J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 6 (7):829-844, 2015

ROLE OF BIO AND ORGANIC FERTILIZERS IN REDUCING SOME CHEMICAL FERTILIZERS DOSES ON YIELD OF STEVIA PLANTS UNDER SOME DIFFERENT SOIL TYPES

El-Sirafy, Z. M[1].; R. A. Hassan[2]; M. M. El-Shazly[3] and M. E. Gad

[1] Soil Dept., Faculty of Agriculture, Mansoura University, Egypt.

[2] Agric. Biochemistry Dept., Faculty of Agriculture, Mansoura University, Egypt.

[3] Plant Nutrition Dept., Soil, Water & Env. Inst., Agric. Res. Centre, Giza.

ABSTRACT

To study the influence of organic and bio fertilization compared with NPK fertilization and their interactions on yield of stevia plant (*Stevia rebaudiana Bertoni*) under some different Egyptian Soils Conditions was carried out a pot experiment at the Experimental Farm of the Fac. Agric. Mansoura Univ. during the summer season of 2013. The experimental design of present study was complete randomized block design with three replications, where soil types represent blocks and each block contains fertilization treatments. Three soil types were used as clay, saline and calcareous and six fertilization treatments are contained in each soil type as control, 100 % of recommended NPK fertilizers,50 % of recommended NPK fertilizers, biofertilizer, organic fertilizer (compost), and mixture of 50 % of recommended NPK + bio + compost. Results indicated that application all fertilizer sources increased the means values of leaves, stems and shoot fresh weights (32.3, 39.7 and 72.0 g/pot) and the others treatments of fertilizers used (63.6, 60.4, 48.6 and 38.9 g/pot for the treatments of mixture, 50 %, organic and biofertilizer, respectively). The corresponding values of increases over control due to the aforementioned respective treatments were 42.5, 34.1, 30.9, 19.1 and 9.0 g/pot. These increases represent the following percentages over control : 144.6, 115.6, 104.7, 64.7 and 30.5 %, respectively. Also dry yield was (24.1, 23.1 and 47.2 g/pot) of stevia plants significantly than control (without fertilization). Concerning to soil types revealed that the greatest value was obtained due to growing stevia plants on clay soil compared to both saline and calcareous soils. The greatest shoots plant fresh weight of stevia was obtained due to growing in clay soil where the mean value was 64.3 g/pot. Both saline and calcareous soils were followed clay soil where the respective mean values of shoot plant fresh weight were 48.5 and 43.8 g/pot. While The highest shoot plant dry yield of stevia was obtained due to growing stevia plants on clay soil where the mean value was 43.2 g/pot. Both saline and calcareous soils were followed clay soil where the respective mean values of shoot plant fresh weight were 31.4 and 28.0 g/pot. In addition, all fertilizers treatments eliminated bad effect of both saline and calcareous soils in comparison with control (interaction effect).

Keywords: NPK fertilizers, Biofertilizer, compost , stevia plant.

INTRODUCTION

Stevia rebaudiana (Bertoni) Bertoni is a perennial shrub of the *Asteraceae* (Compositae) family native to certain regions of South ; Paraguay and Brazil, (Brandle *et al*., 1998 ;Kennelly 2002 and Geuns, 2003). *Stevia rebaundiana* belonging to the family *Steraceae* is an endemic herb from Paraguay and the neighboring Brazilian border, (Maiti and Purohit, 2008).

Stevia, the nature's sweetest gift belongs to the family *Asteraceae*. It is an amazing plant from the rain forest of Amazone. The other names of Stevia are sweet leaf, honey leaf, sweet herb, honey yerba. Stevia is a native to South America; Paraguay and Brazil, (*Bertoni, 1905)*. but Extensively grown in places like central America, Palestine, Australia, Japan and China (Sharma, *et al*., 2006). The sugar obtained from stevia is considered to be the best alternate source of sugar for diabetes. Leaves of stevia contain sweetening compounds Viz., Stevioside, Rebaudieside-A, Rebaudieside-B,C and six other compounds which are said to be having insulin balancing properties , (Farooqi and Sreeramu, 2001).

Stevia leaves contain a number of diterpenoid steviol-glycosides (SGs) that are about 300 times sweeter than sucrose at their concentration of 4% (w/v), (Kinghorn, and Soejarto, 1986). While Mowrey, 1992 found that the fresh leaves itself of stevia 30 - 45 times of sugar. Stevioside concentration usually range from 3 - 10% of leaf dry weight, rebaudioside-A (400 times sweeter than sugar) is less concentrated ranging from 1 - 3% (Cramer and Ikan, 1986).

Stevia is simultaneously an excellent source of sugar with 14 kinds of microelement and 32 kinds of nutrient. Stevia extensively cultivated cross China since the successful introduction from Japanese in 1977 and has became the third most popular natural source of sugar gradually after cane sugar and sugar beet (Ren et al., 2011).

Many authors gave light upon the various kinds of organic fertilizers (organic manures, green manures, composted residues, town refuse, sludge, biogas and animal wastes) and explained their importance on soil properties (physical, chemical, biological) which increase soil fertility and subsequently increase the growth, yield and improve the quality of crops(Kononova, 1966; Tandon, 1992; El-Galla, 2003 and Abo-Alkhair, 2013). The ash content was higher in third harvested sample with simultaneous increased amount of Fe, Mn, Cu and Zn contents due to the residual effect of bio fertilizers (Das and Dang, 2014).

The result showed that organic cultivation and the common had some remarkable difference in yield, quality, as well as the economic benefits. Leaf production of treatment that incorporating organic fertilizer with decomposed stevia dregs lower than the one that incorporating organic fertilizer with inorganic fertilizer, yet higher than applying organic fertilizer only or inorganic fertilizer only; organic cultivation enable stevia produced more Stevioside in leaf blade compared with common cultivation, especially in the content of Rebaudioside A; and incorporating organic fertilizer with decomposed stevia dregs led to a significantly higher economic benefit compared with others (Yang et al 2013).

The results showed that organic manure cultivation promoted root activity in 40 days after transplanting compared with the chemical fertilizer cultivation, and the dry weight of the above-ground has exceeded chemical fertilizer cultivation in 60 days after transplanting. The glycosides synthesis and accumulation main period was in the later growth stage, and organic manure improved the root activity and enhanced the photosynthesis rate in later growth stage, finally the biomass of stevia and the content of glycosides were also increased (Liu et al 2011). Aladakatti, *et al*. (2012), they reported that highest dry leaf yield of stevia plants were obtained with nitrogen at 400 kg ha^{-1}, Phosphorus at 200 kg ha^{-1}, Potassium at 200 kg ha^{-1}. Marschner, (1995) explained the role of N, P and K in many processes which led to dry matter accumulation and he related the application of them with plant growth and plant composition. This study aimed to effect of organic or bio fertilization compared with NPK fertilization and their interactions on yield of stevia plant under some different Egyptian Soils Conditions. In addition, saving some doses of mineral fertilization, reducing both the productivity economical costs and hazards pollution factors.

MATERIALS AND METHODS

In order to obtain the objective of this investigation; a pot experiment was carried out at the Experimental Farm of the Faculty Agriculture Mansoura University during the summer season of 2013 to investigate the effect of organic or bio fertilization compared with NPK fertilization and their interactions on yield of stevia plant (*Stevia rebaudiana* Bertoni) under some different Egyptian Soils Conditions.

The experimental design of present study was complete randomized block design with three replications, where soil types represent blocks and each block contains fertilization treatments. Three soil types were used as clay, saline and calcareous and six fertilization treatments are contained in each soil type as : 1- control, 2- 100 % of recommended NPK fertilizers, 3- 50 % of recommended NPK fertilizers, 4- biofertilizer, 5- organic fertilizer (compost), and 6- mixture of 50 % of recommended NPK, bio and compost. Bio-fertilizer was contained different strains of bacteria to fix nitrogen and dissolve both phosphorus and potassium. The biofertilizer was added by spoonful around each seedling at transplanting.

The source of phosphatic fertilizer was calcium Superphosphate (6.75 % P) which was added at one dose after thinning immediately at the rate of 7.4 and 3.7 g super/pot as 100 and 50 % of the recommended,(10 Kg P) fed respectively. The source of Nitrogen fertilizer was urea (46 % N) which was added at the rates of 2.17 and 1.08 g urea/pot as 100 and 50 % of the recommended; (20 Kg N) fed rate, respectively. Each rate of urea was divided into three doses, where the 1st., 2nd. And 3rd. doses were added after 30, 45 and 60 days from transplanting, respectively. The source of Potasium fertilizer was potassium sulphate (40 % K) which was added at the rates of 1.87 and 0.93 g potassium sulphate/pot as 100 and 50 % of the recommended; (15 Kg K) fed rate, respectively. Each rate of potassium sulphate was divided into two doses, where the 1st. and 2nd. doses were added after 33 and 48 days from transplanting, respectively. Compost was added to certain treatments at the rate of 117.15 g/pot (10 t/fad. at 20 cm depth).

Data in Table 1 and 2 show some properties of Experimental Soil Types and compost used as a treatment. Mechanical analysis was carried out using the pipette method as described by Dewis and Fertais, (1970).

Saturation percentage (SP) was determined according to Dewis and Freitas (1970) but with a modification as the saturation was by the capillary rise of water where the soil was putted in a perforated crucible and soaked for few hours in a basin contain 1/3 its height water. Total carbonate was estimated volumetrically using Collins Calcimeter and calculated as calcium carbonate as described by Dewis and Fertais, (1970). Soil reaction (pH) was measured in saturated soil paste using combined electrode pH meter as mentioned by (Jackson, 1967). The electrical conductivities of the soil paste extract was measured by EC meter according to the method of Jackson, (1967). The amounts of soluble cations (Ca++, Mg++, Na+, K+) and anions (CO3--, HCO3-, Cl-,) in the soil were determined in saturation extract by the method described by Hesse (1971), except SO4-- .was determined by the difference between sum of cations (Ca++, Mg++, Na+, K+) and anions (CO3--, HCO3-, Cl-,). Available N was measured using the conventional method of Kjeldahl as described by Hesse (1971),. Available P was extracted with 0.5 M (NaHCO3) adjusted at pH of 8.5 and was determined at a wavelength 660 nm by Spectrophotometer as described by Jackson, (1973). Available K was determined by extracting with ammonium acetate at pH 7 and measured using a flam photometer according to Hesse, (1971). Soil organic matter was determined by Walkley and Black method as described by Hesse (1971).

Table 1 : Some Physical and Chemical Properties of Experimental Soil Types

	Soil type	**Clay**	**Saline**	**Calcareous**
Particle size distribution %	C. sand	10.15	11.40	76.8
	F. sand	26.87	36.01	14.3
	silt	26.96	33.55	0.87
	clay	36.02	19.04	8.03
Textural class		Clay loam	loam	Sand
Ec/dSm^{-1} *		2.91	4.72	2.52
PH **		8.08	7.99	8.53
OM (%)		1.35	1.04	0.14
Total $CaCO_3$ (%)		2.14	3.31	17.35
SP (%)		77.0	45.4	24.6
Soluble catins, $meqL^{-1}$	Ca	9.21	10.65	7.12
	Mg	6.65	9.32	7.77
	N a	12.89	27.01	9.18
	K	0.42	0.51	0.37
Soluble anions, $meqL^{-1}$	Co3	--	--	--
	HCO3	3.57	5.55	3.92
	CL	8.40	25.53	12.32
	***SO4	17.2	16.21	8.20
Available nutrients, $mgkg^{-1}$	N	67.2	58.8	42
	P	13.36	11.12	13.26
	K	220	204	64

*** in soil paste extract** **** in soil paste** ***** by difference**

Table 2: Some properties of the compost used as a treatment

pH *	EC **, dSm-1	%					
		C	OM	C/N Ratio	N	P	K
8.27	6.24	19.47	33.57	25.96	0.46	0.21	0.66

Statistical Analysis

All data were statistically analyzed according to the technique of analysis variance (ANOVA) and the least significant difference (L.S.D) method was used to compare the difference between the means of treatment values to the methods described by Gomez and Gomez, (1984). All statistical analyses were performed using analysis of variance technique by means of CoSTATE Computer Software.

RESULTS AND DISCUSSION

leaves and stems fresh weight of stevia plants

Results in Tables 3-4and Fig. 1-2 show The effect of chemical (NPK), bio or organic (compost) fertilizers on leaves and stems fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

As shown in the table 3-4 and figure1-2, application all fertilizer sources increased the means values of leaves and stems fresh weight of stevia plants significantly than control (without fertilization). Concerning to soil types, Fig 1-2 and data of Table 3-4 revealed that the greatest leaves and stems fresh weight of stevia plants was obtained due to growing stevia plants on clay soil.

Table 3 : Effect of chemical, bio and organic fertilizers on leaves fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Treatments(T)	Soil Type (S)			
	Clay	Saline	Calcareous	Mean
Control	19.8	11.1	8.2	13.0
100 % NPK	36.1	31.4	29.4	32.3
50 % NPK	33.5	29.0	24.3	28.9
Bio – fertilizer	20.8	16.2	13.5	16.8
Organic Fertilizer	23.7	21.4	18.5	21.2
50 % NPK + Bio+ Organic	34.2	27.1	26.1	29.1
Mean	28.0	22.7	20.0	23.6
LSD (5%)	T	S	T*S	
	0.79	0.56	1.36	
Significe	*	*	*	

*** pot = 2 plants** *** significant at 5 %**

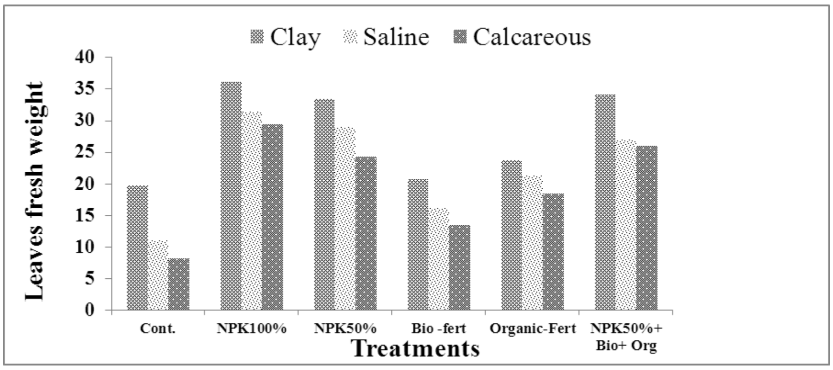

Fig. 1 : Effect of chemical, bio and organic fertilizers on leaves fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Table 4 : Effect of chemical, bio and organic fertilizers on stems fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Treatments (T)	Soil Type (S)			
	Clay	Saline	Calcareous	Mean
Control	23.2	16.1	10.1	16.5
100 % NPK	42.6	35.2	41.2	39.7
50 % NPK	36.7	28.5	29.3	31.5
Bio – fertilizer	35.3	19.7	11.2	22.1
Organic Fertilizer	37.7	24.3	20.4	27.5
50 % NPK + Bio+ Organic	42.0	31.0	30.5	34.5
Mean	36.3	25.8	23.8	28.6
LSD (5%)	T	S	T*S	
	4.4	3.1	7.5	
Significe	*	*	*	

*** pot = 2 plants** *** significant at 5 %**

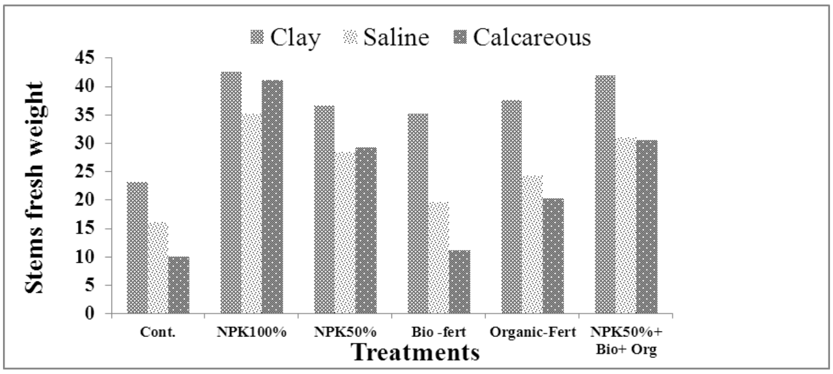

Fig. 2 : Effect of chemical, bio and organic fertilizers on stems fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Shoot Plant Fresh weight of shoots stevia plants

The obtained data in Table 5 and Fig. 3 indicate that, the effects of chemical (NPK), bio and organic (compost) fertilizers under different soil types of Egypt on shoot plant fresh weight of stevia plants (g/pot) and their interactions were reached to the level of significance.

Results in the Table and the Figure showed positive increases in shoot Plant fresh weight of stevia due to fertilization the plants with the different fertilizers types over control (without fertilization). Fertilizing stevia plants with 100 % NPK of the recommended gave The highest shoot Plant fresh weight (72.0 g/pot) in comparison with control (29.5 g/pot) and the others treatments of fertilizers used (63.6, 60.4, 48.6 and 38.9 g/pot for the treatments of mixture, 50 %, organic and bio, respectively). The corresponding values of increases over control due to the aforementioned respective treatments were 42.5, 34.1, 30.9, 19.1 and 9.0 g/pot. These increases represent the following percentages over control : 144.6, 115.6, 104.7, 64.7 and 30.5 %, respectively. It is obvious as shown in the table that the differences between two treatments reached to the level of significance, except the difference between 50 % NPK and mixture did not significant.

Regarding soil types, the obtained data in Table (5) and Fig (3) explain highest shoot plant fresh weight of stevia was obtained due to growing stevia plants on clay soil where the mean value was 64.3 g/pot. Both saline and calcareous soils were followed clay soil where the respective mean values of shoot plant fresh weight were 48.5 and 43.8 g/pot. Thus it is noticed that, calcareous soil gave the lowest shoot plant fresh weight of stevia and saline soil gave intermediate value. However the differences between the means of shoot plant fresh weights resulted from growing stevia plants on different soil types were significant. Calculating increase percentage in shoot plant fresh weight due to growing stevia plants on different soil types resulted in the following figures : clay soil led to 32.6 and 46.8 % increase over both saline and calcareous soils, respectively, while saline soil led to 10.7 % increase over calcareous soil.

interactions effects between fertilizer sources and soil types were highly significant (Table 5). However, the best interaction was obtained due to growing stevia plants on clay soil with 100 % NPK fertilization and followed by the fertilization with the mixture (78.7 and 76.2 g/pot of shoot plant fresh weight, respectively), while the lowest interaction was obtained when plants were grown on calcareous soil without fertilization (18.3 g/pot). The increase percentages of the two aforementioned figures over the lowest one were 330.1 and 316.4 %. As shown in Table 6 it is obvious that, both saline and calcareous soils were followed clay soil for the interaction effect and both take the same trend of clay soil where shoot plant fresh weight was reach the maximum with 100 % NPK fertilization and followed by the fertilization with the mixture (66.6 and 58.1 g/pot under saline soil and 70.6 and 56.6 g/pot under calcareous soil, respectively).

Table 5 : Effect of chemical, bio and organic fertilizers on shoot plant fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Treatments (T)	Soil Type (S)			
	Clay	**Saline**	**Calcareous**	**Mean**
Control	43.0	27.2	18.3	29.5
100 % NPK	78.7	66.6	70.6	72.0
50 % NPK	70.2	57.5	53.6	60.4
Bio – fertilizer	56.1	35.9	24.7	38.9
Organic Fertilizer	61.4	45.7	38.9	48.7
50 % NPK + Bio+ Organic	76.2	58.1	56.6	63.6
Mean	64.3	48.5	43.8	52.2
LSD (5%)	T	S	T*S	
	4.7	3.3	8.2	
Significe	*	*	*	

*** pot = 2 plants** *** significant at 5 %**

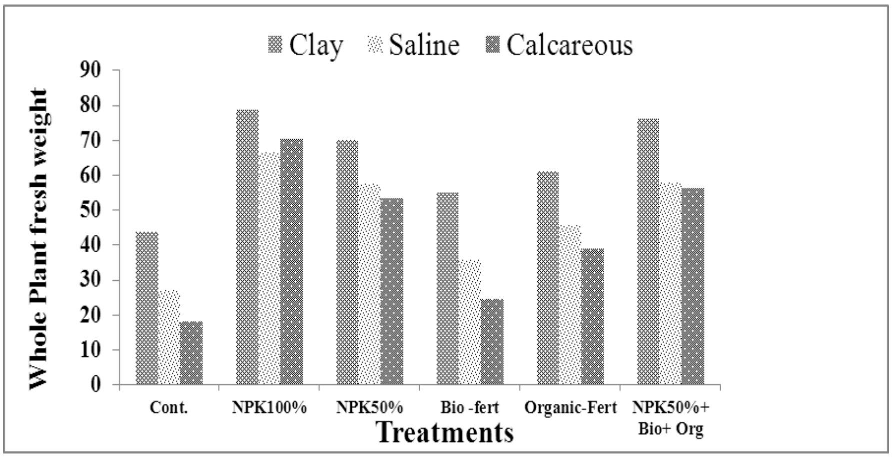

Fig. 3 : Effect of chemical, bio and organic fertilizers on shoot plant fresh weight of stevia plants (g/pot) under different soil types of Egypt and their interactions.

leaves and stems dry yield of stevia plants

Mean values of leaves and stems dry yield of stevia in g/pot as affected by chemical (NPK), bio and organic (compost) fertilizers under different soil types of Egypt (Clay, Saline and Calcareous) and their interactions are presented in table (6-7) and Fig (4-5).

Results indicated that, the main effects of different fertilizers sources were significant in comparison with control. Concerning the effect of soil types on leaves and stems dry yield indicated significant differences between the effect of soil types. Data in the tables and figures, showed that clay soil gave the highest leaves and stems dry yield.

Table 6 : Effect of chemical, bio and organic fertilizers on leaves dry yield of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Treatments(T)	Soil Type (S)			
	Clay	Saline	Calcareous	Mean
Control	13.1	7.4	5.3	8.6
100 % NPK	29.5	21.7	21.2	24.1
50 % NPK	24.8	20.8	16.5	20.7
Bio – fertilizer	14.3	10.9	8.9	11.4
Organic Fertilizer	17.4	16	13.4	15.6
50 % NPK + Bio+ Organic	27.2	21.9	20.9	23.3
Mean	21.1	16.5	14.4	17.3
LSD (5%)	T	S	T*S	
	0.87	0.62	1.51	
Significe	*	*	*	

*** pot = 2 plants** *** significant at 5 %**

Table 7 : Effect of chemical, bio and organic fertilizers on stems dry yield of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Treatments (T)	Soil Type (S)			
	Clay	Saline	Calcareous	Mean
Control	13.6	10.9	6.8	10.4
100 % NPK	27.8	20.5	20.9	23.1
50 % NPK	23.4	15.7	17.5	18.9
Bio – fertilizer	20.0	11.6	7.1	12.9
Organic Fertilizer	22.6	12.9	11.2	15.6
50 % NPK + Bio+ Organic	25.0	18.0	17.8	20.3
Mean	22.1	14.9	13.6	16.9
LSD (5%)	T	S	T*S	
	1.8	1.27	3.1	
Significance	*	*	*	

*** pot = 2 plants** *** significant at 5 %**

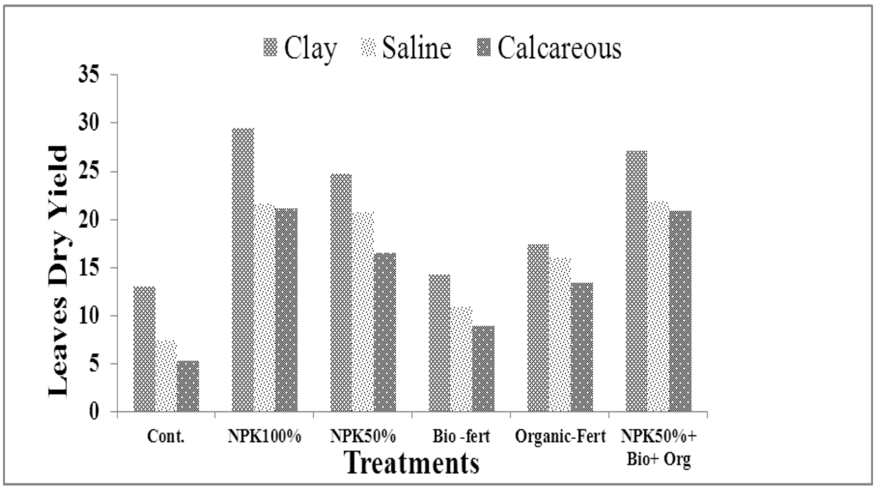

Fig. 4 : Effect of chemical, bio and organic fertilizers on leaves dry yield of stevia plants under different soil types of Egypt and their interactions.

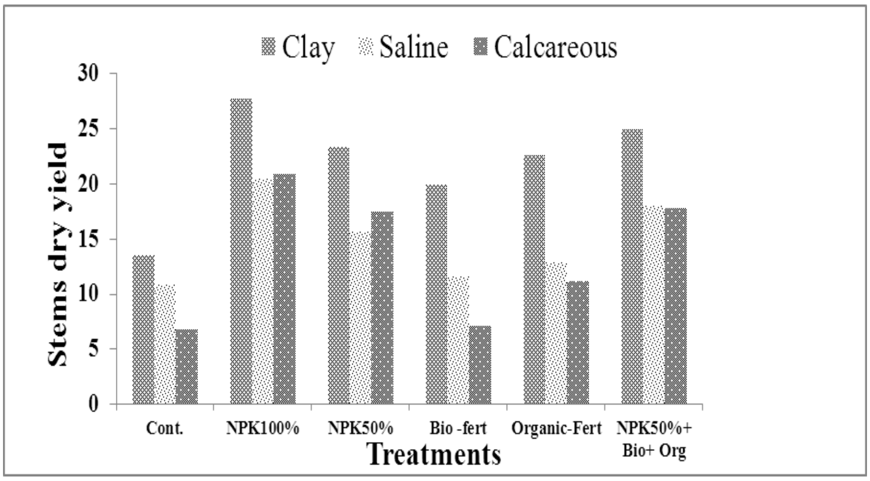

Fig. 5 : Effect of chemical, bio and organic fertilizers on stems dry yield of stevia plants under different soil types of Egypt and their interactions.

Shoot Dry Yield of shoot stevia plants

Data of both Table (8) and Fig.(6) indicate that, shoot dry yield (g/pot) of stevia plants increased significantly due to applying different sources of fertilizer (chemical (NPK), bio and organic as compost) under different soil types of Egypt and their interactions.

As seen in table (8) and Fig. (6) applying different fertilizer sources increased shoot plant dry yield of stevia significantly in comparison with control (without fertilization). The highest shoot plant dry yield of stevia (47.2

g/pot) was obtained due to the fertilization with 100 NPK%. and the lowest one (24.3 g/pot) has been achieved when stevia plants inoculated by (biofertilizer. The descending order of shoot plant dry yield means which calculated on the averages of soil types was : 47.2, 43.6, 39.6, 31.2, 24.3, 19.0 g/pot for respective treatments of 100 % NPK, 50 % NPK+ bio + organic, 50 % NPK, organic, bio, and control. It is clear from the table that the differences between the treatments reached to the level of significance. The ascending increase percentages of shoot dry yield (g/pot) of stevia plants over control were : 27.9, 64.2, 108.4, 129.5 and 148.4 % for fertilizer treatments of bio, organic, 50 % NPK, mixture and 100 % NPK, respectively . It is noticed that from table (8), fertilization of stevia plants with 100 % NPK gave the greatest shoot dry yield of stevia plants and also the highest increase percentage (148.4 %) over control compared with others fertilizer treatments, and followed by mixture treatment (129.5%) and the difference in increase percentage of shoot dry yield of stevia plants between these two treatments was 18.9 % . Also the difference in shoot dry yield of stevia plants between these two treatments was 3.6 g/pot and although the value of this difference is little , it reached to the level of significance.

Concerning to soil types, it is pronounced as shown in Table (8) and Fig. (6), soil types increased shoot dry yield of stevia plants where the highest mean value was obtained when stvevia plants were grown on clay soil where the mean value was 43.2 g/pot. Both saline and calcareous soils were followed clay soil where the respective mean values of shoot dry yield of stevia plants were 31.4 and 28.0 g/pot. On the other hand it is noticed that, calcareous soil led to the lowest shoot dry yield of stevia plants and saline soil gave intermediate values. The difference between any two means of shoot dry yield of stevia plants grown on two types of soil was significant. The increase percentage of shoot dry yield of stevia plants when grown on clay soil over both saline and calcareous soils were : 37.6 and 54.3 % , respectively and increase percentage resulted from saline soil over calcareous was 12.1 %.

From data in Table (8), statistic analysis revealed that interactions effect between fertilizer sources and soil types were significant on shoot dry yield of stevia plants. The highest interaction was obtained due to growing stevia plants on clay soil with 100 % NPK fertilization and followed by the fertilization with the mixture (57.3 and 52.2 g/pot). However, the difference between previous two means was significant (5.1 g/pot) and also increase percentage due to treatment of 100 % NPK over mixture treatment was pronounced (9.8 %). The descending values of increase percentages in shoot dry yield of stevia plants over control at harvest stage when stevia plants were grown in clay soil were : 114.6, 95.5, 80.5, 49.8 and 29.6 for applying fertilizers of 100 % NPK, mixture, 50 % NPK, organic and biofertilizer, respectively. It is clearly from the averages of shoot dry yield of stevia plants which affected by interactions between all fertilizer sources and both saline and calcareous soils that, both interactions take the same trend of clay soil. .

Table 8 : Effect of chemical, bio and organic fertilizers on shoot dry yield of stevia plants (g/pot) under different soil types of Egypt and their interactions.

Treatments(T)	Soil Type (S)			
	Clay	Saline	Calcareous	Mean
Control	26.7	18.3	12.1	19.0
100 % NPK	57.3	42.2	42.1	47.2
50 % NPK	48.2	36.5	34.0	39.6
Bio – fertilizer	34.3	22.5	16.0	24.3
Organic Fertilizer	40.0	28.9	24.6	31.2
50 % NPK + Bio+ Organic	52.2	39.9	38.7	43.6
Mean	43.2	31.4	28.0	34.2
LSD (5%)	T	S	T*S	
	2.0	1.4	3.5	
Significance	*	*	*	

*** pot = 2 plants** *** significant at 5 %**

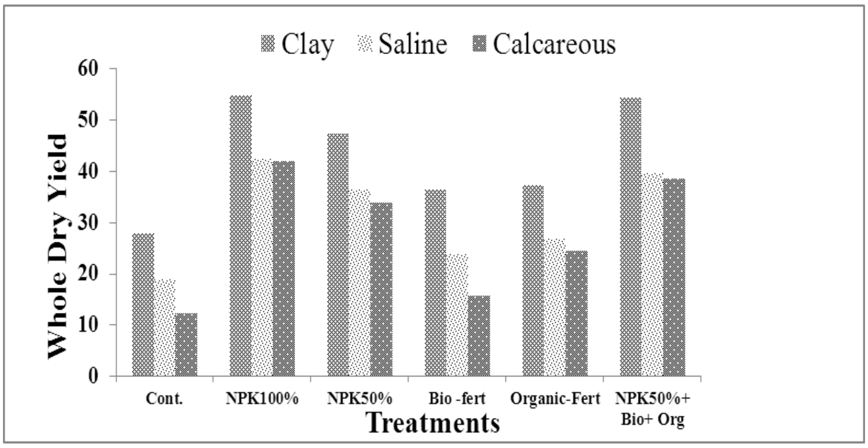

Fig. 6 : Effect of chemical, bio and organic fertilizers on shoot dry yield of stevia plants under different soil types of Egypt and their interactions.

From aforementioned discussion about response stevia plants to different fertilizer sources as chemical fertilizers (100 % and 50 % NPK), bio and organic fertilizer, as well as mixture (50 % NPK + Bio+ Organic) which grown on different soil types (clay, saline and calcareous) and their interactions (Tables from 3 to 8), it could be concluded that stevia plants were responded positively and significantly to all fertilizer sources in comparison with control (without fertilization). This positive effect may be attributed to the intermediate values of both available N and P of all soil types used (67.2, 58.8, and 42.0 mg N Kg-1 soil for available N, and 13.36, 11.12, and 13.26 mg P Kg-1 soil for available P of clay, saline and calcareous soils, respectively). Whereas due to intermediate values of available K in both clay (220 mg K Kg-1 soil) and saline soil (204 mg K Kg-1 soil) and low value of calcareous soil (64.0 mg K Kg-1 soil) before cultivation, (Table 1). This values were compared with the limits of Hamissa (1993) as 40-80 mg N , 10-15 mg P and 200-400 mg K Kg-1 soil for available N, P, K, respectively.

The positive effect of NPK fertilizers on fresh weight and dry yield of stevia plants forage is in consistency with Aladakatti, et al. (2012), they reported that highest dry leaf yield of stevia plants were obtained with nitrogen at 400 kg ha-1, Phosphorus at 200 kg ha-1, Potassium at 200 kg ha-1.

The enhanced effect of applying NPK fertilizers on fresh weight and yield of stevia plants which grown for foliage parts may be due to the nutritional balance which is achieved through application them where N form new cells and make a big vegetative growth as well as to the formation of proteins which participate in dry matter accumulation. In addition, P has an important role in energy translocation, and sugars, starch, lipids and albumin formation, whereas K has many biochemical processes. Marschner, (1995) explained the role of N, P and K in many processes which led to dry matter accumulation and he related the application of them with plant growth and plant composition.

Positive results of applying organic fertilizer to stevia plants is compatible with the results obtained by Liu, et al., (2011) where they observed that organic manure cultivation promoted the dry weight of the above-ground. The promoted effect of applying organic fertilize in present study on fresh weight and dry yield of stevia plants may be attributed to low content of OM in soil before cultivation. As shown in table (1), soil organic matter content were : 1.35, 1.04, and 0.14 % for clay, saline and calcareous soil, respectively. Also significant effect of OM on stevia plants, may be due to the high N, P, and K content and the low C/N ratio than 33 : 1 (25.96) for compost used (Table 2) which help in dominant mineralization process and consequently increases available nutrients in soil media. Many workers explained the beneficial effects of adding organic fertilizers on soil properties (physical, chemical, biological) which increase soil fertility and subsequently increase the growth, yield and improve the quality of crops(Kononova, 1966; Tandon, 1992; El-Galla, 2003 and Abo-Alkhair, 2013).

From current study , it can be concluded that inoculation stevia plants with biofertilizer increases both fresh weight and dry yield of plants over control treatment (Tables 3-8 and Figures1-6). The present results are in harmony with results of Das, et al. (2007), they reported stevia plant has been found to be increased. They explained the causes of increase as a result using biofertilizers due to their ability to fix atmospheric nitrogen (symbiotic and asymbiotic) and transform native soil nutrients likely phosphorus, zinc, copper, iron, sulfur from the non-usable (fixed) to usable form and decompose organic wastes through biological processes which in turn releases nutrients in a form which can be easily assimilated by plants resulting in an increase in biomass production of stevia plant.

The present work revealed superiority of clay soil compared both saline and calcareous soils where it induced the maximum fresh weight and dry yield parameters of stevia plants. Also, all fertilizers treatments eliminated bad effect of both saline and calcareous soils in comparison with control (interaction effect). The reduction in fresh weight and dry yield of stevia plants when grown on saline soil, may be confirmed by explanation of Soliman,

(2013) who mentioned that soluble salts in soils absorb a lot of water and increase the osmotic potential consequently increase the soil water potential (decrease energy of soil water) and decrease water availability for plants. Also, The high reduction in fresh weight and yield of stevia plants grown on calcareous soil may be confirmed by explanation of El-Sirafy, and El-Ghamry, (2010) where they mentioned that, calcareous soil has problems in its physical and chemical properties due to the presence of calcium carbonates. The high soil pH, soluble and exchangeable Ca as well as CaCO3 % reduce availability of macro (N by volatilization, P by fixation and K by antagonism) and micronutrients (Fe induced chloroses and others). Calcareous soil has low content of OM, soft after irrigation and solid at dryness.

The results suggested that fresh and dry yield of stevia plant has been markedly increased due to apply 100% NPK fertilizer doses and it followed application mixture of 50% NPK with bio and organic fertilizer. Therefore, we can say that addition this last application saving some doses of mineral fertilization, reducing both the productivity economical costs and hazards pollution factors. Also we can recommend the cultivation stevia plant in clay soils, also it planted in saline and calcareous soils.

REFERENCES

Abo-Alkhair, A. M. Y. (2013). Organic Matter In Agricultural Soils. 10485/2013. ISBN: 978-977-90-0675-8. Soils and Water Depart., Fac. Agric. Kafr-Elshekhuniv.

Aladakatti, Y. R. ; Palled, Y. B. ; Chetti, M. B. ; Halikatti, S. I. ; Alagundagi, S. C. ; Patil, P. L. ; Patil, V. C. andjanawade, A. D. (2012).Effect of nitrogen, phosphorus and potassium levels on growth and yieldof stevia (Stevia rebaudianaBertoni.).Karnataka J. Agric. Sci,25 (1) : 25-29.

Bertoni,MS. (1905). Ancient Paraguayos.1(5): 1.(C. F. Dasand Dang, 2010).

Brandle, J.E. ; Starrratt, A.N.andGijen, M. (1998).Stevia rebaudiana: its agricultural, biological and chemical properties. Can. J. Plant Sci. 78, 527–536.

Cramer, B. and Ikan, R. (1986).Sweet glycosides from the Stevia Plant. Chemistry in Britain.22: 915.

Das and Dang, 2014

Das, K. and Dang, R. (2014). Influence of biofertilizers on protein, moisture and ash content in relation to swelling property, water absorption capacity, mineral elements, total phenolic level of Stevia (Stevia rebaudiana Bert.) plant grown under acidic soil zone of South India. International Letters of Natural Sci. (6) 78-97.

Dewis, J. and F. Freitas 1970. Physical and Chemical Methods of Soil and Water Analysis. Soil Bultin 10, FAO, Rome.

El-Galla, A. M. (2003).Organic Farming, Principles, Regulations and Quality of Products. 2nd. Ed. 13330 / 2002 – I.S.B.N. 977-17-0582-2.(In Arabic).

El-Sirafy, Z. M. and El-Ghamry, A. M. (2010). Soil Reclamation Technology, " How to reclaim your Soil". Alasria Library for publishing, Marshal Algezera Hotel, Mansoura, Egypt. 11577/2009, I.S.B.N : 977-410-150-2. Soils Depart. Fac. Agric. Mansoura Univ., Egypt. (in Arabic).

Farooqi, A.A. and Sreeramu, B.S. (2001).Cultivation of Medicinal and Aromatic Crops, University Press (India) Ltd., Hyderabad, India.
Geuns, J. M.C.(2003). Stevioside. Phytochemistry,64(5): 913 – 921.
Gomez, K. A. and A. A. Gomes (1984). Statistical Procedures for Agriculture Research. 2nd Ed. John Wiley and Sons, PP. 680.
Hamissa, M. R.; A. Serry, and N. M. El-Mowelhi (1993). Fertilizer management for corn in Egypt. Soil and Water Research Istitute, Cairo, Egypt, P.63.
Hesse, P. R. (1971). "A Text Book of Soil Chemical Analysis". John Murry (Publishers) Ltd, 50 Albermarle Street, London.
Jackson, M. L. (1967). "Soil Chemical Analysis". Printice Hall of India, New Delhi. PP. 144-197.
Jackson, M. L. 1973. Soil Chemical Analysis. Prentice- hall. Inc. Englewood Cliffs, N.J.U.S.A.
Kennelly, E. (2002). Sweet and non-sweet constituents of Stevia rebaudiana.In A. D.Kinghorn (Ed.), Stevia, the genus Stevia. Medicinal and Aromatic Plants–Industrialprofiles(pp. 68–85). London and New York: Taylor and Francis.
Kinghorn, A. D. and Soejarto, D.D. (1986).Sweetening agents of plant origin,Crit. Rev. Plant Sci, 4: 79 - 120.
Kononova, M. M.(1966). Soil Organic Matter, its Nature, its Role In Soil Formation and in Soil Fertility. 2nd. Ed. Pergamon Press.Oxford .London .Edinburgh . New York,Toronto .Sydney .Paris .Braunschweig.(In English).
Liu, X. ;Ren, G. and Shi, Y. (2011).The effect of organic manure and chemical fertilizer on growth and development of Stevia rebaudiana Bertoni. Energy Procedia, 5: 1200 – 1204.
Maiti, R. K. and Purohit, S. S. (2008).Stevia, a miracle plant for human health, Agrobios (India), 71. (C.F. Dube, 2011).
Marschner, H. (1995). Mineral Nutrition of Higher Plants.2nd. Ed. Academic Press, Harcourt Brace and Company, Publishers. London, San Diego. New York, Boston. Sydney, Tokyo Toronto.
Mowrey, D. (1992). Life with Stevia: How sweet it is. Op. Cit. pp. 1- 9. (C. F. Das, et al., 2007).
Ren, G. ; Liu, X. and Shi, Y. (2011). Effects of drought stress on physiological indices and dry leaf yield of stevia rebaudiana bertoni. J. Agric., pp: 1 - 6. (C. F. Yang, et al. , 2013).
Sharma, N. ;Kaushal, N. ; Chawla, A. and Mohan, M. (2006).Agribios.5, 46.(C. F. Dasand Dang, 2010).
Soliman, E. M. A. (2013).Water potential movement of salts and some nutrients in soil.Ph.D.Thesis, Soils Depart. Fac. Agric., Mansoura Univ. Egypt.
Tandon, H. L. S.(Ed.), (1992).Fertilisers, Organic Manures,Recylable Wastes and Biofertilisers, Components of Integrated Plant Nutrition., Fertilizer Development and Consultation Organisation 204-204A Bhanot Corner, 1-2 Pamposh Enclave, New Delhi 110048 (India).

Yang, J. ; Liu, X. and Shi, Y. (2013).Effect of Different Mixed Fertilizer on Yield, Quality and Economic Benefits in Stevia rebaudiana Bertoni. Advance J. Food Sci. and Techn, 5(5): 588-591.

مقارنة تأثير كل من التسميد العضوي والحيوي مع التسميد المعدني على محصول نبات استيفيا السكرية تحت ظروف بعض أنواع الاراضى المصرية.

زكريا مسعد الصيرفي[1] ، رمضان احمد حسن [2] ، مجدي محمد الشازلي [3] و محمد المندوه جاد

[1]قسم الأراضى – كلية الزراعة – جامعة المنصورة – مصر.

[2]قسم الكيمياء الزراعية – كلية الزراعة – جامعة المنصورة – مصر.

[3]قسم بحوث تغذية النبات- معهد بحوث الأراضي والمياه والبيئة- مركز البحوث الزراعية- الجيزة.

لدراسة تأثير التسميد العضوي و الحيوي مقارنة بالتسميد المعدني والتفاعل بينهما علي الوزن الطازج والجاف لكل من الاوراق والسيقان لنبات استيفيا السكرية تحت ظروف الأراضي المصرية المختلفة تم تنفيذ هذه الدراسة بزراعة تجربة أصص بمزرعة كلية الزراعة بجامعة المنصورة في موسم صيف 2013، وقد تم استخدام تصميم القطاعات كاملة العشوائية مع 3 مكررات حيث تم استخدام ثلاثة أنواع من التربة وهي التربية الطينية والملحية والجيرية وكانت المعاملات المستخدمة من الأسمدة المختلفة هي 6 معاملات لكل نوع تربة وهي كالتالي: معاملة المقارنه (بدون تسميد)، 100 % NPK من الموصي به، 50 % NPK من الموصي به، سماد حيوي، سماد عضوي (الكمبوست) و سماد خليط (50 % NPK من الموصي به + سماد حيوي + سماد عضوي). وكانت النتائج المتحصل عليها هي أن كل المعاملات السمادية أدت إلي زيادة متوسطات قيم المحصول الخضري والجاف لكل من الأوراق والسيقان والنبات الكلي (مجموع الأوراق والسيقان) لنبات الاستيفيا مقارنة بالكنترول وكانت الزيادة معنوية وكانت اعلي القيم للوزن الطازج للأوراق والسيقان والنبات الكلي هي 32,3 - 39,7 - 72,0 جم/ أصيص علي الترتيب وذلك للمعاملة 100 % NPK من الموصي به اما باقي المعاملات فكانت (63,6 – 60,4 – 48,6- 38,9 جم/ أصيص) وذلك للمعاملات (سماد خليط – 50 % NPK – الكمبوست- سماد حيوي) علي الترتيب. وبناءا عليه فكانت نسبة الزيادة للمعاملات مقارنة بالكنترول 144,6 – 115,6 – 104,7 – 64,7 – 30,5 علي الترتيب. اما بالنسبة لاعلي قيم المحصول الجاف وزنا (أوراق – سيقان- نبات كلي) فكانت 24,1 - 23,1- 47,2 جم/ أصيص علي الترتيب. وبالنسبة لأنواع التربة المختلفة فقد تم الحصول علي القيم للوزن الطازج والجاف للنبات الكلي مع التربة الطينية حيث كانت القيم 64,3 – 43,2 جم/ أصيص علي الترتيب أما القيم المتحصل عليها مع التربة الملحية والجيرية لكل من المحصول الطازج فكانت (48,5 – 31,4 جم/ أصيص) والمحصول الجاف (43,8 – 28,0 جم/ أصيص) علي الترتيب. بالإضافة إلي أن كل قيم الوزن الطازج والجاف للمعاملات السمادية مع كل من التربة الملحية والجيرية كانت اقل منها مع التربة الطينية ولكن أيضا كانت قيمها اعلي من الكنترول.

الكلمات المفتاحية: الأسمدة المعدنية NPK – الأسمدة الحيوية – الكمبوست – نبات الاستيفيا السكرية..