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EFFECT OF GLYCINE, LYSINE AND NITROGEN FERTILIZER RATES ON GROWTH, YIELD AND CHEMICAL COMPOSITION OF POTATO

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ABSTRACT

The present work was carried at Baramoon Experimental Farm, Dakhalia Governorate, Egypt, during the two spring seasons of 2004 and 2005. Potatoes cv. Spunta was cultivated to study the effect of glycine, lysine and nitrogen fertilizer rates on growth, yield and chemical composition of potato *, i.e.*, (control, glycine at dose 100 ppm, lysine at dose 100 ppm, a mixture of glycine 100 ppm plus lysine 100 ppm) and nitrogen rates of 120, 150 and 180 kg/fed.

The results showed that nitrogen fertilizers rates increased significantly vegetative growth parameters, *i.e.*, plant height, number of main stems, foliage fresh and dry weight at 75 days after planting, in addition to total tuber yield, tuber number, tuber weight/plant, NPK in leaves at 75 days after planting and P, dry matter, starch, protein contents in the tubers in two seasons.

The best growth parameters of potatoes were recorded with foliar addition of glycine plus lysine each at 100 ppm. The highest total tuber yield, tuber number, tuber weight, NPK in the leaves at 75 days after planting and tuber at harvest time, dry matter, starch as well as protein content in the tuber were obtained by glycine plus lysine treatment in both seasons.

The interaction between N fertilizer rates and amino acid, had significant effect on all vegetative growth parameters, total tuber yield and its components, NPK in the leaves and tubers, dry matter, starch and protein contents in the tubers except N in the first season.

INTRODUCTION

Potatoes are an important crop in Egypt with annually approximately 220,000 feddan. The recent trend preferrs to use naturally occurring compounds such as amino acids for regulation of plant growth and development. Kamar and Omar (1987) indicated that early and total yield, average number of fruits/plant of cucumber as well as total yield of the two potato cultivars (Alpha and King Edward) were significantly increased as a result of spraying with amino acid solution. Sedletskii *et al.* (1987) found that spraying grapes with phenylalanine at 0.003 % three times increased yield by 10-32 %. Moursey *et al.* (1988) on *Dature stramonium* L. stated that phenylalanine or ornithine at 500 ppm showed the highest values of fresh and dry weight of callus explant. Sharma and Kothari (1993) indicated that foliar addition of cereal protein hydrolysate (CPH), which contained amino acids, increased yield of *Vigna radiate* and wheat. Gamal El-Din *et al.* (1997) revealed that spraying ornithine at 50 mg/L or phenyl alanine at 100 mg/L + 0.15 % micronutrients mixture led to significant increases in the number of leaves and tillers per plant, fresh and dry weight of lemon - grass herb.

Recently, Reda *et al.* (1999) found that vegetative growth criteria of *Hyoscyamus muticus* L. were significantly increased with the treatments of amino acids ornithine, proline or cysteine as foliar spraying.

Attoa *et al.* (2002) found that spraying *I. amara* with tryptophan at 75 ppm increased vegetative growth parameters, total carbohydrates, nitrogen and phosphorus contents, while aspartic acid at 75 ppm increased both yield of fixed oil and total glucosinolates. El-Shabasi *et al.* (2005) indicated that foliar spraying of garlic plants with mixture of glycine, alanine, cysteine and arginine (each at 100 ppm) gave the highest values of plant height, leaf blade area, neck and bulb diameter, fresh weight of leaves and markedly produced higher yield total and amino acid as well as crude protein.

Nitrogen is important factor influencing potato tuber growth, development, quality and yield (Vos, 1997 ; Errebhi *et al.,* 1998).Belanger *et al.* (2000 and 2002) reported that nitrogen fertilization increased the average fresh tuber weight, number of tubers per plant. Miller and Rosen (2005) found that yields increased with increasing N rates (170, 250 and 340 kg/ha). Love *et al.* (2005) showed that maximum total yield of potato was produced with 278 kg/ha.

The objective of this study was find out the effect of potato to glcine, lycine and rates of nitrogen fertilizer on growth, yield and chemical composition of potato.

MATERIALS AND METHODS

A field experiment was carried out during the two Spring seasons of 2004 and 2005 on potato (*Solanium tuberosum* L.) cv. Spunta at Baramoon Experimental farm, Dakhalia Governorate, Egypt.

Cut seed pieces with an average weight of about 50 g per each were planted in rows 0.75 m apart with 0.25 m intrarow spacing. Planting dates were carried out on January 18 and 22 in the two seasons of 2004 and 2005, while the harvesting time was done on May 4 and 8, in both seasons, respectively.

Some physical and chemical properties of the experimental soil at depth of 0-30 m are shown in Table 1.

Table1. Some physical and chemical properties at the experimental soil.

Sand (%)	Silt (%)	Clay (%)	Texture	O.M.	pH	Available (ppm)		
						N	P	K
27.0	23.5	48.4	**Clayey**	1.1	8.0	31.8	14.6	115

The source of amino acids (Glycine and Lysine) were obtained from El-Gomhoura Chemicals Co.

Calcium superphosphate (15.5 % P_2O_5) was added as one time during soil preparation at rate of 75 kg P_2O_5/fed and potassium sulphate (48.0 % K_2O) was added after 7 weeks from planting date at the rate of 96 kg K_2O/fed.

The experimental design and treatments

The experimental design was split plot design with three replicates. Nitrogen fertilizer with three rates (120, 150 and 180 kg N/fed) were randomly distributed in the main plots, while the sub – plots were assigned to the amino acids glycine and lysine each at 100 ppm and their combination, besides the control. Nitrogen as a source of ammonium nitrate (33.5 % N) was added at three equal portions at 30, 42 and 56 days after planting. The amino acids were foliary sprayed at 42, 56 and 70 days after planting date (DAP).

The experimental plot area was 11.25 m^2 which contained 3 ridges, each with 5 m length and 0.75 m width. Other field practices were applied according to the Ministry of Agriculture recommendations.

Studied parameters

1. Vegetative growth parameters

Samples of five potato plants were taken at 75 days after planting date (DAP) from each experimental plot to measure plant height (cm), number of main stems/plant, foliage fresh and dry weight/plant (g).

2. Yield and its components

Total tuber yield (ton/fed), number of tubers/plant and tuber weight/plant (g), were determined at harvesting time.

3. Chemical composition

The contents of N, P and K were determined in the fourth leaf at 75 days from planting and in tubers at harvest time. Samples were dried at 70 ºC until constant weight. Nitrogen, phosphorus and potassium content according to the methods described by Bremmer and Mulvaney (1982), Dry matter and starch content percent were evaluated according to A.O.A.C (1990) Total protein percentage in tubers, was calculated as N X 6.25.

Statistical analysis

Data were statistically analyzed and means were compared using the Least Significant Differences (LSD) according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1. Vegetative growth parameters

a. Effect of nitrogen rates

Data concerning the effect of the various nitrogen rates on vegetative growth parameters of potatoes are presented in Table (2). The results indicated that the plant height, number of main stems, foliage fresh and dry weight per plant were significantly increased with increasing nitrogen rates, in both seasons. The increase in plant growth may be attributed to the beneficial effects of N on stimulating the meristmatic activity for producing more tissues and organs, since N plays major roles as a primary component of all nucleic acids, proteins and amino acids, in addition to its vital contribution in several biochemical processes that related to growth (Marschner, 1995 ; Westermann, 2005). These results are in agreement with those obtained by Gabr and Sarg (1998), Ghoneim and Abd-Razik (1999) and Gabr *et al.* (2001), they found that increasing N rates caused increasing in vegetative growth characters of potato.

b. Effect of amino acids

Data presented in Table (2) showed that the plant height, number of main stems, foliage fresh and dry weight per plant at 75 days after planting were significantly increased by foliar spraying with amino acids compared to control plants, in the two seasons. The highest values of all vegetative growth parameters were obtained with a mixture of glycine and lysine at dose of 100 ppm for each one compared with other treatments. These results may be due to the increase in productivity of the photosynthetic areas. Bidwell (1980) stated that amino acids are known as building blocks of proteins, in plants they severe in number of additional functions in the regulating of metabolism, transport and storage of nitrogen, indicating that continuous protein synthesis was necessary during the development growth. El-Shabasi (2005) found that foliar spraying with a mixture of glycine, alanine, cysteine and arginine at 100 ppm of each type scored higher values on all vegetative growth parameters on garlic.

Table 2. Effect of N rates, amino acids and their interactions on vegetative parameters of potato plant in the spring seasons 2004 and 2005.

Parameters / Treatments		Plant height (cm)		Number of main stems/plant		Foliage fresh weight /plant (g)		Foliage dry weight/plant (%)	
		2004	2005	2004	2005	2004	2005	2004	2005
A- N . fertilizer rates (kg/fed)									
120		37.0	35.8	2.26	2.17	255.1	249.7	11.02	10.57
150		45.3	43.8	2.39	2.27	282.0	279.4	12.16	11.64
180		54.5	51.5	2.83	2.73	335.0	326.3	12.65	12.34
LSD at 5 %		0.3	0.7	0.08	0.19	4.6	6.2	0.03	0.08
B- Amino acids									
Control		42.0	40.1	2.25	2.16	264.5	262.5	11.50	10.97
Glysine		46.3	44.7	2.57	2.52	294.9	287.7	12.05	11.68
Lysine		44.2	42.5	2.41	2.30	283.2	275.4	11.84	11.44
Glysine + Lysine		49.8	47.5	2.73	2.59	320.2	314.9	12.38	11.99
LSD at 5 %		0.6	0.5	0.07	0.13	3.9	3.7	0.06	0.04
C- N . fertilizer rates(kg/fed) X Amino acids									
120	Control	34.3	33.0	2.08	2.11	241.5	235.4	10.55	10.09
	Glysine	37.0	36.6	2.27	2.16	259.0	253.1	11.15	10.75
	Lysine	35.0	34.0	2.18	2.10	251.5	244.4	11.02	10.51
	Glysine + Lysine	41.6	39.6	2.50	2.33	268.5	265.9	11.36	10.94
150	Control	42.6	41.0	2.21	1.99	253.4	256.5	11.91	11.15
	Glysine	46.0	44.6	2.54	2.55	284.1	281.0	12.22	11.73
	Lysine	44.0	42.6	2.22	2.05	276.5	269.8	11.98	11.48
	Glysine + Lysine	48.6	47.0	2.59	2.50	314.0	310.3	12.53	12.21
180	Control	49.0	46.3	2.46	2.37	298.5	295.6	12.05	11.68
	Glysine	56.0	53.0	2.92	2.84	341.8	329.1	12.77	12.57
	Lysine	53.6	51.0	2.83	2.75	321.6	312.1	12.54	12.32
	Glysine + Lysine	59.3	56.0	3.12	2.96	378.0	368.4	13.24	12.82
LSD at 5 %		1.2	1.0	N.S	N.S	7.2	7.2	0.11	0.08

c. Effect of the interaction between N rates and amino acids

The effect the interaction between N rates and amino acids on vegetative growth parameters of potatoes is shown in Table (2). It had a significant effect on plant height, foliage fresh and dry weight per plant in both seasons study. On the other hand, the number of main stems per plant was not significantly affected. The application of N at the rate 180 kg N/fed with foliar application of glycine at (100 ppm) plus lysine (100ppm) in combination resulted in the maximum values of the above mentioned growth parameters.

2. Yield and its components

a. Effect of nitrogen rates

Data in Table (3) revealed that increasing N supplied rates from 120 to 180 kg N/fed significantly increased total tuber yield, tuber number and tuber weight, in both seasons.

Table 3. Effect of N rates, amino acids and their interactions on total tuber yield and its components of potato plant in the spring seasons 2004 and 2005.

Parameters / Treatments		Total tuber yield (ton/fed)		Tuber number/plant		Tuber weight/plant (g)	
		2004	2005	2004	2005	2004	2005
A- N . fertilizer rates (kg/fed)							
120		10.408	10.128	3.46	3.39	518.82	505.83
150		12.626	12.266	4.38	4.17	627.15	608.39
180		14.145	13.727	4.63	4.56	704.95	689.59
LSD at 5 %		0.072	0.187	0.07	0.15	7.25	4.24
B- Amino acids							
Control		11.611	11.422	3.88	3.77	572.37	556.74
Glysine		12.597	12.043	4.19	4.07	630.53	614.65
Lysine		12.260	12.009	4.08	3.92	608.89	595.35
Glysine + Lysine		13.104	12.688	4.49	4.41	656.11	638.33
LSD at 5 %		0.079	0.215	0.03	0.04	6.47	4.63
C- N .fertilizer rates(kg/fed X Amino acids							
120	Control	10.132	9.868	3.14	3.06	501.80	491.65
	Glysine	10.478	10.192	3.59	3.50	525.47	510.11
	Lysine	10.248	10.030	3.53	3.41	512.18	503.48
	Glysine + Lysine	10.775	10.423	3.58	3.59	535.84	518.08
150	Control	11.353	11.162	4.26	4.08	553.47	535.17
	Glysine	12.910	12.465	4.42	4.20	647.58	628.58
	Lysine	12.690	12.233	4.32	4.01	625.46	608.43
	Glysine + Lysine	13.550	13.205	4.54	4.41	682.10	661.36
180	Control	13.348	13.237	4.25	4.16	661.85	643.41
	Glysine	14.402	13.473	4.56	4.53	718.53	705.25
	Lysine	13.843	13.763	4.38	4.34	689.03	674.14
	Glysine + Lysine	14.987	14.437	5.35	5.23	750.38	735.54
LSD at 5 %		0.146	0.444	0.06	0.08	11.98	8.02

These increases might be due to the favorable effects of nitrogen fertilizer on activating the vegetative growth and photosynthetic capacity which was reflected on significant increases on various growth parameters (Table 2), which in turn resulted in more accumulation of stored food and finally produced good tuber yield and its components. Similar results were reported by Belanger *et al.* (2000 and 2002), Miller and Rosen (2005) and Love *et al.* (2005).

b. Effect of amino acids

Data in Table (3) showed the effect of amino acids on yield and its components of potato. The foliar application of amino acids significantly increased total yield by 12.85 % and 11.08 % compared with control in the two seasons, respectively. The importance of amino acids came from their widely use for the biosynthesis of a large variety of noproteinic nitrogenous materials, *i.e*, pigments, vitamins, coenzymes, purine and purimidine bases. Amino acids are starting materials for the synthesis alkaloids and various products of secondary metabolisms (Stroev, 1986). These results are agreeable with those reported by El-Shabasi *et al.* (2005) on garlic and Kamar and Omar (1987) on cucumber and potato.

c. Effect of the interaction between N rates and amino acids

Data on total tuber yield, number of tubers and tuber weight per plant as affected by the interaction between N rates and amino acids in both growing seasons are shown in Table (3). Application of N at 180 kg/fed and spraying with glycine and lycine was the best treatment for increasing the yield and its components Generally, these results might be due to the increase in the vegetative growth and dry matter (Table 2) as well as, the main tuber weight (Table 4) which consequently increased the total tuber yield of potato crop.

3. Chemical composition

3.1. N,P and K contents

a. Effect of nitrogen rates

Data in Table (4) show the effect of N rates on N, P and K contents in leaves and tubers,nitrogen addition significantly increased N, P and K contents in the leaves. This was true in the two seasons. Concerning tuber content, it could be clearly noticed hat N content in the second season, P content in both seasons were increased significantly by nitrogen fertilizer rates. On the other hand, potassium content in tubers was not affected significantly in both seasons. This could be due to higher availability of the nutrients with increase in the N fertilizer supplied which ultimately resulted in better root growth and increased physiological activity of roots to absorb the nutrients and thereby, nutrient uptake was found closely lineked with productivity (Marschner, 1995). Similar results were obtained by Gabr *et al.* (2001) and Westermann (2005) on potato.

b. Effect of amino acids

Data in Table (4) indicated that N, P and K contents in the leaves at 75 days after planting (DAP) and tubers at harvest were significantly affected compared with untreated (control) in both seasons. The highest values of N,P and K were detected in the plants sprayed by a mixture of glycine plus lysine

together. Such improvement could be reflected on the increase in dry matter accumulation through the improvement of photosynthate production. These results are in line with those obtained by Gamal El-Din *et al. (*1997) and El-Shabasi *et al.* (2005**).**

Table 4. Effect of N rates, amino acids and their interactions on N, P and K contents in leaves and tubers in the spring seasons 2004 and 2005.

Parameters / Treatments		In leaves						In tuber					
		N %		P %		K %		N %		P %		K %	
		2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
A-N . fertilizer rates (kg/fed)													
120		2.909	2.939	0.297	0.300	2.884	2.999	1.555	1.488	0.273	0.284	1.633	1.643
150		3.198	3.255	0.330	0.331	3.313	3.255	1.622	1.657	0.297	0.305	1.632	1.643
180		3.121	3.099	0.310	0.311	3.148	3.176	1.528	1.567	0.282	0.292	1.638	1.648
LSD at 5 %		0.131	0.017	0.005	0.002	0.127	0.118	N.S	0.015	0.011	0.010	N.S	N.S
B-Amino acids													
Control		2.709	2.749	0.275	0.279	2.732	2.770	1.372	1.402	0.251	0.259	1.376	1.383
Glysine		3.105	3.052	0.309	0.308	2.994	3.016	1.514	1.535	0.281	0.292	1.630	1.642
Lysine		3.154	3.202	0.323	0.324	3.253	3.272	1.700	1.621	0.292	0.302	1.696	1.707
Glysine + Lysine		3.335	3.387	0.343	0.345	3.481	3.515	1.687	1.724	0.313	0.322	1.834	1.846
LSD at 5 %		0.119	0.024	0.004	0.002	0.093	0.114	0.124	0.014	0.003	0.004	0.004	0.004
C-N . fertilizer rates(kg/fed) X Amino acids													
120	Control	2.827	2.857	0.277	0.287	2.679	2.717	1.411	1.419	0.258	0.269	1.416	1.423
	Glysine	2.863	2.872	0.297	0.297	2.611	2.958	1.446	1.453	0.270	0.280	1.666	1.676
	Lysine	2.938	2.976	0.304	0.304	3.076	3.113	1.834	1.528	0.277	0.290	1.709	1.722
	Glysine + Lysine	3.009	3.051	0.311	0.313	3.170	3.206	1.528	1.551	0.288	0.297	1.742	1.752
150	Control	2.615	2.652	0.271	0.273	2.711	2.750	1.331	1.369	0.247	0.253	1.336	1.342
	Glysine	3.132	3.186	0.326	0.323	3.256	2.933	1.597	1.620	0.293	0.301	1.606	1.618
	Lysine	3.352	3.413	0.341	0.343	3.430	3.437	1.681	1.719	0.304	0.312	1.694	1.704
	Glysine + Lysine	3.691	3.767	0.384	0.387	3.857	3.898	1.878	1.921	0.344	0.354	1.891	1.907
180	Control	2.685	2.740	0.277	0.277	2.808	2.842	1.373	1.419	0.248	0.256	1.377	1.385
	Glysine	3.319	3.098	0.304	0.305	3.115	3.156	1.500	1.532	0.282	0.294	1.619	1.632
	Lysine	3.173	3.218	0.325	0.326	3.254	3.266	1.583	1.615	0.294	0.302	1.685	1.696
	Glysine + Lysine	3.306	3.342	0.335	0.334	3.416	3.440	1.654	1.701	0.305	0.315	1.869	1.880
LSD at 5 %		0.231	0.042	0.007	0.003	0.205	0.252	N.S	0.024	0.005	0.007	0.006	0.007

c. Effect of the interaction between N rates and amino acids

Data in Table (4), also, showed that there was significant effect for the interaction between N rates and amino acids on N, P and K contents in the leaves and tubers in both seasons. The addition of 150 kg N/fed along with spraying with a mixture of glucine and lycine amino acids was the most favorable treatment for increasing N,P and K contents in both seasons.

3.2. Dry matter, starch and protein contents in tubers

a. Effect of nitrogen rates

Results in Table (5) demonstrated clearly that dry matter, starch and protein contents in tubers were significantly increased with N fertilizer rates, in the two seasons. The superior values of dry matter, starch and protein content in the tubers were obtained when the plants received 150 kg N/fed compared with other treatments. These results may be due to the increase in the photosynthetic rates that lead to an increase of the assimilation rates. Similar findings were reported by Gabr *et al.* (2001) and Belanger *et al.* **(**2002).

Table 5. Effect of N rates, amino acids and their interactions on dry matter, starch and protein % in tubers in the spring seasons 2004 and 2005.

Parameters / Treatments		Dry matter(%)		Starch (%)		Protein (%)	
		2004	2005	2004	2005	2004	2005
A- N . fertilizer rates (kg/fed)							
120		18.15	18.03	11.116	11.15	9.16	9.29
150		20.05	19.83	11.661	11.76	10.12	10.30
180		19.19	19.04	11.565	11.60	9.72	9.77
LSD at 5 %		0.13	0.08	0.09	0.08	0.37	0.11
B- Amino acids							
Control		18.44	18.26	11.13	11.22	8.53	8.73
Glysine		19.37	19.22	11.53	11.60	9.78	9.52
Lysine		19.03	18.94	11.30	11.35	9.82	10.14
Glysine + Lysine		19.67	19.46	11.80	11.85	10.54	10.76
LSD at 5 %		0.10	0.10	0.07	0.06	0.35	0.08
C- N . fertilizer rates(kg/fed) X Amino acids							
120	Control	17.46	17.23	10.71	10.80	8.72	8.81
	Glysine	18.35	18.27	11.25	11.30	8.99	9.05
	Lysine	18.10	18.05	11.10	11.10	9.33	9.62
	Glysine + Lysine	18.69	18.59	11.38	11.41	9.59	9.68
150	Control	19.08	19.01	11.22	11.34	8.31	8.54
	Glysine	20.48	20.23	11.76	11.90	9.95	9.95
	Lysine	19.91	19.73	11.43	11.53	10.49	10.72
	Glysine + Lysine	20.75	20.35	12.21	12.28	11.72	11.99
180	Control	18.77	18.55	11.46	11.53	8.55	8.85
	Glysine	19.30	19.15	11.59	11.62	10.39	9.56
	Lysine	19.10	19.05	11.38	11.41	9.64	10.08
	Glysine + Lysine	19.58	19.44	11.82	11.86	10.33	10.62
LSD at 5 %		0.22	0.18	0.13	0.12	0.68	0.13

b. Effect of amino acids

Data in the Table (5) show that the effect of amino acids on dry matter, starch and protein contents in tubers was significant in both seasons. The maximum values of dry matter, starch and protein contents in tubers

were obtained from the plants sprayed with a mixture of glycine with lysine at dose of 100 ppm of each one. These results may be attributed to the role of amino acids as organic nitrogenous compounds in synthesis of proteins (Davies, 1982). El-Shabasi *et al.* found that using two doses of amino acids mixture (100 and 200 ppm) increased the curde protein percent of garlic.

c. Effect of the interaction between N rates and amino acids

Data in Table (5) also indicated that the interaction between N rates and amino acids had significant effect on dry matter, starch and protein contents in the tubers in both seasons. The highest values were recorded at 150 kg N/fed with a mixture glycine plus lysine at dose of 100 ppm in both seasons.

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تـأثير الجليسـين والليسـين ومعـدلات التسـميد النيتروجينـى علـي النمـو والمحصـول والتركيب الكيماوى في البطاطس

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أجريت هذه الدراسة فى مزرعة بحوث البساتين بالبرامون ، محافظة الدقهلية خلال موسمين ربيعيين متتاليين 2004 و2005 على محصول البطاطس صنف سبونتا لدراسة تأثير الجليسين والليسين ومعدلات التسميد النيتروجينى علي النمو والمحصول والتركيب الكيماوى في البطاطس (كنترول ، جليسين 100 جزء فى المليون ،الليسين 100 جزء فى المليون وخليط من الجليسين 100 جزء فى المليون + الليسين 100 جزء فى المليون معاً) مع معدلات 120 ، 150 و180 كجم نيتروجين/فدان.

وأوضحت نتائج هذه الدراسة أن معدلات التسميد النيتروجينى أدت إلى زيادة معنوية فى كل قياسات النمو الخضرى مثل طول النبات وعدد السيقان والوزن الطازج والجاف للنبات عند عمر 75 يوم من الزراعة والمحصول الكلى وعدد الدرنات ووزن الدرنات للنبات ومحتوى N ، P ، K فى الأوراق عند 75 يوم من الزراعة والفوسفور فى الدرنات فى كلا الموسمين والنيتروجين فى الموسم الثانى بالإضافة إلى محتوى المادة الجافة والنشا والبروتين فى الدرنات فى موسمى الزراعة.

أدى خليط من الأحماض الأمينية جليسين 100 جزء فى المليون و الليسين 100 جزء فى المليون إلى الحصول على أفضل صفات النمو الخضرى والمحصول الكلى وعدد ووزن الدرنات للنبات ومحتوى الأوراق من N ، P ، K عند 75 يوم من الزراعة والدرنات عند الحصاد ومحتوى المادة الجافة والنشا فى الدرنات بالإضافة إلى البروتين فى كل من موسمى الزراعة. وقد أدى التفاعل بين معدلات التسميد النيتروجينى والأحماض الأمينية إلى زيادة معنوية أيضاً فى كل قياسات النمو الخضرى وعلى المحصول الكلى ومكوناته ومحتوى N ، P ، K فى الأوراق والدرنات ما عدا النيتروجين فى الموسم الأول ومحتوى المادة الجافة والنشا والبروتين فى الدرنات فى كلا موسمى الزراعة.