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MANUFACTURING AMINO ACIDS BIO FERTILIZERS FROM AGRICULTURAL WASTES.
II- EFFECT OF SYNTHETIC ORGANIC FERTILIZERS ON THE GROWTH AND YIELD OF SOME FORAGE CROPS AS WELL AS SOME SOIL PROPERTIES

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ABSTRACT

A field experiment was conducted at Ismailia Research Station, Agricultural Research Center, Ismailia Governorate, Egypt, during the summer season of 2011 to evaluate the efficacy of organic synthesized fertilizers obtained from tomato and sugar beet thrones on yield and quality of pearl millet (*Pennisetumamericanum*) and sorghum (*Sorghum vulgare*) forage crops as well as their effects on some soil properties. The micronutrients like iron, zinc, copper, manganese and boron were chelated with organic synthesized fertilizers.

Obtained results showed that amino acids synthesized fertilizers (details about these amino acids are found in first part) chelate micronutrients improved the growth and yield of either pearl millet or sorghum and their uptake of macro and micro nutrients when their applied either separately or integrated with NPK fertilization as foliar or soil + foliar application to foliage crops grown in poor sandy loam soil at Ismailiah area.

Concerning the effect of synthesized fertilizers on soil properties, the results indicated that organic matter and CEC of soil tended to increase slightly with the use of synthesized fertilizers as compared with unfertilized check, also they improved the soil content of macro and micro elements. The efficiency of organic synthesized fertilizers were improved when their applied in combination with $1/_2$ unit or one unit of NPK recommended rates.

Depending on results of this study, it can be recommended to use these organic synthesized fertilizers which obtained from tomatoes and sugar beet thrones commercially as cheap source of amino acids chelate micronutrients to solve the problem of micro elements in new lands and recycling these wastes and improve soil nutrient conditions.

Keywords: Foliar application, Pearl millet, Sorghum, Growth, Yield, Amino acids

INTRODUCTION

The requirement of amino acids in essential quantities is well known as a means to increase yield and overall quality of crops. The application of amino acids for foliar use is based on its requirement by plants in general and at critical stages of growth in particular. Foliar nutrition in the form of Protein Hydrolysate (Known as amino acids Liquid). Amino acids are fundamental ingredients in the process of Protein Synthesis. Studies have proved that amino acids can directly or indirectly influence the physiological activities of the plant. Amino acids are also supplied to plant by incorporating them into the soil. It helps in improving the microflora of the soil thereby facilitating the assimilation of nutrients. Since amino acids are the basic building blocks of proteins found in all living things, the chelation of minerals with amino acids provides a tremendous advantage in increasing the efficiency of absorption and translocation of minerals within plants (Hsu, 1986).

On the other hand, natural organic chelating agents such as polyflavonoids, lignosulfonates, humic and fulvic acids, amino acids, and polyphosphates do help the plant in translocating the micronutrients. These chelators are not phytotoxic to plants (Koksal *et al.*, 1998). They are easy to produce and are inexpensive. In recent times, consumers are highly interested in organic products and demanding quality and safer food (Ouda and Mahadeen, 2008). Hence, there is urgent need to produce organic chelate of micronutrients for growing plants. Also, Amino acids are a well-known bio stimulant which has positive effects on plant growth, yield and significantly mitigates the injuries caused by a biotic stresses (Kowalczyk and Zielony, 2008). El- Zohiri and Asfour (2009) on potato found that spraying of amino acids at 0.25 ml/L significantly increased vegetative growth expressed as plant height and dry weight of plant. Meanwhile on cowpea crop, amino acid foliar spraying on all measured traits was significant at 1% probability level. Also, the interaction effect of nitrogen and amino acid application on seed yield and plant height at 1% and on number of pods per plant was significant at 5% (Moraditochaee *et al.* 2012). Asra *et al.*, (2012) found that amino acids play an important role in photosynthesis, protein synthesis and respiration. Additionally, foliar application of Stimurel: (A group of amino acid based fertilizers) has significant effect on some characteristics such as panicle length and tiller. They also reported that foliar feeding resulted in number, crude fiber, fresh matter, and dry weight but no effect on height and thickness of plants.

Sorghum is a major cereal food and feed crop in many parts of the world. It is becoming an increasingly important forage crop in many regions of the world (Kasozi *et al.*, 2005). Pearl millet *(Pennisetum glacum)* is an important plant from Graminacea family which can play an important role in the case of lack of forage in summer (Piri, and Tavassoli, 2012).

Mortvedt (1991) reported that micronutrients are mostly applied either to plant leaves by foliar spray in chelated form (like EDTA-EDDHA-Citric acid, ….etc) or applied to the soil. Foliar sprays are widely used to apply micronutrients, especially iron and manganese, for many crops. Anonymous (2013) indicated that foliar fertilization is the most efficient way to increase the yield and plant health. Tests have shown that foliar feeding can increases yields from 12% to 25% compared to conventional fertilization.

Soleymani and Shahrajabian (2012) noted that application methods of micronutrients are very important to attain the best absorption. In addition, use foliar application on sorghum crop had significant effect on all vegetative plant parts and ash percentage. Fe, Zn and Mn had positive effect on yield and quality of forage sorghum. The maximum ash percentage and appropriate protein percentage also was achieved in application of Zn+Fe+Mn. So, on the basis of the results, it seems that application Zn+Fe+Mn was suitable to gain high forage yield and gain to high quality.

Eisa *et al.*, (2010) found that a combined application of amino acid with micronutrient Fe, Zn, Mn in the presence of elemental sulphur significantly increased the sesame yield; improved nutrition and increased seed quality.

Thus, the objective of this study is to determine the effects of organic synthesized fertilizers chelated–microelements as either foliar sprays or soil application on the growth, yield and quality of pearl millet and sorghum crops as well as some soil properties were taken into consideration.

MATERIALS AND METHODS

A field experiment was carried out at Ismailia Research Station of the Agricultural Research Center, Ismailia Governorate, Egypt, during the period from 12/6/2011 until 1/11/2011 to evaluate the effect of the organic synthesized fertilizers obtained from tomato and sugar beet thrones chelate–microelements applied as either foliar sprays or soil application as compared to mineral fertilization on the growth of two forage crops namely Pearl millet (Shandaweel cultivar) and Sorghum (super Feed 17 cultivar). Soil sample of 1 kg was collected, air dried then oven dried at 105ºC for 2 days and prepared for physical and chemical analyses. Some physical and chemical properties of the used soil are given in Table (1).

Table (1): Some physical and chemical properties of the used soil

Soil location	**Particle size distribution, %**				**Texture class**	**pH (soil paste)**	**EC, $dS.m^{-1}$**	**OM, %**	**SP, %**
	Coarse sand	**Fine sand**	**Silt**	**Clay**					
Ismailia Soil	26.7	43.9	19.6	9.8	Sandy loam	7.3	0.68	0.52	20.0
Soluble ions, $meq.l^{-1}$								FC, %	CEC meq/100g
SO_4^{--}	Cl^-	HCO_3^-	CO_3^{--}	K^+	Na^+	Mg^{++}	Ca^{++}		
0.8	5.2	1.0	0.0	0.1	3.8	1.2	1.9	13.7	2.3
Macro and micronutrients soluble, $meq.l^{-1}$									
N	K	P	B	Cu	Fe	Mn	Zn		
115	40.5	4.82	0.04	0.36	5.18	1.02	0.40		

The experiment included twelve treatments, amino acid chelate–microelements applied as either foliar sprays or soil application, in three replicates as follows:

1- Foliar sprays with water only (Unfertilized plot, T1).
2- Soil application of 120 kg/fed N in the form of ammonium nitrate +30 kg P_2O_5/ fed in the form of super phosphate + 48 kg K_2O/fed as potassium sulfate (Recommended rates, T2).
3- Foliar sprays with mixture of amino acids (A.A.) obtained from tomato thrones, macro and chelate- microelements donated as T3 {$T_{A.A.-Mac.-Mic.}$}.
4- Foliar sprays with mixture of amino acids (A.A.) obtained from sugar beet thrones, macro and chelate-microelements donated as T4 {$S_{A.A -Mac.-Mic.}$}.
5- Foliar + soil application of T5 {$T_{A.A -Mac.-Mic.}$}.
6- Foliar + soil application of T6 {$S_{A.A -Mac.-Mic.}$}.

7- Soil application of NPK at recommended rates + foliar sprays with mixture of amino acids (A.A.) obtained from tomato thrones, K and chelate micro elements donated as T7 {$T_{A.A.-K-Mic.}$}.
8- Soil application of NPK at recommended rates + foliar sprays with mixture of amino acids (A.A.) obtained from sugar beet thrones, K and chelate micro elements donated as T8 {$S_{A.A.-K-Mic.}$}
9- Soil application of 60 kg/fed N in the form of ammonium nitrate + 15 kg P_2O_5/ fed in the form of super phosphate + 24 kg K_2O/fed in the form of potassium sulfate {1/$_2$ NPK rec.} + foliar sprays with mixture of amino acids (A.A.) obtained from tomato thrones, N, P and K donated as T9 {$T_{A.A.-NPK}$}.
10- Soil application of {1/$_2$NPK rec.} + foliar sprays with mixture of amino acids (A.A.) obtained from sugar beet thrones, N, P and K donated as T10 {$S_{A.A.-NPK}$}.
11- Soil application of {1/$_2$NPK rec.}+{$T_{A.A.-Mac.-Mic.}$}as foliar sprays T11.
12- Soil application of {1/$_2$NPK rec.}+{$S_{A.A.-Mac.-Mic}$} as foliar sprays T12.

Each amino acid based fertilizer which synthesized from either tomatoes or sugar beet thrones was added as foliar application at 1 liter/600 liter water per feddan with knapsack spray three times at 25, 35 and 45 days from sowing before first cut, 15, 25 and 35 days before second cut and at 15, 25 and 35 days before third cut. Soil application of organic synthesized fertilizers {$T_{A.A\ -Mac.-Mic.}$} and {$S_{A.A.-Mac.-Mic.}$} were applied at 2 liter/600 liter water per feddan as soil application after three days from sowing or cutting.

Mineral fertilizer was added as soil application of nitrogen which applied at the rates mentioned in each treatment at 40 kg/fed after 21 days from sowing followed by 40 kg/fed after each cut, super phosphate and potassium sulphate fertilizers were added during soil preparation for sowing. Super phosphate was added at 200 kg/fed. Potassium sulphate was added at 100 kg/fed. Other cultural practices i.e. weed control or sprinkler…etc. irrigation were added as normal. Seeding rate of pearl millet was 14 kg/fed of Shandaweel cultivar and the seeding rate of sorghum was 18 kg/fed of super Feed 17 cultivar were sown at 12/6 /2011 by drilling in rows 20 cm apart between hills, plot area was 3m x 3.5m =10.5 m^2 in five ridges.

At time of cutting in each cut the following data were recorded for Pearl millet-plant height average of 10 tillers, Number of tillers, Fresh weight of forage yield and then converted into yield tons per feddan and dry weight of forage pearl millet. Sample of fresh weight was taken and air dried for 3 days and then oven dried at 70^0C for chemical analyses such as: Ash and fat content of pearl millet or sorghum foliage was determined according to the methods described by the AOAC (2006). Nitrogen was estimated by semi-micro kieldahl method of Page *et al.*, (1982). The protein percentages were accounted by multiplying nitrogen content by 6.25._ Phosphorus (Page *et al.*, 1982) and potassium, Fe, Mn, Zn, Cu and B (using atomic absorption spectrophotometer according to AOAC, 2006).

At the same time, at harvest, one kg of soil was taken randomly from the surface layer (0-25 cm depth) from each plot, air dried, oven dried at 105 ^{0}C then kept for chemical analyses (available nutrients) according to the standard methods of Page *et al.,* (1982), Soltanpoor (1991) and Cottenie *et al.*, (1982).

Statistical analysis

The collected data were subjected to proper statistical analysis of randomized complete block design according to procedure out lineal by Snedecor and Cochran (1980) and the combined analysis of the growth and yield of each crop was been done. Means were compared by determination LSD values at 5% levels and Duncan's multiple range tests (1955) where means had the same alphabetical letters were not statistically significant at 5% level.

RESULTS AND DISCUSSION

Effect of organic synthesized fertilizers on pearl millet and sorghum crops:

Fresh and dry yields:

Data in Table (2) show the effect of organic synthesized fertilizers obtained from tomatoes and sugar beet thrones chelate- microelements ,i.e. $\{T_{A.A.\text{-}Mac.\text{-}Mic.}\}$, $\{S_{A.A.\text{-}Mac.\text{-}Mic.}\}$, $\{T_{A.A.\text{-}k\text{-}Mic.}\}$, $\{S_{A.A.\text{-}k\text{-}Mic.}\}$, $\{T_{A.A.\text{-}NPK}\}$ and $\{S_{A.A.\text{-}NPK}\}$, applied as foliar sprays or soil application compared to either mineral fertilizer or the control treatment (unfertilized check) on the yields of pearl millet and sorghum namely fresh and dry yields. The obtained results indicated that organic synthesized fertilizers effects and their interactions with NPKrec. on fresh and dry weights of both corps were statistically significant at 5% level where fresh and dry weights exceeded the control treatment (unfertilized check). Adding NPK at recommended rates supplemented with foliar application of $\{T_{A.A.\text{-}k\text{-}Mic.}\}$(T7) exceeded the foliage yield than the NPK recommended fertilizer added to soil by 10.98% and 13.15% for fresh and dry yields of pearl millet crop and this treatment was superior for increasing the yields, while the treatments of T2 followed by T10 were superior for increasing the yields of sorghum. In this respect, applying $1/_2$ NPK recommended fertilizer plus foliar application of amino acids obtained from sugar beet thrones and chelate- micronutrients (T12) did not differ significantly than NPK recommended rates for increasing both fresh and dry yields of pearl millet. Meanwhile, all tomatoes and sugar beet thrones based fertilizers either foliar or foliar + soil application without any mineral NPK addition to soil did not significantly increase the fresh and dry yields of pearl millet or sorghum than unfertilized treatment.

Data in Table (2) show also that all fertilizer treatments either with recommended NPK or with different synthesized fertilizers used separately or combined with $1/_2$ NPK recommended rates increased total yield % of 3 cuts of both pearl millet and sorghum compared to unfertilized check.

T2

Appling NPK at recommended rate combined with T7 {$T_{A.A.-K-Mic.}$} exceeded total fresh yield (3 cuts) by 5.28 t/fed (10.7%) as compared to T2 {NPK rec.}. While addition NPK at recommended rate only or 1/2 NPK combined with {$S_{A.A.-NPK}$}(T10) increased total fresh yield (3 cuts) of sorghum. In this respect, T5 {$T_{A.A.-Mac.-Mic.}$} and T6 {$S_{A.A.-Mac.-Mic}$}.as (foliar + soil application) increased total fresh yield (3 cuts) of pearl millet by 25.5 and 32.1% and 6.8 and 28% for sorghum, respectively compared to unfertilized check whereas, applying T12 {$1/_2$ NPK rec. + $S_{A.A.-Mac.-Mic.}$} resulted non significantly decrease in total fresh yield (3 cuts) for both the studied crops, relative to NPK rec. treatment. Supplementing NPK recommended rates plus foliar spray of amino acid-micro elements T7 {$T_{A.A.-K-Mic.}$} was superior treatment and exceeded dry yield of pearl millet than NPK rec. by 13.2%. At the same time, the treatment of NPK rec. was superior for increasing dry yield of sorghum. In general, the rest of treatments exceeded significantly dry yield (ton/fed) than the unfertilized check. It is worth mentioned that adding all amino acids fertilizers obtained from sugar beet or tomatoes thrones lonely without any NPK soil application increased insignificantly dry foliage yield but not arrived to the increasing rate of amino acids based organic fertilizers plus NPK or $1/_2$ NPK at recommended rates.

The present results suggest that the integrated effects of amino acids with macro and micro nutrients improve the growth of pearl millet and consequently photosynthetic activities of the crop. Similar results were obtained by Jie *et al.*, (2008) who found that amino acid chelated micro nutrient fertilizers by hydrolyzation of chicken waste feathers on growth of rice. They found that amino acid chelated Zn and Fe fertilizers increased growth parameters from 22 – 73%. Therefore, amino acid chelated micronutrient fertilizer is used in small amounts, has a low cost and high rates of return. Similar results were obtained by Eisa *et al.*, (2010) who found, in field experiments in Ismailiah, that the application of amino acids with micronutrient Fe, Zn, Mn in presence of elemental sulfur significantly increased the sesame yield. Shehata *et al.*, (2011) also found that the integrated effects of compost, amino and humic acids and mineral fertilization increased plant length, the yield of strawberry compared to mineral fertilizer and limited effects on the growth with foliar application either with humic acid or amino ones.

As for the effect of cutting on dry foliage yield regardless of kind of both methods of application and fertilizers, data in Table (2) show, also, that the dry yield of pearl millet was arranged in descending order as follows: first cut (4.23 t/fed) > second cut (3.93 t/fed) > the third cut (1.57 t/fed) whereas, for sorghum was second cut (5.75 t/fed) > first cut (2.95 t/fed) > third cut (0.90 t/fed) and the differences among them ,in general, arrived to the level of significance at 5%.

As in the previous parameters of foliage green yield, the effect of interaction between fertilization treatments and cuts on dry yield had the same behavior where the highest dry yield of pearl millet was obtained in the 1^{st} cut for the treatment of T7 {NPK rec. +TA.A.-k-Mic.}and the lowest dry yield was obtained from unfertilized check. On the contrary, the highest dry yield of sorghum was found in the second cut for the treatment of T10{$1/_2$ NPK rec. + $S_{A.A.-NPK}$}.

It is clear from the previous table that the mean yield of pearl millet and sorghum either fresh or dry forage yield (t/fed) over cuts increased significantly at 5% level under all fertilization treatments, i.e. either prepared amino acids based fertilizer alone or chelate-mineral nutrients. This may be owing to the increases in plant heights or vegetative parts under fertilization treatments. Similar results were obtained by Eisa *et al.*, (2010). The highest fresh forage yield of pearl millet was obtained from applying a recommended rate of NPK supplemented with 3L/fed {$T_{A.A.-k-Mic.}$} as foliar spray (T7) where each cut yielded (18.2 t/fed), unfertilized check yielded (7.12 t/fed) and (5.42 t/fed), (1.66 t/fed) dry foliage, in the same respective. The recommended rates of NPK fertilization exceeded fresh and dry weights by 16.4 (t/fed) and 4.79 (t/fed), in the same order. As for sorghum, the highest fresh and dry forage yields were obtained for NPK rec. which reached 14.70 (t/fed) and 5.92(t/fed), respectively, This may be due to improvement the uptake of NPK by plants through soil and foliar sprays consequently the absorption through the xylem and phloem.

The application of organic synthesized fertilizers either as single fertilizer or in combination with mineral NPK or $1/_2$ recommended rates increased fresh or dry foliage yields of both pearl millet and sorghum. As instance, foliar application of T7 {$T_{A.A.\ -k\ -\ Mic.}$} combined with mineral NPK resulted increase in fresh yield reached 12.60 (t/fed) which can sustain the pearl millet yield in the third cut as compared with NPK application (9.97 t/fed) or unfertilized check (5.33 t/fed). These results were in agreement with those of Westwood (1993) who stated that foliar fertilizers as chelate should be easily absorbed by the plants, rapidly transported and should be easily release their ions to affect the plant. They added that natural chelators as mid molecular weight compounds (like humic and fulvic acid, amino acids, polyflavanoids that have long organic chains) and low molecular weight compounds (like citric acid, ascorbic acid, tartaric acid that have short organic chains) diffuse easily to cell cytoplasm according to their chemical structure. These chelators are not phytotoxic to plants. They are easy to produce and are inexpensive. In recent times, consumers are highly interested in organic products and demanding quality and safer food (Ouda and Mahadeen, 2008). Hence there is urgent need to produce organic chelate of micronutrients for organic vegetable cultivation.

Effect of organic synthesized fertilizers on chemical constituents of pearl millet and sorghum crops at 1st cut:

Data in Table (3) show the effect of different organic synthesized fertilizers chelate-micronutrients on NPK (%), Fe, Mn, Zn, Cu (mg/kg) as well as protein, fat and ash % in plant materials of pearl millet and sorghum crops.

Nitrogen in foliage of pearl millet, in general, increased as affected by various fertilization treatments with either amino acids chelate-microelements or mineral NKP rec. compared to unfertilized check. The highest increases were achieved by the treatment of T7 {NPK rec. +$T_{A.A.-k-Mic}$.} followed by T2 {NPK rec.} as soil application where the difference between them arrived to significant followed by T9 {1/$_2$NPK rec. +$T_{A.A.-NPK}$}, T12 {1/$_2$ NPK rec. +$S_{A.A.-NPK}$} which increased nitrogen significantly compared to unfertilized check by 66.7, 53.3, 40 and 26.7 %, respectively. Concerning the nitrogen in foliage of sorghum, data indicate that the treatment of T10 {1/2 NPK rec. + $S_{A.A.-NPK}$} was superior for increasing N content followed by T8 **{**NPK rec. + $S_{A.A.-k-Mic.}$} and T2 {NPK rec.} which increased nitrogen significantly compared to unfertilized check by 83.3, 75.0 and 66.7%, respectively. It is obvious, again, that the treatments which have mineral fertilization combined with organic synthesized fertilizers were superior for increasing N than organic synthesized fertilizers which used only without any addition.

As for phosphorous, obtained results indicate that it did not differ significantly as affected by all fertilizer treatments except the treatments of T4 {$S_{A.A.-Mac.-Mic.}$} as foliar spray, T7 {NPK rec. + $T_{A.A.-k-Mic.}$} and T9 {1/$_2$ NPK rec. + $T_{A.A.-\ NPK}$} which increased by 50%, respectively. It is true for both pearl millet and sorghum crops.

Concerning the iron, data in the same Table show that its increased significantly in foliage pearl millet due to applying the treatments of T5 {$T_{A.A.-Mac.-Mic.}$} as foliar plus soil application followed by T11 {1/$_2$ NPK rec. + $T_{A.A.-Mac.-Mic.}$}, T7 { NPK rec. + $T_{A.A.-k-Mic.}$}, and T12 {1/$_2$ NPK rec. + $S_{A.A.-Mac.-Mic.}$} as foliar+ soil application where their results were 270.6, 257.4, 250 3 and 242.4 mgkg-1,respectevily. In addition, Fe content in plant material of sorghum (Table, 3) increased significantly as results of the treatments which can arranged them in descending order as follows:T12 (264 mgkg-1) > T4 (251 mgkg-1) >T2 (244 mgkg-1) > T10 (253 mgkg-1).

As for Mn content, in general, obtained results indicate that almost all fertilizer treatments caused significant increases of Mn in foliage of pearl millet crop as results of applying T11 {1/$_2$ NPK rec. + $T_{A.A.-Mac.-Mic.}$}, T3 {$T_{A.A.-Mac.-Mic.}$}, T7 {NPK rec. + $T_{A.A.-k-Mic.}$} and T9 {1/$_2$ NPK rec. + $T_{A.A.-NPK}$} which the increases reached 106.1, 58.6, 58.1 and 45.6 %, respectively compared to unfertilized check . With respect to Mn content in foliage of sorghum, different trends were obtained where the treatment of T2 {NPK rec.}was superior for increasing Mn in foliage of sorghum followed by T4**{**$S_{A.A.\ -Mac.-Mic}$**}**, T10 **{**1/$_2$ NPK rec. + $S_{A.A.-NPK}$} and T7 {NPK rec + $T_{A.A.-k-Mic.}$}.

Zinc concentration in foliage of pearl millet, also, was increased significantly compared to unfertilized check due to applying T12 {1/$_2$ NPK rec. + $S_{A.A.-Mac.-Mic.}$} followed by T4{$S_{A.A.-Mac.-Mic.}$} as foliar + soil application, T11 {1/$_2$ NPK rec. + $T_{A.A.-Mac.-Mic.}$}, T8 {NPK rec. + $T_{A.A.-k-Mic.}$} and T3 {$T_{A.A.-Mac.-Mic}$}. as foliar application, which zinc concentration increased by 105.8, 33.1, 28.8, 20.7 and 9.7%, respectively. On the other hand, the treatments of T2 {NPK rec.} increased Zn concentration significantly to about 148.1% followed by T4 (90.88%), T6 (74.64%) and T7 (14.53%) as compared to unfertilized check.

Copper concentration in foliage of pearl millet at the first cut exceeded as results of applied all fertilization treatments in general. The highest increases were achieved for the treatments of T12 followed by T10, T7 and T11 where Cu content was increased significantly compared to unfertilized check by 135.5, 75.8, 74.2 and 74.2%, respectively. In this concern, the highest values of Cu concentration in foliage of sorghum were achieved for the treatments of T12 (71.6%), T3 (49.3%), T7 (44.8%) and T2 (41.8%) compared to control.

These results are in good agree with those of Khalil *et al.*, (2010) who found that foliar spray of both amino acids and micronutrients together on onion plants could improve its components.

Also data in Table (3) show the effect of organic synthesized fertilizers on the quality characters namely protein %, fat % and ash % in pearl millet and sorghum crops at the first cut. The obtained results indicate that all fertilizer treatments improved protein percentage in pearl millet foliage, in general, the highest protein % were obtained from T7 followed by T2, T9 and T8 which increased protein percent significantly by 66.3, 51.6, 40 and 26.3% respectively compared to control. So it is clear that protein % in both foliage crops which have mineral fertilizers (NPK or ½ NPK) combined with amino acids chelate-micronutrients were highest than organic synthesized fertilizers when used only.

The performance of different fertilizers treatments on fat percentage of pearl millet in the first cut were almost similar with their effects on protein percentage, where the highest increases were obtained from NPK rec. followed by T11 and T4 as foliar application which increased by 20.7, 13.8 and 13.8%, respectively. Fat percentage in sorghum foliage was the highest values owing to application the treatments of T2, T9 and T10 at the first cut.

The behavior of fertilizers treatments on ash % of pearl millet foliage indicate that T7 {NPK rec. + $T_{A.A.\text{-}K\text{-}Mic.}$}, T9 {1/2 NPK rec. + $T_{A.A.\text{-}NPK}$}, T8 {NPK rec. + $S_{A.A.\text{-}K\text{-}Mic}$.} and T2 {NPK rec.} caused significant increases in ash % compared to unfertilized treatment which were 34.4, 12.5, 9.4 and 9.4%, respectively. Similar results were attained for sorghum where its ash % was significant increase due to applied the treatment of T7 {NPK rec. + $T_{A.A.\text{-}K\text{-}Mic.}$}.

These results show that the quality of both pearl millet and sorghum were improved with applying organic synthesized fertilizers as a complement with NPK fertilizers. This may be attributed to the possibility of direct absorption of amino acids through the leaf epidermis from stomata or cleavages. Westwood (1993) mentioned that amino acids have a chelating effect on micro nutrients when applied together, the absorption and transportation of micro nutrients inside the plant is easier, this effect is due to the chelating action, the effect of cell membrane permeability and low molecular weight. Hassan *et al.*, (2010) mentioned that amino fertilizers at 0.25% A.A. significantly increased N and K % in the leaves than that of the control. They mentioned also that the status of nutrient in the plant resulted from spraying different solutions might be attributed to the quick absorption via leaves and limited loss of nutrients when they sprayed. Similar results were obtained by Abd El Mawgood *et al.*, (2011) who found that foliar application of amino acids and micronutrients containing iron, Mn, Zn improved pod quality particularly protein content. It has been suggested that micro elements as inorganic or organic complexes should be applied to the leaves instead of adding them to the growing medium in order to solve micro element requirements of the plants. The leaf fertilizers which an inorganic mineral structure hardly diffuses from the leaf surface into the plant because of high weight molecular structure. In order to eliminate these negative effects leaf fertilizers with organic structure as synthetic chelates were developed

Some chemical properties of the soil after cultivation of both pearl millet and sorghum crops:

Data in Table (4) show the effect of different organic synthesized fertilizers and mineral fertilization on NPK (%), Fe, Mn, Zn and Cu concentration (mgkg^{-1}) in the soil at harvest of both pearl millet and sorghum crops.

Nitrogen % in the soil after cultivation of pearl millet in general was increased significantly due to application all fertilizer treatments accept the organic synthesized fertilizers which used only without any mineral fertilization either as foliar or foliar plus soil application (T2, T3, T4, T5 and T6). The highest values of nitrogen % in the soil after cultivation of pearl millet can be arranged in descending order as follows: soil application of T7 {NPK rec. + $T_{A.A.-k-Mic}$}., T11 {1/2 NPK rec. + $T_{A.A.-Mac.-Mic.}$} followed by T2 {NPK rec.} and T8 {NPK rec. + $S_{A.A.-K-Mic.}$} which increased N% in soil by 170.3, 150.3, 100.2 and 70.3%, respectively compared to unfertilized plots. In general, T7 or T11 increased nitrogen % in soil by 34.9 and 25.0 % relative to NPK (rec.). At the same time, the highest values of nitrogen % in the soil after cultivation sorghum plant were 140% for the treatments of T2 and T11 as well as 80% for the treatments of T7 and T8. Regarding to phosphorous level in soil, data in the same table, show that it is increased with applying the treatments of T3 {$T_{A.A\ -Mac.-Mic}$} as foliar spray and T12 {1/$_2$NPK rec. + $S_{A.A.-Mac.-Mic}$.} which reached 16.9 % for both compared to NPK treatment only. Phosphorous contents in soil after cultivation sorghum plant were significantly increased due to applied the treatments of T2, T3, T4, T5, T6, 8 and T9.The rest of treatments almost didn't differ significantly affected.

As for potassium, it is clear that the potassium concentration was increased significantly in the soil after cultivation both pearl millet and sorghum crops, in general, almost at all fertilization treatments. The highest values of K% were achieved by the treatment of T5 {$T_{A.A.-Mac.-Mic.}$} as foliar + soil application which it significantly increased by 50.7% relative to NPK treatment. Concerning the effect of organic synthesized fertilizers as well as mineral fertilization on Fe content in soil, it is obvious that all fertilizer treatments exceeded Fe content in soil after cultivation both pearl millet and sorghum crops, where the highest values were obtained from T5 {$T_{A.A.-Mac.-Mic}$}. as foliar + soil application followed by T2 {NPK rec.}. In this respect, Mn content in soil after cultivation pearl millet, did not differ significantly affected by almost all fertilizer treatments except the treatments of T11{1/$_2$NPK rec. + $T_{A.A.-Mac.-Mic.}$}, T9 {1/$_2$ NPK rec. + $T_{A.A.-NPK}$} and T7 {NPK rec. + $T_{A.A.-K-Mic.}$} which increased Mn content in soil by 129, 129 and 90.3%, respectively as compared to unfertilized check.

T3 -4

The effect of various fertilizer treatments behaved different manners on Zn content in soil where the highest values of Zn were obtained from T9 {$1/_2$ NPK rec. + ($T_{A.A.-NPK}$} followed by T4 {$S_{A.A.-Mac.-Mic.}$} as foliar application ,T12 {$1/_2$ NPK rec. + $S_{A.A.-Mac.-Mic.}$} which increased Zn in soil significantly as compared to unfertilized check by 116.7, 33.3 and 33.3%, respectively. In addition, copper content in the soil was increased as results of most fertilizer treatments where the highest values were obtained from T7 {NPKrec. + $T_{A.A.-K-Mic.}$}, followed by T4 {$S_{A.A.-Mac.-Mic.}$} as foliar application, T5 {$T_{A.A.-Mac.-Mic.}$} as foliar + soil application and T12 {$1/_2$ NPK rec. + $S_{A.A.-Mac.-Mic.}$} which exceeded Cu content in soil by 220, 80, 60 and 40%, respectively as compared to unfertilized check. Concerning the Mn, Zn, Cu contents in soil after cultivation sorghum crop, the highest increases in Mn concentration were obtained for the treatments of T10 (51.21%) followed by T11 (42.5%) and T5 (24.29%) compared to control. Whereas the highest increases for Zn concentration were obtained when the treatments T11, T9 and T3 were applied, where Zn concentration reached 225%, 175%, 125%, respectively compared to control. In this concern, Cu concentrations were significantly increased due to addition the treatments of T3, T4, T5 and T8 which resulted in increasing percentage of Cu concentration by 125% for all them compared to control. These results suggest that synthesized fertilizers either used alone or combined with mineral nutrients improved the growth of foliage crops i.e. pearl millet and sorghum yields, quality, mineral uptake and soil content of macro and micro elements.

In addition, data in Table (4) show the effect of organic synthesized fertilizers on some chemical properties namely pH, cation exchange capacity (CEC) and organic matter (OM) content of the soil at harvest of pearl millet and sorghum crops. The differences between treatments of T4 {$S_{A.A.-Mac.-Mic.}$}, T11 {1/2 NPK rec. + $T_{A.A.-Mac.-Mic.}$} and the treatment of T1 unfertilized check arrived to the significant at 5% level for its effects on SOM and CEC of the used soil after pearl millet cultivation whereas, T12 {1/2 NPK rec. + $S_{A.A.-Mac.-Mic.}$} indicate significant effect on both aforementioned parameters after sorghum cultivation; meanwhile pH of the soil did not differ significantly as affected by all fertilizer treatments. The rest of treatments were similar or less compared to unfertilized check.

CONCLUSION

Under poor sandy loam soil conditions, the use of amino acid synthesized fertilizers obtained from tomatoes or sugar beet thrones keep our environment clean and healthy for growing plants. Usage of organic synthesized fertilizers cheleate- micronutrients as complement for NPK recommended fertilizers improved the growth, yields and elemental status of forage crops especially grasses of both pearl millet and sorghum. So, it can be recommended to use these synthesized fertilizers commercially as cheap source of amino acids and solve the problem of micro elements in new lands and improve soil conditions.

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تصنيع احماض امينية من المخلفات الزراعية
2- تأثير الأسمدة العضوية المصنعة علي النمو والمحصول لبعض محاصيل العلف وخصائص التربة

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أجريت تجربة حقلية في محطة الإسماعيلية التابعة لمركز البحوث الزراعية, بمحافظة الإسماعيلية, مصر, وذلك خلال الموسم الصيفي عام 2011, بهدف تقييم فاعلية أسمدة عضوية تم تصنيعها من عروش الطماطم وبنجر السكر وذلك علي النمو والمحصول وجودة اثنتين من المحاصيل العلفية الهامة وهي الدخن والذرة الرفيعة (السورجم) وكذا تأثيرها علي خواص التربة عند الحصاد. تم خلب المغذيات الدقيقة مثل الحديد والزنك والنحاس والمنجنيز والبورون مع الأسمدة العضوية المصنعة.

أظهرت النتائج المتحصل عليها أن استخدام الأسمدة العضوية المصنعة من عروش الطماطم أو بنجرالسكر والمخلوبة بالعناصر الصغرى (تفاصيل حول هذه الأحماض الأمينية المصنعة في الجزء الأول من البحث) سواء كانت منفردة او مع اضافة كل من النيتروجين والفسفور والبوتاسيوم بالمعدلات الموصى بها أو نصف الموصى بها قد أدت إلي تحسين كل من نمو وإنتاجية وجودة محصول الدخن أو الذرة الرفيعة وزيادة القدرة علي امتصاص العناصر الغذائية الكبرى والصغرى سواء بإضافتها للتربة أو بالرش كتسميد ورقي ما يعنى امكانية التوصية باستخدامها تجارياً مستقبلاً لتحسين إنتاجية محاصيل الأعلاف الصيفية خصوصا في الأراضي الرملية الفقيرة في العناصر الغذائية الكبرى والصغرى.

أما من ناحية تأثير الأسمدة المصنعة علي خصائص التربة فقد أشارت النتائج إلي ميل كل من المادة العضوية والسعة التبادلية الكاتيونية للتربة إلي الزيادة الطفيفة بالمقارنة بالكنترول. كما إنها أدت إلي تحسين محتوي التربة من العناصر الكبرى والصغرى وتحسين إنتاجية محاصيل الأعلاف الصيفية خصوصا في الأراضي الرملية الفقيرة في محتواها من العناصر الغذائية الكبرى والصغرى.

واعتمادا على نتائج هذه الدراسة، فإنه يمكن أن التوصية بإستخدام هذه الأسمدة العضوية المصنعة التي تم الحصول عليها من عروش الطماطم وبنجر السكر تجاريا كمصدر رخيص للأحماض الأمينية وخلبها بالمغذيات الدقيقة من أجل حل مشكلة العناصر الصغرى في الأراضي الجديدة وإعادة تدوير هذه المخلفات تحسين ظروف التربة.

قام بتحكيم البحث

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Table (2): Effect of organic synthesized fertilizer and mineral nutrients on Yields of pearl millet and sorghum foliage crops.

Treatment	Pearl millet forage crop									Sorghum forage crop								
	Fresh forage yield, (ton/fed.)					Dry forage yield, (ton/fed.)				Fresh forage yield, (ton/fed.)					Dry forage yield, (ton/fed.)			
	Cut			Total fresh yield (3 cut)	Mean	Cut			Mean	Cut			Total fresh yield (3cut)	Mean	Cut			Mean
	1st	2nd	3rd			1st	2nd	3rd		1st	2nd	3rd			1st	2nd	3rd	
T1	8.93	2nd	5.33	21.35	7.12	2.63	1.64	0.70	1.66	6.33	9.47	2.10	17.89	5.96	1.10	3.15	0.50	1.58
T2	19.80	7.09	9.97	49.29	16.40	5.83	6.54	2.00	4.79	15.70	23.20	5.10	44.02	14.70	5.83	7.76	1.17	5.92
T3	7.53	19.50	5.20	21.15	7.05	2.50	2.34	1.20	2.01	6.53	12.70	2.07	21.34	7.11	2.23	4.82	0.60	2.55
T4	10.30	8.42	4.43	26.29	8.76	3.30	3.23	1.00	2.51	5.33	16.00	2.70	24.08	8.03	1.50	3.96	0.77	2.08
T5	8.03	11.60	6.60	26.80	8.93	2.60	3.63	1.45	2.56	4.77	12.40	1.97	19.10	6.37	1.43	4.29	0.60	2.11
T6	12.80	12.20	5.53	28.21	9.40	3.67	2.52	1.38	2.52	7.83	12.90	2.17	22.90	7.63	2.13	4.92	0.73	2.59
T7	23.20	9.85	8.63	54.57	18.20	6.83	7.72	1.70	5.42	15.30	13.90	5.10	34.31	11.40	5.23	6.11	1.33	4.22
T8	17.70	22.70	12.60	44.25	14.80	4.67	3.77	2.27	3.57	12.30	17.10	4.73	34.08	11.40	3.30	8.33	1.00	4.21
T9	14.00	13.90	9.50	41.21	13.70	4.00	5.32	1.77	3.69	11.20	22.60	3.33	37.21	12.40	2.90	6.67	0.97	3.51
T10	15.10	17.70	8.53	38.33	12.80	4.23	3.60	1.63	3.16	13.40	23.80	3.90	35.21	13.70	3.07	9.00	0.94	4.33
T11	16.00	14.70	9.57	39.06	13.00	4.57	3.53	1.80	3.30	9.70	17.90	3.73	37.27	10.40	3.30	6.18	1.10	3.53
T12	21.70	13.50	9.90	44.58	14.90	5.90	3.33	1.90	3.71	13.90	12.80	4.00	30.70	10.20	3.40	3.86	1.13	2.80
Mean	14.60	13.00	7.99	36.26		4.23	3.93	1.57		10.20	16.20	3.41	29.84		2.95	5.75	0.90	1.58
LSD at 0.05 for																		
Treatments				6.22	0.85				2.14				3.68	1.35				0.73
Cut					0.81				0.28					0.53				0.31
Intraction					2.82				0.97					1.84				1.08

T1 = Unfertilized plot , T2= Recommended rates, T3 = foliar spray of $\{T_{A.A.-Mac.-Mic.}\}$, T4= foliar spray of $\{S_{A.A -Mac.-Mic.}\}$. T5=Foliar + soil application of ,$\{T_{A.A -Mac.-Mic.}\}$. T6= Foliar + soil application of $\{S_{A.A -Mac.-Mic.}\}$. T7 $\{T_{A.A.-K-Mic.}\}$. T8 $\{S_{A.A.-K-Mic.}\}$ T9 $\{T_{A.A.-NPK}\}$. T10 $\{S_{A.A.- NPK}\}$. T11= Soil application of {1/$_2$NPK rec.}+$\{T_{A.A.-Mac.-Mic.}\}$as foliar sprays. T12.= Soil application of {1/$_2$NPK rec.}+$\{S_{A.A.-Mac.-Mic}\}$ as foliar spray.

Table (3): Effect of different organic synthesized fertilizers treatments on elemental status and foliage quality of pearl millet and sosghum crops at first cut.

treatment	Pearl millet forage crop										Sorghum forage crop									
	N	P	K	Fe	Mn	Zn	Cu	Protein	Fat	Ash	N	P	K	Fe	Mn	Zn	Cu	Protein	Fat	Ash
	%			mg kg^{-1}				%			%			mg kg^{-1}				%		
T1	1.5 g	0.2 c	2.6 cd	222.4 f	37.7 f	48.3 e	6.2 d	9.5 h	2.9 f	6.4 d	1.2 e	0.2 b	2.1 d	213 ef	53.6 e	35.1 e	6.7 g	7.3 h	2.5 f	6.7 de
T2	2.3 b	0.3 abc	2.9 ab	198.9 g	51.0 d	33.8 h	7.0 cd	14.4 b	3.5 a	7.0 bc	2.0 a	0.3 a	2.5 c	244 c	71.4 a	87.1 a	9.5 c	12.6 bc	3.1 a	6.8 d
T3	1.6 fg	0.3 abc	2.4 d	240.9 d	59.8 b	53.0 d	8.7 bc	10.2 fg	3.1 d	6.7 cd	1.5 cd	0.3 a	2.6 bc	212 f	45.7 f	29.8 f	10.0 b	9.1 f	3.0 b	6.4 f
T4	1.6 efg	0.3 a	2.8 bc	170.1 j	31.0 h	35.4 h	6.6 cd	10.3 f	3.3 b	6.4 d	1.4 d	0.3 a	2.7 ab	251 b	63.9 b	67.0 b	7.8 e	8.9 f	3.0 b	6.8 d
T5	1.5 g	0.3 abc	2.9 ab	270.6 a	46.7 e	40.4 g	6.1 d	9.4 h	3.0 e	6.5 d	1.3 de	0.3 ab	2.6 bc	216 e	56.7 de	35.3 e	6.5 h	7.9 g	2.7 e	6.7 de
T6	1.6 fg	0.2 bc	2.7 bc	229.0 e	35.0 fg	64.3 b	7.4 cd	10.1 fg	2.8 g	6.6 d	1.3 de	0.3 ab	2.6 bc	188 i	42.8 f	61.2 c	6.4 h	7.9 g	3.0 b	6.4 f
T7	2.5 a	0.3 ab	2.4 d	250.3 c	59.6 b	58.3 c	10.8 b	15.8 a	3.2 c	.6 a8	2.0 a	0.2 ab	1.8 e	216 e	56.8 d	40.2 d	9.7 c	12.5 c	2.7 e	10.0 a
T8	1.9 cd	0.2 bc	2.4 d	180.0 h	52.8 cd	44.8 f	8.1 cd	12.0 d	3.2 c	7.0 bc	2.1 a	0.2 ab	1.8 e	194 h	56.2 de	39.8 d	8.9 d	12.9 b	2.9 c	7.8 b
T9	2.1 bc	0.3 ab	2.8 bc	175.1 i	54.9 c	50.6 de	7.6 cd	13.3 c	3.3 b	7.2 b	1.8 b	0.3 ab	2.6 bc	203 g	45.9 f	38.5 d	7.4 f	11.2 d	3.1 a	6.8 d
T10	1.9 de	0.3 abc	3.1 a	171.5 j	34.4 g	33.9 h	10.9 b	11.7 de	3.2 c	6.6 d	2.2 a	0.3 a	2.9 a	235 d	60.2 c	31.1 f	7.3 f	13.5 a	3.1 a	7.9 b
T11	1.6 g	0.3 abc	2.7 bc	257.4 b	77.7 a	62.2 b	10.8 b	9.9 g	2.7 h	6.6 d	1.4 d	0.2 ab	1.8 e	150 j	45.4 f	26.7 g	5.7 i	8.8 f	2.8 d	6.6 e
T12	1.8 def	0.3 abc	2.6 cd	242.4 d	35.8 fg	99.4 a	14.6 a	11.4 e	2.9 f	6.6 d	1.7 bc	0.2 ab	1.8 e	264 a	55.0 de	41.1 d	11.5 a	10.3 e	2.8 d	7.3 c

T1 –T12 dontated in Table(2).

Table (4): Effect of organic synthesized fertilizers on available macro and micro nutrients in soil after cultivation of both pearl millet and Sorghum crops.

Treatment	Pearl millet crop										Sorghum crop									
	Available macro nutrients, %			Available micro nutrients, mg/kg				pH 1:2.5	OM %	CEC meq / 100g soil	Available macro nutrients, %			Available micro nutrients, mg/kg				pH 1:2.5	OM %	CEC meq / 100g soil
	N	P	K	Fe	Mn	Zn	Cu				N	P	K	Fe	Mn	Zn	Cu			
T1	43.7 g	6.0 ab	46.0 f	7.8 c	3.1 bc	0.6 d	0.5 g	7.6 a	0.7 cd	3.4 c	43.7 f	3.8 g	55.6 d	7.9 c	4.1 bcd	0.4 ef	0.4 ef	7.3 a	0.7 d	3.5 f
T2	87.5 c	5.9 ab	49.8 e	11.4 ab	4.9 abc	0.4 g	0.6 efg	7.5 a	0.8 bc	3.7 c	105 a	7.4 bc	49.8 e	13.8 a	4.8 abcd	0.3 f	0.4 f	7.5 a	0.6 f	4.0 d
T3	35.0 i	6.9 a	63.4 b	9.8 bc	5.9 ab	0.5 e	0.6 cde	7.2 a	0.8 bc	2.4 e	43.7 f	6.7 bcd	63.4 b	10.3 bc	3.6 cd	0.9 c	0.6 a	7.4 a	0.7 de	4.0 d
T4	39.4 h	5.0 ab	59.5 c	7.9 c	2.6 c	0.8 b	0.9 b	7.5 a	0.9 a	5.5 a	43.7 f	7.8 b	55.6 d	11.6 ab	3.1 d	0.7 d	0.6 ab	7.4 a	0.7 de	5.1 b
T5	43.7 g	5.5 ab	69.3 a	13.8 a	4.7 abc	0.4 f	0.8 bc	7.4 a	0.8 bc	3.0 d	35 g	6.2 b-e	73.3 a	11.0 abc	5.1 abc	0.4 e	0.6 ab	7.5 a	0.7 d	3.5 f
T6	39.4 h	5.4 ab	61.4 bc	7.8 c	2.9 c	0.4 g	0.5 fg	7.4 a	0.6 d	2.3 e	43.7 f	5.3 d-g	73.3 a	9.1 bc	4.9 abc	0.4 ef	0.5 bcd	7.3 a	0.9 b	3.7 e
T7	118.1 a	4.3 ab	40.3 g	9.4 bc	5.9 a	0.2 i	1.6 a	7.3 a	0.6 d	2.5 e	78.7 b	4.1 fg	42.2 f	13.9 a	5 abc	0.4 ef	0.4 f	7.5 a	0.5 f	3.5 f
T8	74.4 d	4.5 ab	55.6 d	12.1 ab	5.3 abc	0.1 k	0.6 def	7.5 a	0.7 cd	5.1 b	56.9 e	5.1 d-g	73.3 a	9.2 bc	4.1 bcd	0.4 e	0.6 abc	7.4 a	0.9 a	4.3 c
T9	48.1 f	4.1 ab	53.6 d	10.0 bc	7.1 a	1.3 a	0.4 g	7.2 a	0.6 d	2.6 e	70.0 c	12.9 a	55.6 b	9.9 bc	3.8 cd	1.1 b	0.4 ef	7.2 a	0.7 e	4.3 c
T10	61.2 e	3.4 b	63.4 b	9.1 bc	2.9 c	0.5 e	0.5 fg	7.3 a	0.8 ab	3.0 d	56.9 e	5.6 def	65.4 b	10.1 bc	6.2 a	0.5 e	0.5 cde	7.3 a	0.7 e	4.1 d
T11	109.4 b	4.1 ab	67.4 a	10.4 bc	7.1 a	0.2 j	0.6 efg	7.4 a	0.9 ab	5.3 ab	105 a	5.9 cde	57.5 cd	9.3 bc	5.8 ab	1.3 a	0.4 def	7.3 a	0.8 c	4.1 d
T12	61.2 e	6.9 a	53.6 d	9.1 bc	4.9 abc	0.8 c	0.7 cd	7.2 a	0.7 cd	3.5 c	65.6 d	4.6 efg	59.5 c	10.3 bc	3.8 cd	0.4 e	0.5 def	7.4 a	0.8 c	5.5 a