Growth, Yield and Chemical Composition of Moringa as affected by some Mineral Fertilizers, Amino Acids and Active Dry Yeast

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ABSTRACT: Due to the importance of *Moringa* as a medicinal plant and for the sake of increasing its growth and yield, this investigation was conducted during two successive seasons of 2017 and 2018 in the Experimental Farm of the Faculty of Agriculture (Saba- Basha), Alexandria University, Egypt, to study the effect of some mineral fertilizers, amino acids and active dry yeast on the growth and yield of moringa (*Moringa oleifera*, L.). Each replicate contained 13 treatments namely (100%) NPK [control], 100% NPK+3g active dry yeast, 100% NPK + 250 mg/l AA_1 (tryptophan), 100% NPK + 250 mg/l AA_2(glutamic), 100% NPK + 250 mg/lAA_1 (tryptophan)+ 250 mg/l AA_2(Glutamic)+ 3 g active dry yeast, 75% NPK + 3 g active dry yeast, 75 % NPK+ 25 mg/l AA_1(tryptophan), 75% NPK+ 250mg/l AA_2(glutamic), 75% NPK+ 250 mg/l AA_1 (tryptophan))+ 250mg/l AA_2(glutamic)+ 3 g active dry yeast, 50% NPK+ 3 g active dry yeast, 50% NPK+ 250 mg/lAA_1(tryptophan),½NPK+ 250 mg/lAA_2(glutamic) and 50%NPK+ 250 mg/lAA_1 (tryptophan)+250 mg/l AA_2 (glutamic)+ 3 g active dry yeast. The gained results revealed that, 100% NPK + 250 mg/lAA_1 (tryptophan)+ 250 mg/l AA_2(glutamic)+ 3 g active dry yeast followed by 75 % NPK + 250mg/l AA_1(tryptophan)+ 250 mg/lAA_2(glutamic) + 3 g active dry yeast gave the highest mean values of vegetative growth as (plant height [cm], number of branches/ plant, dry weight of shoot/ plant [g] and leaf green color degree using SPAD units, compared to the other treatments and control. Also, the given traits treatment gave the higher chemical composition such as percentages of nitrogen, phosphorus, potassium, protein, calcium and magnesium compared with the other treatments during both seasons under this study.

Key words: moringa, mineral, amino acids, active dry yeast, vegetative growth, chemical composition.

INTRODUCTION

Moringa (*Moringa oleifera* Lam.) is a member of monogeneric family, Moringaceae its origin in Agra and Oudh, in the northwest region of India, south of the Himalayan Mountains. Many thousands of years the usage of plants and their contents in primary health care is known has long as old as human beings. Various medicinal plants has been utilized in the health management via antioxidant, anti-inflammatory, antidiabetic, and other biological activities. As a result of herbs has been, also, stated in the different religious books (Rahmani, 2015). It is mostly promising tree which has been used for nutritional benefits, medicinal properties and environmental conservation (Koul and Chase, 2015).

The Moringa tree can, also, play crucial role in conservation of both soil and water and alleviate climate changes (Mall and Tripathi, 2017).

Moringa oleifera is the best known among of the thirteen species in the genus *Moringa* of family Moringaceae (Mahmood *et al.,* 2010).

Furthermore, Anwar *et al.* (2007) reported that, *Moringa oleifera* is very important for its medicinal value. Various parts of this plant such as the leaves, roots, seed, bark, fruit, flowers and immature pods act as cardiac and circulatory stimulants, anti-inflammatory, antihypertensive, antidiabetic and are being employed for the treatment of different ailments in the indigenous system of medicine, particularly in South Asia.

Plant nutrition is one of the most important factors that increase plant production. For instance, nitrogen (N) is the most recognized element in plant for its presence in the structure of the protein molecules. Accordingly, N plays an important role in synthesis of the plant constituents through the action of different enzymes (Khalid, 2013a). Phosphorus is required in large quantities in young cells, such as shoots and root tips, where metabolism is high and cell division is rapid. Phosphorus root development, flower initiation, seed and fruit development. Also, phosphorus (P) improves encourages (in form of P_2O_5) has been shown to reduce disease incidence in some plants and has been found to improve the quality of certain crops (Nyoki and Ndakidem, 2014). Additionally, potassium (K) is an important macro-nutrient and the most abundant cation in higher plants. Potassium has been recorded as the target of some researchers mainly because it is essential for enzyme activation (Khalid, 2013b).

Bio-stimulants are amino acids and organic components, which can play main role in the plant growth and dry matter accumulation (Mehrafarin *et al*., 2015).

Amino acids are the precursors of phytohormones and other growth substances. Amino acids improve the efficiency of the plant's metabolism to induce yield increases and enhance crop quality, increasing plant tolerance and recovery from abiotic stresses, facilitating nutrient assimilation, translocation and use, enhancing quality attributes of product (Calvo *et al.,* 2014), promoting the processes of plant respiration, photosynthesis, protein synthesis, strengthening plant growth and yield formation (Davies, 2010). In addition, active dry yeast is considered as a natural safety biofertilizer causes various promoted effect on plants. It is deliberated as a natural source of cytokinins which simulates cell division and enlargement, as well as, the synthesis of protein, nucleic acid and vitamin B, it also releases CO_2 which reflected in improving net photosynthesis (Kurtzman and Fell, 2005) and it contains macro- and microelements which important for the growth parameters (Ezz El-Din and Hendawy, 2010). Therefore, the main goal of the present field experiments is to investigate the effects of some mineral fertilizers, amino acids and active dry yeast on the growth and production of Moringa plants. As well as, to find out the best fertilization treatment to improve the growth, chemical composition of Moringa and reducing the intensive use of chemical fertilizers.

MATERIALS AND METHODS

The present investigation was carried out during the two seasons of 2017 and 2018 in Abees Experimental Farm of the Faculty of Agricultural (Saba Basha), Alexandria University to study the effect of some mineral fertilizers, some amino acids and active dry yeast on the growth and yield of moringa plants. Analysis of soil physical and chemical properties are presented in Table 1.

Table (1). Some physical and chemical properties of the experimental soil in 2016 and 2017 growing seasons (average two seasons)

Soil parameters	Value	Unit
Physical analysis		
Particle size distribution		
Sand	29.7	**%**
Silt	15.0	**%**
Clay	55.3	**%**
Textural class	Clayey	**-**
Chemical analysis		
Organic matter content (%)	2.87	%
Total calcium carbonate	18.12	%
Electrical Conductivity (EC_{sw}), (1:1, soil: water extract)	2.98	dS/m
pH (1:1, soil : water suspension)	8.05	-
Soluble cations:		
Ca^{2+}	1.00	meq/l
Mg^{2+}	3.29	meq/l
Na^{+}	24.45	meq/l
K^{+}	0.56	meq/l
Soluble anions:		
CO_3^{-2} + HCO_3^{-}	0.58	meq/l
Cl^{-}	21.70	meq/l
SO^{-2}_4	6.80	meq/l
Available nutrients		
Nitrogen (N)	98.23	mg/kg soil
Phosphorus (P)	18.00	mg/kg soil
Potassium (K)	850	mg/kg soil

Experimental Design

The experiment was designed as randomized complete block design with three replicates. Each replicate contained 13 treatments as follows.

1. 100% NPK(control) (recommended dose)
2. 100% NPK + 3 g active dry yeast
3. 100% NPK + 250 mg/l(AA_1tryptophan)
4. 100% NPK + 250 mg/l (AA_2glutamic)
5. 100% NPK + 250 mg/l (AA_1tryptophan)+ 250 mg/l(AA_2glutamic)+ 3 g active dry yeast
6. 75 % NPK+ 3 g active dry yeast
7. 75 % NPK+ 250 mg/l (AA_1tryptophan)
8. 75 % NPK+ 250 mg/l (AA_2glutamic)
9. 75 % NPK+ 250 mg/l (AA_1tryptophan))+ 250mg/l (AA_2 glutamic)+ 3 g active dry yeast
10. 50 % NPK+ 3 g active dry yeast
11. 50 % NPK+ 250 mg/l (AA_1tryptophan)
12. 50 % NPK+ 250 mg/l (AA_2glutamic)
13. 50 % NPK+ 250 mg/l (AA_1 tryptophan))+ 250 mg/l (AA_2glutamic)+ 3 g active dry yeast

All tested *Moringa* plants were received from the Research and Production Station, Cairo (National Research Center). However, planted in 2.5 x 2.5 meter space and planting date on 20th March. Mineral fertilizers were applied at 600 g/tree as ammonium nitrate (33.5%N), 250 g/tree of calcium superphosphate (15.5% P_2O_5) and 300g/tree of potassium sulphate (48% K_2O). Rate of calcium superphosphate was mixed within 0.15 m depth of top soil around the tree trunk at one dose at March, while nitrogen and potassium fertilizer were applied in three equal doses, whereas, the first dose was applied after 20 days after sowing, meanwhile, the second dose was applied after the first cut and third dose was applied after the second cut. Also, amino acids and active dry yeast were sprayed in four equal doses, the first dose was sprayed after 30 days after sowing, the second dose was sprayed after the first cut and third dose was sprayed after the second cut and four doses was sprayed after the third cut. The plants were harvested 3 times per season, i.e. 20 July, 20 August and 20 September, in the first and second seasons by cutting the vegetative parts.

- **Data recorded**

The following data were recorded:

- Plant height (cm).
- Number of branches/ plant.
- Dry weight of shoot/ plant (g).

Chemical composition

- Green color degree (as SPAD units) (Yadava, 1986)

The N, P, K, Ca and Mg percentages were determined in the dry leaves at the harvest. The dry weights were determined following drying in a drying chamber to a constant weight at 75^{o}C for 72 hour according to Tandon (1995). After dryness, the plant samples were milled and stored for chemical analyses as reported. However, 0.5g of the leaves powder was wet-digested with H_2SO_4-H_2O_2 mixture (Lowther, 1980) and the following determinations were carried out in the digested solutions.

- Nitrogen percentage

  Nitrogen was determined in digested plant material colorimetrically by Nessler`s method (Chapman and Pratt, 1978). Reading was achieved using wave length of 420 nm and N was determined as percentage as follows:

% N = NH4 % x 0.776485

- Phosphorus percentage

  Phosphorus was determined by the Vanadomolybdate yellow method as given by Jackson (1973) and the intensity of color developed was read in spectrophotometer at 405nm wavelength.
- Potassium percentage

  Potassium was determined according to the method described by Jackson (1973) using Beckman Flame photometer.
- Protein (%) was determined by estimating the total nitrogen in the herbs and multiplied by 6.25 to obtain the given percentage according of herbs protein percentage (A O A C, 1990).
- Calcium (Ca %): was determined according to the wet ashing method technique as reported by Jackson (1973), by using atomic absorption

Spectrophotometer.

- Magnesium (Mg %) content in *M. oleifera* leaves were determined by the method described by Jackson (1973).

Statistical analysis

All collected data were subjected to statistical analysis of variance as described by Gomez and Gomez (1984). The least significant difference test (L.S.D.) at 0.05 level of probability was used to compare between means of the different treatments.

RESULTS AND DISCUSSIONS

A. Vegetative growth

Averages outlined in Tables (2 and 3) express that, 100% NPK+ 250 mg/l AA_1 + 250 mg/l AA_2 + 3 g ADY, significant by ($p \leq 0.05$) gave nose to the higher average values of (plant height, number of branches/ plant, dry weight of shoot/ plant (g) and leaf green color degree [SPAD]) at three growth stage during both seasons of the study (125.23, 156.53 and 196.00 cm, 8.42, 10.53 and 13.17, 32.21, 40.26 and 50.33g and 38.45, 48.06 and 60.08 SPAD units) in the first season and (144.01, 180.01 and 225.00 cm, 9.69, 12.11 and 15.14 and 37.04, 46.30 and 57.88 g and 44.22, 55.27 and 69.09 SPAD units) in the second season, respectively, followed by the treatment composed of 75% NPK+ 250 mg/l + 250 mg/l AA2 + 3 g ADY had recorded 112.85, 141.07 and 176.33 cm, 8.04, 10.06 and 12.58, 29.81, 37.26 and 46.58 and 32.07, 40.12 and 50.15 SPAD units in the first season and 129.78, 162.23 and 202.80 cm, 9.25, 11.56 and 14.47, 34.28, 42.85 and 48.85 g and 36.91, 45.97 and 57.67 SPAD units in the second season, each in turn, in comparing to other treatments.

These results are in harmony with those found by Abou Dahab *et al*. (2006) on *Philodendron erubescens,* Alizadeh *et al.* (2010) on *Satureja hortensis* plant and Boroomand *et al.* (2012) on medicinal and aromatic plants (basil, turmeric, black pepper, cardamom, fennel and fenugreek), Youssef (2014) on *Echinacea purpurea*.

Foliar spraying of Moringa plants with tryptophan and dry yeast, significantly increased, ($p \leq 0.05$) growth parameters compared to the control. Spraying with dry yeast at 9 g/l + tryptophan at 100 mg/l; resulted in the tallest plants and recorded maximum values of number both leaves and branches, total dry weight/plant, nodule number/plant and fresh weight of nodule/plant. The increases in total dry weight/plant were about 1 and 1.09 g/plant for dry yeast at 3 g/l + tryptophan at 100 mg/l, 1.49 and 1.40 g/plant for dry yeast at 6g/l + tryptophan at 100 mg/l and 2.84 and 2.29 g/plant for dry yeast at 3 g/l + tryptophan at 100 mg/l over the control in the 1^{st} and 2^{nd} seasons, consecutively, (Ezz ElDin and Hendawy, 2010) on borage plant regarding dry yeast and (Hassan and Bano, 2015) on wheat regarding L-Trp, who reported, more or less, similar results.

Table (2). Average values of *Moringa oleifera* plant height (cm) and number of branches/plant as affected by some mineral fertilizers, active dry yeast, and amino acids during 2017 and 2018 growing seasons

Treatments	Plant height (cm)						Number of branches/plant					
	2017 Season			2018 Season			2017 Season			2018 Season		
	1st cut	2nd cut	3th cut	1th cut	2nd cut	3th cut	1st cut	2nd cut	3th cut	1st cut	2nd cut	3th cut
Control (100% NPK recommended dose)	82.16^{e}	102.70^{f}	128.38^{f}	94.48^{e}	118.10^{e}	147.60e	5.52i	6.91i	8.63i	6.35i	7.94i	9.93i
100% NPK+ 3 g active dry yeast	91.29^{d}	114.11^{e}	142.64^{e}	104.97^{d}	131.23^{d}	164.00d	6.14g	7.68g	9.60g	7.06g	8.83g	11.04g
100% NPK+ 250 mg/l AA_1	101.43^{c}	126.79^{c}	158.49^{dc}	116.64^{c}	145.80c	182.26c	6.82e	8.53e	10.66e	7.84e	9.64e	12.26e
100% NPK+ 250 mg/l AA_2	112.67^{b}	140.88^{b}	176.10^{b}	129.60^{b}	162.01b	202.50b	7.58c	9.48c	11.85c	8.71c	10.90c	13.62c
100% NPK+ 250 mg/l AA_1 + 250 mg/l AA_2 + 3 g active dry yeast	125.23^{a}	156.53^{a}	196.00^{a}	144.01^{a}	180.01a	225.00a	8.42a	10.53a	13.17a	9.69a	12.11a	15.14a
75% NPK+ 3 g active dry yeast	82.27^{e}	102.83^{f}	128.54^{f}	94.60^{e}	118.25e	147.80e	5.86h	7.33h	9.17h	6.74h	8.42h	10.55h
75% NPK+250 mg/l AA_1	91.41e^{d}	114.26^{e}	142.83^{e}	105.11^{d}	131.40d	164.30d	6.51f	8.14f	10.19f	7.49f	9.36f	11.71f
75% NPK+ 250 mg/l AA_2	101.57^{c}	126.96^{c}	158.70^{c}	116.80^{c}	146.00c	182.50c	7.24d	9.05d	11.32d	8.32d	10.41d	13.02d
75% NPK+ 250 mg/l + 250 mg/l AA_2 + 3 g active dry yeast	112.85^{b}	141.07^{b}	176.33^{b}	129.78^{b}	162.23b	202.80b	8.04b	10.06b	12.58b	9.25b	11.56b	14.47b
50% NPK+ 3 g active dry yeast	71.60^{f}	91.17^{g}	113.96^{g}	83.88^{f}	104.85f	131.10f	5.47i	6.84i	8.55i	6.29i	7.87i	9.83i
50% NPK+250 mg/l AA_1	81.04^{e}	101.31^{f}	126.63^{f}	93.19^{e}	116.50e	145.60e	6.08g	7.60g	9.50g	6.99g	8.74g	10.92g
50% NPK+ 250 mg/l AA_2	90.04^{d}	112.56^{e}	140.70^{e}	103.55^{d}	129.44d	161.80d	6.75e	8.45e	10.56e	7.76 e	9.72e	12.14e
50% NPK+ 250 mg/l + 250 mg/l AA_2 + 3 g active dry yeast	100.05^{c}	124.40^{d}	156.33^{d}	115.05^{c}	143.83c	179.80c	7.51c	9.39c	11.74c	8.64c	10.80c	13.50c
LSD (0.05)	**1.77**	**2.10**	**2.36**	**1.75**	**2.18**	**2.49**	**0.13**	**0.15**	**0.19**	**0.15**	**0.22**	**0.22**

Table (3). Average values of *Moringa oleifera* shoots dry weight /plant (g) and leaf green color degree (SPAD units) as affected by some mineral fertilizers, active dry yeast and amino acids during 2017 and 2018 growing seasons.

Treatments	Shoots Dry weight /plant (g)						Total chlorophyll (SPAD units)					
	2017 Season			2018 Season			2017 Season			2018 Season		
	1st cut	2nd cut	3th cut	1st cut	2nd cut	3th cut	1st cut	2nd cut	3th cut	1st cut	2nd cut	3th cut
Control (100% NPK recommended dose)	21.13kl	26.41kl	33.02i	24.30kl	30.37kl	37.97gh	25.23ef	31.53e	39.42e	29.01e	36.26e	45.33e
100% NPK+ 3 g active dry yeast	23.48i	29.35ih	36.69g	26.99ih	33.75ih	42.19ef	31.36cd	35.03d	43.80d	32.23d	40.29d	50.35d
100% NPK+ 250 mg/l AA_1	26.09ef	32.61ef	40.76e	30.00ef	37.50ef	46.88cd	31.15cd	38.93c	48.67c	35.81c	44.77c	55.97c
100% NPK+ 250 mg/l AA_2	28.99cb	36.24cb	45.29c	33.33cb	41.67cb	52.09b	34.61b	43.49b	54.07b	39.79b	49.74b	62.18b
100% NPK+ 250 mg/l AA_1 + 250 mg/l AA_2 + 3 g ADY	32.21a	40.26a	50.33a	37.04a	46.30a	57.88a	38.45a	48.06a	60.08a	44.22a	55.27a	69.09a
75% NPK+ 3 g ADY	21.73kj	27.16kj	33.95h	24.99kj	31.24kj	39.05gf	23.40fg	29.24f	36.56f	26.89f	33.63f	42.04f
75% NPK+250 mg/l AA_1	24.14gh	30.18gh	37.73f	27.76gh	34.71gh	43.39ed	26.00fe	32.49e	40.62e	29.89e	37.37e	46.71e
75% NPK+ 250 mg/l AA_2	26.83ed	33.54ed	41.92d	30.85ed	38.57ed	48.21c	28.89d	36.10d	45.13d	33.21d	41.52d	51.90d
75% NPK+ 250 mg/l + 250 mg/l AA_2 + 3 g ADY	29.81b	37.26b	46.58b	34.28b	42.85b	48.85cb	32.07cb	40.12c	50.15c	36.91c	45.97c	57.67c
50% NPK+ 3 g ADY	20.26l	25.33l	30.43j	23.30l	29.12l	35.00h	21.14g	26.42g	33.03g	24.31g	30.39g	37.99g
50% NPK+250 mg/l AA_1	22.51ij	28.14ij	33.81h	25.89ij	32.36ij	38.88gf	23.49feg	29.36f	36.71f	27.00f	33.77f	42.21f
50% NPK+ 250 mg/l AA_2	25.01gf	31.27gf	37.57f	28.76gf	35.96gf	43.21ed	26.10e	32.62e	40.78e	30.01e	37.52e	46.90e
50% NPK+ 250 mg/l + 250 mg/l AA_2 + 3 g ADY	27.80cd	34.7cd	41.67d	31.96cd	39.96cd	48.01c	29.00d	36.25d	45.32d	33.34d	41.69d	52.11d
LSD (0.05)	**1.32**	**1.64**	**0.56**	**1.51**	**1.89**	**3.67**	**2.68**	**1.84**	**2.23**	**1.65**	**2.10**	**2.57**

B) Chemical composition

Average values presented in Table 4 showed that all chemical composition of Moringa plants, significantly influenced ($p\leq 0.05$) to different application of some mineral fertilizers, plant simulators of active dry yeast and amino acids.

Nitrogen percentage (N %)

It is realized from Table 4 indicated that the treatment of 100% NPK +250 mg/l AA_1 +250 mg/l AA_2+ 3 g ADY significantly ($p\leq 0.05$) increased the nitrogen percentage of Moringa plants, which were 4.51 and 4.64 % during both seasons, respectively, followed by the treatment consist of 75 % NPK+ 250 mg/l AA1 +250 mg/l AA_2+ 3 g ADY which were 4.28 and 4.62 % in the first and second season, serially, as compared to treatment of 50% NPK+ 3 g ADY which gave the lowest nitrogen percentage of 2.86 and 3.08 % in 2017 and 2018 seasons, in series. Thon *et al.* (1981) pointed out that amino acids provide plant cells with an immediately available source of nitrogen, which generally can be taken by the cells more rapidly than inorganic nitrogen.

Phosphorus percentage (%)

Results presented in Table 4 indicated that the treatment consist of 100% NPK +250 mg/l AA_1 +250 mg/l AA_2+ 3g ADY significantly ($p\leq 0.05$); increased the phosphorus percentage of Moringa plants, which were 0.61 and 0.700 during both seasons, respectively, followed by the treatment consist of 75 % NPK+ 250 mg/l AA_1 +250 mg/l AA_2+ 3 g ADY which recorded 0.46 and 0.527 in 2017 and 2018 seasons, each in turn, as compared to treatment of 50% NPK+ 3 g ADY which gave the lowest phosphorus percentage of 0.280 and 0.320 in the first and second seasons, respectively.

Potassium percentage (%)

Results tabulated in Table 4 indicated that the treatment represent by 100% NPK+ 250 mg/l AA1 +250 mg/l AA_2+ 3 g ADY significantly ($p\leq 0.05$); increased the potassium percentage of Moringa plants, which were 3.18 and 3.66 % in the first and second seasons, in succession, followed by the treatment made of 75 % NPK+ 250 mg/l AA1 +250 mg/l AA_2+ 3 g ADY of 2.94 and 3.38 % during both seasons under this study, respectively, as compared to treatment 50% NPK+ 3g ADY which gave the lowest potassium percentage of 2.001 and 2.30 % during 2017 and 2018 seasons, each in turn.

Protein percentage (%)

Results of Table 4 indicated that the treatment of 100% NPK+ 250 mg/l AA_1 +250 mg/l AA_2+ 3 g ADY, significantly ($p\leq 0.05$); increased the protein percentage of Moringa plants, which were 28.18 and 29.02 % in the first and second seasons, sequentially, followed by the treatment of 75 % NPK+ 250 mg/l AA1 +250 mg/l AA_2+ 3g ADY which were 26.75 and 28.89 % and the treatment composed of 100% NPK+ 250 mg/l AA_2 which were 25.33 and 27.39 %, during both seasons under this study, in sequence, as compared to the treatment of 50% NPK+ 3g ADY, which gave the lowest protein percentage of 17.90 and 19.33 % during 2017 and 2018 seasons, relevantly.

Calcium percentage (Ca %)

Results presented in Table 4 indicated that the treatment made of 100% NPK +250 mg/l AA_1 +250 mg/l AA_2+ 3g ADY, significantly ($p\leq 0.05$); increased the calcium percentage of Moringa plants, which were 0.583 and 0.670 % during 2017 and 2018 seasons, correspondingly, followed by the treatment of 100% NPK+ 250 mg/l AA_2 which were 0.523 and 0.600 % and the treatment of 75 % NPK+ 250 mg/l AA1 +250 mg/l AA_2+ 3g ADY of 0.520 and 0.596 %, during both seasons, respectively, as compared to treatment 1/2 NPK+ 3 g ADY, which gave the lowest protein percentage of 0.330 and 0.376 % during the first and second seasons, each in turn.

Magnesium percentage (%)

It is explicit from the results of Table 4 indicated that the treatment composed of 100% NPK +250 mg/l AA_1 +250 mg/l AA_2+ 3g ADY significantly ($p\leq 0.05$); increased the magnesium percentage of Moringa plants, which were 0.360 and 0.430 % in the first and second seasons, consequence, followed by the treatment composed of 100% NPK+ 250 mg/l AA_2 which were 0.320 and 0.380 % and the treatment of represented by 75 % NPK+ 250 mg/l AA_1 +250 mg/l AA_2+ 3g ADY which were 0.313 and 0.373 %, during both seasons, respectively, as compared to treatment 1/2 NPK+ 3 g ADY, which; gave the lowest protein percentage of 0.330 and 0.213 % during 2017 and 2018 seasons, respectively.

These results are in harmony with those found by Abdel Aziz *et al.* (2010) on *Thuja orientalis,* Ali and Hassan (2013) on marigold Commercially available amino acid stimulants can improve fertilizer assimilation, increase uptake of nutrients and water, enhance the photosynthetic rate and dry matter partitioning, and hence increase crop yield (El- Shabasi *et al.,* 2005, Shaheen *et al.,* 2010 and Papenfus *et al.,* 2013).

The positive effect of yeast are in line with those obtained by Ahmed *et al*. (1998), Eid (2001), Gad (2001), Wahba (2002) and Mekki and Ahmed (2005) whom reported that the increase in yield components as a result of yeast treatment mainly attributed to the effect of yeast which can play a very significant role in making available nutrient elements for plants, also yeast content macro-and micronutrients, growth regulators and vitamins or may due to that yeast stimulate the plant to build up dry matters (Heikal, 2005).

This study came to the conclusion that the combinations among either 100% NPK+ 250 mg/l AA_1 (tryptophan)+ 250 mg/l AA_2(Glutamic)+ 3 g active dry yeast, or 75% NPK+ 250 mg/l AA_1 (tryptophan)+ 250 mg/l AA_2(Glutamic)+ 3 g active dry yeast achieved the best growth, yield and chemical composition of moringa plants.

Table (4). Average values of *Moringa oleifera* chemical composition (NPK, protein, Ca and Mg %) as affected by some mineral fertilizers, active dry yeast and amino acids during 2017 and 2018 growing seasons at harvest

Treatments	Chemical composition											
	2017 Season						2018 Season					
	N %	P %	K %	Protein %	Ca %	Mg %	N %	P %	K %	Protein %	Ca %	Mg %
Control (100% NPK recommended dose)	2.95l	0.40e	2.08k	18.49i	0.383fg	0.233f	3.19k	0.463e	2.39l	19.96i	0.440fg	0.280gf
100% NPK+ 3 g active dry yeast	3.28i	0.44d	2.31i	20.54g	0.423de	0.260d	3.54h	0.510d	2.66i	22.18fg	0.483de	0.310d
100% NPK+ 250 mg/l AA_1	3.65f	0.49c	2.57f	22.82e	0.470c	0.290c	3.94e	0.563c	2.96f	24.64d	0.540c	0.346c
100% NPK+ 250 mg/l AA_2	4.05c	0.55b	2.86c	25.33c	0.523b	0.320b	4.38b	0.630b	3.29c	27.39b	0.600b	0.380b
100% NPK+ 250 mg/l AA_1 + 250 mg/l AA_2 + 3g ADY	4.51a	0.61a	3.18a	28.18a	0.583a	0.360a	4.64a	0.700a	3.66a	29.02a	0.670a	0.430a
75% NPK+ 3 g ADY	3.12k	0.34g	2.14k	19.50h	0.376fg	0.226f	3.36j	0.400gf	2.46k	21.05h	0.433fg	0.270gh
75% NPK+250 mg/l AA_1	3.46h	0.37fg	2.38h	21.66f	0.420e	0.250e	3.73g	0.423gf	2.73h	23.39e	0.480e	0.296ed
75% NPK+ 250 mg/l AA_2	3.85e	0.41e	2.64e	24.07d	0.466c	0.283c	4.15d	0.470e	3.04e	25.99c	0.536c	0.340c
75% NPK+ 250 mg/l + 250 mg/l AA_2 + 3g ADY	4.28b	0.46d	2.94b	26.75b	0.520b	0.313b	4.62a	0.527d	3.38b	28.89a	0.596b	0.373b
50% NPK+ 3g ADY	2.86m	0.28i	2.00l	17.90i	0.330h	0.176i	3.08l	0.320i	2.30m	19.33i	0.376h	0.213j
50% NPK+250 mg/l AA_1	3.18j	0.31h	2.23j	19.22h	0.366g	0.196h	3.43i	0.353h	2.56j	21.65hg	0.420g	0.236i
50% NPK+ 250 mg/l AA_2	3.53g	0.34g	2.47g	22.10f	0.406fe	0.216g	3.81f	0.397g	2.84g	23.01fe	0.466fe	0.256h
50% NPK+ 250 mg/l + 250 mg/l AA_2 + 3g ADY	3.93d	0.38fe	2.75d	24.56d	0.453dc	0.243e	4.24c	0.427f	3.16d	26.52c	0.520dc	0.290ef
LSD (0.05)	**0.05**	**0.03**	**0.05**	**0.69**	**0.03**	**0.01**	**0.05**	**0.03**	**0.06**	**0.85**	**0.04**	**0.01**

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الملخص العربي

نمو وإنتاجية والتركيب الكيماوي للمورينجا المتأثرة ببعض الأسمدة المعدنية والأحماض الأمينية والخميرة الجافة النشطة

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أجريت تجربتان حقليتان في مزرعة كلية الزراعة (سابا باشا) جامعة الإسكندرية خلال موسمي ٢٠١٧، ٢٠١٨ وذلك لدراسة تأثير بعض الأسمدة المعدنية والأحماض الأمينية والخميرة الجافة النشطة علي نمو وإنتاج نباتات المورينجا. تم تصميم التجربة بنظام تصميم القطاعات العشوائية الكاملة بثلاث مكررات، تحتوي كل مكررة على ١٣ معاملة (١٠٠٪ ن فو بو [كنترول]، ١٠٠٪ ن فو بو + ٣ جم/لتر خميرة جافة نشطة،١٠٠٪ ن فو بو + ٢٥٠ مجم/لتر الحمض الأميني تربتوفان،١٠٠٪ ن فو بو + ٢٥٠ مجم/لتر الحمض الأميني جلوتاميك،١٠٠٪ ن فو بو +٢٥٠ مجم/لتر تربتوفان + ٢٥٠ مجم/لتر جلوتاميك +٣ جم/لتر خميرة جافة نشطة،٧٥٪ ن فو بو + ٣ جم/لتر خميرة جافة نشطة،٧٥٪ ن فو بو + ٢٥٠ مجم/لتر الحمض الأميني تربتوفان،٧٥٪ ن فو بو +٢٥٠ مجم/لتر الحمض الأميني جلوتاميك، ٧٥٪ ن فو بو + ٢٥٠ مجم/لتر تربتوفان+٢٥٠ مجم/لتر جلوتاميك +٣ جم/لتر خميرة جافة نشطة، ٥٠٪ ن فو بو + ٣ جم/لتر خميرة جافة نشطة، ٥٠٪ ن فو بو + ٢٥٠مجم الحمض الأميني تربتوفان، ٥٠٪ ن فو بو +٢٥٠ مجم/لتر الحمض الأميني جلوتاميك، ٥٠٪ ن فو بو + ٢٥٠ مجم/لتر تربتوفان+٢٥٠ مجم/لتر جلوتاميك +٣ جم/لتر خميرة جافة نشطة.

أوضحت النتائج مايلي:

سجلت المعاملة ١٠٠٪ (ن، فو، بو) +٢٥٠ جزء فى المليون تربتوفان + ٢٥٠ جزء فى المليون من جلوتاميك +٣ جم/لتر خميرة جافة نشطة يتبعها المعاملة ٧٥٪ ن فو بو+٢٥٠ جزء فى المليون تربتوفان+٢٥٠ جزء فى المليون جلوتاميك+٣جم/لتر خميرة جافة نشطة أعلي القيم لصفات النمو الخضري (إرتفاع النبات، عدد الأفرع/نبات، الوزن الجاف للمجموع الخضري/نبات (جم)، درجة اللون الأخضر)، مقارنة بالمعاملات الآخري، أيضاً أعلي القيم للمكونات الكيميائية (النسب المئوية لكل من النيتروجين، الفوسفور، الكالسيوم، البروتين، الكالسيوم، الماغنسيوم) مقارنة بالمعاملات الآخري في كلا الموسمين. لذلك يوصي بإستخدام أي من المعاملتين السابقتين لتسميد المورينجا.