

Effect of foliar application of free amino acids on alfalfa performance under rainfed conditions

MAHMOOD POORYOUSEF AND KHOSHNOOD ALIZADEH¹

Department of Agronomy, College of Agriculture, Mahabad Branch

Islamic Azad University, Mahabad, Iran

*(e-mail : kh dizaj@yahoo.com)

(Received : December 2013)

ABSTRACT

This work investigated the efficiency of free amino acid compounds to improve production of alfalfa (*Medicago sativa* L.) under rainfed conditions during 2011-12. Experiment was conducted as complete randomized block design with three replications at three already established alfalfa cv. Garayonja fields. There was two different spraying times including one spray at early 4-6 leaves stage and three times spraying started at 4-6 leaves stage with two weeks' intervals. The experiment included 12 treatments resulting from factorial of six spray treatments and two spraying times. Spray treatments included Aminol-forte, Kadostim, Fosnutren and Humiforte at 1 l/ha, along with water spray and no spray as control. Results indicated that increasing the spraying times of plants with amino acid compounds significantly ($P < 0.01$) increased plant height, dry biomass weight and crude protein content compared to control. Different amino acid compounds showed different effects regarding the studied traits. The highest fresh biomass (14 t/ha) achieved in using Kadestim which was 100% more than control. Application of Aminol-forte resulted in the highest crude protein content (22%) comparing 17% in the control. It was concluded that foliar spray of free amino acids could enhance the quality and quantity of alfalfa in the rainfed conditions.

Key words : Alfalfa, aminol-forte, Fosnutren, Humiforte, Kadostim, *Medicago sativa*

INTRODUCTION

Alfalfa (*Medicago sativa*) is a perennial forage legume of great agronomical interest. It is known as the queen of forage crops and is capable of producing high yields when supplied adequate water and nutrients. Previous agronomical, physiological and biochemical studies strongly suggest that alfalfa is more drought tolerant than other grain legumes (Aranjuelo, 2011). Garayonja is an Iranian alfalfa variety which is widely used as suitable cultivar under rainfed conditions with drought stress and different nutritional limitations (Alizadeh and Shiv, 2013).

Amino acids are the basic ingredients for the process of protein synthesis and are widely used for the biosynthesis of non-protein nitrogenous materials in plants (Shehata *et al.*, 2011). Amino acids are a well known bio-stimulant with positive effects on plant growth and plant yield. Amino acids could significantly mitigate the injuries caused by abiotic stresses

(Kowalczyk and Zielony, 2008). Furthermore, amino acids are the fundamental ingredients for the process of protein synthesis. The importance of amino acids was highlighted from their widely use for synthesis of large variety of non-protein materials i. e. pigments, vitamins, coenzymes, purine and pyrimidine bases (El-Zohiri and Asfour, 2009). It is reported that amino acids can directly or indirectly influence the physiological activities in plant growth and development (Kowalczyk and Zielony, 2008). Foliar application with the mixture of amino acids to radish plants increased N content of shoots, whereas NO_3 content reduced by 24-38% (Shehata *et al.*, 2011). El-Zohiri and Asfour (2009) reported that spraying of amino acids at 0.25 ml/l on potato significantly increased vegetative growth expressed as plant height and dry weight of plant. Abo Sedera *et al.* (2010) revealed that spraying strawberry plants with amino acids (peptone) at 0.5 and 1.0 g/l significantly increased total nitrogen, phosphorus and

¹Dryland Agricultural Research Institute, Maragheh, Iran.

potassium in plant foliage as well as total yield, weight, TSS, vitamin C and total sugars content of fruits compared to control treatment. It has been reported that the foliar application of amino acids caused an enhancement in plant growth, yield and its components on potato (El-Zohiri and Asfour, 2009) on garlic (El-Shabasi *et al.*, 2005) and on sweet pepper (Al-Said and Kamal, 2008). The foliar application of vitamins caused a promotion effect on the plant productivity as reported by many workers (Akram and Hosni, 2007). However, the effect of free amino acids along with vitamins on growth and yield of alfalfa have not been seen in the literature that was studied under rainfed conditions in this research.

MATERIALS AND METHODS

The experiment was carried out in three already established alfalfa cv. Garayonja field under rainfed conditions around Hashrood, Iran during 2011-12 growing season. A randomized complete block design with three replications was adopted for this purpose and the plot area was 10 m². Neither fertilizer nor irrigation was applied to plants in this research. There were two different spraying times including spraying plantlets at early 4-6 leaves stage and three times spraying started at 4-6 leaves stage with two weeks' intervals. The experiment included 12 treatments resulting from factorial of six spray treatments and two spraying times. Spray treatments included Aminol-forte, Humiforte, Kadostim and Fosnutren at 1 l/ha, along with two controls i. e. spray with water and no spray.

Plants were harvested at 50% flowering stage and were evaluated. The samples (0.50 kg biomass from each plot) were dried at 72°C for 48 h to determine dry biomass weight. The nitrogen (N) concentration of hay was determined by the micro-Kjeldahl procedure described by Nelson and Sommers (1973), and crude protein (CP) concentration was calculated ($N \times 6.25$). The data were analyzed using SPSS software. Duncan's multiple range test was used to compare the mean treatments.

RESULTS AND DISCUSSION

Analyses of variances revealed that free amino acid compounds and foliar spraying time effects were significant in most studied characteristics (Table 1). It was clear that plant height responded significantly to the application of studied free amino acid compounds where the higher spray times of all compounds showed significant positive effect on plant height, however, there was not any significant difference between studied compounds regarding this parameter (Table 1). On the other hand, the effects of locations along with two way and three-way interactions of locations, amino acid compounds and spraying times were not significant in this research. In other words, consistence differences were observed in the three locations. Increasing the spraying time ultimately increased all studied characteristic means except plants fiber and calcium content significantly (the means were not shown).

Response of some studied alfalfa traits to foliar spray of different amino acids over

Table 1. Combined analysis of variance for plant height (PH), number of leaves (NL), fresh biomass (FB), dry biomass (DB), crude protein per cent (CP), calcium (Ca), Fiber (Fi) and ash per cent at three different alfalfa cv. Garayanja field during 2010-11

Source of variation	d. f.	Mean squares							
		PH	NL	FB	DB	CP	Ca	Fi	Ash
Locations (Loc.)	2	70.8 ^{ns}	19.5 ^{ns}	102.4 ^{ns}	3.2 ^{ns}	2.1 ^{ns}	0.0021 ^{ns}	1.3 ^{ns}	2.4 ^{ns}
Replications/Loc.	6	73.4	576.7	95.7	2.9	1.8	0.0017	1.9	2.1
Amino acids (AA)	5	52.9 ^{ns}	188.4 ^{**}	289.3 ^{**}	16.5 ^{**}	5.7 ^{**}	0.0021 ^{ns}	7.1 ^{**}	8.6 ^{**}
Foliar spray time (ST)	1	3593.7 ^{**}	432.0 ^{**}	389.4 ^{**}	27.4 ^{**}	9.2 ^{**}	0.0004 ^{ns}	1.9 ^{ns}	6.8 ^{**}
AA × ST	5	101.1 ^{ns}	17.8 ^{ns}	112.4	2.8 ^{ns}	1.7 ^{ns}	0.0014 ^{ns}	0.1 ^{ns}	1.3 ^{ns}
Loc. × ST	10	23.9 ^{ns}	14.8 ^{ns}	87.3 ^{ns}	3.1 ^{ns}	2.3 ^{ns}	0.0019 [*]	0.7 ^{ns}	0.9 ^{ns}
AA × Loc.	2	23.8 ^{ns}	8.3 ^{ns}	79.6 ^{ns}	2.6 ^{ns}	2.2 ^{ns}	0.0018 ^{ns}	0.4 ^{ns}	0.4 ^{ns}
AA × ST × Loc.	10	14.1 ^{ns}	12.3 ^{ns}	62.8 ^{ns}	1.8 ^{ns}	0.9 ^{ns}	0.0001 ^{ns}	0.1 ^{ns}	0.1 ^{ns}
Error	66	52.13	35.37	81.2	2.3	1.15	0.0009	0.46	0.92

NS : Not Significant.

*, **Significant at P=0.05 and P=0.01 levels, respectively.

fields is illustrated in Figs. 1 and 2. The highest fresh and dry biomass yield was obtained with Kadestim foliar application that was not significantly different from Aminol-forte (Fig. 1). It was cleared that biomass yield responded positively and significantly to all applied compounds except the one time spray of amino acid compounds which was significantly not different than control (Table 1). It was found that the active ingredients were fully incorporated in the metabolism of the plant after foliar application. The increment in plant height may be brought about by the presence of B which acts as constituents of cell walls (B) and membranes (B and Zn) (Abd El-Samad *et al.*, 2010). Higher number of leaves means higher interception of light and higher photosynthesis. Photosynthesis was also affected by the presence of Fe, Cu and Mn (Abd El-Samad *et al.*, 2010) which was used in some treatments including Kadostim. These results are confirmed by the higher fresh and dry weights recorded with Aminol-forte and Kadostim applications. Moreover, saving energy by providing the cell with biologically active free amino acids at no cost to the plant that was readily incorporated into the plants biosynthesis processes using Aminol-forte and

Kadostim that reflected on better dry matter production and forage yield. Aminol-forte enhanced the overall metabolic rate (between 130-330%) by increasing m-RNA synthesis i. e. the rate at which the plant accesses its own genetic information (Garacia *et al.*, 2010).

Chemical analysis of the hay samples revealed that all foliar applications resulted in higher percentages of studied parameters compared to the control except crude fiber and calcium per cent (Fig. 2). Biomass quality (Fig. 2) in terms of protein content was significantly affected by the applied compounds and there was a significant tendency to be highly compared to control treatment. Aminol-forte resulted in the highest protein content (22.15%) in this research. Improvement in protein content using Kadostim may be brought about by the activation of RNA splicing due to the presence of Zn (Garacia *et al.*, 2010). Moreover, the effect of nitrogen and oligo-peptides of low molecular weight in Aminol-forte cannot be ignored regarding the observed positive results.

Regarding fiber and calcium contents, some foliar treatments significantly decreased these parameters in the fields, while the only significant difference was recorded with the Aminol-forte and Kadostim treatments in terms

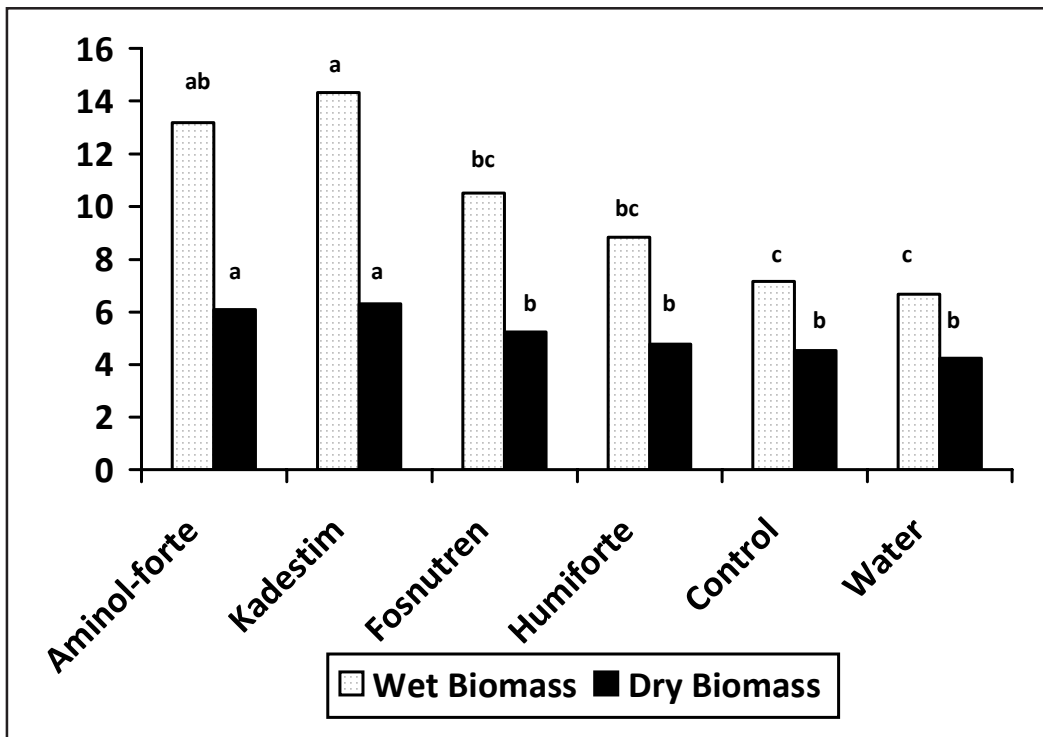


Fig. 1. Mean fresh and dry biomass yield (t/ha) in alfalfa over three locations using different free amino acid compounds.

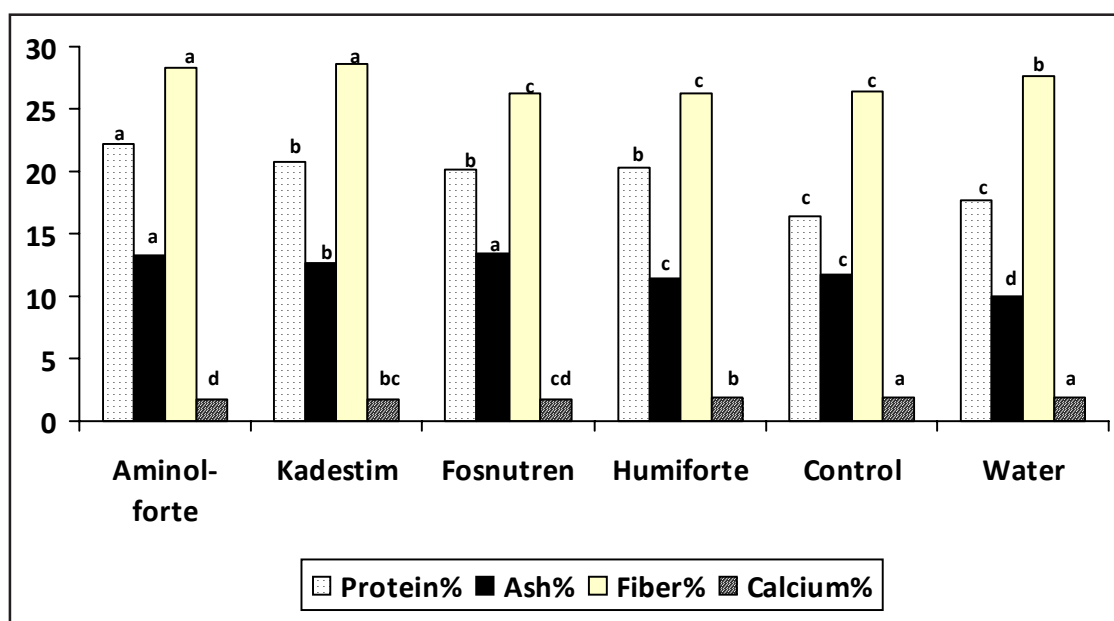


Fig. 2. Mean protein, fiber, calcium and ash per cent in alfalfa over three locations using different free amino acid compounds.

of crude fiber per cent (Fig. 2).

Meanwhile, the overall improvement in plant growth parameters and yield due to application of amino acids may be due to providing readily source of growing substances which form the constitutes of protein in the living tissues. Generally, amino acids were found to increase number of vegetative organs, fruit setting and fruit yield (Shehata *et al.*, 2011). The positive effects of amino acids application may be brought about by its cell-internal function as osmo-regulatory (El-Zohiri and Asfour, 2009) since it is very soluble in water therefore increases the concentration of cellular osmotic components. Mixture of amino acids proved to be effective in improving plant growth under abiotic stress (Abdel-Mawgoud *et al.*, 2011).

It could be concluded that all studied characteristics responded positively and significantly to all applied free amino acid compounds except their one time spray which was significantly not different from control. Foliar spray of free amino acid compounds could enhance the quality and quantity of alfalfa in the rainfed conditions.

ACKNOWLEDGEMENTS

The author would like to thank Dr. Khoshnood Alizadeh for his assistance for language improvement. The scientific guidance

of Dr. Jaime A. da Silva is greatly acknowledged.

REFERENCES

- Abdel-Mawgoud, A. M. R., El-Bassiouny, A. M., Ghoname, A. and Abou-Hussein, S. D. (2011). Foliar application of amino acids and micronutrients enhance performance of green bean crop under newly reclaimed land conditions. *Aust. J. Basic & Appl. Sci.* **5** : 51-55.
- Abd El-Samad, H. M., Shaddad, M. A. K. and Barakat, N. (2010). The role of amino acids in improvement in salt tolerance of crop plants. *J. Stress Physiol. & Biochem.* **6** : 25-37.
- Abo Sedera, F. A., Amany, A., Abd El-Latif, L. A., Bader, A. and Rezk, S. M. (2010) Effect of NPK against *Meloidogyne incognita* on soybeans. *J. Agric. Sci. Mansoura Univ.* **30** : 1097-1103.
- Akram, A. A. and Hosni, A. M. (2007). Effect of vitamin C growth and yield of broad beans exposed to ambient ozone in KSA. *J. Agric. and Biol. Sci.* **3** : 195-99.
- Al-Said, M. A. and Kamal, A. M. (2008). Effect of foliar spray with folic acid and some amino acids on flowering yield and quality of sweet pepper. *J. Agric. Sci. Mansoura Univ.* **33** : 7403-12.
- Alizadeh, K. and Shiv Kumar, A. (2013). Development of vetches and grass pea as suitable crops for highlands of Iran. Paper presented in 11th International Conference on Dryland Development (ICDD), Beijing,

- China, 18-23 March.
- Aranjuelo, I., Molero, G., Erice, G., Avicé, J. C. and Nogue, S. (2011). Plant physiology and proteomics reveal the leaf response to drought in alfalfa (*Medicago sativa* L.). *J. Exp. Bot.* **62** : 111-23.
- El-Shabasi, M. S., Mohamed, S. M. and Mahfouz, S. A. (2005). Effect of foliar spray with amino acids on growth, yield and chemical composition of garlic plants. Paper presented in the 6th Arabian Conference for Horticulture, Ismailia, Egypt, 14-19 August.
- El-Zohiri, S. M. and Asfour, Y. M. (2009). Effect of some organic compounds on growth and productivity of some potato cultivars. *Ann. Agric. Sci.* **47** : 403-15.
- Garacia, J. R., Estrada, J. A., Gonzalez, M. T., Ayala, C. R. and Moreno, D. M. (2010). Exogenous application of growth regulators in snap bean under water stress and salinity. *J. Stress Physiol. & Biochem.* **5** : 13-21.
- Kowalczyk, K. and Zielony, T. (2008). Effect of aminoplant and Asahi on yield and quality of lettuce grown on rock wool. Paper presented in Conference of Bio-stimulators in Modern Agriculture, 7-8 February.
- Nelson, D. W. and Sommers, L. E. (1973). Determination of total nitrogen in plant material. *Agric. J.* **65** : 109-12.
- Shehata, S. M., Heba, S., Abdel-Azem, A., Abou El-Yazied, A. and El-Gizawy, M. (2011). Effect of foliar spraying with amino acids and seaweed extract on growth chemical constituents, yield and its quality of celeriac plant. *European J. Sci. Res.* **58** : 257-65.