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EFFECT OF DIFFERENT AMINO ACID FOLIAR FERTILIZERS ON YIELD AND FRUIT QUALITY OF 'REDIX' APPLE CULTIVAR

Alina Viorica ILIE[1, 3], Cristina PETRIȘOR[2], Dorel HOZA[3]

[1]Research and Development Station for Tree Fruit Growing Băneasa, 4 Ion Ionescu de la Brad Blvd, District 1, Bucharest, Romania
[2]Research and Development Institute for Plant Protection, 8 Ion Ionescu de la Brad Blvd, District 1, Bucharest, Romania
[3]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, Bucharest, Romania

Corresponding author email: crisstop@yahoo.com

Abstract

In fruit orchards the foliar application of nutrients is very important especially in certain periods when fruit trees required important quantity of different compounds. The present study was aimed to determine the effect of foliar application of amino acids on yield and fruit quality of 'Redix' apple cultivar. The field experiments were carried in two succesive seasons of 2016 and 2017, in a superintensive apple experimental orchard of USAMV Bucharest. The fertilizers utilized in this experiment were Terra sorb complex, Terra sorb foliar, Naturamin, Hit AA in different concentration. Fruit quality: average fruit size, weight, firmness, shape index (length/diameter) and also fruit chemical features: dry matter, total soluble solids content of fruits and fruit acidity were recorded. Results indicates that all the applied treatments were very effective in increase yield and fruit quality of 'Redix' than control unfertilized.

Key words*: firmness, weight, acidity, foliar application.*

INTRODUCTION

The production of apple using sustainable and environmentally friendly agricultural practices plays an essential role in determining their market value and nutritional benefits.
In recent years, different strategies have been applied to enhance the quality and productivity of apple without compromising quality standards (Tanou et al., 2017; Sala et al., 2014; Jivan and Sala, 2013; Amiri et al., 2012).
One of these is using fertilizers which can be applied through the plant root suystem or through leaves and each of these treatments has its advantages and disavantages (Murtic et al., 2017; Dudu et al., 2015; Amiri et al., 2012; Jafapour and Poursakhi, 2011).
Foliar fertilization has advantages of low application rates, uniform distribution of fertilizer materials, easiest method of application and quick responses to applied nutrients (Abd El-Gleel Mosa et al., 2015).
Amino acids act as buffers for maintain favorable pH value within the plant cell and also have a chelating effect on micro nutrients when applied together making absorption and transportation of micro nutrients easier inside the plant (Abo-Elmagd et al., 2015).
Today, foliar spraying of aminoacids in most of the fruit orchards in the world has become usual and its positive effects on fruit growth and quality characteristics are evident (Murtic et al., 2017; Arabloo et al., 2017; Molaie et al., 2013; Fayek et al., 2011; Morales-Payan and Stall, 2003; Koksal et al., 1999).
The objectiv of this study were to test several amino acids formulations by applied them during growth and development of fruit and determining the impact on quality and yield of the 'Redix' apple cultivar.

MATERIALS AND METHODS

The experiment was carried out at the USAMV Bucharest experimental orchard during the period 2016-2017 in an superintensive orchard planted in 2012 with 'Redix' apple cultivar grafted on the M9 rootstock, at planting distance of 3.5 x 1 m.
In both years of investigation the following foliar fertilization treatments were applied to the plots:

Vo - Control (water only);
V1 - Terra sorb complex applied to leaves as a 0.2% solution;
V2 - Terra sorb foliar applied to leaves as a 0.2% solution;
V3 - Naturamin applied to leaves as a 0.2% solution;
V4 - Hit AA applied to leaves as a 0.2% solution.

First treatment was applied at petal drop and next treatments were done every two weeks. Each year, the chemical composition of the fruits was analysed with specific methods in three replications. Yield per tree (kg) was measured on five trees on three replications. A sample of randomly picked 15 fruits per cultivar was harvested at commercial maturity for determining of quality traits.

Dry matter of fruits was determined with a gravimetric method through drying an aliquot ~5 g of fruit tissue at 105°C to constant weight.

Titratable acidity (TA) was determined by titration of an extract of fruit homogenate with 0.1 N NaOH to the end point of pH 8.1 and expressed as malic acid percent.

Soluble solids (SS) expressed as °Brix were measured in juice pressed from the whole fruit sample using a digital refractometer (model PR-101, ATAGO, Tokyo, Japan) at 21°C.

Fruit firmness (kg/cm^2) was measured using a penetrometer (FT-327) with a 11-mm diameter probe from three different areas (top, middle and bottom) of the whole fruit.

RESULTS AND DISCUSSIONS

According to our results the foliar application of amino acids improved both quality and yield of 'Redix' apple fruit.

The obtained results showed that the foliar application of amino acids gave great increases in the yield, fruit firmness, average fruit weight, soluble solids content, and decreased the fruit acidity.

It can be noticed that foliar fertilizers application does not significantly influence fruit diameter and fruit length in both seasons as compared to the control.

The fruit weight of apple increased signify-cantly from 173.26 g in the control variant to 188.80g in Terra sorb foliar variant (V2) and 190.86 g in Naturamin variant (V3) and also 225 g in Hit AA (V4) in 2016 year (Table 1).

The similar results were obtained by Arabloo et al., 2017 who have found a significant increase in fruit weight for 'Golden Delicious' and 'Granny Smith' cultivars fertilized with amino acids.

The average fruit weight was higher in 2017 compared to 2016.

The all foliar application also resulted in a significant increase in yield of apple fruit as compared to the control. Kamiab et al. (2015) reported that foliar spraying of amino acids increased the quantitative and qualitative characteristics of pistachio.

Table 1. Influence of foliar fertilizer on fruit size, fruit weight and fruit yield of 'Redix' cultivar during 2016-2017

Treatment	Fruit weight (g)		Fruit diameter (mm)		Fruit length (mm)		Fruit yield/tree (kg)		Yield (t/ha)	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
V0 - water	173.26	183.06	77.00	70.60	9.03	8.71	10.57	12.27	30.20	35.06
V1 - Terra sorb complex	175.21	186.75	75.00	71.05	10.51	9.52	20.32	18.30	58.05	52.28
V2 - Terra sorb foliar	188.80	198.28	77.50	73.70	10.33	9.82	24.36	16.66	69.60	47.60
V3 - Naturamin	190.86	192.21	79.00	74.55	9.13	10.20	20.07	21.33	57.34	60.94
V4 - Hit AA	225.12	197.99	81.20	71.80	9.06	10.68	21.84	30.69	62.40	87.68

Data presented in table 2 show that in all foliar treatments (V1-V4), dry matter content was higher in comparison to control variant (V0) both in 2016 as weel as in 2017. The highest dry matter content in apple fruit was determined in variant V4 (16.35 g%) followed by the variant V3 (16.32 g%) and V2 (16.07 g%) compared to the control variant V0 (14.91 g%). The values of this compound are slightly low in 2017 compared with 2016.

Table 2. Influence of foliar fertilizer on fruit quality parameters of 'Redix' cultivar in 2016-2017

Treatment	Dry matter (g%)		Firmness kg/cm^2		Soluble solids °Brix		Titratable acidity (malic acid %)		SS/TA ratio	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
V0-water	14.91	14.65	9.03	8.71	10.62	10.2	0.96	0.85	11.06	12
V1 - Terra sorb complex	15.60	14.98	10.51	9.52	12.04	11.03	0.85	0.82	14.16	13.45
V2 - Terra sorb foliar	16.07	15.08	10.33	9.82	11.10	10.65	0.91	0.84	12.20	12.68
V3 - Naturamin	16.32	15.11	9.13	10.20	12.78	11.76	0.88	0.80	14.52	14.70
V4 - Hit AA	16.35	15.68	9.06	10.68	13.80	12.20	0.81	0.79	17.04	15.44

Foliar application of V1 and V2 foliar fertilizers resulted in a significant increase in apple fruit firmness. Firmness of the fruit to which the Naturamin (9.13 kg/cm^2) and Hit AA (9.06 kg/cm^2) fertilizers has been applied was very close to the value of the control (9.03 kg/cm^2) in 2016 year. Similar results for fruit firmness were obtained by Arabloo et al., 2017 on 'Golden Delicious' and 'Granny Smith' apple cultivars. Milosevic and Milosevic, 2015 reported that spraying with foliar fertilizer increased fruit firmness of 'Idared' apple cultivar .

The TA content of apple fruit was not significantly affected by the application of foliar fertilizers. However application of Naturamin and Hit AA fertilizers decreased titratable acidity percent.

From the results obtained, the all foliar application of amino acids improved TSS and TSS/ acid ratio and decreased acidity percentage in the fruits as compared to the control in the two seasons studied. The results of our experiment confirm data obtained by Abo-Elmagd et al., 2015, that found a positive effect of amino acids on the soluble solids content of apple fruit. However results obtained by Malik and Singh, 2006 showed that total soluble solids content of fruit was reduced by the aqueous solutions of amino acids when sprayed on mango, cv. 'Kensington pride" like foliar fertilizers. Also positive impact of amino acids foliar spray on fruit quality was also supported by other authors (Fayek et al., 2011; Khan et al., 2012).

CONCLUSIONS

The foliar application of amino acids had a positive effect to improve the yield and fruit quality of 'Redix' apple trees.

Application of Naturamin and Hit AA fertilizers had the highest positive effect to improve the percentages of yield and average fruit weight. Also, it increased dry matter content of apple in both seasons, as compared to the control treatment.

All fertilizers used decreased the percentage of acidity, but differences were not significant among treatments for each year studied.

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