Journal of Agricultural Science and Engineering
Vol. 1, No. 2, 2015, pp. 39-45
http://www.publicscienceframework.org/journal/jase

Effect of Foliar Spray of Glutamine on Growth, Yield and Quality of Two Snap Bean Varieties

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Abstract

Two field experiments were carried out in two successive seasons of 2013 and 2014 at the Agricultural Experimental Station of the National Research Centre, EL-Nubaria, Elbehira Governorate, Egypt, to study the effect of three levels of Glutamine (25ppm, 50ppm and 100ppm) spraying in addition the control on growth, yield and pods quality of two bean cultivars (Paulesta and Oxzira). Results showed that using Oxzira cv. gave the highest values of the vegetative growth (number of leaves and number of branches as well as fresh and dry weight of whole plant), total yield, quality and Chemical constituents (Total Free amino acids in leaves and total phenolic acids in pod). Whereas, Paulesta cv. Resulted the highest values of plant length and Total Free amino acids in pods. Spraying bean plants by Glutamine (25ppm, 50 ppm) increased vegetative growth, total yield and quality with no significant difference between 50 and 25 ppm. Whereas, using Glutamine as (25ppm) increased Total Free amino acids in leaves and total phenolic acids in pod but Total Free amino acids in pods highest when using Glutamine (100ppm).

Keywords

Snap Bean, Foliar Spray, Glutamine, Growth, Yield, Chemical Composition

Received: March 22, 2015 / Accepted: April 2, 2015 / Published online: April 6, 2015

1. Introduction

Snap Bean, *Phaseolus vulgaris* L. which commonly known in Egypt as Phasolia is a member of family Fabaceae. It is also known as Common, Snap, Kidney, French or Haricot beans (Bisby *et al*., 2011). It is one of the most important food crops in Egypt and consumed as a cooked vegetable either as dry seeds or green pods. It plays an important role in human nutrition as a cheap source for protein, carbohydrates, vitamins and minerals.

Many investigators reported that the vegetative growth, total and exportable yield as well as pod quality of snap bean (*Phaseolus vulgaris*, L) are greatly affected by genotype of the variety Nassar (1986), Abou El Hassan *et al*., (1993), Mohamed (1997) , Amer *et al.,* (2002),, Abdul Mawgoud *et al*., (2005).

Nitrogen is required by plants in comparatively larger amounts than other elements (Marschner., 1995).

In recent years, the world focused his attention to minimize environmental pollution and human health impacts, by reducing the use of synthetic fertilizers and chemicals in crops production. Especially, vegetables which eat fresh using natural alternatives, (IFAOM/SOEL, 2000 and FAO/TTC, 2001).

Amino acids is a well known biostimulant which has positive effects on plant growth, yield and significantly mitigates the injuries caused by abiotic stresses (Kowalczyk and Zielony 2008). Saeed *et al.,* (2005) on soybean found that treatments of amino acids significantly improved growth parameters of

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shoots and fresh weight as well as pod yield. El- Zohiri and Asfour (2009) on potato found that spraying of amino acids at 0.25 ml/L significantly increased vegetative growth expressed as plant height and dry weight of plant.

The requirement of nitrogen of amino acids in essential quantities is well known as a mean to increase growth and yield for all crops. Furthermore, nitrogen and/or amino acids are the fundamental ingredients for the process of protein synthesis. The important of nitrogen or amino acids came from their widely use for the biosynthesis of large variety of non protein nitrogenous materials i.e., pigments, vitamins, coenzymes, Purine and pyrimidine bases (Kamar and Omar, 1987).

Many studies reported that, the foliar application of amino acids caused an enhancement in plant growth, fruits yield and its components (Kamarand Omar, 1987) on sweet pepper. Karuppaiah *et al*., 2000 on potato, El-Shabasi *et al.,* 2005 on cucumber and Awad *et al.,* 2007 on garlic

The possibilities of using amino acid in modern agriculture have been studied by many researchers (Fawzy et al., 2010; Abdel-Mawgood *et al.,* 2011; El Awadi *et al.,* 2011; Razieh *et al.,* 2012).

The aim of the present study is to investigate the effects of Foliar Spray of Glutamine on growth, yield and quality of two snap bean varieties

2. Material and Methods

Table (1). Physical properties and chemical analysis of the experimental soil.

Physical properties		Chemical analysis	
Sand	90.08	Ca (Mg/L)	7.02
Clay	9.26	Mg (Mg/L)	0.527
Silt	0.66	Na (Mg/L)	0.982
Texture	Sandy	K (Mg/L)	0.31
F.C. %	16.57	HCO3 (Mg/L)	1.3
W. P. %	5.25	Cl (Mg/L)	0.566
E. C. (ds/m)	1.7		
PH	8.2		

A field experiment was carried out at the experimental station of National Research Centre, at EL-Nubaria, EL-Behira Governorate, Northern Egypt, during two successive summer seasons of 2013 and 2014 to study the differences between two bean cultivars (Paulesta and Oxzira) and three levels of Glutamine (25ppm, 50ppm and 100ppm) spraying in addition the control on growth, yield and pods quality of snap bean (*Phaseolus vulgaris* L.). Seeds of bean were sown on the last week of April in 2013 and 2014, respectively. Seeds were sown on two sides of ridge; ridge was 80 cm width and 4 m length and 10 cm apart. Each plot included 4 ridges and the plot area was 12.8 m^2. Glutamine foliar application sprayed 30 and 40 days after sowing.

The soil of the experimental field was sandy soil and the physical and chemical analyses were presented in Table (1). The normal agricultural practices required for bean production were applied as commonly followed in the farm.

2.1. Data Recorded

Vegetative growth: A random sample of 5 plants from each plot was taken at 45 days after sowing and the following vegetative characters were recorded: plant length, number of leaves and number of branches as well as fresh and dry weight of whole plant.

Pods yield: At harvest stage the mature pods of bean for each experimental plot were collected along the harvesting season and the total pods yield was recorded as ton/fed.

2.2. Pods Quality

Random sample of 50 pods from each plot was taken and the physical properties (average pod weight and pod length) were recorded.

2.3. Chemical Constituents

Protein percentage was determined according to A.O.A.C. (1990). Total Free amino acids were determined using the ninhydrin colorimetric method defined by Plummer (1978). Following the method reported by Snell and Snell (1952), total phenolic compounds were estimated.

The treatments were arranged in a split plot design with four replicates where, bean cultivars were arranged in main plots, while Glutamine foliar application treatments were in addition the control distributed in the sub plots. The obtained data were statistically analyzed according to the method described by Gomez and Gomez (1984).

3. Results and Discussion

3.1. Vegetative Growth Parameters

3.1.1. Effect of Snap Bean Varieties

Data in Table (2) show that, snap bean varieties in both seasons have a significant effect in their vegetative growth parameters except for fresh and dry weight of leaves in the two seasons of study. Meanwhile, the highest value of plant length was recorded by Paulista cv. However, Oxzira cv. gave the highest values of other vegetative growth parameters (number of leaves and branches as well as fresh and dry weights of leaves of snap bean). These results held true in the two seasons of the study. On the contrary, the lowest amount of plant height was found by Oxzira cv. and the lowest amount of all other vegetative parameters were

found by Paulista cv. The observed differences in vegetative growth of cultivars are mainly due to the genotype of each cultivar. This result was in harmony with previous findings (Abou El –Hassan *et al* 1993, Mouhamed. F.M., 1998, and Abdul – Mawgoud *et al* 2005) on snap bean plants.

3.1.2. Effect of Foliar Application of Glutamine

Data of the measured vegetative growth parameters of snap bean plants in relation to the applied Glutamine are presented in Table (2). Generally, application of Glutamine had a significant effect in the vegetative growth parameters (number of leaves and fresh and dry weight of leaves) in both seasons of study. Meanwhile, the highest values plant height parameter was obtained from the application of Glutamine at a rate of 100 ppm in both seasons as compared with those obtained from the control and other treatments. Moreover, the lowest of plant length was found by control plant (foliar spray of water). Furthermore, the highest amount of number of leaves and branches as well as fresh and dry weights of leaves of snap bean were found by application of Glutamine as a rates of 25 ppm. On the other hand, the lowest values of vegetative growth parameters were found by foliar application of Glutamine at rates of 100 ppm. These findings were true in the two seasons. These results are in agreement with those obtained by many investigators Kowalczyk and Zielony 2008.

Table (2). Effect of cultivars and Glutamine foliar application on vegetative growth parameters of bean plants.

Characters		Plant length (cm)		Leaf number		Branch number		Leaves fresh weight (g)		Leaves dry weight (g)	
		2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
		Effect of Cultivars									
Paulesta		43.66	41.09	17.01	15.81	9.92	9.31	28.62	28.58	5.98	6.23
oxzira		42.18	39.74	20.68	19.19	11.99	11.21	30.76	30.54	6.54	6.75
LSD at 5%		1.02	1.12	2.86	3.75	2.01	1.39	NS	NS	NS	NS
		Effect of Glutamine									
Control		39.94	37.68	18.30	17.00	10.46	9.81	29.60	29.48	5.69	5.96
25ppm		43.56	41.00	24.84	23.00	12.41	11.60	38.75	37.88	7.84	7.94
50ppm		43.67	41.10	16.94	15.75	10.83	10.15	28.78	28.73	5.93	6.18
100ppm		44.51	41.88	15.30	14.25	10.10	9.48	21.61	22.15	5.60	5.88
LSD at 5%		NS	NS	3.14	4.57	NS	NS	2.16	4.30	1.87	2.46
		Effect of the interaction									
Control	Paulesta	41.65	39.25	16.39	15.25	9.90	9.29	28.86	28.80	5.38	5.68
	oxzira	38.22	36.10	20.21	18.75	11.03	10.33	30.33	30.15	5.99	6.24
25ppm	Paulesta	43.02	40.50	22.12	20.50	8.76	8.25	36.27	35.60	7.18	7.33
	oxzira	44.11	41.50	27.57	25.50	16.07	14.95	41.23	40.15	8.50	8.55
50ppm	Paulesta	46.39	43.60	17.21	16.00	11.22	10.50	28.92	28.85	6.25	6.48
	oxzira	40.94	38.60	16.67	15.50	10.45	9.80	28.64	28.60	5.60	5.89
100ppm	Paulesta	43.56	41.00	12.31	11.50	9.80	9.20	20.41	21.05	5.13	5.45
	oxzira	45.47	42.75	18.30	17.00	10.40	9.75	22.81	23.25	6.07	6.32
LSD at 5%		2.19	2.13	3.07	3.03	3.33	3.27	NS	NS	1.98	1.64

3.1.3. Effect of the Interaction

The results of the interaction effects of varieties and different concentrations of Glutamine were found statistically significant at 5 % level (Table 2) in the two seasons except for leaves fresh weight parameter. The highest plant high of snap bean plants was recorded by foliar spray of Glutamine at a rate of 50 ppm with Paulista cv. in both seasons of study. On the country, the lowest amount of plant high was found by control (foliar spray with water) with Oxzira cv. in both seasons However, the highest amount of number of branches and leaves as well as fresh and dry weight of snap bean were found by using Glutamine as a foliar spray at rates of 25 ppm with Oxzira cv. in both seasons of study. On the other hand, the lowest amount of number of leaves as well as fresh and dry weight of snap bean plants was found by foliar spray of Glutamine at rates of 100 ppm with Paulista cv. These results were true in the both seasons of study. Moreover, the lowest amount of number of branches was found by foliar spray of Glutamine at rates of 25 ppm with Paulista cv.

3.2. Yield and Quality Parameters

3.2.1. Effect of Snap Bean Varieties

Data in Table (3) show that, snap bean varieties in both seasons has a significant effect about total yield and length and weight of snap bean parameters .Meanwhile, the highest values of all parameters (total yield, length and weight of pod of snap bean plants) were recorded in Oxzira cv. .However, Paulesta cv. gave the lowest values of total yield and pod quality parameters. These results held true in the two seasons of the study. The observed differences in vegetative growth of cultivars are mainly due to the genotype of each cultivar. This result was in harmony with previous findings (Abou El

–Hassan *et al*., 1993, and Abdel – Mawgoud *et al* 2005) on snap bean plants.

3.2.2. Effect of Foliar Application of Glutamine

Data of the measured total yield and pod quality parameters of snap bean plants in relation to the applied Glutamine are presented in Table (3). Generally, application of Glutamine had a significant effect in the total yield and pod quality parameters (pod weight and pod length) in both seasons of study. Meanwhile, the highest value total yield parameter was obtained from the application of Glutamine at a rate of 25 ppm in both seasons as compared with those obtained from the control and other treatments. On the other hand, the lowest value of total yield was found by foliar spray of Glutamine in both seasons of study. However, the highest amount of length and weight of pod of snap bean were found by foliar spray of Glutamine at rates of 50 ppm in both seasons. On the contrary, the lowest amount of length and weight of pod were found by control plants (foliar spray of water). These findings were true in the two seasons. Similar results were obtained by Fawzy *et al.,* 2010; Abdel-Mawgood *et al.,* 2011; El Awadi *et al.,* 2011; Razieh *et al.,* 2012.

3.2.3. Effect of the Interaction

The results of the interaction effects of varieties and different concentrations of Glutamine were found statistically significant at 5 % level (Table 3) in the two seasons except for pod weight parameter. The highest total yield of snap bean plants was recorded by foliar spray of Glutamine at a rate of 25 ppm with Paulista cv. in the both seasons of study. Furthermore, the highest amounts of length and weight of pod of snap bean plants were recorded by foliar spray of Glutamine at rates of 50 ppm with Oxzira cv. On the country, the lowest amount of total yield and quality parameters (length and weight of pod) of snap bean plants were found by control (foliar spray with water) with Paulista cv. in both seasons .

Table (3). Effect of cultivars and Glutamine foliar application on yield and quality of bean plants.

Characters		Total yield ton/fed.		Pod length (cm)		Pod weight (g)	
		2013	2014	2013	2014	2013	2014
		Effect of Cultivars					
Paulesta		2.96	2.97	11.22	11.20	3.37	3.39
oxzira		3.37	3.35	13.66	13.44	4.03	4.00
LSD at 5%		0.23	0.29	1.78	1.62	0.46	0.37
		Effect of Glutamine					
Control		2.99	3.00	10.24	10.30	2.34	2.45
25ppm		3.65	3.60	12.44	12.33	4.25	4.20
50ppm		3.31	3.29	13.89	13.65	4.88	4.78
100ppm		2.70	2.74	13.18	13.00	3.31	3.34
LSD at 5%		0.32	0.37	1.09	1.91	1.32	1.51
		Effect of the interaction					
Control	Paulesta	2.40	2.46	10.02	10.10	2.29	2.40
	oxzira	3.59	3.55	10.46	10.50	2.40	2.51
25ppm	Paulesta	3.75	3.70	11.27	11.25	4.19	4.14
	oxzira	3.55	3.51	13.62	13.40	4.31	4.26
50ppm	Paulesta	3.17	3.17	11.38	11.35	4.15	4.11
	oxzira	3.45	3.42	16.40	15.95	5.62	5.45
100ppm	Paulesta	2.52	2.57	12.20	12.10	2.84	2.91
	oxzira	2.89	2.90	14.16	13.90	3.78	3.77
LSD at 5%		0.45	0.67	1.14	1.95	NS	NS

3.3. N, P and K %of Pod of Snap Bean Plants

3.3.1. Effect of Snap Bean Varieties

Data in Table (4) show that, snap bean varieties in both seasons has a significant effect about N% of pod of snap bean and no significant effect about P and K% of pod of snap bean plants .Meanwhile, the highest values of N% and P% of pod of snap bean were recorded by using Oxzira cv. However, Paulesta cv. gave the highest values of K% of pod of snap bean .On the other hand, the lowest amount of N and P% of pod were recorded by Paulista cv. However, the lowest value of K% of pod of snap bean was found by using Oxzira cv. These results held true in the two seasons of the study. The observed differences in vegetative growth of cultivars are mainly due to the genotype of each cultivar. This result

was in harmony with previous findings (Mouhamed. F.M., 1998, Amer *et al*., 2002 and Abdel – Mawgoud *et al*., 2005) on snap bean plants.

3.3.2. Effect of Foliar Application of Glutamine

Data of the measured of N, P and K % of pod of snap bean plants in relation to the applied Glutamine are presented in Table (4). Generally, application of Glutamine had a significant effect in the N, P and K% in both seasons of study. Meanwhile, the highest values of N% of pod of snap bean were recorded by foliar spray of Glutamine at rates of 25 ppm. However, the lowest amount of N% was found by foliar spray of Glutamine at rates of 100 ppm. This result was true in both seasons. Moreover, the highest values of P and K% of pod of snap ban were recorded by foliar spray of Glutamine at rates of 50 ppm in the both seasons of study. On the country, the lowest values of P and K % were recorded by foliar spray of Glutamine at rates of 25 ppm and 100 ppm, respectively. These findings were true in the two seasons. This result was in harmony with Fawzy *et al.,* 2010; Abdel-Mawgood *et al.,* 2011; El Awadi *et al.,* 2011; Razieh *et al.,* 2012

3.3.3. Effect of the Interaction

The results of the interaction effects of varieties and different concentrations of Glutamine were found statistically significant at 5 % level of N and K% (Table 4) in the two seasons. The highest N, P and K% of pod of snap bean plants were recorded by foliar spray of Glutamine at a rate of 50 ppm with Oxzira cv. in the both seasons of study except for K% in first season. On the country, the lowest amount of N% of pod of snap bean plants was found by foliar spray of Glutamine at rates of 100 ppm with Paulista cv. Moreover, the lowest value of P% of pod was found by foliar spray of Glutamine at rates of 50 ppm with Paulista cv. On the other hand, the lowest value of K% of pod of snap bean was found by foliar spray of Glutamine at rates of 100 ppm with Oxzira cv. These results were true in the both seasons of study.

Table (4). Effect of cultivars and Glutamine foliar application on N P and K in bean pods.

Characters		N%		P%		K%	
		2013	2014	2013	2014	2013	2014
		Effect of Cultivars					
Paulesta		2.81	2.85	0.38	0.41	2.02	1.93
oxzira		3.13	3.11	0.43	0.47	1.78	1.74
LSD at 5%		0.21	0.14	NS	NS	NS	NS
		Effect of Glutamine					
Control		2.92	2.94	0.39	0.42	1.53	1.51
25ppm		3.19	3.17	0.35	0.39	2.06	1.96
50ppm		3.15	3.13	0.50	0.53	2.55	2.41
100ppm		2.61	2.68	0.40	0.42	1.46	1.47
LSD at 5%		0.15	0.21	0.1	0.09	0.19	0.27
		Effect of the interaction					
Control	Paulesta	3.01	3.02	0.45	0.47	1.52	1.52
	oxzira	2.83	2.87	0.32	0.37	1.53	1.50
25ppm	Paulesta	3.01	3.02	0.36	0.40	2.57	2.39
	oxzira	3.37	3.32	0.34	0.38	1.56	1.52
50ppm	Paulesta	2.74	2.79	0.32	0.36	2.47	2.31
	oxzira	3.55	3.47	0.68	0.70	2.62	2.50
100ppm	Paulesta	2.47	2.57	0.41	0.42	1.50	1.50
	oxzira	2.74	2.79	0.40	0.43	1.43	1.44
LSD at 5%		0.53	0.36	0.23	0.12	0.33	0.45

3.4. FAA in Leaves and Protein %, Phinolic Acid, FAA in Pod of Bean Plants

3.4.1. Effect of Snap Bean Varieties

Data in Table (5) show that, snap bean varieties in both seasons has a significant effect of all parameters except for FAA in pod of snap bean plants in the second season .Meanwhile, the highest values of FAA in leaves and pod as well as phinolic acid were recorded by using Paulista cv. However, Oxzira cv. gave the highest values protein of snap bean .On the other hand, the lowest amount of FAA in leaves and pod as well as phinolic acid were recorded by Oxzira cv. However, the lowest value of protein of snap bean was found by using Paulista cv. These results held true in the two seasons of the study. The observed differences in vegetative growth of cultivars are mainly due to the genotype

of each cultivar. This result was in harmony with previous findings (Abou El –Hassan *et al*., 1993, Mouhamed. 1998,) on snap bean plants.

3.4.2. Effect of Foliar Application of Glutamine

Data of the measured of FAA in leaves and Protein %, Phinolic acid, FAA in pod of bean plants in relation to the applied Glutamine are presented in Table (5). Generally, application of Glutamine had a significant effect in the all parameters in both seasons of study. Meanwhile, the highest values of FAA in leaves and pods were recorded by foliar spray of Glutamine at rates of 100 ppm. However, the highest value of protein % was found by foliar spray of Glutamine at rates of 25 ppm. Furthermore, the highest value of phinolic acid was found by foliar spray of Glutamine at rates of 50 ppm. These results are true in both seasons of study. On the country, the lowest value of FAA in leaves was found by foliar spray of Glutamine at rates of 50 ppm in both seasons. Moreover, the lowest value of protein % was found by foliar spray of Glutamine at rates of 100 ppm in both seasons. However, the lowest values of FAA in pod and phinolic acid of snap bean plants was recorded by control treatment (foliar spray of water). These findings were true in the two seasons. Similar results were obtained by El-Zohiri and Asfour (2009)

3.4.3. Effect of the Interaction

The results of the interaction effects of varieties and different concentrations of Glutamine were found statistically significant at 5 % level of all parameters (FAA in leaves and Protein %, Phinolic acid, FAA in pod of bean plants) (Table 5) in the two seasons. The highest values of FAA in leaves of snap bean plants was recorded by foliar spray of Glutamine at a rate of 100 ppm with Paulista cv. in the both seasons of study. Moreover, the highest values of protein in pods of snap bean plants were recorded by foliar spray of Glutamine at rates of 50 ppm with Oxzira cv.in both seasons. Furthermore, the highest value of phinolic acid was found by foliar spray of Glutamine at rates of 25 ppm with Paulista cv. Moreover, the highest value of FAA in pod was found by foliar spray of Glutamine at rates of 100 ppm with Oxzira cv. On the contrary, the lowest value of FAA in leaves and pods of snap bean were found by foliar spray of water (control plants) with Oxzira cv. Moreover, the lowest value of protein in pod of snap bean plants was found by foliar spray of Glutamine at rates of 100 ppm with Paulista cv. However, the lowest value of phinolic acid in pod was found by foliar spray of Glutamine at rates of 25 ppm with Oxzera cv.These results were true in the both seasons of study.

Table (5). Effect of cultivars and Glutamine foliar application on FAA in leaves and Protein %, Phinolic acid, FAA in pod of bean plants.

Characters		FAA in leaves		Protein % in pod		Phinolic acid in pod		FAA in pod	
		2013	2014	2013	2014	2013	2014	2013	2014
		Effect of Cultivars							
Paulesta		40.51	39.73	17.57	17.81	16.05	15.77	27.29	27.59
oxzira		30.88	30.89	19.53	19.46	14.05	13.93	25.98	26.40
LSD at 5%		2.63	2.36	0.95	0.76	1.65	1.63	1.09	NS
		Effect of Glutamine							
Control		31.09	31.09	18.27	18.40	12.26	12.28	22.24	22.97
25ppm		33.74	33.51	19.95	19.81	14.77	14.59	25.24	25.72
50ppm		30.48	30.53	19.67	19.58	17.17	16.79	27.61	27.89
100ppm		47.47	46.11	16.30	16.75	16.01	15.73	31.44	31.40
LSD at 5%		2.79	5.12	1.22	1.03	2.01	2.88	2.33	2.86
		Effect of the interaction							
Control	Paulesta	38.66	38.03	18.83	18.87	13.79	13.69	24.41	24.95
	oxzira	23.52	24.14	17.71	17.93	10.72	10.88	20.08	20.99
25ppm	Paulesta	40.65	39.85	18.83	18.87	19.23	18.68	27.57	27.86
	oxzira	26.83	27.17	21.08	20.76	10.32	10.50	22.92	23.59
50ppm	Paulesta	29.57	29.69	17.15	17.45	15.36	15.13	30.46	30.51
	oxzira	31.40	31.37	22.20	21.70	18.98	18.45	24.77	25.28
100ppm	Paulesta	53.18	51.35	15.46	16.04	15.83	15.56	26.71	27.07
	oxzira	41.76	40.88	17.15	17.45	16.19	15.89	36.17	35.74
LSD at 5%		2.92	3.40	2.83	3.02	2.07	2.94	1.21	1.45

4. Conclusion

It could be recommended that all spraying bean plants by Glutamine (25ppm and 50 ppm) increased vegetative growth, total yield and quality. Whereas, using Glutamine as (25ppm) increased Total Free amino acids in leaves and total phenolic acids in pod but Total Free amino acids in pods highest when using Glutamine (100ppm).

Acknowledgment

The authors would express their thanks for all fruitful efforts presented and supported by Ministry of Science and Technology- Talented Young Scientists Program- China

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