Response of Longiflorum X Asiatic Hybrid Lilium Plants to Foliar Spray with Some Amino Acids

El-Naggar, A.A.M., Amani I. Adam and Fatma El-Zahraa H. El –Tony
Ornamental Plants Research Branch, Antoniades Botanical Gardens,
Horticultural Research Institute, Alex. Egypt.

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ABSTRACT

A pot experiment was carried out on during the two successive seasons of 2011 and 2012 at Ornamental Plants Research Branch, Antoniades Botanical Gardens, Alex, Egypt, to evaluate the effect of different amino acids mixture concentrations (0, 1.0, 1.5 and 2 ml/l) as foliar application on growth, flowering, bulbs production as well as some chemical constituents of two Longiflorum-Asiatic lily (L.A) Hybrids namely., 'Rubino' and 'Red Alert' The results revealed that all studied vegetative growth parameters were significantly affected by amino acid treatments. Spraying the plants with 900 mg/l amino acid gave the highest significant records of plant height, leaf number, fresh and dry weights of leaves in both seasons. The "Red Alert" cultivar showed higher significant response than "Rubino" cultivar for the vegetative growth parameters of plant height, leaf number/plant, and leaf area. Whereas, the "Rubino" cultivar gave higher significant records with respect to leaf fresh weight. As for the "Rubino" ,the results indicated that foliar spray with 2 ml/l amino acid gave the highest significant records in fresh and dry weight of leaves. While applying the aforementioned treatment on "Red Alert" cultivar resulted in the highest records for plant height, leaf number/plant and leaf area. Spraying the plants with the highest concentration (2 ml/l) gave the highest significant values of flowering duration, petiole length and flower fresh and dry weights as well as advanced the flowering compared to the control. The "Rubino" cultivar gave higher significant records than the "Red Alert" cultivar in spike length, petiole length, flower fresh and dry weights and flower bud length, while the "Red Alert" cultivar gave higher significant records in number of flowers, flowering duration and flower diameter as well as advanced the flowering. The results revealed that spraying the plants with the highest level of amino acid (2 ml/l) resulted in the highest significant records in flowering duration, flower diameter and flower fresh and dry weights for both of lilium cultivars. All the studied bulb parameters (bulb circumference and fresh and dry weights of bulbs) significantly affected as a result of spraying with amino acid treatments compared to the control. The results revealed that foliar application with the highest level of amino acid (2 ml/l) gave the best significant records for bulb circumference and fresh and dry weights of bulbs. The "Red Alert" cultivar gave higher significant records than "Rubino" cultivar in bulb circumference and fresh and dry weights of bulbs. Spraying the plants with 2 ml/l amino acid resulted in the highest significant records in all of the studied bulb parameters for both lilium cultivars. The amino acid treatments caused significant increases in leaf chlorophyll (a and b), leaf total carbohydrates and leaf NPK contents. The highest significant records, in the previously mentioned parameters, were observed due to foliar application with 2 ml/l amino acid for both of the studied cultivars.

Key words: amino acids mixture, Amino Mix, Longiflorum-Asiatic (L.A) Hybrid Lily, foliar spray, vegetative growth, flowering, chemical constituents, photosynthetic pigments, carbohydrates, nitrogen, phosphorus, potassium.

INTRODUCTION

Lilium is a genus of herbaceous flowering plants gowing from bulbs, all with large prominent flowers. Most species are native to the temperate northern hemisphere, though their range extends into the northern subtropics. The genus Lilium belong to the family Liliaceae comprising of approximately 200 genera made up of approximately 2,000 lily species (Le Nard and De Hertogh, 1993). Longiflorum and Asiatic lilies of the genus Lilium are two important groups of modern lily cultivars. One of the main trends of lily breeding is to realize introgression between these groups. With cut style pollination and embryo rescue, distant hybrids between the two groups have been obtained. These hybrid lily works for an intense startling accent and it is used as a good cut flower with light fragrance (Miller, 1992).

Amino acids as organic nitrogenous compounds are the building blocks in the process of protein synthesis. Amino acids are particularly important for stimulation cell growth. They act as buffers which help to maintain favorable pH value within the plant cell, since they contain both acid and basic groups. They remove ammonia from the cell., so they protect plants from ammonia toxicity (Smith, 1982). They also function in the biosynthesis of other organic compounds i.e., pigments, vitamins, alkaloids, enzymes, terpenoids, coenzymes, purine and pyrimidine bases (Kamar and Omar, 1987). About 20 important amino acids are involved in the process of each function. Amino acids stimulate the physiological functions of the plants in periods of

great activity such as sprouting and flowering as well as the development of roots, bulbs and flowers (Phillips, 1971). It incorporates micro elements of rapid assimilation and participation in the metabolic process as a result; there is a decrease in the appearance of deficiencies (Cohen, 1998). Amino acids have the greatest importance in plant nutrition for obtaining of higher yields and quality and shortening of the productive cycle with better dry material. It gave more abundant and more uniform flowering (Bidwell, 1997). Studies have proved that amino acids can directly or indirectly influence the physiological activities of the plant. Besides, amino acids help in improving the microflora of the soil thereby facilitating the assimilation of nutrients .

Glycine and Glutamic acids are fundamental metabolites in the process of chlorophyll synthesis. Amino acids are precursors or activators of phytohormones and growth substances. L-Tryptophan is precursor for auxin synthesis. L-Methionine is porecursor of ethylene and of growth factors such as Espermine and Espermidine. L-Arginine has high biostimulant efficiency in development besides it induces synthesis of flower hormones. L- Glutamic acid and L- Aspartic acid by transamination give rise to rest of the amino acids. L- Proline act mainly on strengthening the cellular walls in such a way that they increase resistance to unfavorable climatic conditions, (Gross, 1973). Hass (1975) stated that the biosynthesis of cinamic acids which are the starting materials for the synthesis of phenols are derived from phenylalanine and tyrosine. Tyrosine is the hydroxyl phenol amino acid that is used to build hormones.

In the recent years many researchers applied foliar spray of amino acids and proved remarkable enhancement in plant growth and flowering on various ornamental plant species i.e., Talaat *et al.* (2005) on Periwinkle plants (*Catharanthus roseus* L.), Mahgoub and Talaat (2005) on rose geranium (*Pelargonium graveolens*, L.), Gamal El-Din *et al.* (2005) on chamomile plants (*Chamomilla recutita*, L.), Abou Dahab and Abd El-Aziz (2006) on *Philodendron erubescens* , Abd El-Aziz and Balbaa (2007) on *Salvia farinacea* plants, Abd El-Aziz *et al* . (2007) on *Syngonium podophyllum*, Mazher *et al.* (2007) on *Buhinia variegate,* Abdel Aziz *et al* . (2009).on gladiolus, El-Quesni *et al*. (2009) on *Hibiscus rosa sinenses*, Eid *et al*. (2010) on *Jasminum grandiflorum*, Ibrahim *et al*. (2010) on *Helichrysum bracteatum*, Abo leila and Eid (2011) on gladiolus and Mahgoub *et al*. (2011) on *Dahlia pinnata*.

The objective of the study was to evaluate the effect of different amino acids mixture concentrations as foliar application on growth, flowering, bulbs production and some chemical constituents of two genotypes of Longiflorum-Asiatic (L.A) Hybrid Lily namely., 'Rubino' and 'Red Alert'.

MATERIALS AND METHODS

A pot experiment was carried out during the two successive seasons of 2011/2012 at Ornamental Plants Research Branch, Antoniades Botanical Gardens, Horticultural Research Institute, Alexandria, Egypt. It was intended to find out the effect of amino acids commercial product mixture (Amino Mix) with different concentrations (0.0, 1.0 , 1.5 and 2 ml/l) on growth, flowering, bulbs productivity and some chemical constituents on two genotypes of Longiflorum-Asiatic (L.A) Hybrid Lily namely., 'Rubino' and 'Red Alert'. Standard lilium bulbs with premium size (16/18 cm in circumference) were kindly provided by a commercial company, Nasr City, Cairo, Egypt. These bulbs were imported from Hillegom Nursery, Netherlands.

Air dried sandy loam soil was crushed and passed through a 2 mm sieve. Each cubic meter of substrate mixed thoroughly with 400 g of ammonium nitrate (33.5%), 200 g of calcium super phosphate (15.5% P_2O_5) and 35 g of potassium sulphate (48.5% K_2O) were used as base fertilizer (Ress, 1992). The soil physical and chemical properties are presented in Table (1).

The lilium bulbs were planted on 3 March 2011 and 5 March 2012 for the two seasons, respectively. The product "Amino Mix" was used as a source of amino acids. This product contained amino acids namely; aspartic acid (249 mg/100 cm^3), thrionine (45 mg/100 cm^3),serine (56 mg/100 cm^3),glutamic acid (55 mg/100 cm^3),glycine (50 mg/100 cm^3), alanine (1005 mg/100 cm^3), proline (38 mg/100 cm^3), valine (68 mg/100 cm^3), cystine (44 mg/100 cm^3), methionine (18 mg/100 cm^3), isoleucine (52 mg/100 cm^3), tyrosine (38 mg/100 cm^3), phenylalanine (32 mg/100 cm^3), histidine (12 mg/100 cm^3), lysine (40 mg/100 cm^3), arginine (20 mg/100 cm^3) and tryptophan (20 mg/100 cm^3).

Plants were sprayed with Amino acids (Amino Mix) twice times until run-off occurred; the first spraying was in the first week of April. Three weeks later the second spray was performed, while the control plants were sprayed with distilled water at the same time.

At the end of the flowering season (second week of June 2011 and 2012) the following growth measurements were recorded: plant height (cm), leaf number/ plant, leaf area (cm^2), fresh and dry weight of leaves (g), flowering date (days), flowering duration (days), flower diameter (cm), spike length (cm), petiole length (cm),number of flowers/plant, fresh and dry weight of flowers (g) and flower bud length (cm). At the second week of July for both seasons, bulb circumference (cm) and bulb dry weight (g) were measured.

Table 1: Some physical and chemical properties of the used soil (Page *et al*, 1982).

Physical properties						Chemical properties				
Particle size distribution (%)			Texture	EC dS	pH	Organic matter(%)	$CaCO_3$ (%)	Available cations mg/k g soil		
Sand	Silt	Clay	Sandy loam	2.08	8.14	2.5	3.38	N	P	k
64.8	18.7	16.5						41.62	17.86	32.74

E.C. and pH were measured in the soil paste extract.

As for the chemical analysis, leaf nitrogen content (%) was determined using the Kjeldahl method. Phosphorus content (%) was measures using a colorimetric assay, while leaf potassium content (%) was measured by atomic absorption spectrophotometry (Walinga *et al*., 1995). As for the photosynthetic pigments (chlorophyll a and b) contents were determined by using the method described by Moran (1982). Leaf total carbohydrates content (%) was determined spectrophotometrically using the phenol/sulphuric acid method as described by Buysse and Merchx (1993). All chemical measurements were made in dry ground materials from fully expanded leaves of nine plants per treatment (three plants per block).

The experimental layout was designed to provide a completely randomized block design (RCBD) in a factorial experiment containing three replicates. Each replicate had eight treatments (amino acids concentrations of 0, 300, 600 and 900 mg/l for two Longiflorum-Asiatic lily (L.A) Hybrids namely, 'Rubino' and 'Red Alert'). Nine plants (plot) were used for each treatment in the replicate. The data were statistically analyzed according to Snedecor and Cochran (1990) with the aid of COSTAT computer program for statistics. Difference among treatments were tested with Duncan Multiple Range Test at 5% level of significance.

RESULTS AND DISCUSSION

1- Vegetative growth:

Data presented in Table (2) revealed that all the studied vegetative growth parameters were significantly affected by amino acid treatments. As for the effect of amino acid concentration, the results revealed that spraying the plants with 2 ml/l amino acid gave the highest significant records of plant height, leaf number, fresh and dry weights of leaves in both seasons. It can be noticed that there were no significant differences in plant height due to spraying with 1.5 or 2 ml/l amino acid. Also, it can be observed that foliar spray with either 1 or 1.5 ml/l amino acid gave similar effects on leaf number/ plant, fresh and dry weights of leaves.

Regarding the effects of lilium varieties, the "Red Alert" cultivar showed higher significant response than "Rubino" cultivar for the vegetative growth parameters of plant height, leaf number/plant, and leaf area. Whereas, the "Rubino" cultivar gave higher significant records with respect to leaf fresh weight.

For the interaction effects, the results of the two seasons indicated that as for the "Rubino" cultivar, foliar spray with 2 ml/l amino acid gave the highest significant records in fresh and dry weight of leaves. While applying the aforementioned treatment on "Red Alert" cultivar resulted in the highest records for plant height, leaf number/plant and leaf area. Moreover it can be observed that there were no significant differences detected due to spraying with 1.5 or 2 ml/l amino acid in plant height for "Rubino" cultivar and plant height and leaf area for "Red Alert" cultivar.

Our findings are in agreement with those obtained by Youssef and Talaat (2003) who reported that foliar application with Thiamine enhanced plant growth of rosemary plants. The regulatory effect of Thiamine on the meristem and plant growth and development indirectly through enhancing the endogenous level of various growth factors as cytokinins and gibberellins. Furthermore, Thiamine is a necessary ingredient for the biosynthesis of the co-enzyme thiamine pyrophosphate. It plays an important role in carbohydrates metabolism. Saeed *et al*. (2005) on soybean found that treatments of amino acids significantly improved growth parameters of shoots. El-Zohiri and Asfour (2009) on potato found that spraying of amino acids significantly increased vegetative growth expressed as plant height and dry weight of plant. Abd El-Aal *et al*. (2010) found that foliar application of squash plants with Amino-Mix (amino acids mixture) at 500 ppm gave more vigor plant growth in comparison with the control treatment. Also Mahgoub *et al*. (2011) reported that spraying *Dahlia pinnata* L. plants with Thiamine significantly increased plant height, number of branches, number of leaves, fresh and dry weights of leaves, stem diameter and fresh and dry weight of stem. Shehata *et al*. (2011) investigated the effect of the biostimulator, Amino Total (Which is amino acids mixture) on the celeriac plant. The results indicated that spraying the plants with 750 ppm significantly increased plant height and fresh and dry weight of leaves compared to the control.

The regulatory effect of amino acids on growth could be explained by the notion that some amino acids e.g. phenylalanine, ornithine can affect plant growth and development through their influence on gibberellins biosynthesis. Also, Amino Total as a source of amino acids may be play an important role in plant metabolism and protein assimilation which

necessary for cell formation and consequently increase fresh and dry matter (Walter and Nawacki, 1978).

2- Flowering characteristics:

It is evident from data in Tables (3, 4 & 5) that all flowering characteristics were significantly affected by the amino acid treatments. With respect to the amino acid concentration, the results indicated that spraying the plants with the highest concentration (2 ml/l) gave the highest significant values of flowering date, flowering duration, petiole length and flower fresh and dry weights as well as advanced the flowering. There were no significant differences detected due to spraying with either 1.5 or 2 mg/l regarding the traits of flower diameter, spike length and number of flowers/spike.

As for the effect of lilium varieties, the "Rubino" cultivar gave the higher values of spike length, petiole length, flower fresh and dry weights and flower bud length, while "Red Alert" cultivar gave higher significant records in number of flowers, flowering duration and flower diameter.

Table 2: Means of some vegetative growth characteristics of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum-Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Plant height (cm)									
Rubino	60.56	61.53	66.2	66.53	63.71	58.10	59.06	65.70	68.06	62.73
Red Alert	66.96	75.06	81.3	84.53	76.98	63.50	72.06	79.06	82.63	74.31
Mean	63.76	68.30	73.8	75.53	70.35	60.80	65.56	72.38	75.35	68.52
L.S.D. (0.05)	For Amino conc. = 4.14 For Varities = 2.92 For the interaction = 5.85					For Amino conc. = 2.98 For Varities = 2.10 For the interaction = 4.21				
	Leaf number / plant									
Rubino	31.76	35.00	36.3	37.00	35.02	30.53	33.00	35.33	36.66	33.88
Red Alert	64.10	74.36	78.6	85.75	75.70	63.46	73.56	76.53	86.33	74.97
Mean	47.93	54.68	57.4	61.37	55.36	47.00	53.28	55.93	61.50	54.42
L.S.D. (0.05)	For Amino conc. = 3.22 For Varities = 2.27 For the interaction = 4.55					For Amino conc. = 2.66 For Varities = 1.88 For the interaction = 3.76				
	Leaves fresh weight (g) / plant									
Rubino	26.43	29.54	28.43	40.53	31.23	24.69	27.89	27.03	39.60	29.80
Red	21.30	25.38	29.74	32.94	27.34	21.42	23.72	29.52	32.10	26.69
Mean	23.87	27.46	29.08	36.73	29.28	23.05	25.81	28.27	35.85	28.25
L.S.D. (0.05)	For Amino conc. = 3.01 For Varities = 2.12 For the interaction = 4.25					For Amino conc. = 3.09 For Varities = 2.19 For the interaction = 4.38				
	Leaves dry weight (g) / plant									
Rubino	4.22	4.72	4.83	6.95	5.18	3.94	4.45	4.59	7.12	5.03
Red	3.37	4.49	4.84	6.78	4.87	3.45	4.57	4.75	6.51	4.82
Mean	3.80	4.61	4.84	6.87	5.03	3.70	4.51	4.67	6.82	4.93
L.S.D. (0.05)	For Amino conc. = 0.46 For Varities = 0.32 For the interaction = 0.657					For Amino conc. = 0.45 For Varities = 0.31 For the interaction = 0.638				
	Leaf area (cm^2) / plant									
Rubino	71.50	85.83	108.97	118.50	96.20	74.44	90.72	120.05	124.31	102.38
Red	115.8	138.01	141.00	143.43	134.50	114.54	135.08	138.83	145.05	133.37
Mean	93.65	111.92	124.99	130.97	115.38	94.49	112.90	129.44	134.67	117.88
L.S.D. (0.05)	For Amino conc. = 4.10 For Varities = 2.89 For the interaction = 5.79					For Amino conc. = 4.78 For Varities = 3.38 For the interaction = 6.76				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

Table 3: Means of some flowering characteristics of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum-Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Flowering date (days)									
Rubino	102.83	100.25	95.93	95.60	98.65	101.00	99.50	95.50	95.16	97.79
Red Alert	101.41	100.66	98.73	97.36	99.54	101.28	99.43	98.40	97.82	99.23
Mean	102.12	100.46	97.33	96.48	99.09	101.14	99.47	96.95	96.49	98.51
L.S.D. (0.05)	For Amino conc. = 1.18 For Varities = 0.84 For the interaction = 1.68					For Amino conc. = 0.94 For Varities = 0.66 For the interaction = 1.33				
	Flowering duration (days)									
Rubino	9.00	11.16	12.20	16.00	12.09	8.33	11.53	11.83	16.16	11.96
Red Alert	10.06	11.66	14.50	15.50	12.93	9.70	11.36	14.33	15.36	12.69
Mean	9.53	11.41	13.35	15.75	12.51	9.02	11.45	13.08	15.76	12.32
L.S.D. (0.05)	For Amino conc. = 0.76 For Varities = 0.54 For the interaction = 1.08					For Amino conc. = 0.40 For Varities = 0.28 For the interaction = 0.56				
	Flower diameter (cm)									
Rubino	18.80	22.16	23.51	23.96	22.11	19.03	22.43	24.20	24.26	22.48
Red Alert	19.60	22.83	23.76	24.13	22.58	20.26	23.66	24.20	24.73	23.21
Mean	19.20	22.50	23.64	24.05	22.34	19.65	23.05	24.20	24.50	22.85
L.S.D. (0.05)	For Amino conc. = 0.60 For Varities = 0.42 For the interaction = 0.85					For Amino conc. = 0.69 For Varities = 0.49 For the interaction = 0.98				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

Table 4: Means of spike length, petiol length and flower length of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum-Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Spike length (cm)									
Rubino	23.26	26.73	28.70	28.33	26.76	23.86	28.06	29.80	30.00	27.93
Red Alert	19.16	22.83	20.46	19.86	20.58	19.80	23.36	20.76	20.23	21.04
Mean	21.21	24.78	24.58	24.10	23.67	21.83	25.71	25.28	25.12	24.48
L.S.D. (0.05)	For Amino conc. = 1.03 For Varities = 0.73 For the interaction = 1.46					For Amino conc. = 0.91 For Varities = 0.64 For the interaction = 1.29				
	Petiol length (cm)									
Rubino	7.16	7.40	7.63	8.26	7.61	7.40	7.60	7.80	8.53	7.83
Red Alert	4.60	5.40	5.46	5.63	5.27	4.36	5.23	5.33	5.43	5.09
Mean	5.88	6.40	6.55	6.95	6.44	5.88	6.42	6.57	6.98	6.46
L.S.D. (0.05)	For Amino conc. = 0.24 For Varities = 0.17 For the interaction = 0.353					For Amino conc. = 0.188 For Varities = 0.13 For the interaction = 0.260				
	Flower bud length (cm)									
Rubino	9.66	12.66	14.16	13.50	12.50	8.96	12.50	13.33	12.50	11.82
Red Alert	8.70	10.93	12.73	11.60	10.99	8.46	10.70	12.23	11.30	10.67
Mean	9.18	11.80	13.45	12.55	11.74	8.71	11.60	12.78	11.90	11.25
L.S.D. (0.05)	For Amino conc. = 0.81 For Varities = 0.57 For the interaction = 1.15					For Amino conc. = 0.68 For Varities = 0.48 For the interaction = 0.97				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

Table 5: Means of number of flowers/plant and flower fresh and dry weights of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum-Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Number of flowers/ plant									
Rubino	2.16	2.75	3.33	3.41	2.91	2.18	3.00	3.41	3.58	3.04
Red Alert	3.26	4.60	5.93	5.76	4.89	3.13	4.73	6.16	6.13	5.04
Mean	2.71	3.68	4.63	4.59	3.90	2.66	3.87	4.79	4.86	4.04
L.S.D. (0.05)	For Amino conc. = 0.51 For Varities = 0.36 For the interaction = 073					For Amino conc. = 0.34 For Varities = 0.24 For the interaction = 0.48				
	Flower fresh weight (g)									
Rubino	21.26	22.95	23.35	24.75	23.08	21.37	23.13	23.06	24.61	23.04
Red Alert	9.47	12.43	13.31	14.62	12.46	9.64	12.52	13.44	14.42	12.51
Mean	15.37	17.69	18.33	19.69	17.77	15.51	17.83	18.25	19.52	17.77
L.S.D. (0.05)	For Amino conc. = 0.36 For Varities = 0.26 For the interaction = 0.520					For Amino conc. = 0.40 For Varities = 0.28 For the interaction = 0.567				
	Flower dry weight (g)									
Rubino	2.97	3.28	3.50	3.95	3.43	2.99	3.43	3.45	3.88	3.44
Red Alert	0.84	1.35	1.72	1.83	1.44	0.86	1.43	1.69	1.72	1.43
Mean	1.91	2.32	2.61	2.89	2.43	1.93	2.43	2.57	2.80	2.43
L.S.D. (0.05)	For Amino conc. = 0.11 For Varities = 0.08 For the interaction = 0.16					For Amino conc. = 0.10 For Varities = 0.07 For the interaction = 0.14				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

Regarding the interaction effects, the obtained results revealed that spraying the plants with the highest level of amino acid (2 ml/l) resulted in the highest significant records in flowering duration, flower diameter and flower fresh and dry weights for both of lilium cultivars. Moreover, it can be observed that spraying the plants with either 1.5 or 2 ml/l gave the higher significant results on number of flowers/plant for both cultivars. No significant differences were detected due to applying either 900 or 600mg/l amino acid in traits of flowering date and spike length for "Rubino" cultivar.

Similar findings were observed by Youssef and Talaat (2003) who found that number of flowers of rosemary plants increased by application of Ascorbic acid. Also, Abdel Aziz *et al*. (2009) demonstrated that promising results of flowering parameters were obtained by foliar application of gladiolus plants with 200 ppm Ascorbic acid. Ibrahim *et al*. (2010) reported that all studied flowering parameters of *Helichrysum bracteatum* i.e., number of flowers/plant, flower diameter and fresh and dry weights of flowers were significantly promoted by foliar spray with 1000 ppm peptone (a commercial amino acid mixture). Abo Leila and Eid (2011) revealed that gladiolus plants which received the combined treatments of Thiamin and Ascorbic acid recorded the highest flower growth and quality. Mahgoub *et al*. (2011) reported that foliar application of *Dahlia pinnata* L. plants with Thiamine increased yield of flowers and flower characters.

3- Bulb characteristics:

It can be noticed from data presented in Table (6) that all the studied bulb parameters (bulb circumference and fresh and dry weights of bulbs) significantly affected as a result of spraying with amino acid treatments compared to the control.

As for the effects of amino acid treatments, the results indicated that foliar application with amino acid at 2 mg/l gave the highest significant records for bulb circumference and fresh and dry weights of bulbs. Moreover, no significant differences on bulb circumference were detected due to applying either 1.5 or 2 ml/l amino acid.

Regarding the effects of The Amino Mix application on the lilium cultivars, the "Red Alert" cultivar gave higher significant records than "Rubino" cultivar in bulb circumference and fresh and dry weights of bulbs.

With respect to the interaction effects, the results revealed that spraying the plants with 1.5 or

2 ml/l amino acid resulted in the highest significant records in all of the studied bulb parameters for both lilium cultivars. It can be noticed that, no significant differences on bulb fresh weight were detected due to spraying the plants with either 1.5 or 2 ml/l amino acid for "Red Alert" cultivar.

The obtained results are in accordance with those obtained by Khalil *et al.* (2008) who found that foliar spray of amino acids and micronutrients together on onion plants improve the onion yield and its components.

Also, Fawzy *et al*. (2012) studied the response of garlic plants to foliar spraying of some bio-stimulants (amino acids). The results showed that foliar spraying had significant effects on bulb yield and quality.

4- Chemical constituents:

4-1 Photosynthetic pigments (Chlorophyll a & b):

The results presented in Table (7) indicated that the amino acid treatments caused significant increase in leaf chlorophyll (a and b) contents. With respect to the effect of Amino Mix concentration, the highest significant records, in previously mentioned parameters, were observed due to foliar application with 2 ml/l amino acid. As for the effect of lilium varieties, the "Red Alert" cultivar gave higher significant values of chlorophyll "a" than the "Rubino" cultivar. While, the "Rubino" cultivar recorded higher significant values of chlorophyll " b" than other cultivar. Regarding the interaction effects, the results revealed that, spraying the plants with 2 ml/l Amino Mix gave the highest significant values of chlorophyll "a" and " b" for both cultivars in both seasons.

The results are in agreement with those obtained by Hussein *et al*. (1992) who stated that application of amino acids resulted in significant increase in chlorophyll a and b in datura leaves. Abou-Dahab and Abdel-Aziz (2006) reported that foliar application of *Philodendron erubescene* with amino acids caused a significant increase in photosynthetic pigments content. El-Lethy *et al*. (2011) studied the response of geranium (*Pelargonium graveolens,* L.) to foliar spray with amino acids. A pronounced increase in photosynthetic pigments was observed as a result of applying ascorbic acid at 150 ppm.

Murugan *et al.* (2012) studied the response of camellia to exogenous application of ascorbic acid and found that foliar application with 400 ppm enhanced chlorophyll a and b contents compared to the control. The promotive effect can be explained by that ascorbic acid regulates mitosis, cell expansion, subsequently a promotion in growth and metabolism (Noctor and Foyer, 1998).

Table 6: Means of some bulb characteristics of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum-Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Bulb circumference (cm)									
Rubino	5.64	6.84	8.16	8.74	7.35	5.50	6.65	8.01	8.47	7.16
Red Alert	6.74	7.84	8.81	8.45	7.96	6.45	7.63	8.55	8.22	7.71
Mean	6.19	7.34	8.49	8.60	7.65	5.98	7.14	8.28	8.35	7.44
L.S.D. (0.05)	For Amino conc. = 0.19 For Varities = 0.13 For the interaction = 0.27					For Amino conc. = 0.20 For Varities = 0.14 For the interaction = 0.29				
	Bulb fresh weight (g)									
Rubino	14.52	15.55	18.25	19.56	16.97	14.31	15.31	18.04	19.29	16.74
Red Alert	16.25	18.06	19.57	19.26	18.29	16.11	17.89	19.22	19.08	18.08
Mean	15.39	16.81	18.91	19.41	17.63	15.21	16.60	18.63	19.19	17.41
L.S.D. (0.05)	For Amino conc. = 0.34 For Varities = 0.24 For the interaction = 0.48					For Amino conc. = 0.32 For Varities = 0.22 For the interaction = 0.45				
	Bulb dry weight (g)									
Rubino	1.64	1.89	2.23	2.69	2.11	1.55	1.76	2.15	2.60	2.02
Red Alert	1.86	2.52	3.18	3.15	2.68	1.83	2.46	3.09	3.07	2.61
Mean	1.75	2.21	2.71	2.92	2.40	1.69	2.11	2.62	2.84	2.31
L.S.D. (0.05)	For Amino conc. = 0.10 For Varities = 0.07 For the interaction = 0.14					For Amino conc. = 0.08 For Varities = 0.06 For the interaction = 0.12				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

Table 7: Means of leaf chlorophyll (a) and (b) content mg/g and leaf carbohydrates content (%) of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum -Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Chlorophyll (a) mg/g leaf fresh weight									
Rubino	14.37	16.43	17.54	18.45	16.70	14.20	16.28	17.43	18.56	16.62
Red Alert	13.96	16.32	19.08	20.40	17.44	14.11	16.51	18.81	20.21	17.41
Mean	14.17	16.38	18.31	19.43	17.07	14.16	16.40	18.12	19.39	17.01
L.S.D. (0.05)	For Amino conc. = 0.49 For Varities = 0.35 For the interaction = 0.70					For Amino conc. = 0.53 For Varities = 0.37 For the interaction = 0.76				
	Chlorophyll (b) mg/g leaf fresh weight									
Rubino	4.06	5.22	5.63	6.60	5.38	3.81	5.11	5.30	6.67	5.22
Red Alert	3.55	4.01	4.62	5.28	4.37	3.34	4.11	4.50	5.44	4.35
Mean	3.81	4.62	5.13	5.94	4.87	3.58	4.61	4.90	6.06	4.79
L.S.D. (0.05)	For Amino conc. = 0.32 For Varities = 0.23 For the interaction = N.S.					For Amino conc. = 0.42 For Varities = 0.29 For the interaction = N.S.				
	Total carbohydrates (%)									
Rubino	15.10	15.50	16.20	16.66	15.87	14.83	15.33	16.03	16.33	15.63
Red Alert	13.40	14.53	14.66	14.73	14.33	13.20	7.84	8.81	8.45	9.58
Mean	14.25	15.02	15.43	15.70	15.10	14.02	14.80	15.26	15.50	14.89
L.S.D. (0.05)	For Amino conc. = 0.14 For Varities = 0.10 For the interaction = 0.203					For Amino conc. = 0.16 For Varities = 0.12 For the interaction = 0.232				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

4-2 Leaf total carbohydrates content (%):

The results presented in Table (7) indicated on leaf carbohydrate content significantly affected by Amino Mix application. The highest significant values of this parameter were detected due to applying 2 ml/l Amino Mix. Regarding the effect of lilium cultivars, the "Rubino" cultivar gave higher significant values than "Red Alert" cultivar in leaf carbohydrate content. As for the interaction effects, the results indicated that foliar application with 2 ml/l Amino Mix gave the highest significant efect on this parameter for both studied cultivars.

Similar tendency of results were observed by Refaat and Naguib (1998) who reported that application of amino acids (alanine, cytosine, guanine, thiamine and L-tyrosine) increased the total carbohydrates percentage in peppermint leaves. El-Bassiuony and Bekheta (2001) obtained increases in total carbohydrates content in wheat plants treated with putrescine which is considered a polyamine that modulates several growth and developmental process. They mentioned that these increments may be attributed to increase in photosynthetic process efficiency, which led to an increase in net assimilation of leaf CO_2 which is known as the basic unit of carbohydrates. Abdel-Aziz *et al*. (2006) on *Khaya senegalensis* plants and Farahat *et al*. (2007) on *Cupressus sempervirense*, L. Abdel-Aziz *et al*. (2007) mentioned that foliar application of *Syngonium podophyllum* plants with 100 ppm ascorbic acid and 50 ppm thiamine gave the highest levels of total carbohydrates content. Abo-Sedera *et al*. (2010). Revealed that spraying strawberry plants with amino acids at 0.5 g/l significantly increased total sugars contents. Also, Abo Leila and Eid (2011) reported that foliar application of gladiolus plants with ascorbic acid and thiamine led to significant increment in carbohydrates % of leaves.

The promotive effect of the amino acids on carbohydrates content may be due to their important role on the biosynthesis of chlorophyll molecules which in turn affected carbohydrates content (Kawasaki, 1992).

Several hypothesis have been proposed to explain the role of amino acids in plant growth. Available evidence suggests several alternative routes of IAA synthesis in plants starting from amino acids, (Hashimoto and Yamada, 1994). In this respect, Walter and Nawacki, (1978) suggested that the regulatory effects of certain amino acids like phenylalanine and ornithine on plant growth and development is through their influence on gibberellins.

Table 8: Means of leaf NPK content (%) of two Longiflorum-Asiatic lily (L.A) Hybrids as affected by foliar spray with different Amino Mix concentrations during 2011 and 2012 seasons.

Longiflorum-Asiatic lily Hybrids	Amino Mix Conc. (ml/l)									
	2011					2012				
	0.0	1.0	1.5	2.0	Mean	0.0	1.0	1.5	2.0	Mean
	Nitrogen content (%)									
Rubino	1.64	2.14	2.32	2.48	2.15	1.60	2.13	2.29	2.45	2.12
Red Alert	1.79	2.19	2.46	2.66	2.28	1.75	2.17	2.43	2.63	2.25
Mean	1.72	2.17	2.39	2.57	2.21	1.68	2.15	2.36	2.54	2.18
L.S.D. (0.05)	For Amino conc. = 0.06 For Varities = 0.04 For the interaction = N.S.					For Amino conc. = 0.06 For Varities = 0.04 For the interaction = N.S.				
	Phosphorus content (%)									
Rubino	0.19	0.21	0.24	0.26	0.23	0.18	0.21	0.23	0.25	0.22
Red Alert	0.20	0.22	0.25	0.24	0.23	0.20	0.21	0.24	0.24	0.22
Mean	0.20	0.22	0.25	0.25	0.23	0.19	0.21	0.24	0.25	0.22
L.S.D. (0.05)	For Amino conc. = 0.004 For Varities = 0.003 For the interaction = 0.006					For Amino conc. = 0.007 For Varities = 0.005 For the interaction = 0.010				
	Potassium content (%)									
Rubino	3.21	3.43	3.54	3.70	3.47	3.16	3.38	3.47	3.65	3.42
Red Alert	3.33	3.42	3.63	4.03	3.60	3.29	3.38	3.59	3.97	3.56
Mean	3.27	3.43	3.59	3.87	3.54	3.23	3.38	3.53	3.81	3.49
L.S.D. (0.05)	For Amino conc. = 0.04 For Varities = 0.03 For the interaction = 0.067					For Amino conc. = 0.06 For Varities = 0.04 For the interaction = 0.091				

The means were compared using the Duncan's Multiple Range Test at 0.05 level of probability.

4-3 Leaf NPK contents (%):

The results presented in Table (8) indicated that the amino acid treatments caused significant increase in leaf NPK contents.The highest significant records of leaf NPK contents were observed due to foliar application with 2 ml/l amino acid for both of the studied cultivars. The "Red Alert" cultivar gave higher significant records than "Rubino" cultivar with respect to leaf contents of nitrogen and potassium.

The findings are in accordance with those obtained by Talaat (2003) on sweet pepper who detected that ascorbic acid foliar application increased the contents of macronutrients (N,P and K). Abdel-Aziz *et al*. (2007) mentioned that foliar application of *Syngonium podophyllum* plants with 100 ppm ascorbic acid gave the highest levels of nitrogen, phosphorus and potassium contents of leaves. Liu Xing *et al*. (2008) revealed that foliar application with the mixture of amino acids to radish plants increased nitrogen content of shoots. Also, Abdel Aziz *et al*. (2009) mentioned that foliar spray of gladiolus plants with ascorbic acid at 200 ppm showed a stimulatory effect on most studied chemical constituents including N, P and K contents. Abo Sedera *et al*. (2010) revealed that spraying strawberry plants with amino acids mixture (Peptone) at 0.5 g/l significantly increased total nitrogen, phosphorus and potassium in plant foliage as compared to the control treatment. Abo Leila and Eid (2011) reported that foliar application of gladiolus plants with ascorbic acid and thiamine led to significant increments in mineral ions contents (N, P and K) of leaves.

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الملخص العربى

استجابة نباتات هجن الليليم الاسيوية للرش الورقى ببعض الاحماض الامينية

عاصم عباس محمد النجار، أمانى اسماعيل ادم وفاطمة الزهراء حسين التونى

فرع بحوث نباتات الزينة– حدائق أنطونيادس– معهد بحوث البساتين– الاسكندرية – مصر

أجريت التجربة فى الاصص على نباتات اثنين من هجن الليليم الاسيوية (روبينو وردألرت) خلال الموسمين ٢٠١١ و ٢٠١٢ فى فرع بحوث نباتات الزينة– حدائق انطونيادس بالاسكندرية لدراسة تأثيرالرش الورقى بتركيزات مختلفة(.، ١، ١.٥، ٢.٠ مل/لتر) من خليط من الاحماض الامينية(المستحضرالتجارى أمينو ميكس) وذلك على نمو وازهار وانتاج الابصال وكذلك على بعض المكونات الكيماوية للاوراق. وقد أظهرت النتائج أن كل صفات النمو الخضرى المدروسة تاثرت معنوياً بالمعاملة بخليط الاحماض الامينية. وقد أظهرت النتائج أن الرش الورقى للنباتات بتركيز ٢ مل/لتر أعطت أعلى قيم معنوية لكلاً من صفات ارتفاع النبات وعدد الاوراق والوزن الطازج والجاف للاوراق لكلا الموسمين. وقد تفوق الهجين الاسيوى "ردألرت" فى صفات النمو الخضرى(ارتفاع النبات وعددالاوراق/نبات والمساحة الورقية). فى حين أن الهجين الاسيوى "روبينو" تفوق وأعطى أعلى قيم معنوية فى صفة الوزن الطازج للاوراق. وأظهرت النتائج ان رش الهجين الاسيوى "روبينو" بخليط الاحماض الامينية بتركيز٢ مل/لتر أعطى أعلى قيم معنوية للوزن الطازج والجاف للاوراق والمساحةالورقية فى حين ان رش الهجين الاسيوى "ردألرت" بنفس التركيز المشار اليه أعطى أعلى قيم معنوية لصفات الوزن الجاف للاوراق. وأظهرت النتائج أن الرش الورقى للنباتات بتركيز ٢مل/لترأعطت أعلى قيم معنوية لصفات النموالزهرى(فترة بقاء الازهار متفتحة على النبات وطول عنق الزهرة والوزن الطازج والجاف للازهار) واحدث تبكير معنوى فى التزهير. وفيما يتعلق بالهجين الاسيوى "روبينو" فقد تفوق معنوياًفى بعض صفات النموالزهرى مثل طول الشمراخ الزهرى وطول عنق الزهرة والوزن الطازج والجاف للازهار وطول البرعم الزهرى. فى حين ان الهجين الاسيوى "ردألرت" تفوق فى صفات عدد الازهار وفترة بقاء الازهار متفتحة على النبات وقطر الزهرة. وأوضحت النتائج أن رش النباتات بخليط الاحماض الامينية بتركيز٢ مل/لتر أعطى أعلى قيم معنوية لصفات فترة بقاء الازهار متفتحة على النبات وقطر الزهرة والوزن الطازج والجاف للازهار لكلا الهجينين. وأظهرت النتائج زيادة معنوية لكل صفات الابصال المدروسة(محيط البصلة والوزن الطازج والجاف للابصال) كنتيجة لرش النباتات بخليط الاحماض الامينية بتركيز٢ مل/لتر لكلا الهجينين. وقدأظهرالهجين الاسيوى "ردألرت" تفوق معنوى فى صفات محيط البصلة والوزن الطازج والجاف للابصال. وأوضحت النتائج أن الرش بمخلوط الاحماض الامينية بتركيز٢ مل/لتر أعطى أعلى زيادة معنوية لمحتوى الاوراق من كلوروفيل(أ & ب) ومحتوى الاوراق من الكربوهيدرات ومحتواها من عناصر النتروجين والفوسفور والبوتاسيوم مقارنة بالكنترول(النباتات الغير معاملة).