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# EFFECT OF AMINO ACIDS AND MICRONUTRIENTS FOLIAR APPLICATION ON ONION GROWTH, YILD AND ITS COMPONENTS AND CHEMICAL CHRACTERISTICS

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## ABSTRACT

Two field experiments were carried out at Bahteem farm, Agricultural Research Station, Agricultural Research Center, Giza, in two successive winter seasons during 2005/2006 and 2006/2007 on onion crop. The objective of these experiments are to study the effect of micronutrients mixture (Zn 1.5%, Mn 2%, Fe 3%, Cu 1%,MgO 4% and B 0.5%) applied at two concentrations of 250 and 500g fed$^{-1}$ and free amino acids mixture (29.7% w/v) also at two concentrations of 1.5 and 3.00 L fed-1 on onion plant growth, dry matter yield, its yield components and chemical characteristics (bulb total soluble solids, bulb pH and bulb NPK contents) of onion variety Giza 20. Both micronutrients and free amino acids mixture were sprayed on onion plants at two periods of 60 and 75 days from transplanting. Results indicate that foliar application for both amino acids and micronutrients together on onion plants led to an increase in onion yield and its components, total soluble solids and NPK bulb contents. However, the foliar spray effect of both amino acids (1.5 L fed$^{-1}$) and micronutrients (250 g fed$^{-1}$) on all the onion plant tested parameters was superior than those recorded due to the use of both amino acids (3 L fed$^{-1}$) and micronutrients (500 g fed$^{-1}$) without significant difference. In conclusion, the foliar spray of both amino acids and micronutrients together on onion plants could improve the onion yield and its components.

## INTRODUCTION

Onion crop *(Allium cepa* L.)is one of the most important vegetable crops in Egypt for local consumption and export. Fertilization is considered one of the main practices that increase the productivity and improve the quality of onion bulbs. In this concern, technique of foliar spraying with different nutrients offers great opportunities for raising their effectiveness, saving cost and reducing environmental pollution, while assuring high yields. Micronutrients are elements which are essential for plant growth, but are required in quite smaller amounts than those of the primary nutrients, nitrogen, phosphorus and potassium. They play an indispensable role in cell division and development of meristematic tissues, stimulate photosynthesis, respiration, energy and nucleotide transfer reactions and fasten the plant maturity (Marschner, 1998). For onion crop, Khalate (2002) found that spraying onion plants with micronutrients gave rapid growth, high yield and good bulb maturity. Micronutrients also' markedly increased the number of leaves as well as length, diameter,fresh and dry weights of onion. El-Gamili (2000) indicated that the growth parameters (plant height, bulb diameter, number of leaves per plant, fresh bulb weight, total fresh and dry weight per plant) were positively affected by application of micronutrients and the tested foliar fertilizers.

Although micronutrients are needed in relatively very small quantities for adequate plant growth and production, their deficiencies induce a great disturbance in the different physiological and metabolic processes inside the plant.

However, every plant like any organism needs certain components for growth under and above soil. The basic comonent of living cells is protein, with building b[ock material, amino acids. Proteins are formed by sequence of amino acids from the primary elements, the corbon and oxygen obtained from air, hydrogen from water in the soil, forming carbon hydrate by means of photosynthesis and combining it with the nitrogen, which the plants obtain from the soil, leading to synthesis of amino acids by collateral metabolic pathways. The requrement of amino acids in essential quantities is well known as a mean to increase yield and overall quality of crops. The application of amino acids for foliar use is based on their requirement by plants in general and critical stages of growth in particular. Plants absorb amino acids through stomatas and is proportionate to environment temprature that controls the opening mechanism of the plant stomats. Also amino acids are fundmental ingrredients in the process of protein synthesis. About 20 important amino acids are ivolved in the process of each function (Ewais *et al.*, 2005).

Studies have proved that amino acids can directly or indirectly influence the physiological activities of the plant. Funcuntionally, amino acids especially L- amino acids rather than D- amino acids are involved in the enzymes responsible for the strctural photosynthesis process. Also, amino acids have a acid chelating effect on micronutrients, when applid together with micronutrients, the absorpition and transportation of micronutrients inside the plant is easier (Ibrahim *et al.*, 2007).

The current investigation aims to evaluate the impact of foliar spraying with different levels of amino acids and micronutrients on the growth and yield as well as the quality, mineral content and storability of onion bulbs.

## MATERIALS AND METHODS

Two field experiments were carried out at Bahteem Farm, Agricultural Research Station, Agricultural Research center, Giza, in two successive winter seasons during 2005/2006 and 2006/2007 on onion plant. The objective of these experiments is to study the effect of micronutrients mixture (Zn 1.5%, Mn 2%, Fe 3%, Cu 1%, Mg O 4% and B 0.5%) applied at two concentrations of 250 and 500g $fed^{-1}$ and free amino acids mixture (29.7% w/v) also at two concentrations of 1.5 and 3.00 L $fed^{-1}$ on growth, dry matter yield, its yield components and chemical characteristics (bulb total soluble solids, bulb pH and bulb NPK contents) of onion variety Giza 20.. Both micronutrients and free amino acids mixture were applied as foliar for onion plants at two times of 60 and 75 days from transplanting. Tables (a) and (b) show the relevant physical and chemical analyses of soils in which the experiments were carried out.

**Table (a): Some physical and chemical properties of the studied soils**

| Season | pH | EC, $dSm^{-1}$ | OM | $CaCO_3$ | S.P | Sand | Silt | Clay | Soil texture |
|---|---|---|---|---|---|---|---|---|---|
| | | | % | | | | | | |
| 2005/2006 | 7.7 | 1.8 | 1.5 | 2.0 | 64 | 15 | 35 | 50 | Clay |
| 2006/2007 | 7.2 | 1.3 | 1.4 | 3.2 | 59 | 20 | 25 | 55 | Clay |

**Table (b): Cations and anions concentration in a paste extract of the studied soil samples with and some nutrient concentrations**

| Season | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO^{--}_3$ | $HCO^-_3$ | $Cl^-$ | $SO^{--}_4$ | N | P | K | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Meq/L | | | | | | | | Available (ppm) | | | | | |
| 2005/2006 | 7.7 | 6.5 | 6.5 | 1.3 | 0.0 | 2.6 | 6.1 | 13.3 | 35.4 | 8.4 | 460 | 14 | 3.2 | 9.5 |
| 2006/2007 | 8.3 | 3.6 | 7.0 | 1.4 | 0.0 | 3.2 | 3.2 | 13.9 | 39.7 | 7.3 | 456 | 13 | 2.4 | 4.6 |

Onion seedlings were transplanted on the 1st and 5th of November, 2005 & 2006 and harvested on the 25th & 30th of April, 2006 and 2007, respectively. The plot area was 3 x 3.5 m containing 5 rows each of 50 cm width and 3-5 m length and the seedlings were 10 cm apart.

The experiments were statistically arranged in a randomized complete block design.

The treatments were applied as follows:

1- Without application.
2- Amino acids [1.5 L $fed^{-1}$ (A)]
3- Amino acids [3.0 L $fed^{-1}$ (B)]
4- Micronutrients [250 g $fed^{-1}$ (C)]
5- Micronutrients [500 g $fed^{-1}$ (D)]
6- Amino acids (A) + Micronutrients (C).
7- Amino acids (A) + Micronutrients (D).
8- Amino acids (B) + Micronutrients (C).
9- Amino acids (B) + Micronutrients (D).

A basal application of 582 kg ammonium sulphate (20.6%)/ feddan, 300 kg super phosphate (15.5%) / feddan and 200 kg potassium sulphate (48% $K_2O$) / feddan was added to all plots at 18 and 45 days after planting. Normal agricultural practices were followed concerning irrigation, management and pest control.

At harvest, onion bulb dry weight percentage, yield (ton $fed^{-1}$and yield components [onion bulb length (cm), bulb diameter (cm) and bulb weight (g)] and chemical characteristics were determined.

Plant samples were digested according to the procedure of Ryan *et al.* (1996), then the digested plant solutions were analysed for N, P and K.

Nitrogen was determined using micro Kjeldahl ,while phosphorous was determined colorimetrically using ammonium molybdate and ammonium metavanadate according to the procedure outlined by Ryan *et al.* (1996).Potassium was determined using the flame spectrophotometry method (Black, 1982).

**3.4. Statistical Methods.**

The results were statistically analyzed using M Stat computer package to calculate F ratio according to Snedecor and Cochran (1980). Least significant differences method (L.S.D) was used to differentiate means at the 0.05 level (Waller and Duncan, 1969).

## RESULTS AND DISCUSSION

Data in Tables (1 & 2) indicate the effect of foliar application of both amino acids and micronutrients utilized at two different concentrations and sprayed after 60 and 75 days from onion seedlings transplanting on onion dry weight percentage, yield and its components as well as its effect on chemical characteristics of the onion bulbs. In Table (1) all the tested parameters were exceeded significantly than that of the control. However, the highest significant bulbs dry matter percentage of 17.98 was recorded due to foliar spray of both amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$). This high percentage of bulbs dry matter was significantly higher than those recorded by the other tested parameters although it was close to 17.15% that obtained due to the foliar application of both amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$).

**Table (1): Effect of the foliar application with both amino acids and micronutrients at two different concentrations on onion yield and its yield components (Data presented are the mean values of two seasons)**

| Treatments | Bulb dry matter (%) | Bulb length (cm) | Bulb diameter (cm) | Bulb weight (g) | Bulb yield (ton $fed^{-1}$) |
|---|---|---|---|---|---|
| Control | 12.84 | 5.72 | 6.65 | 74.84 | 4.18 |
| Amino acids (A) | 16.67 | 6.44 | 5.95 | 94.40 | 5.18 |
| Amino acids (B) | 15.85 | 6.61 | 6.11 | 100.17 | 5.69 |
| Micronutrients (C) | 16.17 | 6.60 | 5.92 | 101.92 | 6.65 |
| Micronutrients (D) | 16.53 | 6.78 | 6.27 | 107.04 | 7.56 |
| Amino acids (A) + Micronutrients (C) | 17.98 | 7.78 | 7.88 | 122.64 | 14.93 |
| Amino acids (A) + Micronutrients (D) | 16.43 | 6.84 | 6.24 | 108.24 | 8.07 |
| Amino acids (B) + Micronutrients (C) | 16.75 | 7.04 | 6.37 | 111.98 | 8.84 |
| Amino acids (B) + Micronutrients (D) | 17.15 | 7.39 | 7.30 | 117.24 | 11.90 |
| L. S. D. 0.05 | 0.27 | 0.22 | 0.27 | 4.97 | 3.00 |

Concerning to onion bulb length, the highest significant length of 7.78 cm was achieved by spraying the onion plants with both amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$). This high value was significantly higher than these achieved by the other applied treatments. However, the bulb length value of 7.39 cm recorded by the treatment of foliar application of both amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$) comes in the second order to the highest value but with less significant difference.

Concerning to the onion bulb diameter, the highest significant bulb diameter of 7.88 cm was obtained by spraying onion plants with both amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$). This high bulb diameter value was significantly higher than those achieved by the other applied treatments and followed by 7.39 cm due to foliar application of both amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$).

Regarding to onion bulb weight, the treatment of amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$) gave the highest weight of 122.64 g followed by 117.24 g due to spraying onion plants with amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$). However, the highest value was significantly different from those recorded by the other tested treatments. Also spraying onion plants with high dose of amino acids (3 L $fed^{-1}$) and \or high dose of micronutrients (500 g $fed^{-1}$) each alone gave significantly higher bulb weight than the use of lower doses of both amino acids (1.5 L $fed^{-1}$) and\or micronutrients (250 g $fed^{-1}$) when they applied each alone. The corresponding values were 100.17, 107.04, 94.40 and 101.92 g, respectively.

The same trend was observed in all previous tested treatments for the onion bulb yield (ton $fed^{-1}$), since the highest bulb yield of 14.93 ton $fed^{-1}$ was achieved by spraying onion plants with amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$). This high bulb yield value was significantly higher than those recorded by the other treatments even when it compared with the subsequent bulb yield of 11.90 (ton $fed^{-1}$) due to spraying onion plants with amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$).

Results in Table (2) show no significant positive effect for the applied treatments on both pH and P% in onion bulbs. However, all the treatments caused a slight increase in P% of onion bulbs over the control treatment keeping the highest one of 0.25% for the treatment of amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$).

**Table (2): Effect of the foliar application with both amino acids and micronutrients at two different concentrations on chemical characteristics of onion bulbs (Data presented are the mean values of two seasons)**

| Treatments | Bulb total soluble solids % | Bulb pH | Bulb nutrient % | | |
|---|---|---|---|---|---|
| | | | N | P | K |
| Control | 11.80 | 5.47 | 1.16 | 0.18 | 1.22 |
| Amino acids (A) | 12.60 | 5.47 | 1.22 | 0.20 | 1.24 |
| Amino acids (B) | 12.62 | 5.48 | 1.23 | 0.20 | 1.26 |
| Micronutrients (C) | 13.20 | 5.49 | 1.24 | 0.20 | 1.29 |
| Micronutrients (D) | 13.10 | 5.50 | 1.27 | 0.21 | 1.33 |
| Amino acids (A) + Micronutrients (C) | 14.71 | 5.53 | 1.56 | 0.25 | 1.46 |
| Amino acids (A) + Micronutrients (D) | 13.22 | 5.50 | 1.36 | 0.21 | 1.29 |
| Amino acids (B) + Micronutrients (C) | 13.60 | 5.51 | 1.39 | 0.22 | 1.32 |
| Amino acids (B) + Micronutrients (D) | 14.18 | 5.44 | 1.42 | 0.23 | 1.37 |
| L. S. D. 0.05 | 0.53 | NS | 0.13 | NS | 0.06 |

All tested treatments increased significantly the onion total soluble solids over the control treatment. The highest total soluble solids percentage of 14.71 was due to spraying onion plants with amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$). This percentage followed with 14.08 [amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$) and was significantly higher than all the percentages recorded by the other tested treatments.

Spraying onion plants with both amino acids and\or micronutrients both individually led to slightly insignificanty increases in NPK percentages insignificantly over the control treatment. While, spraying onion plants with amino acids (1.5 L $fed^{-1}$) and micronutrients (250 g $fed^{-1}$) gave significantly the highest N & P percentages of 1.56 and 1.46, respectively. These two high recorded percentages for N & P were followed by the respective ones of 1.42 & 1.37 due to spraying onion plants with amino acids (3 L $fed^{-1}$) and micronutrients (500 g $fed^{-1}$).

Plants make their proteins by synthesising them from amino acids, which are produced by complex biochemical processes starting with the elements of nitrogen, carbon, oxygen and hydrogen. This process consumes biological and biochemical energy. Foliar application of pre-formed amino acids gives the plant its requirements and thereby saving biological energy (Ibrahim *et al.*, 2007). However, Amino acids have chelating effect on micronutrients. When applied together with micronutrients, the absorption and transportation of micronutrients inside the plant becomes easier. This effect is due to the chelating action and to the effect of cell membrane permeability (Ewais *et al.*, 2005). In the present study, foliar application of both amino acids and\or micronutrients either individually or both in combination led to a increase in both yield and yield components (onion bulb dry weight, bulb length, bulb diameter, bulb weight and bulb yield) as well as the chemical characters of onion (total soluble solids and bulb NPK% contents). However, the combination of amino acids and micronutrients at the concentrations of 1.5 L $fed^{-1}$ and 250 g $fed^{-1}$, respectively, was significantly superior to the combination of amino acids and micronutrients at the concentrations of 3 L $fed^{-1}$ and 500 g $fed^{-1}$, respectively, as well as to the individual use of both amino acids and micronutrients in affecting positively the aforementioned onion parameters Such results are in agreement with those recorded by Bekheta (2004), on wheat who, found that foliar application for both amino acids and micronutrients led to obvious increases of, grain and straw yields and NPK contents of wheat grains and straw. While, Ibrahim *et al.* (2007) in faba bean found that foliar application of both amino acids and micronutrients increased significantly plant height, number of branches, leaf area as well as number of pods per plants and consequently the faba bean seed yield. This explained that foliar application of amino acids affects positively the plant growth and crop yield through 1) Their rule in quick nutrient absorpition and systemic transportation through the aerial parts of plants. 2) Rapidly metabolized with subsequent formation of biologically useful substances (i.e. chlorophyll and plant growth regulators). 3) Nutritional and reconstituent function with formation of proteins and carbohydrates. 4) Catalyst and biostimulant action on the activities of main enzyme systems. 5) Hormonelike action of equilibrium and synergistic action with endogenous plant growth regulators. 6) Better transport and use of micronutrients. 7) Regulation of water equilibrium.

In this respect, due to amino acids effect on increasing both plant nutrients uptake and yield crops, El-Kady (2002) and Mahgoub *et al.*, (2006) explained that plants synthesize carbohydrates, low photosynthesis rate implies a low growth leading to death of of the plants, chlorophyll is the responsible molecule for the absorpition of light energy. Glycine and glutamic acids are fundamental metabolites in the formation of vegetable tissues and chlorophyll synthesis. These amino acids help to increase chlorophyll concentration in plant leading to higher degree of photosynthesis. This makes crops mush green and leads to more accumulation of the dry matter and subsequently increases the crop yield.

**Conclusion**

From the present study, it could be concluded that foliar application for both amino acids and micronutrients together on onion plants led to an increase in onion yield and its components, total soluble solids and NPK bulb contents. Therefore, further studies may be needed to establish and recommend the use of both amino acids and micronutrients as foliar spray for other crops .

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## تــأثير الــرش بالأحمــاض الأمينيــة والعناصــر الصــغرى علــى نمــو نبــات البصــل والمحصول ومكوناته وخواصه الكيميائية

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**معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر**

أجريت تجربتان حقليتان بمحطة بحوث بهتيم – مركز البحوث الزراعية فى موسمين متتالين 2006/2005، 2007/2006 لدراسة الرش بالأحماض الأمينية والعناصر الصغرى بتركيزات مختلفة (1.5 لتر أو 3 لتر/فدان للأحماض الأمينية، 250 جم أو 500 جم/فدان من العناصر الصغرى سواء منفردين أو مجتمعين على نمو نبات البصل صنف جيزة 20 والمحصول ومكوناته والخواص الكيميائية ومحتوى البصل من النيتروجين والفوسفور والبوتاسيوم.

**هذا وقد أوضحت النتائج مايلى:-**

1. أدى الرش لنباتات البصل بكل من الأحماض الأمينية بتركيز 1.5 لتر/فدان والعناصر الصغرى بتركيز 250 جم/فدان مجتمعين إلى زيادة معنوية فى الوزن الجاف، المحصول ومكوناته وخواصه الكيميائية (المواد الصلبة الكلية – درجة الحموضة ومحتوى البصل من عناصر النيتروجين والفوسفور والبوتاسيوم) وذلك بالمقارنة مع معاملة المقارنة أو مع المعاملات التى استخدم فيها الرش بالأحماض الأمينية والعناصر الصغرى منفردين.
2. الرش بالأحماض الأمينية بتركيز 1.5 لتر/فدان بمصاحبة العناصر الصغرى بتركيز 250 جم/فدان كان أفضل من الرش بـ 3 لتر/فدان (أحماض امينية) بمصاحبة 500 جم/فدان (عناصر صغرى) فى التأثير على محصول البصل وكذا القياسات الأخرى تحت الدراسة حيث كانت الفروق بين المعاملتين غير معنوية بالرغم من أن الزيادة كانت أكثر عند استخدام التركيزات الصغيرة سواء من الأحماض الأمينية والعناصر الصغرى مجتمعين يمكن أن يحسن من محصول البصل ومكوناته وصفاته الكيميائية مثل المواد الصلبة الكلية – درجة الحموضة – محتوى البصل من عناصر النيتروجين والفوسفور والبوتاسيوم.