J. BIOL. ENVIRON. SCI.,
2012, 6(16), 77-79

Effect of Humic Acid on Nutrient Uptake and Physiological Characteristic *Fragaria ananassa* var: Camarosa

Atefe Ameri* **and Ali Tehranifar**
Department of Horticultural Science, Ferdowsi University of Mashhad, IRAN

ABSTRACT

The investigation was carried out for evaluation effects of humic acid fertilizer on nutrient uptake (N, P, and K) and physiological characteristics of *Fragaria ananassa* var: Camarosa. Experiment treatments included different concentration of humic acid (0, 10, 20, 30 and 40 ppm) with two methods of application (fertigation and spray). Result of experiment showed that there is highest amount of N in fertigation in concentration of 20 ppm and there are highest of Phosphorus, potassium and amount of assimilation in concentration of 10 ppm. In spray method there are highest amount of N and chlorophyll in concentrations of 10 and 20 ppm and there is potassium in concentration of 10 ppm.

Key Words: Humic acid, foliar application, strawberry, nutrient uptake, fertigation.

INTRODUCTION

Humic acid (HA) is a heterogeneous mixture of many compounds with generally similar chemical properties; it performs various functions in the soil and on plant growth. One of the functions of HA is the positive effect on the promotion of root development.(Rengrudkij and Partida 2003) Humic substances (HS) are recognised as a key component of soil fertility properties, since they control chemical and biological properties of the rhizosphere (Nardi *et al.,* 2005, Trevisan *et al.,* 2009) The mechanism of humic acid activity in promoting plant growth is not completely known, but several explanations have been proposed by some researchers such as increasing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake, and root cell elongation (Cacco and Dell'Agnolla 1984, Türkmen *et al.,* 2004) Addition of HA to soil increases the rate of absorption of ions on root surfaces and their penetration into the cells of the plant tissue. Plants show more active metabolism and increased respiratory activity, which are attributed to the intervention of the quinone groups of HA (Petronio *et al.,* 1982). The effect of HA on the availability of P and micronutrients has been given particular attention because of observed increases in uptake rates of these nutrients following application of HA (Ayuso *et al.,* 1996) The aim of this study was, therefore, to determine the effect humic acid fertilizer on nutrient uptake (N, P, and K) and physiological characteristic of *Fragaria ananassa*.

MATERIALS AND METHODS

The investigation was conducted in 6 Oct. 2010 to 13 Jan. 2010 at the experimental greenhouse of the Agricultural Faculty, Ferdowsi University of Mashhad (latitude 36◦ 16′ N, longitude 59◦36′ E and 985 m elevation), Iran. The experiment was arranged in factorial experiment based on randomized complete design with three replications. The treatments of experiment included concentrations of humic acid (0, 10, 20, 30, 40 ppm) with two application methods of spray and fertigation. Daily temperature was 22℃ and nightly temperature was 17℃. Fertigation was begun two week after the planting and repeated each 14 day interval. In Foliar application, the first spray started at the beginning of flowering and later at 14 days interval. No other fertilizer was used during plant growth. Total nitrogen of the sample was determined by Kjeldahl method (Kacar 1972). For determination of P and K contents of leaf, plant samples were air-dried and were then ground. K was determined after dry digestion of dry and sub-samples in a HCL preparation, P was measured spectrophotometrically by reaction with ascorbic acid. Potassium was determined by flame photometry. Also chlorophyll, assimilation, evapotranspiration and gas exchanges were measured. Leaf chlorophyll content was measured by a portable chlorophyll meter, SPAD-502 (Minolta Corporation, Ramsey, NJ). Assimilation, evapotranspiration and gas exchanges were measured by LCi portable photosynthesis meter. Data were analyzed using SAS 9 and means were compared by LSD test at 5% level of confidence.

* Corresponding author: atefeameri@yahoo.com

RESULTS AND DISCUSSION

Analysis of variance showed type of fertilization was effective on all of traits except chlorophyll. (Table 1). Humic acid fertigation application was effective on assimilation, leaf uptake of N and P. foliar application of humic acid was effective on evapotranspiration, gas exchanges and leaf uptake of K. (Table 2). Used concentrations were significant in all of traits except evapotranspiration. (P< 0.01) (Table 1). Application humic acid was no effective in assimilation, evapotranspiration, gas exchanges. 20 ppm humic acid had the highest of chlorophyll content. The highest of leaf uptake of N was observed in 10 and 20 ppm and the lowest of leaf uptake of N was in 40 ppm. There are this probably which high concentration is inhibiter agent in leaf uptake of N. the highest of leaf uptake of P and K were related to 10 ppm. (Table 3). Interaction of type of humic acid application and their concentration were effective in all of traits except chlorophyll and gas exchanges. (P< 0.01). (Table 4). The highest of assimilation and leaf uptake of P were related to fertigation of humic acid in concentration 10 ppm. There are the highest of percentage N in 20 ppm of fertigation and 10 ppm of foliar application. The highest of percentage of K in leaf was observed in 10 ppm of foliar application. Studies were carried out about effect of humic acid on strawberry characteristics which offered using of low concentration of humic acid. (Pilanal and Kaplan 2003) It has been demonstrated that plant growth can be stimulated by very low concentrations of humic substances (Cacco and Dell'Agnolla 1984).which is in agreement with this investigation, so that in this investigation high concentration was negative effect on traits under study. Fagbenro and Agboola (1993) reported: with addition humic acid to soil, nutrient uptake including N, P, K, Mg ,Ca, Zn, Fe and Cu increased which is in agreement with results of this experiment and low concentration had high leaf uptake. Humic substances (HS) have positive effects on plant physiology (Turkmen *et al.,* 2004) so that concentration of 20 ppm acid humic was effective on increasing of chlorophyll content. There are two major peaks in June-bearing strawberries which these are in fall and spring. After the beginning of fruit maturation in late spring, nitrogen moves directly from leaves to fruit and its soil uptake was limited. (Neri *et al.,* 2002). In during flowering and fruiting which soil uptake is low, importance foliar application is clear. In this experiment leaf uptake of K in foliar application was higher than fertigation but leaf uptake of N and P were lower than spray which it related to time of measurement which was carried out in postharvest of fruits. In conclusion was better measurement was done in during different periods and also for using humic acid in strawberry should use from low concentration.

Table 1. Analysis of variance of the traits under study.

S.V	DF	M.S						
		Assimilation ($\mu mol/m^2.s$)	**evapotranspiration ($mmol/m^2.s$)**	**gas exchange ($mol/m^2.s$)**	**chlorophyll**	**%N**	**%P**	**% K**
F	1	5.36**	0.077**	0.0017*	1.24 ns	0.010*	0.0136**	0.57**
C	4	7.20**	0.029 ns	0.0015**	16.87**	0.17**	0.0079**	3.38**
F × C	4	3.64**	0.051**	0.00028 ns	2.24 ns	0.014**	0.0205**	0.129**
Error	20	0.095	0.0027	0.0003	1.026	0.002	0.00066	0.014

NS, *,** Nonsignificant or significant at $P = 0.05$ or 0.01, respectively.
F= Type of fertilization, C= concentration of humic acid, F × C= fertilization × concentration.

Table 2. Effect of type of fertilization on physiological characteristics and leaf nutrient uptake of strawberry cv. Camarosa.

Treatment	Assimilation ($\mu mol/m^2.s$)	evapotranspiration ($mmol/m^2.s$)	gas exchanges ($mol/m^2.s$)	chlorophyll	%N	%P	% K
Fertigation	2.86 a	0.16 b	0.05 b	44.36 a	0.73 a	0.30 a	2.41 b
Spray	2.02 b	0.26 a	0.06 a	43.96 a	0.69 b	0.26 b	2.69 a

Different letters indicate significant difference between treatments at 5% levels.

Table 3. Effect of concentration of humic acid on physiological characteristics and leaf nutrient uptake of strawberry cv. Camarosa.

Treatment	Assimilation ($\mu mol/m^2.s$)	evapotranspiration ($mmol/m^2.s$)	gas exchange ($mol/m^2.s$)	chlorophyll	%N	%P	% K
0 ppm Humic acid	4.03 a	0.22 ab	0.06 ab	42.96 c	0.58c	0.27bc	2.18 c
10 ppm Humic acid	2.90 b	0.26 a	0.07 a	44.86 b	0.86a	0.34a	3.85 a
20 ppm Humic acid	2.41 c	0.19 b	0.06 ab	46.26 a	0.88a	0.24 c	2.54 b
30 ppm Humic acid	1.60 d	0.23 ab	0.036 c	44.70 b	0.72b	0.28 b	1.99 d
40 ppm Humic acid	1.27 d	0.17 b	0.04 bc	42.01 c	0.49d	0.29b	2.20 c

Different letters indicate significant difference between treatments at 5% levels.

Table 4. Effect of concentration of humic acid and type fertilization on physiological characteristics and leaf nutrient uptake of strawberry cv. Camarosa.

Treatment		Assimilation ($\mu mol/m^2.s$)	evapotranspiration ($mmol/m^2.s$)	%N	%P	%K
Fertilization	Concentration Of Humic acid (ppm)					
Fertigation	0	4.03 b	0.22 b	0.58 e	0.27 b	2.18 d
	10	4.68 a	0.25 b	0.81 bc	0.46 a	3.51 b
	20	2.82 c	0.12 c	0.90 a	0.21 c	2.5 c
	30	1.58 de	0.12 c	0.77 c	0.28 b	1.74 e
	40	1.22 e	0.11 c	0.57 e	0.29 b	2.14 d
Foliar application	0	4.03 b	0.22 b	0.58 e	0.27 b	2.18 d
	10	1.12 e	0.27 ab	0.91 a	0.22 c	4.18 a
	20	2.01 d	0.26 ab	0.86 ab	0.27 b	2.58 c
	30	1.62 de	0.34 a	0.68 d	0.28 b	2.25 d
	40	1.32 e	0.23 b	0.41 f	0.28 b	2.26 d

Different letters indicate significant difference between treatments at 5% levels.

CONCLUSIONS

Using of humic acid is proposed as fertilizer of activator nutrition uptake of leaf and growth if was used in low concentration.

REFERENCES

Ayuso M, Hernandez T, Garcia C, and Pascual JA (1996). Stimulation of barley growth and nutrient absorption by humic substances originating from various organic materials. Bioresourc. Technol. 57: 251–257.

Cacco G and Dell'Agnolla G (1984). Plant growth regulator activity of soluble humic substances. Can. J. of Soil Sci. 64: 25- 28.

Fagbenro JA, and Agboola AA (1993). Effect of different levels of humic acid on the growth and nutrient uptake of teak seedlings. J. of Plant Nutr. 16(8): 1465 – 1483.

Kacar B, (1972). Bitki ve topragin kimyasal analizleri. II. Bitki analizleri. Ankara Univ. Ziraat Fak., Ankara, Turkey; Yayin. 453.

Nardi S, Tosoni M, Pizzeghello D, Provenzano MR, Cilenti A, Sturaro A, Rella R, and Vianello A (2005) Chemical characteristics and biological activity of organic substances extracted from soils by root exudates. Soil Sci. Soc. of Am. J. 69, 2012–2019.

Neri D, Lodolini EM, Savini G, Sabbatini P, Bonanomi G and Zucconi F (2002) Foliar Application of Humic Acids on Strawberry (cv Onda). Acta Hort. 594: 297-302

Pilanal N, and Kaplan M (2003). Investigation of effects on nutrient uptake of Humic Acid applications of different forms to Strawberry Plant. J. of Plant Nutri. 26(4): 835–843.

Petronio P, Vitorovic D, and Jablanovic M (1982). Investigations of the biological effect of HA. Acta Biol. Med. Exp. 7 (1): 21–25.

Rengrudkij Ph, and Partida GJ (2003). The effects of humic acid and phosphoric acid on grafted Hass avocado on Mexican seedling rootstocks. Actas V Congreso Mundial del Aguacate pp. 395-400.

Trevisan S, Pizzeghello D, Ruperti B, Francioso O, Sassi A, Palme K, Quaggiotti S, and Nardi, S. (2009). Humic substances induce lateral root formation and expression of the early auxin-responsive IAA19 gene and DR5 synthetic element in Arabidopsis. Plant Biol. 12: 604-614.

Turkmen O, Dursun A, Turan M, and Erdinc C (2004). 'Calcium and humic acid affect seed germination, growth, and nutrient content of tomato (*Lycopersicon esculentum* L.) seedlings under saline soil conditions', Acta Agriculturae Scandinavica, Section B- Plant Soil Sci. 54(3): 168- 174.