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Effect of amino acid containing organic fertilizers on nitrogen use efficiency and qualitative and quantitative properties of sugar beet

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ABSTRACT

In order to study the effect of organic fertilizers application on increasing nitrogen efficiency and also quantitative and qualitative characteristics of sugar beet, a series of experiments were performed for two years (2008 and 2009) using three amino acid containing organic fertilizers at Motahari Research Station of Sugar Beet Seed Institute (SBSI), Karaj, Iran. Four rates of organic fertilizers including control (no organic fertilizer), Humiforte, Humiforte + Fosnutren, and Humiforte + Kadostim which were applied twice with 40 and 60 days interval after sowing and one per mil concentration, and four rates of N fertilizer including control (no N fertilizer), 30% less than optimum (100 kg/ha), optimum, and 30% higher than optimum level were evaluated in factorial experiment based on randomized complete block design with four replications. Results showed that at 0-30 cm soil depth with 15 mg/kg N, 100 kg N level was the optimum level which resulted in 71 and 10.1 t/ha root and sugar yields, respectively. 70 kg/ha N level and Humiforte + Fosnutren organic fertilizer were placed in high sugar yield group (with 74.5 and 11 t/ha root and sugar yields, respectively). It was also shown that organic fertilizer application led to nitrogen efficiency improvement; however these compounds cannot be completely replaced by nitrogen fertilizer (with 60 and 9.16 t/ha root and sugar yields, respectively). Since N fertilizer application may have deleterious effects on environment, using appropriate organic fertilizers and consequently increased efficiency of nitrogen, may reduce N application.

Keywords: Amino acids, nitrogen, organic fertilizers, sugar beet

INTRODUCTION

To increase the yield per hectare of agricultural products, several agronomic and breeding operations such as cultivar breeding or fertilizer application have been conducted. As a result of these activities, especially chemical fertilizers application, environmental pollution has occurred and reached critical levels and consequently threatened human health due to its relation with human-related food sources (kim and Stoecker 2006). For example, in the groundwater of the north and some other parts of Iran, nitrate, phosphorus and cadmium have been accumulated in agricultural soils which made vital problems for farmers (Karimian 2010). In recent years, many research centers in the world have conducted great studies on the use of oligopeptides with low molecular weight and amino acids such as BSAA or Bio Synthesized Amino Acid (Gawronaka et al. 2008). Studies showed that organic stimulants affect metabolic processes such as respiration, photosynthesis, nucleic acid formation and ion absorption. Organic stimulants act in accordance with plant nutrients. A combination of organic stimulant and nitrogen increases plant root growth rather than nitrogen alone. The increase of plant metabolism by organic stimulant also increases plant chlorophyll and causes uniformity in plant establishment (Gordon and *et al.* 2007). In a study conducted by Huffaker and Harbit (1988),

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the effect of Aminol Forte, synthesized by biological engineering method in a set of free crystalline amino acids and oligopeptides and combined with essential macro- and micro elements for growth, on the growth and aboveground yield of wheat through foliar application was evaluated. Results showed that its application significantly increased the yield. In another study, the optimal use of plant growth regulators together with sugar beet planting technology were investigated by Guisbullin and Gontarenko (1996). In their study, three organic fertilizers (various combinations of amino acids) including Aminol Forte, Fosnutren and Kadostim were used as foliar application at 1.5 to 10 l ha^{-1} concentration in five areas. Results showed that the use of chemical growth stimulants such as Aminol Forte, Fosnutren and Kadostim increased crop production dramatically. The largest increase in quantitative and qualitative traits was related to 1 l ha^{-1} (Anonymous 2007). In another study and in order to evaluate the effects of four types of amino acid (AA) combinations including Aminol Forte Brands, Hume Forte, Fosnutren and Kadostim, the effect of three concentrations: C3 = 1.5, C2 = 1.0, C1 = 0.5 l ha^{-1} plus control (water) was evaluated on yield and quality of sugar beet (Noshad, 2008). Results showed that the main effect of each organic compound as well as their interactions on root yield, sugar content and white sugar yield was not statistically significant. The results of mean comparison showed that the percent change of root yield in different treatments was as follows: in aminole fort defoliation treatment at 6-8 leaf-stage after thinning and weeding (about 30 days after planting), Humiforte foliar application 10 days after aminole fort application, Fosnotron foliar application 10 days after Humiforte application, Humiforte foliar application 10 days after Fosnotron application, and Kadostim foliar application 70 days after planting. The foliar application of Kadostim 5-10 days before sugar beet harvest (C2), followed by B3C1 treatment (i.e. Humiforte foliar application at 40 and 60 days after planting and C1 i.e. at 0.5 l ha^{-1}) which were statistically placed in one group, had the highest increase compared with the control treatment.

The percent increase in root yield in these two treatments compared with control was 19 and 17%, respectively, which was statistically significant at P<0.05. White sugar yield increased in most treatments compared with control, with the highest increase in B2C2 treatment of about 12% (P <0.05). Assuming the availability of factors other than nutrient elements affecting the growth of agricultural crops, and the use of nutrients if needed, the use of biological fertilizers, regulators and growth promoters, or amino acids alone cannot make 100% growth of the plant maximum yield potential achievement (Asadi Rahmani et al., 2010).

Table 1. Chemical characteristics of the organic fertilizers (different combinations of amino acids) used in this experiment

Compounds	Fosnotren	Kadostim	Humi Forte
Total nitrogen (%)	3.8	5	6
Urea nitrogen (%)	-	-	3.7
amino-N (%)	2.1	1.6	1.4
Nitrate nitrogen (%)	1.4	3.1	0.5
Organic nitrogen (%)	0.3	0.3	0.3
Organic (%)	2	2	2
Free amino acids complex (mg l^{-1})	3750	3750	3750
P_2O_5 Phosphorus dioxide (water-soluble) (%)	6	-	3
K_2O potassium oxide (soluble) (%)	-	6	5

Name and percentage of free amino acids include: glycine (11.34), valine (5.1), proline (8.4), alanine (13.21), aspartic acid (4.5), arginine (8.4), glutamic acid (0.9), lysine (5.1), leucine (16.51), isoleucine (4.5), phenylalanine (5.1), methionine (4.2), serine (3.9), threonine (3.0), histidine (3.0), tyrosine (1.5), glutamine (0.9), cysteine (0.3), asparagine (0.4), tryptophan (0.4).

MATERIALS AND METHODS

To evaluate the effect of organic fertilizers containing Humi Forte, Fosnotren, and Kadostim amino acids on nitrogen use efficiency and quantitative and qualitative traits of sugar beet, a study was conducted at Motahari Research Station (Latitude 35°59'N, Longitude 51°6'E and altitude 1300 m), for two years (2008-09). This area with 150-180 dry days is considered as warm and dry Mediterranean climate with hot summer and dry winter.

The studied factors included various combinations of amino acids and nitrogen fertilizer. Organic fertilizers composed of amino acids including Humi Forte, Fosnotren, and Kadostim (Table 1). As Table 1 shows, in addition to amino acid composition, these fertilizers contain main elements such as N, P, and K with different amounts. Organic fertilizers containing amino acids were used in four levels: 1- control, 2- Humi Forte, 3- equal combination of Humi Forte and Fosnotren, and 4- equal combination of Humi Forte and Kadostim which was used in 40 and 60 days after planting (at 1/1000 concentration). Nitrogen was used in four levels including 1- control (N0), 2- 30% lower than optimal level (N1), 3- optimal level (N2), 4- 30% higher than optimal

Table 2. Some physical and chemical properties of the soil in experimental field (0-30 cm depth)

Year	P	K	Nitrate	Ammonium	pH	EC	Ca	Mg	Na	Organic carbon	Soil saturation	Clay	Silt	Sand	Soil texture
	mg kg^{-1}						meq l^{-1}					%			
2008	18.8	569.25	14.84	14.42	7.78	1.075	5.0	5.2	3.21	1.43	54.3	40.8	43.6	15.6	Clay-silt
2009	15.3	614.7	15.2	5.9	8.2	1.1	5.5	5.7	4.9	0.7	57.0	45.5	38.9	15.6	Clay-silt

Table 3. Mean squares for the effects of three fertilizers containing amino acids and different N levels and their interaction on some quantitative and qualitative traits of roots as well as nitrogen use efficiency for sugar yield during the two years of experiment (2008-09)

S.O.V.	df	Sugar content	Root yield	Sugar yield	Na	Amino-N	K	Sugar extraction Coefficient	df	N use efficiency
Year	1	2.67	16295.31**	400.9**	488.5**	4.23**	55.44**	5322**	1	36007.14**
Rep	6	1.4	349.3	8.5	1.83	0.15	0.99	33.4	6	591.31
N	3	5.54	475.3**	4.83	9.56	2.25*	0.42	122.92	2	36418.92*
Year × N	3	0.67	13.38	0.54	1.85	0.19	0.24	34.05	2	1366.50**
Organic fertilizer	3	0.17	136.38	3.22	0.79	0.12	0.43	21.3	3	558.53
Year × organic fertilizer	3	0.26	104.7	2.20	1.84	0.06	0.32	9.6	3	128.17
N × organic fertilizer	9	0.51	99.96**	2.34	1.28	0.07	0.17	18.22	6	64.33
Year × N × organic fertilizer	9	0.77	18.46	0.82	1.37	0.06	0.23	21.64	6	103.45
Error	90	0.55	38.81	1.05	1.1	0.11	0.15	15.48	66	127.30

* and **: significant at 5 and 1% probability levels, respectively.

level (N3). According to soil test results, the optimal nitrogen level in this experiment was 100 Kg ha^{-1} pure nitrogen. The treatments resulted from a factorial arrangement were laid out in randomized complete block design with four replications. Nitrogen was supplied from urea source and top-dressed among rows followed by cultivator and irrigation practices. Each year and before conducting experiment, samples were taken from different regions of the station and soil nitrate content was measured at the depth of 30 cm. Experiments were conducted in lands with $\geq$15 mg Kg^{-1} nitrate at the depth of 0-30 cm. The optimum nitrogen for optimal sugar beet growth was considered as 25 mg Kg^{-1} (Noshad and Niroomand Jahromi 2010; Hoseinpoor 2006). According to soil test results (Table 2), 200 kg ha^{-1} triple superphosphate fertilizer was used before planting. Zarghan cultivar was used in this study and each plot consisted of six rows with 8 m length. The between- and on-row spacings were 50 cm and about 17 cm, respectively. Five-meter distance was applied between replications. First irrigation in 2008 and 2009 was done on 22nd and 25th April, and Nitrogen fertilizer was applied on 25th May and 7th June, respectively. Furrow irrigation was applied and experiments were managed according to local agronomic practices. Each of fertilizers were diluted based on 600 liters of water per hectare. At harvest, roots were taken from 3 m of four middle rows and root number and weight were measured. Then, pulp was prepared from the roots and qualitative characteristics (such as sugar content, white sugar content, Na, K, and amino-N) were measured in laboratory. Nitrogen use efficiency for sugar yield was estimated using equation 1. Combined analysis of variance was conducted using SAS and MSTATC software. Mean comparison was performed using Duncan's multiple range test at 5%.

$$\text{Nitrogen use efficiency} = \frac{\text{sugar yield}}{\text{applied nitrogen}} \qquad (1)$$

RESULTS AND DISCUSSION

Results of combined analysis for different nitrogen and organic fertilizer treatments is shown in Table 3. The effect of year on root yield, sugar yield, root impurities including Na, K and amino-N, as well as the extraction coefficient of sugar and nitrogen use efficiency for sugar yield was significant (p<0.01). The main effect of nitrogen on root yield (p<0.01) and also nitrogen use efficiency and amino-N (p<0.05) was significant. The interactions of nitrogen components in fertilizers containing amino acids was significant on root yield (P<0.01). The main and interaction effects of the treatments were not significant for other traits (P> 0.05). Root yield, sugar yield, nitrogen use efficiency for sugar yield was higher in the first than the second year whilst the amounts of impurity elements in the first year was lower than the that in the second year (Table 4). In other words, the sugar beet production in 2008 was better than 2009 in terms of quantity and

Table 4. Comparison of different N levels and organic fertilizer containing amino acids on quantitative and qualitative characteristics of root as well as nitrogen use efficiency in sugar beet cultivation during the two years of experiment (2008-09)

Year	Sugar content	Root yield (t ha^{-1})	Sugar yield (t ha^{-1})	Na	Amino-N	K	Sugar extraction coefficient (%)	Nitrogen use efficiency for sugar yield (Kg Kg^{-1})
					Mg g pulp			
2008	14.91 a	78.85 a	11.75 a	2.84 b	1.01 b	4.46 b	80.53 a	127.38 a
2009	14.62 a	56.28 b	8.21 b	6.58 a	1.38 a	5.78 a	67.63 b	88.64 b

Means with same letter in each column are not significantly different.

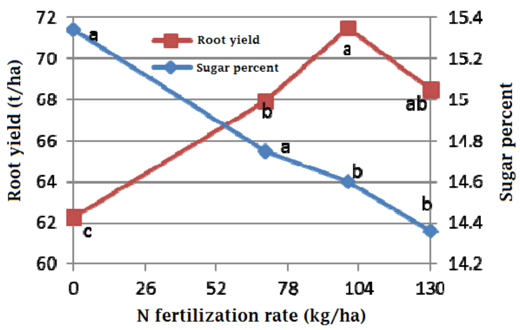

Figure 1. Root yield and sugar content variation in different N levels

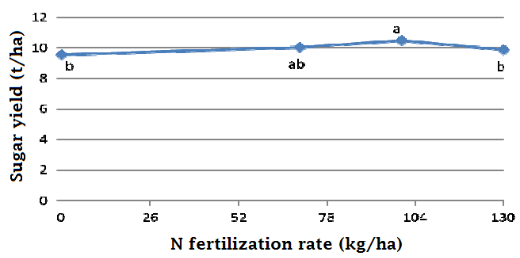

Figure 2. Changes in sugar yield in relation to different N levels

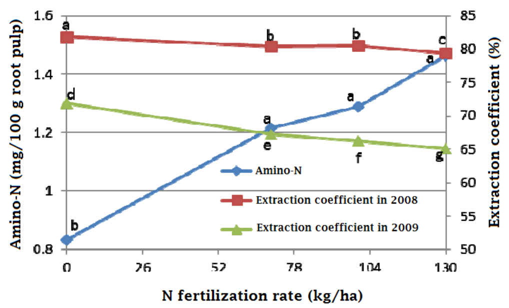

Figure 3. Effects of different N levels on extraction coefficient of sugar and amino-N in different years

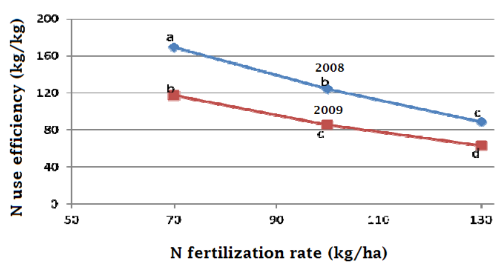

Figure 4. Changes in nitrogen use efficiency at different N levels in two years in Karaj (2008 and 2009)

quality. It would be probably due to better soil fertility status in 2008 compared with 2009. As can be seen in Table 2, the soil organic matter and clay percentage was higher and lower, respectively, in the first year compared with the second year. Although the effect of nitrogen on sugar content was not significant (P<0.05) but sugar content decreased with increase in applied nitrogen (Figure 1). Application of 100 Kg N ha^{-1} decreased sugar yield (P<0.05) compared with 70 Kg ha^{-1} treatment. In contrast, by increasing the nitrogen rate to 100 Kg ha^{-1} root yield increased (P <0.05, Figure 1). Application of more than 100 kg N ha^{-1} had no significant effect on root yield (P <0.05, Figure 1). The negative impact of nitrogen on sugar content could be due to its positive impact on yield. It is proved that each factor that causes root weight increase can be effective in reducing the sugar content. Since the product of these two variables is the sugar yield which is economically important for farmers, it is desirable to assess the optimal level of each agricultural input on sugar yield. Mean comparison showed that the application of 100 kg N per ha increased the sugar yield and more nitrogen application decreased it (P <0.05, Figure 2). Therefore, the results of this experiment confirmed that in soil with 15 mg kg^{-1} N at 0-30 cm depth, application of 100 kg N is the optimum level. These results are consistent with the results obtained by Noshad and Jahromy (2008 and 2010) and Hosseinpour (2006). With increase in N fertilizer, the amount of amino- N increased (Figure 3). Furthermore, in both years, with an increase in N application, the extraction coefficient of sugar decreased (Figure 3) with more decrease in the second year than the first year. The decrease in extraction coefficient of sugar with increase in N fertilizer could be due to the effect of N fertilizer on the amount of amino-N. In addition, the higher response of extraction coefficient of sugar to N application in the second year, compared with first year, could be due to root impurities such as Na and K in addition to amino-N in the second year (Table 4).

In both years, with increase in N application, the nitrogen use efficiency for sugar yield decreased (Figure 4). However, the nitrogen use efficiency at each fertilizer level and also their

Table 5. Mean comparison of the effect of different organic fertilizers containing amino acids on root yield during the two years of experiment (2008-09)

Organic stimulants	Root yield (t ha^{-1})	
	2008	2009
Control (B0)	74.49 c	56.78 d
Humiforte (H)	78.12 bc	55.76 d
Humiforte and Fosnotren (HF)	79.13 b	55.25 d
Humiforte and Kadostim combination	83.63 a	57.34 d

Means with same letter in each column are not significantly different.

reduction with increase in applied nitrogen in the two years was different. Generally, at each fertilizer level, the nitrogen use efficiency in the first year was more than the second one owing to the higher yield in the first year than the second year.

The main effect of organic matter containing amino acids on root yield and the interaction between year and organic fertilizer containing amino acids was not significant (Table 3). However, mean comparison (P<0.05) showed that in 2008 the use of fertilizer containing amino acids increased root yield so that the highest impact was achieved from the combination of Humiforte and Kadostim in 2008 (Table 5), while in 2008, application of fertilizer containing amino acids did not have a significant effect on root yield. This is probably due to higher soil fertility in the first year than the second year. This confirms that organic fertilizers containing amino acids are more effective in soils with high fertility. Guizbolin and Gonzarco (1996) reported that fertilizer containing amino acids had a positive impact on root yield and sugar content. However, this impact varied in different areas. Therefore, one of the characteristics of organic fertilizers is the contradiction in the effectiveness of their application. This is because of soil environment viability or the need of special conditions including the presence of high levels of organic matter, proper texture and generally fertile soil. Asadi and Khademi (2009) evaluated the effect of four commercial amino acids on increasing the fertilizer use efficiency and grain yield of corn. Their results showed that the use of these materials did not affect the yield and in some cases, it decreased the yield. Therefore, the ineffectiveness of a fertilizer in certain conditions cannot be a sign of its ineffectiveness in other conditions (Asadi et al., 2010). In our study, the greatest result from the use of Humiforte and Kadostim was observed in 2008 (Table 5). Guizbolin and Gonzarco (1996) reported that fertilizer

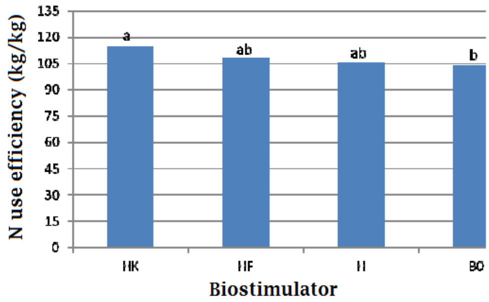

Figure 5. Nitrogen use efficiency based on sugar yield in the presence or absence of organic fertilizers in Karaj (2008 and 2009)

containing amino acids had a positive effect on sugar beet root yield and sugar content. Mean comparison showed that there was significant (P<0.05) differences in nitrogen use efficiency for different levels of organic fertilizer containing amino acids (Figure 5). In general, application of organic fertilizer increased the nitrogen use efficiency. The highest nitrogen use efficiency for sugar yield was obtained from the application of 114 kg Humiforte and Kadostim. Mean comparison of nitrogen × organic fertilizer containing amino acids interaction for root yield showed that the highest impact was obtained in application of 130 kg N in a combination of Humiforte and Kadostim (Table 6). Although the root yield obtained from this treatment had no significant difference with the other treatments including application of 100 kg N in Humiforte + Fosnutren, Humiforte + Kadostim, and control, and also application of 70 kg N in Humiforte + Kadostim (Table 6).

Mean comparison of different treatments resulting from no application of nitrogen and different levels of humic acid with the other treatments for root yield showed that different compounds of organic fertilizer containing amino acids cannot solely replace nitrogen application (Table 6). So, four treatments of no application of nitrogen and different levels of organic fertilizer containing amino acids were placed in the lowest root yield group (Table 6). Assuming that other factors, except nutrients, are available for the growth and development of agricultural products, the application of biological fertilizers, regulators and stimulators of the growth, or amino acids alone cannot contribute solely to 100% of the plant growth (Asadi Rahmani et al., 2010). It has also been reported that simultaneous application of bioactive stimulants and nitrogen leads to root growth increase since bioactive stimulants increases the plant metabolism and consequently

Table 6. Mean comparison of the effect of different organic fertilizers containing amino acids and different N levels on root and sugar yield and also nitrogen use efficiency in sugar beet cultivation during the two years of experiment (2008-09)

Treatment	Sugar content	Root yield (t ha^{-1})	Sugar yield (t ha^{-1})	Nitrogen use efficiency for sugar yield (Kg Kg^{-1})
N_0×B0	9.64 cdef	62.67 ef	9.64 cdef	-
N_0×H	10.0 abcdef	64.93 def	10.0 abcdef	-
N_0×HF	9.40 def	61.68 ef	9.40 def	-
N_0×HK	9.16 ef	59.84 f	9.16 ef	-
N_1×B_0	9.88 bcdef	67.60 bcde	9.88 bcdef	141.07 a
N_1×H	9.93 abcdef	66.48 cdef	9.93 abcdef	141.83 a
N_1×HF	9.87 bcdef	66.47 cdef	9.87 bcdef	140.94 a
N_1×HK	10.40 abcd	71.19 abcd	10.40 abcd	148.95 a
N_2×B_0	10.10 abcde	70.98 abcd	10.10 abcde	101.93 bc
N_2×H	10.10 abcde	68.25 bcde	10.10 abcde	101.05 bc
N_2×HF	10.70 abc	72.30 abc	10.70 abc	107.28 b
N_2×HK	10.90 ab	74.51 ab	10.90 ab	109.32 b
N_3×B_0	8.87 f	61.30 ef	8.87 f	68.24 e
N_3×H	9.53 cdef	68.11 bcde	9.53 cdef	73.30 e
N_3×HF	9.93 abcdef	68.30 bcde	9.93 abcdef	76.40 de
N_3×HK	11.10 a	76.41 a	11.10 a	85.83 cd

Means with same letter in each column are not significantly different.

the amount of chlorophyll which results in early germination (Gordon et al., 2007). In the absence of organic stimulants, the increase in nitrogen application from zero to 100 kg ha^{-1} significantly increased root yield (Table 6). While application of 130 kg N significantly reduced the root yield compared to the application of 100 kg Nitrogen (P <0.05) so that it didn't have significant difference with no application of nitrogen. Observing the effects of 130 kg N application with different humic acid compounds it seems that various biostimulants can reduce the negative effects of high nitrogen levels on root yield (Table 6). In this study, the best combination of humic acid reducing the harmful effects of nitrogen uptake was found to be Humiforte and Kadostim (Table 6). The abovementioned treatment produced the highest root yield. Interestingly, this humic acid composition showed its positive impact on root yield when use in combination with the wo other nitrogen fertilizer levels (70 or 100 kg ha^{-1}). The effect of growth regulators on root yield increase in other plants has also been reported, so that the application of growth regulator on yield increase of ryegrass (Anonymous 2007), aminole fort on yield of wheat (Huffakar and Harbit 1988) and application of aminole fort with KNO_3 on dry matter of barley was reported (Huffakar and Harbit 1987).

Contrary to root yield, increasing the amount of applied nitrogen without the use of organic fertilizer containing amino acids led to a decrease in the sugar content (Table 6). Application of organic fertilizer containing amino acids together with nitrogen also could not significantly reduce the harmful effects of nitrogen on the sugar content (Table 6).

Application of aminole forte, fosnotron and Kadostim combination has increased the yield and sugar content of sugar beet (Anonymous 2007). In general, the amino acids in the organic fertilizers have a vital role in plant life. For example, proline, in addition to being effective in plant adaptation to stress, has many biological effects such as osmotic adjustment, cell support and cellular structure (membrane and protein), antioxidant activity, energy transfer, carbon and N storage, and several other roles that are necessary for cellular stability and transfer from one state to another. Proline, as a source of organic nitrogen, can also be used after the stress relief and recovery (Parvaiz and Satyawati 2008). Golzadeh et al. (2012) showed that by spraying Kadostim, aminole forte and Humiforte on plants, higher qualitative and quantitative yield can be achieved and these factors can be influential in successful cultivation. With Kadostim usage, the root and shoot growth rates were increased in the ornamental plant *Picea abies* (Slawik 2005).

Although the interaction of nitrogen and organic fertilizer containing amino acids was not significant for sugar yield, mean comparison of treatments resulted from these two factors showed that like root yield, the highest sugar yield was achieved in 130 kg N ha^{-1} with Humiforte and Kadostim combination (Table 6). However, this treatment had no significant difference with other treatments of Humiforte (without nitrogen), application of 70 N ha^{-1} with Humiforte or Humi-forte and Kadostim and application of 100 kg N ha^{-1}

with each of four levels of organic fertilizers containing amino acids (Table 6). The sugar yield of Humiforte (without nitrogen) and also 70 kg N ha^{-1} treatments had no significant difference with the treatment producing the highest and lowest sugar content (Table 6, P> 0.05). The abovementioned treatments were not placed in high root yield group (Table 6). Therefore, it can be deduced that high sugar yield achievement in these two fertilizer treatments is mainly due to the positive effect of Humiforte on sugar content. Among the treatments which were placed in one group with the treatment producing the maximum sugar (application of 130 kg N with Humiforte and Kadostim), the treatment of 70 kg N ha^{-1} and Humiforte plus Kadostim is recommended. According to the results of soil test, optimum nitrogen fertilizer application without organic fertilizer was 100 kg ha^{-1}. Therefore, it can be deduced that with the application of the abovementioned organic fertilizer, N application can be decreased to 30% without significant change in sugar yield.

Thomas et al. (2009) reported the use of organic stimulants of aminole forte and Kadostim which have essential amino acids and mineral elements were effective in stimulating the plant growth. The authors have also shown that spraying with aminole forate and Kadostim will be able to significantly increase the biochemical composition, physiological indices and yield of tea plant. The yield of vegetables, rapeseed and sunflower was increased by spraying with aminole forte and Kadostim and Humiforte (Asad et al., 2002). Amino acids are absorbed through leaf stomata. Similarly, amino acids can be used through soil application and mixing with soil, resulting in increased microorganisms in the soil, thereby accelerating nutrient absorption (Ashmed 1986). By studying the concentration of free amino acids in maize, it was found that application of a small amount of nitrogen fertilizer from amino acid source increased the aspartate, glutamate and alanine amino acids in this plant (Venecamp and Koot 1988). It should be noted that in fertilizer recommendation, in addition to the objective of raising the yield, the environmental and economic aspects of fertilizers should be considered. Therefore, since increasing the amount of N can have harmful environmental effects, its application can be reduced through increasing nitrogen use efficiency by appropriate organic fertilizer application. With the help of modern nutrition knowledge such as organic and inorganic compounds derived from organic activities, the pollution can be significantly reduced. In this case, organic compounds containing active organic oligopeptides, amino acids, and the main mineral elements associated with organic matter can be mentioned (Kupper 2003).

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