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Amino and Humic Acids Promote Growth, Yield and Disease Resistance of Faba Bean Cultivated in Clayey Soil

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Abstract: A field experiment was conducted in 2007-2008 winter season to study the effect of humic (HA) and amino acids (AA) and their interactions on growth, chemical composition, chlorophyll content and chocolate spot and rust diseases of faba bean plants. All morphological (plant height, no of branches and leaves plant^{-1}) and yield components (no of pods/plant and weight of 100 seed) as well as macronutrients content (N, P, K in seeds and straw) and chlorophyll content significantly increased by the application of HA (2000 ppm) interacted with AA (2000 ppm). On the other hand, number of seeds pod^{-1} did not significant effected. The maximum reduction of disease severity of chocolate spot at 55 days from planting was recorded with the interaction between HA at1000 ppm + AA at 1000 ppm then HA at 1000 ppm, while, at 75 days the maximum reduction in both disease severity and disease incidence occurred by AA at 3000 ppm followed by the treatment of HA at 1000 ppm. HA at 3000 ppm followed by the interaction between HA 1000 and AA 1000 ppm then the treatment with HA 2000 ppm were the most effective in reducing rust disease severity of faba bean plant. The study under these application recommended using HA and AA as foliar application to improve growth and mineral content as well as decreasing the damage of chocolate spot and rust diseases of faba bean, in addition the advantages as environmental safety and coast effective.

Key words: Humic acid, Amino acids, Faba bean, Growth, Chemical composition, Chocolate spot and rust diseases

INTRODUCTION

Application of humic acids (HA) has several benefits and agriculturists all over the world are accepting humic acids as an integral part of their fertilizer program. It can be applied directly to the plant foliage in liquid form or to the soil in the form of granules alone or as fertilizer mix. Humic acid is one of the major components of humus. Humates are natural organic substances, high in humic acid and containing most of known trace minerals necessary to the development of plant life (Senn, 1991). Humic substances are an important soil component because they constitute a stable fraction of carbon and improve water holding capacity, pH buffering and thermal insulation (McDonnell *et al*., 2001). Studies of the positive effects of humic substances on plant growth have demonstrated the importance of optimum mineral supply, independent of nutrition (Yildirim, 2007).

Amino acids (AA), which account for the majority of organic nitrogen in soils and humic substances, impact plant growth and serve to explain how organic matter promotes soil productivity (Schnitzer, 2001). However, foliar nutrition in the form of hydrolysed amino acids through foliar spray provides readymade building blocks for protein synthesis. The amino acid is absorbed by the cells as such, and is simply fed into the metabolic machinery of the cell. Evidently, the cells absorb the glutamate faster than it is metabolized, as the glutamate eventually is found in glutamine, glutathione, and protein. The subsequent utilization of these pools of free glutamate in various synthetic and derogative processes leaves little doubt that at least some plants can incorporate amino acids directly into their metabolic pathways.

Faba bean is a major fabaceous legume crop in Egypt. Due to its high nutritive value in both energy and protein contents, it is a primary source of protein in the diet of masses. Therefore, increasing the crop

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production is one of the most important targets of agricultural policy in several countries. This strategic crop is suffering from many destructive diseases. It is attacked by more than 100 pathogens in the Mediterranean region (Hebblethwaite, 1983).

Chocolate spot caused mainly by *Botrytis fabae* sard, and to some extent by *B. cinerea* pers ex fr (Rahman *et al*., 2002), and rust (*Uromyces viciae fabae* pers. Schroet.) diseases are the most important limiting factors which cause great annual losses and sometimes complete crop failures (Mohamed, 1982; Hebblethwait, 1983 and Hanounik and Bisri, 1991). Chocolate spot occurs mainly on leaves, but stems and flowers may also be infected under favorable conditions. Under optimum conditions of temperature (18-20°C) and relative humidity (90-100%), the infection becomes aggressive. Also, under prolonged wet conditions, the disease may reach epidemic proportions with heavy crop losses (Harrison, 1988 and Bernier *et al*, 1993).

The infection by *Uromyces vicia faba* first appear as minute, slightly raised, white to cream colored spots on leaves and to a lesser extent on stems. As spots enlarge the epidermis ruptures, releasing masses of dark brown spores (urediospores) to form characteristic pustules (uredia). The pustules are often surrounded by a ring of yellow tissue. On highly susceptible cultivars, rust can build up rapidly until most of the leaves are covered with pustules. Severely infected leaves rapidly dry up and premature defoliation may occur (Benier *et al.*, 1993).

Due to the widespread occurrence of fungicide resistance in species of *Botrytis* and Uromyces, many chemicals traditionally used to control chocolate spot and rust diseases are less effective (Harrison, 1988), giving only partial disease control, high cost of their use and adverse environmental effects as well as on the accompanying microflora (Khaled *et a*l., 1995). So, there is a growing need to develop alternative approaches for controlling plant diseases. HA is a suspension, based on potassium-humates, which can be applied successfully in many areas of plant production as a plant growth stimulant or soil conditioner for enhancing natural resistance against plant diseases and pests (Scheuerell & Mahaffee, 2004 and Scheuerell. & Mahaffee, 2006), stimulation plant growth through increased cell division, as well as optimized uptake of nutrients and water, (Atiyeh *et al*., 2002 and Chen *et al*., 2004). Moreover, HA stimulated the soil microorganisms (Atiyeh *et al*., 2002. Several reports indicated the efficiency of HA in reducing some plant diseases. In this respect, Scheuerell and Mahaffee (2006) reported that the most effective treatments for suppression gray mould disease caused by *Botrytis cinerea* in Geranium plants was compost tea plus kelp extract and HA. Moreover, HA at concentrations of 6 or 8 ml/L as foliar spray reduced root rot and Alternaria leaf spot diseases in bean plants (Abd El-Kareem, 2007).

The role of AA in plant diseases may be due to the correlation between these acids and plant health. AA are used both for the production of new cell biomass and to produce energy. Followed by deamination into the keto acid which inter into the Tri Carboxylic acid (TCA) cycle, which play important role in plant resistance (Bush, 1993).

The present study was amid to study the influence of AA and HA and their combination on some morphological and physiological characteristics, yield and its components and chemical composition. In addition to, the alleviation of damage of chocolate spot and rust diseases on faba bean.

MATERIALS AND METHODS

Source of Chemicals and Faba Bean Seeds:

Amino and humic acids were kindly obtained from Egyptian Fertilizer Development Center, El-Mansoura, Egypt. Meanwhile, faba bean seeds cv. Giza 3 were obtained from Vegetable Crops Research Dept., Agricultural Research Centre, Giza, Egypt.

Soil Analysis:

The physical and chemical properties of studied soil were found in Table (1). Particle size distribution was determined using the international pipette method as described by piper (1950). Electrical conductivity in 1:2.5 soil: water extract, pH values, OM, available NPK, $CaCO_3$ and Real density were determined according to Jackson (1967), Hesse (1971), Dewis and Freitas (1970) and AOAC (1990).

Plant Analysis:

The plant parts (straw as well as seeds) were dried to fine powder and 0.2 gm was wet digested with a mixture of sulphuric and perchloric acids according to Jackson (1967). N, P and K were determined according to Chapman and Pratt (1961) and Hesse (1971).

Table 1: Physical and chemical analysis of the soil.

Physical characteristics								
Soil texture	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)	$CaCO_3$ (%)	EC dSm^{-1}	Field capacity (%)	Real density (g/cm^3)
Clay loam	6.2	32.6	25	36	2.4	0.32	34.3	2.66

Chemical characteristics					
pH soil paste	Organic matter (%)	CECmeq/100g	Available nutrients (ppm)		
			N	P	K
7.6	1.42	35.2	32.3	14.4	215

Effect of Humic and Amino Acids on Faba Bean Foliar Disease Incidence and Severity under Field Conditions:

A field experiment was carried out under natural infection at the Experimental farm of Tag EL-Ezz, Agric. Res. Station, Dakhlia, Egypt, during the successive growing season of (2007–2008). In addition to, of kocide 101 at 2.5 g/L as a fungicide of chocolate spot disease as well as plantvax 20% EC at 3.5 ml/L as a fungicide for rust disease. HA (Hammr) contain 86% humic acid + 6% K_2O and amino acid (Pepton) contain 6% free amino acid + 12% organic nitrogen + 3.5% K_2O interactions were used as foliar treatments as follows:
Check (Tab water)
HA at 1000, 2000, and 3000 ppm
AA at 1000, 2000, and 3000 ppm
HA at 1000 ppm + AA at 1000 ppm
HA at 2000 ppm + AA at 2000 ppm
Coside 101 2.5 g/L
Plantvax 20% EC at 3.5 ml/L

Seeds were sow (10^{th} November) in 2007-2008 season after the summery rice crop. Each plot was 3.5 x 1.5 m. All agricultural practices were carried out according to the recommendation of Ministry of Agriculture, Egypt. The experimental soil was clayey loam. Complete randomized block design with five replicates was allocated.

Disease Assessment:

The plants developed from each assigned treatment were sprayed with individual AA, HA and its interactions three times with 15-day intervals beginning from 30-day after sowing using a hand atomizer till dripping. Plants sprayed with tap water only served as check. The plants were rated for disease incidence (DI) and disease severity (DS), the former as the presence or absence of disease (percentage of infected leaves on the plant) and the latter as the severity percentage of disease damage.

The disease severity (DS) of chocolate spot disease was estimated at 55 and 75 days from sowing under natural infection by using the scale of Bernier *et al* (1993) as follow:

1= No disease symptoms or very small specks (highly resistance).
3= few small discrete lesions (resistant).
5= some coalesced lesions with some defoliation (moderate resistant)
7= large coalesced sporulating lesions, 50% defoliation and some dead plant (susceptible)
9= Extensive lesions on leaves, stems and pods, severe defoliation, heavy sporulation, stem girdling, blackening and death of more than 80% of plants (highly susceptible)

The disease severity of rust was recorded at 100 days from sowing according to the standard scale suggested by Bernier *et al*., (1993) as follows:

1= No pustules or very small non sporulating flecks (highly resistant).
3= few scattered pustules covering less than 1% of leaf area, and few or no pustules on stem (resistant).
5= pustules common on leaves covering 1-4% of leaf area, little defoliation and some pustules on stem (moderately resistant).
7= pustules very common on leaves covering 4-8% of leaf area, some defoliation and many pustules on stem (Susceptible).
9= Extensive pustules on leaves, petioles and stems covering 8-10% of leaf area, many dead leaves and severe defoliation (highly susceptible).

Percentage of chocolate spot and rust diseases severity were calculated using the formula adopted by (Hanounik, 1986):

$$Disease\ severity\ \% = \frac{\sum(NPC\ x\ CR)}{(NIP\ x\ MSC)}\ x\ 100$$

Where NPC = No. of plants in each class rate
CR = class rate
NIP = No. of infected plants.
MSC = Maximum severity class rate.

The disease incidence (DI) of chocolate spot as a disease percentage was determined after 55 and 75 days from sowing (10 and 20 days from the first treatment according to the following formula:

$$Disease\ incidance = \frac{Number\ of\ infected\ leaflets}{Total\ number\ of\ tested\ leaflets}\ x\ 100$$

Studied Characters:

At 70 days of the cultivation period, growth parameters { plant height (cm), no. of leaves & branches plant^{-1}} and yield components {No. of pods plant^{-1} , No. of seed pod^{-1} and weight of 100-seed (g)} were determined.

Determination of Photosynthetic Pigments:

The blade of the 3rd leaf from plant tip (terminal leaflet) was taken to determine photosynthetic pigments (chlorophyll a, b and carotenoids). Photosynthetic pigments were extracted by methanol 90% for 24h at room temperature after adding traces of sodium carbonate (Robinson and Britz, 2000). Then photosynthetic pigments were determined sepctrophotometrically by the equations of (Mackinney, 1941) at the wave lengths (452.5, 650 and 665 nm).

Statistical Analysis:

All data were subjected to proper statistical analysis of variance (ANOVA) of randomized complete block design by Gomez and Gomez (1984). Mean values of treatments were differentiated by using LSD according to procedure outlined by (Steel and Torrie 1980).

RESULTS AND DISCUSSION

Morphological Characteristics:

After 70 days from sowing, the response of faba bean plants growth to the foliar application of amino and humic acids and its combination was determined by means of measuring height and branches and leaves number per plant. Data of table (2) revel that, the majority of all amino and humic acids treatments significantly increased growth parameters with different extent. In this respect, application of HA at 2000+ AA at 2000 ppm came in the top of other treatments in increasing plant height as well as branches and leaves number per plant. On the other hand, no significant differences was observed in all faba bean growth parameters with the fungicide kocide 101 application as compared to check treatment.

Yield Parameters of Faba Bean:

Data of Table (3) show that treatments of tested amino and humic acids had direct effect on faba bean net yield. Spraying faba bean plants with HA (2000 ppm) + AA (2000 ppm) significantly improved pods no. plant^{-1} and 100-seed weight (192.94 and 25.94%, increase respectively). Both treatments of AA at 3000 and 2000 ppm cam next in increasing 100-seed weight to be 21.51 and 20.24%, respectively. On the other hand, application of amino and/or humic acids or one of fungicides to faba bean plants have no significant effect on number of seeds plant^{-1} as compared to check treatment.

Effect of Amino and Humic Acids on Macronutrients of Faba Bean Plant:

Data in Table (4) show that high significant increase of nitrogen content in seed and straw of faba bean was observed as response to amino and humic acids applications. In seed, the highest increase was recorded either with AA (2000 ppm) or with HA (2000) + AA (2000 ppm) while the highest increase of nitrogen in straw was recorded with A.H. (2000) + A.A. (2000 ppm) treatment.

Table 2: Effect of amino and humic acids on morphological characteristics of faba bean plants

Treatments	Plant height(cm)	No of branches plant^{-1}	No of leaves plant^{-1}
Check	51.33	2.67	33.33
H.A. 1000	67.00	4.33	38.33
H.A. 2000	69.67	4.00	45.33
H.A. 3000	50.00	3.33	29.00
A.A. 1000	63.00	3.67	35.00
A.A. 2000	67.67	2.67	38.00
A.A. 3000	74.33	4.00	38.33
H.A. (1000) + A.A. (1000)	59.00	4.00	30.67
H.A. (2000) + A.A. (2000)	74.00	4.67	46.00
Kocide 101	52.67	2.67	34.00
Plantvax 20% EC	58.00	3.00	35.33
F-test	**	**	**
LSD 5%	6.389	1.033	6.497

Table 3: Effect of amino and humic acids on yield parameters of faba bean plants

Treatments	No of pods plant^{-1}	No of seed pod^{-1}	Weight of 100 seeds (g)
Check	23.00	2.67	52.67
HA 1000	54.00	3.33	48.67
HA 2000	37.33	3.33	62.67
HA 3000	42.67	3.67	51.00
AA 1000	44.67	3.33	62.33
AA 2000	33.67	3.33	63.33
AA 3000	59.67	3.67	64.00
HA (1000) + AA (1000)	41.00	3.00	58.67
HA (2000) + AA (2000)	67.33	3.67	66.33
Kocide 101	34.33	2.67	56.33
Plantvax 20% EC	37.00	3.33	60.67
F-test	**	NS	*
LSD 5%	7.516	---	10.025

Table 4: Effect of amino acids and humic substances on macronutrients in faba bean plants

Treatments	N%		P%		K%	
	Seed	Straw	Seed	Straw	Seed	Straw
Check	2.97	1.61	0.31	0.14	1.83	1.73
HA 1000	3.84	1.75	0.48	0.223	1.92	1.75
HA 2000	3.95	1.89	0.52	0.298	2.02	1.82
HA 3000	4.46	1.92	0.59	0.347	2.06	1.92
AA 1000	4.04	2.21	0.75	0.363	2.12	2.11
AA 2000	5.41	2.36	0.77	0.496	2.14	2.21
AA 3000	5.01	2.51	0.91	0.579	2.18	2.31
HA (1000) + AA (1000)	5.12	2.57	0.97	0.782	2.25	2.50
HA (2000) + AA (2000)	5.77	2.67	1.04	0.989	2.51	2.80
Kocide 101	3.06	1.63	0.37	0.18	1.86	1.73
Plantvax 20% EC	2.93	1.65	0.41	0.16	1.89	1.74
F-test	**	**	**	**	**	**
LSD 5%	0.602	0.037	0.04	0.01	0.05	0.04

The same trend was observed with both P and K content of faba bean seed and straw. On the other hand, no significant increase of any micronutrient content in seed and straw with fungicides applications as compared to check treatment.

Photosynthetic Pigments Content:

The photosynthetic pigments content in fresh plant were determined as chlorophyll a, b and caroteinoids as shown in Table (5). In chlorophyll content, all treatments of AA and HA gave significant increase. In this respect, highest increase was observed with the combination of HA (2000 ppm)+ AA (2000 ppm), followed by HA (1000 ppm)+ AA (1000 ppm). fungicides applications had no significant effects on these parameters.

Disease Assessment:

A: Chocolate Spot:

1- Disease Severity:

Data of DS of chocolate spot disease of faba bean were recorded in Table (6). At 55 days there is no significant difference between all treatments except the application of Kocide 101 which led to the maximum reduction of DS of chocolate spot (84.7%, reduction) followed by HA (1000 ppm) + AA (1000 ppm), then

HA (1000 ppm) to be 75.29 and 72.47% reduction, respectively. At 75 days the maximum reduction after the fungicide of coside 101 in DS was recorded with the foliar application of AA at 3000 & 1000 ppm and combination with HA at 1000 ppm+ AA at 1000 ppm (67.54, 53.26 and 62.57% reduction, respectively).

Table 5: Effect of amino and humic acids on chlorophyll a, b, total chlorophyll and caroteinoid of faba bean plants

Treatments	Chl. a	Chl. b	Total Chl.	Caroteinoids
Check	0.863	0.310	1.173	0.376
HA 1000	0.938	0.380	1.317	0.383
HA 2000	1.094	0.354	1.448	0.436
HA 3000	0.902	0.292	1.194	0.341
AA 1000	0.855	0.292	1.146	0.389
AA 2000	0.934	0.372	1.306	0.482
AA 3000	1.227	0.420	1.647	0.366
HA (1000) + AA (1000)	1.125	0.388	1.512	0.458
HA (2000) + AA (2000)	1.304	0.476	1.780	0.534
Kocide 101	0.892	0.302	1.194	0.389
Plantvax 20% EC	0.913	0.364	1.277	0.429
F-test	**	*	**	**
LSD 5%	0.217	0.102	0.262	0.093

2- Disease Incidence:

Data in Table (6) showed that there is no significant decrease in disease incidence at 55 days as affected by humic and amino acids while at 75 days there is highly significant decrease in DI. The maximum reduction after 75 days recorded with Kocide 101 followed by AA (3000 ppm). In contrast, the application of HA at 3000 ppm increased significantly this parameter.

Table 6: Effect of amino and humic acids on disease severity and disease incidence of faba bean plants

Treatments	55 days				75 days			
	DS	Reduction%	DI	Reduction%	DS	Reduction%	DI	Reduction%
Check	42.5	0.00	15.977	0.00	64.4	0.00	20.265	0.00
HA 1000	11.7	72.47	10.045	37.13	57.9	10.09	19.820	2.19
HA 2000	25.5	40.00	14.551	8.92	46.3	28.01	16.653	17.82
HA 3000	16.7	60.70	9.2770	41.93	62.0	3.72	25.438	-25.52
AA 1000	12.4	70.82	10.421	34.77	30.1	53.26	16.413	19.01
AA 2000	22.0	48.23	12.758	20.14	43.0	33.22	19.675	2.91
AA 3000	16.0	62.35	13.119	17.88	20.9	67.54	10.106	50.13
HA (1000) + AA (1000)	10.5	75.29	7.8850	50.64	24.1	62.57	14.313	29.37
HA (2000) + AA (2000)	18.7	56.00	10.545	33.99	47.5	26.24	18.960	6.43
Kocide 101	6.5	84.70	6.666	58.27	11.3	82.45	5.114	74.76
F-test	**		NS		**		**	
LSD 5%	13.4		---		12.7		3.721	

B: Rust:

Data presented in Table (7) show that, spraying faba bean with humic, amino acids at any dose used and their interactions decreased significantly the DS of rust, irrespective to plantvax 20% EC treatment. The maximum reduction was recorded by HA at 3000 ppm followed by HA at 1000 ppm + AA at 1000 ppm then HA at 2000 ppm.

Table 7: Effect of amino and humic acids on Rust disease severity in faba bean after 100 day from sowing.

Treatments	DS	Reduction %
Check	57.00	0.00
HA 1000	22.33	60.82
HA 2000	17.33	69.59
HA 3000	14.67	74.28
AA 1000	26.66	53.22
AA 2000	23.33	59.07
AA 3000	20.67	63.75
HA (1000) + AA (1000)	16.33	71.35
HA (2000) + AA (2000)	21.33	62.57
Plantvax 20% EC	7.67	86.56
F-test	**	
LSD 5%	3.0238	

Discussion:

Growth parameters, morphological characteristics and chemical contents' of faba bean plants records significant increases especially (HA at 2000 + AA at 2000 ppm), except number of seeds pod^{-1}, with HA and AA treatments.

The increment in growth parameter and yield may be due to that HA are extremely important component because they constitute a stable fraction of carbon, thus regulating the carbon cycle and release of nutrients, including nitrogen, phosphorus, and sulfur, which decreasing the need for inorganic fertilizer for plant growth. HA stimulate plant growth by the assimilation of major and minor elements, enzyme activation and/or inhibition, changes in membrane permeability, protein synthesis and finally the activation of biomass production (Ulukan, 2008). Moreover, Russo and Berlyn (1990) reported that, humates (granular and liquid forms) can reduce plant stress that involved plant diseases as well as enhance plant nutrient uptake. HA contributes significantly to water retention and metal/solute binding and release, and they are necessary for safe plant nutrition (Stevenson, 1994, and Mac Carthy *et al*., 1990). In addition, HA can be used as a growth regulator by regulate endogenous hormone levels (Frgbenro and Agboola, 1993 and Piccolo *et al*., 1992).

Plant growth is influenced indirectly and directly by humic substances. Positive correlations between the humus content of the soil, plant yields and product quality have been published in many different scientific journals. Indirect effects, previously are those factors which provide energy for the beneficial organisms within the soil, influence the soil's water holding capacity, influence the soil's structure, release of plant nutrients from soft minerals, increased availability of trace minerals, and in general improved soil fertility. Direct effects include those changes in plant metabolism that occur following the uptake of organic macromolecules, such as humic acids, fulvic acids. Once these compounds enter plant cells several biochemical changes occur in membranes and various cytoplasmic components of plant cells.

Humic acids and fulvic acids are excellent foliar fertilizer carriers and activators. Application of humic acids or fulvic acids in combination with trace elements and other plant nutrients, as foliar sprays, can improve the growth of plant foliage, roots, and fruits. By increasing plant growth processes within the leaves an increase in carbohydrates content of the leaves and stems occurs. These carbohydrates are then transported down the stems into the roots where they are in part released from the root to provide nutrients for various soil microorganisms on the rhizoplane and in the rhizosphere. The microorganisms then release acids and other organic compounds which increase the availability of plant nutrients. Other microorganisms release "hormone like" compounds which are taken up by plant roots.

Humic substances will maximize the efficient use of residual plant nutrients, reduce fertilizer costs, and help release those plant nutrients presently bound is minerals and salts.

Amino acids are fundamental ingredients in the process of protein synthesis. About 20 important amino acids are involved in the process of each function. Studies have proved that amino acid can directly or indirectly influence the physiological activates of the plant. Because of the amino acid pool is only a small portion of the total dissolved organic nitrogen pool, which generally contains less than 10% free amino acids in temperate ecosystems (Qualls and Haines 1991 and Yu *et al*., 2002). So, several studies have shown that plants can up take N in forms of amino acids without relying on microbial mineralization (Lipson and Nasholm, 2001).

Application of HA (1000 ppm) + AA (1000 ppm) gave the maximum reduction of chocolate spot severity at 55 days, but at 75 days the highest reduction was recorded with AA at 3000 ppm. The highest reduction in rust disease severity occurred at 3000 ppm of HA. The role of HA in overcoming the harmful effects of chocolate spot and rust diseases in faba bean plant may be due to the increase in chitinase activity (Abd-El-Kareem, 2007) and stimulation plant growth through increased cell division, as well as optimized uptake of nutrients and water (Atiyeh *et al*., 2002 and Chen *et al*., 2004) also, regulate hormone level, improve plant growth and enhance stress tolerance (Piccolo *et al*., 1992). HA is a suspension, based on potassium humates, which can be applied successfully in many areas of plant production as a plant growth stimulant or soil conditioner for enhancing natural resistance against plant diseases and pests (Scheuerell and Mahaffee, 2006) which consequently increase yield of plant. Foliar application of HA (25% active HA) consistently enhanced antioxidants such as α-tocopherol, β-carotene, superoxide dismutases, and ascorbic acid concentrations in turf grass species (Zhang, 1997). these antioxidant may play a role in the regulation of plant development, flowering and chilling of disease resistance (Ziadi *et al*., 2001; Dmitrier *et al*., 2003 and Achuo *et al*., 2004).
Amino acids have a chelating effect on micronutrient when applied, that make the absorption and transportation of micronutrients inside the plant is easier due to its effect on cell membrane permeability. Some of these micronutrients play roles in plant resistance by regulating the levels of auxin in plant tissues by activating the auxin oxidase system (Maschner, 1986) and by it appears to be required in synthesis of intermediates in the

metabolic pathway, through trryptophan to auxin (Ohki, 1978). Consequently auxin lead to increase in total phenol, calcium content and activity of chatechol oxidase, these materials protect plants against pathogen stress (Chowdhury, 2003).

Root uptake of amino acids is an energy driven process whereby the outwardly directed plasma membraine H^+-AT pase generates the proton motive gradient to drive inwardly directed amino acid H^+-contransport (Fischer *et al*., 1998). Following of AA deamination and introduction of the keto acids into the TCA cycle, many antioxidant such as citric, succicnic, oxaloacetic and pyruvic acids are produced, which in turn play important role of the plant defense activity (Bush, 1993).

Amino acids help to increase chlorophyll concentration in plant leading to higher degree of photosynthesis. Any factor causes increase in photosynthetic pigments will lead to increase carbohydrate content. Carbohydrates are the main repository of photosynthetic energy, they comprise structurally polysaccharides of plant, principally cellulose, hemicelluloses and pectin and lignin which consider an important structural compound of plant. Also associated with phenolic compounds which play a major role in plant defense (Hahlbrock and Scheel, 1989). Such improvement in yield and growth parameters, especially in a crop like faba bean in Egypt, is seriously needed since all parts of faba bean plants are hundred percent in use regardless fresh or dry. Moreover, humic and amino acids are natural components. So, they are safe for use from an antifungal point of view. In addition to the alleviation of harmful effect of chocolate spot and rust disease. Their practical use in plants under field conditions is easy and possible. Further studies are highly needed to elucidate the mode of action of HA and AA, either on plant host or on the pathogen.

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