

Influence of foliar application of amino acids to yield and quality attributes of apple

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Abstract Apples are a temperate zone fruit, they are consumed worldwide due to their unique characteristics, including color, flavor and aroma, freshness and crispness, and nutritional value including antioxidants, natural sugars and organic acids. Foliar fertilization had become a widespread management tool in important fruit growing areas, often as a complementary practice to soil nutrition supply for improving of fruit quality and yield. Field experiments were conducted during 2016-2017 in an superintensive apple orchard to investigate the effect of foliar fertilizers based on amino acids on quality and yield of apples Generos cv (*Malus L.*). Fruit yield, fruit weight, fruit shape, fruit firmness, dry matter, total soluble solids, titratable acidity content of fruits were determined. Application of foliar fertilizer on apple tree resulted in significant increase in yield and fruit weight parameters compared to control but non significant difference was observed on dry matter, soluble solids and firmness. However, fertilizer type Terra sorb complex, Terra sorb foliar and Hit AA also produced fruits with higher level of total soluble solids and dry matter.

Key words

fruit weight, firmness, soluble solids, foliar fertilizer

The foliar fertilization is a modern and effective technology which may have significant contribution to maintain the physiological balance between growth and fruiting and increasing the quantity and quality of fruit. Also, preharvest foliar sprays may be associated with some other protection works by foliar phytosanitary treatments, which reduces the cost of application and makes fertilization effectiveness to increase (15; 8).

Many reports studied the effect of foliar fertilizer on growth, yield and fruit quality. Foliar fertilizer with micro and macroelements were highly effective in improving, nutritional status yield and quality of different apple trees (12; 9; 16; 2; 14; 17).

Amino acids are considered as precursors and constituents of proteins which are important for stimulation of cell growth. They contain both acid and basic groups and act as buffers, which help to maintain favorable pH value within the plant cell (5). Amino acids can directly or indirectly influence the physiological activities in plant growth and development.

Exogenous application of amino acids have been reported to modulate the growth, yield and biochemical quality of squashes (1), grapes (10), potatoes (4), apples (3), pears (7; 11), pistachio (13), mandarins (18).

The objective of this paper was to study the effect of amino acids foliar application on yield and fruit quality of the Generos apple cultivar.

Material and Methods

The research was conducted during the period 2016 – 2017 in an superintensive apple experimental orchard of USAMV Bucharest planted in 2012 with “Generos” cultivar grafted on the M9 rootstock, at planting distance of 3.5x1 m.

In both years of investigation the following 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 attributes.

Fruit quality parameters fresh weight of fruit, total soluble solids (TSS), titratable acidity (TA), ascorbic acid, firmness, were immediately assayed after harvest with specific analytical methods.

Soluble solids concentration (SS) was assessed in juice of fruits using an thermo-compensated hand-refractometer (model PR-101, ATAGO, Japan) expressed as Brix.

Flesh firmness (kg/m²) was averaged from two measurements taken at the equator of each apple, after removing a peel evaluated with a penetrometer (Model FT 327) fitted with a cylindrical 11.1mm diameter head.

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 a extract of fruit homogenate with 0.1 N NaOH to the end point of pH 8.1 and expressed as malic acid equivalents.

Result and Discussions

The obtained results showed that spraying amino acids was effective in improving yield and quality of apple. Yield and quality parameters in fruits largely depend on fertilizer type used.

According to data in table 1, significant differences between the two seasons in yield parameter of apple fruit Generos cultivar were registered. All foliar

fertilizers (V1-V4) increases the yield compared to the control variant (V0) in both years studied. However, variants V2 (22.3 kg/tree) and V3 (21.3 kg/tree) have been highlighted compared to control V0 (13.43 kg/tree) in 2016. Spraying of amino acids significantly increased the average of fruit weight in both years studied compared with control. This results are in agreement with those of (3) which supported a significantly increased of fruit weight for „Golden Delicious“ and „Granny Smith“ cultivars. The largest fruits, with an average weight of about 204.81g, were collected from the trees fertilized with Naturamin followed by trees fertilized with Hit AA and Terra sorb complex. Yield had a significant effect on fruit weight. In 2017, the year with the lowest yield, fruit weight was significantly higher relative to the 2016 year. However our results in terms of yield/tree were smaller than results obtained by (15) for the same cultivar studied. (4) reported that foliar application of amino acids caused an enhancement in yield and its components on potato. (14) studying the influence of two foliar products on two cultivars (Florina and Auriu de Bistrita) from an intensive plantation found that foliar fertilization influenced positively shoot growth and fruit yield. The general positive effects of amino acid foliar spray applications could be attributed to enhanced pollen tube ovule penetration and delayed ovule senescence which increases fruit set and yield (3).

Table1

Influence of foliar fertilizer on fruit size, fruit weight and fruit yield 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	176.79	200.03	75.60	78.25	63.8	68.4	13.43	10.80	38.36	30.85
V1 –Terra sorb complex	193.37	228.11	78.45	82.25	67.9	71.6	16.82	21.89	48.05	62.53
V2 – Terra sorb foliar	189.97	201.80	77.70	78.10	67.7	70.2	22.22	13.52	63.48	38.62
V3 - Naturamin	204.81	204.97	77.05	77.10	69.7	70.0	21.30	15.98	60.85	45.65
V4 – Hit AA	203.75	233.37	79.50	82.75	68.6	73.3	16.91	21.23	48.31	60.65

From the results in table 1, it can be noticed that all fertilization treatments enhanced remarkably fruit diameter, fruit length in both seasons as compared to the control.

Foliar application of different type of amino acids significantly improved soluble solids contents in fruit (table 2). It was observed that soluble solids content was higher under fertilization with Terra sorb complex

and Hit AA compared to control sprayed with water. Apple harvested from all the treated variants exhibited decrease in the total titratable acidity compared to control (table 2). This findings was observed in the apple harvested from the tree subjected to multiple applications of Terra sorb complex (0.65 mg ac malic%), Terra sorb foliar (0.71 mg ac malic%) but also to Hit AA (0.76 mg ac malic%).

Table 2

Influence of foliar fertilizer on fruit quality parameters in 2016-2017

Treatments	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	12.73	11.98	7.15	8.17	11.64	10.90	0.79	0.84	14.73	12.98
V1 –Terra sorb complex	13.88	12.82	8.33	8.40	13.00	11.88	0.65	0.86	20.00	13.81
V2 – Terra sorb foliar	13.37	12.94	8.37	8.30	12.42	11.12	0.71	0.84	17.49	13.24
V3 - Naturamin	12.58	12.11	8.12	8.62	12.32	11.00	0.74	0.80	16.65	13.75
V4 – Hit AA	13.65	12.78	7.81	8.35	13.16	12.00	0.76	0.79	17.32	15.79

The results for SS and TA are consistent with those obtained by (16) who reported similar tendency for “Anna” apple cultivars. Also fruit firmness increased after foliar fertilization with amino acids but there were no significant differences between fertilized variants. Similar findings were reported on pear by (11). Similar results for fruit firmness were obtained by (3) on Golden Delicious and Granny Smith apple cultivars as well as by (12) on Idared apple cultivar who have argued there is a positive influence of foliar fertilization on fruit firmness. However, our results are not in agreement with those of (6) which established that apple fruit firmness decrease after foliar fertilization.

The improving of fruit quality in response to application of foliar fertilizer was supported by other authors (10; 1; 2; 18; 17; 11).

Conclusions

Foliar application of amino acids at different growth stages had a positive effect on yield and fruit quality of apple.

Results showed that foliar application of amino acids increased the soluble solids content and decrease acidity of fruit.

Differences in fruit firmness were not significant among treatments for each year studied.

The Terra sorb and Hit AA fertilizers had a higher increase in fruit quality parameters.

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