DOI: 10.56511/JIPBS.2015.v2.i04.pp411-425

Journal of Innovations in Pharmaceuticals and Biological Sciences
www.jipbs.com

JIPBS

ISSN: 2349-2759

Research Article

Comparison between foliage activator, root activator and soil fertilization in relation with onion growth, yield and quality of bulbs

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Abstract

Field experiment was conducted at Al Sharkia Governorate, Egypt in a private farm through a project of vegetable research Dept. of the National Research Center. The study aims to investigate the effect of foliar application of two commercial fertilizers, i.e. amino magnical an activator for vegetative growth and root most an activator for the root system beside mineral soil fertilization on the growth, yield as well as physical and chemical constituents of onion plants. The important detected results are as follows: 1.Foliar fertilization method reflected increases in vegetative growth of onion plant expressed as leaves number, bulb and neck diameter, fresh and dry weight of leaves as well as N, P and K content and uptake compared with soil fertilization method. Total yield and bulb quality followed the same trend, but the differences in total yield were not significant.2. Foliar application of amino magnical and root most enhanced vegetative growth; N, P and K content and uptake of plant leaves as well as plant weight and total yield compared with soil fertilization. No significant differences were detected in these parameters between amino magnical and root most.3. Higher values of vegetative growth; N,P and K content and uptake by onion plant leaves as well as plant weight and total yield were obtained by two sprays of amino magnical or root most without significant differences in comparison with soil fertilization.

Key words: amino magnical - root most -number of sprays- onion plants

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1. Introduction

Onion (*Allium cepa* L.) is a species of the *alliaceae* family have great economic importance and is the second most important vegetable crops in the world with a world production of about 55 million tones [23]. In Egypt it is the most important cash crop after rice. Increasing its yield with consequent economic return is the major concern of the farmers [51]. Besides that, it is making a significant nutritional contribution to human diet. Onion also has medicinal and functional properties [35]. Its consumption is attributed to several factors, mainly heavy

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promotion that links flavor and health and the popularity of onion-rich ethnic foods.

Soil application is most common method to supply essential nutrients to plants. In this case applied nutrients are absorbed by plant roots. However, higher plants can also absorb mineral nutrients when applied as foliar sprays in appropriate concentrations. However, in modern high yielding cultivars, nutritional requirements (macronutrients) are rarely met with foliar applications. Furthermore, foliar application of macronutrients requires several sprays, can also be washed off by rain, plant should have sufficient leaf area for absorption and leaf damage by high nutrient concentrations is a serious practical problem. Despite these drawbacks, under certain circumstances foliar application is most effective method to correct nutritional disorder. The interest in foliar fertilizers arose due to the multiple advantages of foliar application methods such as rapid and efficient response to the plant needs, less product needed, and independence of soil conditions. It is also recognized that supplementary foliar fertilization during crop growth can improve the mineral status of plants and increase the crop yield [34].

Using foliar nutrients is being considered as one of various techniques to improve fertilizer efficiency in order to increase productivity and improve quality of crop production. It can improve nutrient utilization and lower environmental pollution through reducing the amount of fertilizer added to the soil [3].

Amino magnical can improves soil structure, regains the soil vitality, promots the development of root system, shortens the time of revival after transplanting and provides all round and balances nutrition. Amino magnical contains free amino acids, nitrogen, Calcium oxide, Magnesium oxide and Boron. Amino magnical can directly or indirectly influence the physiological activities of the plant. Functionally, amino acids especially L- amino acids rather than D-amino acids are involved in the enzymes responsible for the structural photosynthesis process. Also, amino acids have act as chelating effect on micronutrients, when applied together with micronutrients, the absorption and transportation of micronutrients inside the plant is easier [29].

The application of amino acids as foliar spray is based on their requirement by plants in general and critical stages of growth in particular [14]. Plants absorb amino magnical through stomata and are proportionate to environment temperature that controls the opening mechanism of the plant stomata [22].

Khalil *et al* found that foliar spray of both amino acids and micronutrients together on onion plants could improve the onion yield and its components. Some researchers pointed out the importance of amino acids in increasing growth, yield and chemical composition of some economic plants.

Magnesium oxide plays a vital role in stepping up the growth and quantitative as well as qualitative features of the plant. Mg deficiency is most prevalent in sandy textured soils because it is subject to oxidation to become in a form un-available for plant and loss by leaching. In reclaimed sandy soils, foliar application of macro- and/or micro-nutrients are widely used and preferable [5].

This procedure can also improve nutrient utilization and lower environments pollution through reducing the amounts of fertilizers added to soil [3].

In addition, reported that the foliar application of amino acids caused an enhancement in plant growth, fruit yield and its components [21] on garlic [8] on potato, [24] on Squash, [47] on onion.

Improving onion plant growth by using amino acids could be through improve green onion growth physiology that reflect on build blocks of protein synthesis, which could be enzymes, hormones and antioxidants important for metabolic activities [26].

In plants, amino acids fulfill a wide variety of functions. Their common role is to serve as building blocks of proteins, which exert manifold functions in plant metabolism, and as metabolites and precursors they are involved in plant defense, vitamin, nucleotide and hormone biosynthesis, and as precursors of a huge variety of secondary compounds. [14]. One way or the other, as active catalysts or as precursors, amino acids are essentially involved in all metabolic, regulatory, and physiological aspects of plant metabolism [12].

Root most which active for roots improves soil structure, regains the soil vitality, promonts the development of root system, shortens the time of revival after transplanting and provides all round and balances nutrition. Its content nitrogen, phosphorus and potassium.

Phosphorus precipitation and immobilization is the most important problem under calcareous soil having high pH and calcium carbonate. One of these trials is using potassium fertilizer with spraying plants by root most. Among the major nutrients, potassium plays a vital role in plant metabolism such as photosynthesis, translocation of photosynthetic substrates regulation of plant pores, activation of plant catalysts and resistance against pests and diseases. Potassium is considered as a quality element as it improves quality parameters of many crops including onion. Potassium improves color, glossiness and dry matter accumulation besides improving, K also keeping bulb quality of onion [16]. Many investigators studied the response of onion plant to the potassium rates [51] [1][18].

The aim of present study was to evaluate the efficiency of foliar application of amino magnical activator for foliage and root most activator for root system as compared with soil application in improving onion growth, productivity and bulbs quality.

2. Materials and Methods

A field experiment was carried out on onion (Allium cepa, L.) in Diarb Nigm district, Sharkia Governorate, Egypt in 2013 to study the response of onion plant growth, yield and quality of bulbs to foliar nutrients as Amino magnical (foliage activator) and Root most (roots activator) and soil application of NPK. Seedling of onion cvs. after 35 days age were transplanted in the field at the first week of December.

Treatments were as follows:

* Foliar spray of amino magnical at one spray.
* Foliar spray of amino magnical at two sprays.
* Foliar spray of root most at one spray.
* Foliar spray of root most at two sprays.
* Soil application of NPK recommended.

Data recorded:

A. Vegetative growth: three plants from each plot were chosen randomly 90 days after transplanting and the transferred to the laboratory in the National Research Center at Cairo, after recording the following data, leaves and bulbs of every plant were separated and oven dried at 70^0 c till constant weight. The following data were recorded:

1. Plant height (cm).
2. Leaves number/ plant.
3. Bulb diameter (cm).
4. Neck diameter (cm).
5. Bulbing ratio.
6. Leaves fresh weight.

7. Bulbs fresh weight.
8. Total plant fresh weight.

B. Yield: total yield of onion bulbs for every plot was recorded and yield per feddan was computed.

C. Bulb quality: weight and diameter of bulbs at harvesting were recorded.

Methods of analysis

Soil and plant samples were carried out to the laboratory in the National Research Center, oven dried, fine grounded, wet digested and prepared for chemical analysis.

Mechanical analysis of the experimental soil was determined according to the international Pipette method and calcium carbonate content of the soil was determined volumetrically using Calcimeter as described by [44].

Soil pH was measured using a glass-electrode pH meter with a combined glass/ reference at soil: water 1:2.5 [15].

The electrical conductivity (EC) of soil water extract was determined by using the bridge, [30].

Calcium carbonate was determined using a calcimeter and calculated as $CaCO_3$ % as described by Piper[44].

Organic matter content was analyzed according to the modified Walkley-Black method [30].

Carbonate and bicarbonate ions, were determined by titration with a standard solution of sulfuric acid using phenolphthalein as an indicator for CO_3^- and methyl-orange for HCO_3^- as described by Jackson [30].

Chloride ions were determined by titration with silver nitrate using potassium chromate as an indicator according to Mohr, s method [30].

Sulfates ions were determined by difference between total cations and total anions.

Extraction of exchangeable calcium and magnesium was done, and two cations were determined by titration with versinate along with extract of exchangeable sodium and potassium using 1 M ammonium acetate solution and two cations was determined flame photo metrically [44].

For determination of Nitrogen using Micro Kjeldahl method, 1 g of plant sample taken in a Pyrex digestion tube and 30 mL of conc. H2SO4 carefully added, then 10 g potassium sulphate mixture is placed on sand both on a low flame just to boil the solution, it was further heated till the solution becomes colorless and clear, allowed to cool, diluted with distilled water and transferred 800 mL Kjeldahl flask, washing the digestion flask, next 25 mL of 0.1 N sulphuric acids was taken in the receiving flask and distilled; it was tested for completion of reaction. The flask was removed and titrated against 0.1 N caustic soda solution using Methyl Red indicator for determination of nitrogen described by method Jackson [30].

For determination of phosphorous 2 g sample of plant material taken in 100 ml conical flask two spoons of Darco-G-60 is added followed by 50 mL of 0.5 M NaHCo3 solution, next flask was corked, and allowed for shaking for 30 min on shaker. the content was filtered and filtrate was collected in flask from which 5 ml filtrate was taken in 25 mL volumetric flask to this 2 drops of 2, 4- paranitrophenol and 5 N H2SO4 drop by drop was added with intermittent shaking till yellow color disappear, content was diluted about 20 mL with distilled water and then 4 mL ascorbic acid was added then the mixture was shacked well and the intensity of blue color at 660 nm on colorimeter was measured according to Watanabe [52].

For determination of K through flame photometry, standard solution of each mineral was prepared and calibration

curve drawn for K element using flame photometry as described by Cottenie [15].
The data obtained was subjected to analysis variance procedure using SAS [49]. Duncan's Multiple Range Test was adopted for the means comparison among treatments showing significant difference. Effect of N and P fertilizer was partitioned into linear and quadratic components and regressions were calculated for effects significant at 0.05 level of probability.
Some physical – chemical characteristics of the studied soil and material fertilizers are presented in Tables 1 and 2.

Table 1. Physical and chemical properties of the studied soil

Soil characteristics	Soil content
Mechanical analysis:	
Fine sand%	24.66
Coarse sand%	9.92
Silt%	12.80
Clay%	52.62
Textural	Clayey
Chemical analysis:	
Organic matter%	1.88
pH *	8.01
EC (dS m^{-1})**	0.15
$CaCO_3$ g kg^{-1}	0.22
Soluble ions ($mmol^{-1}$)	
Ca^{++}	0.46
Mg^{++}	0.28
Na^{+}	0.84
K^{+}	0.08
CO^{-}_3	-
HCO^{--}_3	0.56
Cl^{-}	0.40
$SO^{—}_4$	0.70
*A*vailable-N (g kg^{-1})	3.61
Available-P (g kg^{-1})	1.62
Available-K (g kg^{-1})	0.81

*Soil- water suspension 1:2.5 ** Soil water extract 1:5

Table 2. chemical properties of the studied fertilizers.

Characteristics	Value
Amino Magnical	
Free amino acids%	1.51
Total nitrogen%	8.5
Calcium oxide%	10.5
Magnesium oxide%	3.5
Boron%	0.35
Root Most	
N%	0.04
P_2O_5%	1.2
K_2O	3.0

*Soil- water suspension 1:2.5 ** Soil water extract 1:5

3. Results and Discussion

A. Vegetative growth

Data in Table 3 reveal that there are significant differences in the vegetative growth of onion plant expressed as number of leaves per plant, Neck diameter and Bulb diameter as well as fresh and dry weight of onion leaves as affected by methods of fertilizer application.
As shown in the same Table, the highest mean values of plant height, number of leaves per plant, neck and bulb diameters, fresh and dry weight of leaves were obtained from foliar method of application. On the other hand, the lowest values of these growth parameters were obtained with soil application.
Foliar application of any amino magnical or root most did not reflect any significant increases in plant height, leaves number, neck and bulb diameters of the recommended NPK. On the other hand, leaves fresh and dry weight were significantly increased by foliar fertilization method in comparison to soil application of NPK recommended.
Plant height, leaves number, bulb and neck diameters as well as bulbing ratio

were not statistically differed between amino magnical and root most. While leaves fresh and dry weight recorded higher values by root most treatment compared with amino magnical.

Regarding to the combined effect of material fertilizer and number of sprays, data in the same Table indicate that there are significant differences average plant height, bulb diameter, fresh and dry weight of leaves as affected by material fertilizer and number of sprays. The highest mean values of plant height, number of leaves per plant, and bulb diameter as well as leaves fresh and dry weight were obtained with amino magnical and root most with two sprays. Lower values of these means were obtained by one spray of these fertilizers. The lowest values of growth parameters were recorded by NPK soil application. Also, the highest values of plant height, bulb diameter, leaves fresh and dry weight were obtained with application of root most with two sprays. It may be also attributed to the increasing photosynthesis rate as a result of more absorption of available nutrients, which cause increasing in growth and yield. These results may be due to effect of the increase in N, P and K concentration and uptake.

Also, root most content potassium which plays a vital role in plant metabolism such as photosynthesis, translocation of photosynthetic substrates regulation of plant pores, activation of plant catalysts and resistance against pests and diseases. It is also considered as a quality element as it improves quality parameters of many crops including onion.

The addition of amino magnical which content an amino acid or amino acid mixture may be used to stimulate cell growth and facilitate plant regeneration. Many studies reported that, the foliar application of amino magnical caused an enhancement effect on plant growth, fruits yield and its component on cucumber [21], on garlic [8], on snap bean [17] and on onion [6]. Parvez et al who revealed that foliar application significantly increased plant height.

These results can be referred to the role of Mg as amino magnical application is ready to be absorbed through leaves and not to be lost through fixation, decomposition or leaching under unfavorable soil conditions. Mg is essential component of chlorophyll molecule and plays a vital role in carbohydrate synthesis due to activation of many enzymes [38]. He also stated that Mg acts as an osmotic material in the cells against adverse conditions and consequently the metabolic activities are completely achieved due to the cell turgor.

Data in the same Table, did not reflected any significant differences in leaves number and neck diameter as well as bulbing ratio. These results agreed with those obtained by Mostafa [42].

Regarding the effect of foliar and soil application, data in the same Table, indicate that foliar spray of amino magnical and root most significantly increased Leaves fresh and dry weight and compared to that of the plants that received soil application NPK. The highest values of plant height, Leaves fresh and dry weight occurred with root most fertilizers. Lower values of plant height, Leaves fresh and dry weight were obtained from application amino magnical. This increase might be due to the root most content N, P and K and more nutrient availability which lead to more photosynthetic and the meristemic activities. These results may be due to the effect of foliar application on photosynthetic rates, plant stomatal conductance and transpiration.

The top or whole plant fresh weight as well as dry weights of leaves were greater for the plants with foliar application of

Table 3. Effect of foliar application on the vegetative growth of onion plants at 60 days after transplanting

Type of fertilizers			Plant height (cm)	Number of leaves per plant	Neck diameter(cm)	Blub diameter (cm)	bulbing ratio	Leaves fresh weight (g)	Leaves dry weight (g)
Mean values as affected by application methods									
Foliar application			70.65	9.92	4.55	5.86	0.77	56.97	28.33
Soil application			47.97	6.33	3.23	4.63	0.70	31.73	14.87
F test			NS	*	*	*	NS	**	*
Mean values as affected by NPK fertilizer and foliar application									
Amino Magnical			70.76	10.17	4.49	5.80	0.77	46.65	20.17
Root Most			70.50	9.67	4.60	5.92	0.78	54.97	26.33
LSD at 0.05			NS	NS	NS	NS	NS	3.02	4.23
Mean values as affected by number of sprays and NPK fertilizer									
NPK+ Foliar application	**Amino Magnical**	**one**	63.27	8.67	3.87	5.30	0.73	43.83	18.83
		two	78.30	11.67	5.10	6.30	0.81	49.47	21.50
	Root Most	**one**	64.10	8.33	4.03	5.13	0.79	52.53	21.93
		two	76.90	11.00	5.17	6.70	0.77	57.40	24.33
NPK Soil application			45.12	5.21	2.19	4.45	0.69	31.45	14.12
LSD at 0.05			5.46	NS	NS	1.78	2.46	2.14	1.23

amino magnical and root most as compared to that of the soil application.

Data in Table 3 indicate that there are significant differences in plant height, bulb diameter and Leaves fresh and dry weight as affected by material fertilizer and number of sprays, the highest values of plant height, bulb diameter and Leaves fresh and dry weight were obtained with root most with two sprays compared with amino magnical. While, the lowest values of these means occurred with soil application. These increases could be interpreted on the basis of the role N and K in improving plant metabolism, enhancing plant merstimatic activity and increasing photosynthesis rate as indicated by Mengel [39]. These results are in harmony with those obtained by Yuncai [53] who emphasized that the application of foliar NPK fertilization improved plant growth as fresh and dry weight although there was a reduction in evapotranspiration, and increased the uptake of K, Ca, Mg and P.

Adding phosphorus-fertilizers lead to significant increments in vegetative growth and productivity of some crops [45][48]. Also, these increase due to potassium which plays a vital role in plant metabolism such as photosynthesis, translocation of photosynthetic substrates [16].

B. Chemical composition

1. Nitrogen concentration and uptake:

The results of Table 4 show that there are significant differences in N concentration and its uptake at harvest. The highest mean value of N concentration and its uptake were obtained with foliar application and the lowest mean value of N concentration and its uptake were obtained with soil application. These results are in harmony with those obtained by Roland et al [46]. Applying soil N at 2/3 the recommended rate followed by foliar N application uses N more efficiently than applying the full recommended rate to the soil, provides at least as much net revenue, and has the added flexibility of correcting N deficiencies during a critical stage of boll development. Bremner et al suggested that the foliar application of NPK can be decreased NH3 volatilization and $NO2^-$ accumulation in soils. Choi, W et al suggested that foliar NPK fertilizer increased the water use efficiency which water stress resulting from increased water demand in the fertilized plots improved water use efficiency through increased stomatal control of water loss.

The highest value of N concentration and its uptake were obtained by root most. Lower values of N concentration and uptake were obtained by amino magnical. On the other hand, the minimum mean value of N content and uptake occurred with soil application.

With regards of N concentration and its uptake results in Table 4 demonstrated that, the highest values of N concentration and its uptake were recorded by using foliar application of root most with two sprays compared to other treatments. Lower values of N concentration and its uptake were recorded by amino magnical with one sprays. Contrary, the lowest value of N concentration and its uptake were recorded with soil application.

As a general conclusion, the application of foliar fertilizers of root most and amino magnical resulted in an increase in the N concentration and its uptake due to a remarkable increase in the available fraction of nitrogen compared with nitrogen fertilizer applied in the soil. Increases in N concentration and uptake resulting from root most might be referred to more absorption of available nutrients. Root most improves soil structure, regains the soil vitality, promonts the development of root system, shortens the time of revival after transplanting and provides all round and balances nutrition.

2. Phosphorus concentration and uptake:

The highest mean values of P concentration and its uptake were obtained with foliar application. While, the lowest mean value of P concentration and its uptake were obtained with soil application. No significant differences were recorded in P concentration and its uptake in onion leaves between amino magnical and root most. The lower values of P concentration and its uptake were obtained with soil application. Also, the maximum value of P concentration and its uptake were found with root most after two sprays. These results are in agreement with the finding of Lovell et al [36]. It was expected that the phytotoxicity of P, the concentration of P solution for foliar application would be able to be increased to significantly supplement P to plants without causing injury to the foliage. This suggests that even if P can be used as a fertilizer, there would be a challenge to supply a significant amount of P to plants without causing leaf damage by foliar application. Meanwhile, the lowest mean value of P concentration was observed with soil NPK fertilizer at harvest. These results are in harmony with those obtained by Yuncai et al [53] who reported that the application

of foliar fertilization increased the uptake of K, Ca, Mg and P, which may be attributed to decreased transpiration.

The combined effect of foliar application and number of sprays on P concentration and its uptake are shown in Table 4. The obtained data reveals that, the interaction treatments did not reflect any significant differences between treatments of the experiment. Generally, it could be summarized that, the highest amount of P and its uptake were recorded by foliar application of root most after two sprays compared with foliar spray of amino magnical after one sprays and soil treatment. On the contrary, the lowest P concentration and its uptake were recorded by soil application.

Table 4. Effect of foliar fertilization on N, P and K concentrations and its uptake of onion plants

Type of fertilizers			N concentration (%)	P Concentration (%)	K concentration (%)	N uptake (g/plant)	P uptake (g/plant)	K uptake (g/plant)
Mean values as affected by application methods								
Foliar application			3.14	0.342	2.12	0.89	0.097	0.60
Soil application			3.02	0.273	1.95	0.45	0.041	0.29
F test			*	**	*	*	**	*
Mean values as affected by NPK fertilizer and foliar application								
Amino Magical			3.24	0.354	2.17	0.65	0.071	0.44
Root Most			3.57	0.331	2.24	0.85	0.087	0.59
LSD at 0.05			0.22	NS	NS	NS	NS	NS
Mean values as affected by number of sprays and NPK fertilizer								
NPK+ Foliar application	**Amino Magical**	one	3.15	0.331	1.90	0.59	0.062	0.36
		two	3.22	0.362	2.01	0.69	0.078	0.43
	Root Most	one	3.25	0.314	2.34	0.76	0.069	0.51
		two	3.36	0.353	2.41	0.82	0.086	0.59
NPK Soil application			2.86	0.244	1.89	0.40	0.034	0.27
LSD at 0.05			NS	NS	NS	NS	NS	NS

3. Potassium concentration and uptake:-

The results in Table 4 show that there are significant differences in K concentration and its uptake. Also, the maximum value of K concentration and its uptake were obtained with foliar application and the minimum value of K concentration and its uptake were obtained with soil application.

Data in the same Table, show that the highest mean value of K concentration and its uptake were found with root most. Lower values were obtained by amino magnical without significant differences. While, the minimum value of K

concentration and its uptake were obtained by soil application.

Regarding the combined effect of this foliar fertilizers and number of sprays, data in the same Table, indicate that the maximum value of K concentration and its uptake were obtained with foliar application of root most after two sprays. Lower values of K concentration and uptake were obtained by amino magnical with one or two sprays compared with root most without significant differences. Meanwhile, the lowest value of K concentration and its uptake were obtained with soil NPK fertilizer. These increases due to the effect of amino magnical may be also attributed to the increase in photosynthesis rate as a result of more absorption of available nutrients. The effect of root most improves soil structure, regains the soil vitality, promonts the development of root system, shortens the time of revival after transplanting and provides all round and balances nutrition. The trends of obtained results are in good accordance of the previous investigators such as El-Shabasi et al, Awad et al, Faten et al [21][8][24].

It was noticed that the best results of N, P and K concentration and its uptake recorded with foliar application with amino magnical or root most with increased number of sprays compared with one spray or soil application.

C. Total yield and its components:

Total yield of onion bulbs and plant weight were affected by fertilizer application method. Foliar fertilization methods out yielded soil application by 11.9%. This increase was not statistically significant. Differences in total yield between foliar application and soil application treatment methods were not significant. Plant weight was signicantly higher in foliar application compared with soil application.

The increase in bulb yield and plant weight might be due to the improved growth and yield attributes as a result of positive influence of micronutrients and growth regulators. Addition of amino magnical and root most might be responsible for improving the soil physical, physiological, and biological properties of soil. The integrated nutrient management showed superior performance towards yield improvements [31]. In addition, Amino magnical and root most resulted in increases in total yield and plant weight compared with soil application. Amino magnical slightly out yielded root most without significant differences in their total yield and plant weight.

The positive increases in the total yield in response to amino acid are in agreement with those obtained by Amin et al. [6]. These increments in total yield of onion bulbs due to foliar application of arginine or glutamine may be attributed to the increased growth rate. Moreover, the stimulatory effects of arginine or glutamine in increasing vegetative growth via increasing growth promoter under normal or stressed conditions [19], endogenous amino acids and their translocation to produced grains [27]. These results are in harmony with those obtained by Antonio P.M et al [7] who showed that foliar NPK fertilization increased yield in 15 to 30 percent of field depending on the trial set and year, and about 15% of field on average. These increasing may be attributed to increasing various physiological processes, as better uptake nutrients, better plant growth, higher rates of photosynthesis and hence, higher dry matter accumulation as indicated by Khater et al [33]. These increased due to the effect of amino magnical and root most may be also attributed to the increasing photosynthesis rate as a result of more

absorption of available nutrients, which cause increases in growth and yield.

Regarding the effect of the interaction, data presented in Table 5 indicate that there are unsignificant differences within total yield. The highest mean values of total yield and plant weight were recorded by amino magnical at two sprays and root most by two sprays without significant differences between the two treatments.

As shown in the Table 5, the highest mean values of total yield at harvest was obtained from foliar application. On the other hand, the lowest mean values of total yield was obtained from soil application.

The highest total yield was obtained by application of amino magnical and root most without significant differences. While, the minimum value of aforementioned attribute was occurred with soil application.

It was noticed that the best results of bulb weight, plant weight and total yield were obtained by foliar application with amino magnical or root most with two sprays. These results are in conformity with those obtained by Ibrahim et al [28] who found the foliar NPK application could be considered as the best way to reduce the salt accumulation and maintain necessary fertility levels in plant root zone and consequently improve plant growth particularly under saline conditions.

Table 5. Effect of foliar fertilization on bulb yield and quality of onion plants

Type of fertilizers			Neck diameter (cm)	Blub diameter (cm)	Bulbing ratio	Plant weight (g)	Total yield (ton/fed)
Mean values as affected by application methods							
Foliar application			4.93	10.02	0.49	222.98	5.62
Soil application			3.73	7.17	0.42	199.27	5.02
F test			*	**	*	*	NS
Mean values as affected by NPK fertilizer and foliar application							
Amino Magnical			5.32	10.33	0.51	223.75	5.64
Root Most			4.54	9.70	0.47	222.20	5.60
LSD at 0.05			0.22	NS	NS	NS	NS
Mean values as affected by number of sprays and NPK fertilizer							
NPK+ Foliar application	**Amino Magnical**	**one**	4.60	9.53	0.48	221.23	5.57
		two	6.03	11.13	0.54	226.27	5.70
	Root Most	**one**	4.30	9.47	0.45	218.70	5.51
		two	4.77	9.93	0.48	225.70	5.69
NPK Soil application			2.21	7.14	0.41	187.12	4.69
LSD at 0.05			2.33	NS	NS	4.25	NS

D. Bulb quality:

The recorded results in Table 5 indicate clearly that bulb quality expressed as bulb and neck diameter as well as bulbing ratio were enhanced by foliar fertilization method compared with soil fertilization.

Higher values of neck and bulb diameter were obtained from foliar application during the growing season. While, the minimum mean value of aforementioned

attribute was occurred with soil application.

Regarding the effect of these fertilizers as foliar application, data in the same Table, indicate that there are significant differences in neck diameter and bulb diameter, the highest value of neck diameter and bulb diameter as well as bulbing ratio were found with foliar fertilizer amino magnical or root most without significant differences. The lowest value of neck diameter and bulb diameter as well as bulbing ratio were occurred with soil application.

These results are in harmony with those obtained by Madison [37] indicated that the foliar application have excellent methods, and personnel to provide accurate results, and have helped us to obtain large yield improvements in onion from foliar applications of macro and micronutrients. Foliar application of macronutrients can help plants recover from temporary stress due to moisture problems, pests or disease.

These results are in harmony with those obtained by Mohammad et al [41] who found that foliar applied nutrient can be more efficient than soil applied so, its improving the plant growth.

It was noticed that the best results of bulb quality expressed as neck diameter, blub diameter and bulbing ratio obtained with foliar application with amino magnical and root most without significant differences, while, the lowest results of neck diameter, blub diameter and bulbing ratio were obtained with soil application. These results are in conformity with those obtained by Ibrahim et al [28] who found the foliar NPK application could be considered as the best way to reduce the salt accumulation and maintain necessary fertility levels in plant root zone and consequently improve plant growth particularly under saline conditions.

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