(without)	9.782	9.883	9.747	**9.804**	9.801	9.909	9.834	**9.848**
	10m^{3}FYM/F	9.794	9.883	9.942	**9.873**	9.793	9.854	9.916	**9.854**
	(Microben)	9.900	9.983	10.006	**9.963**	9.719	9.970	10.201	**9.963**
Average		**9.825**	**9.916**	**9.898**	**9.880**	**9.771**	**9.911**	**9.984**	**9.889**
(120kg N/F)	(without)	10.384	10.355	10.537	**10.425**	10.365	10.335	10.527	**10.409**
	10m^{3}FYM/F	10.709	11.915	11.428	**11.351**	10.630	11.983	11.474	**11.362**
	(Microben)	10.473	10.853	10.971	**10.766**	10.545	10.872	10.996	**10.804**
Average		**10.522**	**11.041**	**10.979**	**10.847**	**10.513**	**11.063**	**10.999**	**10.859**
Average for organic & bio-fertilizer	(without)	9.540	9.829	9.845	**9.738**	9.599	9.655	9.753	**9.669**
	10m^{3}FYM/F	9.888	10.510	10.265	**10.221**	9.744	10.244	10.330	**10.106**
	(Microben)	9.711	10.160	10.310	**10.060**	9.735	10.148	10.164	**10.015**
Average		**9.713**	**10.167**	**10.140**		**9.693**	**10.016**	**10.082**	

L.S.D$_{0.05}$	2014	2015
	A=0.116	A=0.158
	B=0.100	B=0.087
	AB=0.173	AB=0.151
	C=0.093	C=0.093
	AC=0.161	AC=0.161
	BC=0.161	BC=0.161
	ABC=0.278	ABC=0.278

Data given in Tables 3 and 8, indicated that the interaction between nitrogen fertilizer levels with FYM or Microbein gave significant increases in Protein content more than those obtained by control in 2014 and 2015 seasons. The highest values were obtained by adding 120 kg N/fed. combined with $10m^3$ FYM/fed. (11.351 and 11.362 %) in 2014 and 2015 seasons, respectively. Similar finding was conducted by Meena *et al*., (2013).

Results in Tables 3 and 8, showed that the interaction between nitrogen fertilizers levels and the studied activators (H.A or F.A) led to significant and positive increase in Protein content during the two seasons under study. It was found that the highest values of protein content (11.041 and 11.063 %) were obtained by adding 120 kg N/fed. with spraying H.A in 2014 and 2015 seasons respectively. These findings are in harmony with those obtained by Chen *et al.,* (1999) and Hoda *et al*., (2014).

The data in Tables 3 and 8, indicated that the interaction between FYM or Microbein with the studied activators (H.A or F.A) gave significant increasing in Protein content during 2014 and 2015 seasons. The highest Protein content (10.510 %) in 2014 season was obtained by adding 10m3 FYM/fed. and spraying H.A, but in 2015 season the highest protein content (10.330 %) was found by adding $10m^3$ FYM/fed. with spraying F.A. These findings are in harmony with those obtained by Mohamed *et al*., (2008); Mohamed *et al.,* (2009) in maize, and Aisha *et al.,* (2014) in turnip plants.

Results in Tables 3 and 8, showed that the interaction between all different factors had significant increases in Protein content more than those obtained by control (60 kg N/fed., alone) in 2014 and 2015 seasons. The highest values of protein content (11.915 and 11.983 %) were obtained by adding 120 kg N/fed. combined with $10m^3$ FYM/fed. under spraying H.A during 2014 and 2015 seasons respectively. This effect may be due to the highest N concentration in grains under this treatment. These improvement effects were, also, found by Hussaini *et al.,* (2008) in maize; and Dordas (2009) in wheat. The obtained results are in a good agreement with those obtained by Mohamed *et al.,* (2008); Mohamed *et al*., (2009); Epimaque *et al*., (2014) and Hoda *et al*., (2014).

Conclusions

The obtained results revealed that a significant and gradual increase in grain yield, N, P and K uptake, protein content were found by adding nitrogen fertilizer levels from 60 to 120 kg N fed^{-1} during the two seasons of the study. The results also revealed a significant improvement in grain yield due to the application of FYM or Microbein as compared with the control (without organic or bio- fertilizers). Applications of humic acid had a significant effect of all studied traits. The interaction effects of all factors under study were highly significant for all studied traits. Highest values in grain yield (29.078 and 28.735 ard. fed^{-1}) were obtained by adding 90 kg N fed^{-1}. combined with 10m3 FYM fed^{-1}. under spraying (F.A) during 2014 and 2015 seasons respectively. The applications of

10m3 FYM fed^{-1}. or Microbein with spraying of H.A or F.A combined with 75% of the recommended dose of N fertilizer could be enough for improving soil fertility and produce grain yield equal or more than those obtained by the recommended dose.

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استخدام بعض الأسمدة العضوية والحيوية كإحلال جزئي للتسميد النيتروجيني المعدني للذرة

١- التأثير على كمية المحصول، النيتروجين والفوسفور والبوتاسيوم الممتص في الحبوب.

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الملخص

أقيمت تجربة حقلية بمحطة بحوث جزيرة شندويل – محافظة سوهاج خلال كل موسم من المواسم الصيفية ٢٠١٤ ، ٢٠١٥. وقد استهدفت هذه الدراسة استخدام بعض الأسمدة العضوية والحيوية كإحلال جزئي للتسميد النيتروجينى المعدني للذرة الشامية (*TWC 310*) وتأثيرها على كمية المحصول، النيتروجين والفوسفور والبوتاسيوم الممتص ، ومحتوى الحبوب من البروتين. وقد زرعت هذه التجارب في أرض طينية سلتيه ذات رقم pH ٧,٧ كما أنها تحتوى على ١,٢٧ % من المادة العضوية. وقد صممت هذه التجارب في قطع منشقة مرتين في أربع مكررات وبمجموع معاملات ٢٧ معاملة. حيث أضيف التسميد النيتروجينى المعدني في القطع الرئيسية (٦٠ ، ٩٠ ، ١٢٠ كجم ن/ف)، كما وضعت الأسمدة العضوية والحيوية في القطع المنشقة الأولى (بدون إضافة أسمدة عضوية أو حيوية ، ١٠م^{٣} /فدان سماد بلدي ، المخصب الحيوي الميكروبين) ، كما وضع الرش بالأحماض الدبالية في القطع المنشقة الثانية (الرش بالماء ، الرش بحمض الهيوميك ، الرش بحمض الفولفيك).

وقد أوضحت النتائج ما يلى :

• أن إضافة السماد النيتروجينى المعدني بمعدل ٩٠ كجم ن/فدان ، ١٢٠ كجم ن/فدان قد أعطى زيادة معنوية متدرجة لمحصول الحبوب ، النيتروجين والفوسفور والبوتاسيوم الممتص في حبوب الذرة الشامية ، والمحتوى الكلى للبروتين مقارنة بالكنترول ٦٠ كجم ن/فدان . وقد كانت أعلى قيمة لمحصول الحبوب (٢٧,٦٨٤ ، ٢٧,٦٤٢ أردب/فدان) عند إضافة ٩٠ كجم ن/فدان، بينما كانت أعلى قيم للنيتروجين الممتص في الحبوب (٧١,٠٤٧ ، ٧٠,٦٠٠ كجم/فدان) والفوسفور (١٧,٠٣٩ ، ١٧,٣٩٠ كجم/فدان) والبوتاسيوم (٢٠,٤٠٦ ، ٢٠,٣٣٨ كجم/فدان) وأعلى قيمة لمحتوى البروتين في الحبوب (١٠,٨٤٧ ، ١٠,٨٥٩ %) عند إضافة ١٢٠ كجم ن/فدان خلال الموسمين على التوالي.

• وجد أيضا أن إضافة السماد العضوي والحيوي (١٠م^{٣}/فدان ، الميكروبين) قد أدت إلى زيادة معنوية في محصول الحبوب ، النيتروجين والفوسفور والبوتاسيوم الممتص في الحبوب ، والمحتوى الكلى للبروتين مقارنة بالكنترول (بدون إضافة أسمدة عضوية أو حيوية) للموسمين.

• وقد وجد أيضا أن الرش بالأحماض الدبالية (الهيوميك ، الفولفيك) أدى إلى زيادة معنوية لكل من محصول الحبوب ، النيتروجين والفوسفور والبوتاسيوم الممتص في الحبوب ، والمحتوى الكلى للبروتين. وقد كانت أعلى القيم المتحصل عليها للصفات تحت الدراسة عند الرش بحمض الهيوميك لمواسم ٢٠١٤ ، ٢٠١٥ فيما عدا أعلى قيمة لمحتوى البروتين في الحبوب في الموسم ٢٠١٥ كانت ناتجة من رش حمض الفولفيك.

• وجد من نتائج الدراسة أن التفاعل بين العوامل المختلفة تحت الدراسة قد أدى إلى زيادة معنوية عالية لكل من محصول الحبوب ، النيتروجين والفوسفور والبوتاسيوم الممتص في الحبوب ، والمحتوى الكلى للبروتين. وقد وجد أن أعلى محصول للحبوب (٢٩,٠٧٨ ، ٢٨,٧٣٥ أردب/فدان) عند إضافة ٩٠ كجم ن/فدان + ١٠م^{٣}/فدان مع الرش بحمض الفولفيك وذلك خلال الموسمين ٢٠١٤ ، ٢٠١٥ على التوالى. وهذا يوضح القدرة على إمكانية تقليل كمية السماد النيتروجينى الكيماوى المضاف وفى نفس الوقت زيادة المحصول في الكمية وتحسين نوعيته عن المحصول الناتج عن السماد الكيماوى فقط.