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The effect of foliar application of some amino acid compounds on photosynthesis and yield of two commercial cultivars in pistachio orchards of Kerman province in Iran

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ABSTRACT: In order to investigate the effect of foliar application of some of amino acids compounds on photosynthesis and yield of Momtaz and Ohadi pistachio cultivars, this experiment was carried out as a split plot design and in form of complete randomized blocks. The design was carried out in three foliar application treatments including Kadoustim®, Humi Fort® and water as control, any of which were applied on Momtaz and Ohadi pistachio cultivars trees in two times of endocarp lignification and embryo growth completion. During these treatments, the quantitative and qualitative properties, including shell dehiscence percentage, number of blank pistachios, flower bud abscission, sugar content, percentage of sugar, fat and protein of the nut, and photosynthesis were measured and compared with control. The results indicated that the experimental treatments increased the protein percentage of the nut, but had no effect on other measured characteristics.
Key words: Foliar application, amino acids, photosynthesis, yield, cultivar, quantity, quality

INTRODUCTION

Plants are the origin of food chain for life on the earth, and are considered to be the national wealth of any country. Pistachio is one of the most important product and exports of Iran which accounts for a percentage of the value of Iran total non-oil exports (Abrishami, 1994). Pistachio is an agricultural product which has been mixed with the name of Iran, and the role it plays in agricultural and national economic is remarkable and valuable. In addition, pistachio is full of necessary micronutrient, and its consumption is effective on health and power in the society. It's due to its importance in this country that pistachio has been called "green gold" since old times. Today's knowledge has proved the advantages and superiority of pistachio from several points of view in compare with many other nourishing foods (Abrishami, 1994). Reviewing the previous researches reveals the importance and advantage of foliar nutrition. Some researchers have reported that foliar nutrition with iron controls the vegetal glucose; furthermore, in California, foliar application of Zinc, Copper and Magnesium has been used on citrus trees (Swietlik and Fausdt, 1981). By foliar nutrition of grape, researchers have also been successful in increasing total leaf index, rate of reducing sugars and anthocyanin contents, and fruit fresh weight (Swietlik and Fausdt, 1981). In Greece, rate of shell dehiscence and weight of pistachio was increased by foliar application of a sugar compound on Angina pistachio cultivar (Zakinthions and Rouskas, 1995).

This research tries to economize the pistachio production by foliar application, and to prevent the degradation of soil structure, resulted due to excessive use of chemical fertilizers, by providing the essential elements for branches and leaves. It has also been tried to supply the needs of plant organs, especially fruit and leaf, to nutrients such as Calcium, Boron and Zinc immediately during buds swelling, reduce the competition among the reproductive organs (fruit and seed) and roots for absorbing the nutrients during reproducing and fruiting stages, and increase the quantitative and qualitative properties of pistachio nut by foliar nutrition (Malakouti and Tabatabaei, 1997).

MATERIALS AND METHODS

This research has been carried out at pistachio orchards of Firoozabad village located at Zarand area, Kerman province, on two Momtaz and Ohadi pistachio cultivars at two times of May and July, through three treatments including amino acid of Kadoustim®, amino acid of Humi Fort® and water as control with three replicates. Age of the treated trees was 28 years, and irrigation was done in 30-35 days cycles. In the orchards under study, the horticulture operations were done in accordance with the scientific principles, and in framework of fertilizing operations, weeds control and other optimal-cultivation operations. This experiment has been carried out based on the statistic design of split plot and in form of complete randomized blocks. Foliar application was done at 4 a.m. in predominant conditions of minimum temperature and maximum humidity in the orchard and the region, which were appropriate for adsorption at tree canopy. Foliar application was done by use of a 100-litre sprayer, and to the extent that all tree leaves got wet. The amino acids used in this experiment were constituted of mineral elements and various acids and the concentration was chosen to be 1.5 liter per 1000 liters of water. In this experiment, the effect of treatments on the qualitative and qualitative properties of pistachio was investigated. After selecting and tagging the trees, length of the branches of the current year, number of leaves and circumference of tree trunks were measured once every ten days. The Eco-physiologic indexes, including photosynthesis, were measured from 9 a.m. to 12 p.m. in sunny days by use of photosynthesis-measurement devise named LCA4. In order to investigate the effect of treatments on alternate bearing, total flower buds of the branch were counted, then the buds abscissions of the same branch were counted and alternate bearing was calculated accordingly. In order to investigate the effect of treatments on percentage of shell-dehiscent and blank pistachios in each fruit bunches, these pistachio were counted and the related percentage was calculated; and, in addition, in order to measure and calculate the fat, sugar and protein content percentages of the nut, sampling was done and the samples were transferred to the lab for calculations (Crane and Al-shalan, 1974; Crane and Al-shalan, 1997; Emami, 1996).
In order to simplify the data analysis, before presenting the results, all treatments and cultivars have been shown by symbols in tables and graphs:
Treatment 1 (T1): foliar application of Kadoustim® amino acid
Treatment 2 (T2): water spray as control
Treatment 3 (T3): foliar application of Humi Fort® amino acid
First cultivar (CV1): Ohadi cultivar
Second cultivar (CV2): Momtaz cultivar

Table No.1. Effect of different treatments on rate of shell dehiscent, blank pistachios and flower buds abscission

Treatments	Average flower buds abscission (percent)	Average number of blank pistachio (percent)	Average shell dehiscence (percent)	Duncan's classification
CV1	57.330	12.965	74.267	A
CV2	27.651	13.769	60.172	A
T1	36.537	10.683	61.775	A
T2	48.638	14.283	68.408	A
T3	42.297	15.140	71.475	A
T1 × CV1	47.830	11.860	68.567	A
T2 × CV1	69.157	14.467	76.233	A
T3 × CV1	55.003	12.580	78.000	A
T1 × CV2	25.243	9.507	54.983	A
T2 × CV2	28.120	14.100	60.583	A
T3 × CV2	29.590	17.700	64.950	A

P= 0.05
In each column with same alphabet have no significant difference (α: 5%)

Table No.2. Effect of different treatments on the sugar content of the nut

	Variation sources	Average sugar content of the nut (percent)	Duncan's classification
Cultivar	CV1	6.69	A
	CV2	5.74	A
treatment	T1	6.14	A
	T2	6.95	A
	T3	5.55	A
Cultivar × treatment	T1 × CV1	6.07	A
	T2 × CV1	6.40	A
	T3 × CV1	6.12	A
	T1 × CV2	5.24	A
	T2 × CV2	6.81	A
	T3 × CV2	6.85	A

P= 0.05
In each column with same alphabet have no significant difference (α: 5%)

Table No.3. Effect of different treatments on the fat content of the nut

	Variation sources	Average fat content of the nut (percent)	Duncan's classification
Cultivar	CV1	43.267	A
	CV2	46.733	A
treatmen t	T1	41.833	A
	T2	47.433	A
	T3	45.733	A
Cultivar × treatment	T1 × CV1	36.867	A
	T2 × CV1	47.000	A
	T3 × CV1	45.933	A
	T1 × CV2	46.800	A
	T2 × CV2	47.867	A
	T3 × CV2	45.533	A

P= 0.05

In each column with same alphabet have no significant difference (α: 5%)

Table No.4.Effect of different treatments on the protein content of the nut

	Variation sources	Average protein content of the nut (percent)	Duncan's classification
Cultivar	CV1	20.29	A
	CV2	19.29	A
treatment	T1	20.76	A
	T2	18.37	B
	T3	20.27	A
Cultivar × treatment	T1 × CV1	21.11	A
	T2 × CV1	18.90	B
	T3 × CV1	20.90	A
	T1 × CV2	20.40	A
	T2 × CV2	17.84	B
	T3 × CV2	19.61	A

P= 0/05

In each column with same alphabet have significant difference (α: 5%)

According to the table No.4 treatments are placed in group A, and T3 treatment, as control, is placed in group B. accordingly, all foliar application treatments by amino acids improve the protein content of the nut in compare with the control.

Table No.5. Effect of different treatments on photosynthesis intensity

	Variation sources	Average photosynthesis intensity ($\mu mol/m^{-2}/S^{-1}$)	Duncan's classification
Cultivar	CV1	5.664	A
	CV2	6.182	A
treatmen t	T1	6.164	A
	T2	5.806	A
	T3	5.799	A
Cultivar × treatment	T1 × CV1	5.946	A
	T2 × CV1	5.294	A
	T3 × CV1	5.751	A
	T1 × CV2	6.382	A
	T2 × CV2	6.317	A
	T3 × CV2	5.846	A

P= 0.05

In each column with same alphabet have no significant difference (α: 5%)

RESULTS & DISCUSSION

According to the results, foliar application of two compounds of amino acids only improved the rate of protein content of nut by 10 percent. However, this rate on increase in the protein content had no effect on the quantitative and qualitative properties of pistachio cultivars, such as increasing shell dehiscence, reducing blank

pistachios, reducing buds abscission (alternate bearing), and increasing the sugar and fat contents. The studies carried out on organic compounds containing amino acids have reported the successful absorption of these materials by leaf. For instance, foliar application of 5% urea in autumn improved the buds growth in compare with buds in trees fertilized through soil. Foliar application of 5% urea on apple trees yielded 62% more in compare with use of soil nitrogen. However, urea is less effective on the vegetative growth of stone fruits (Swietlik and Fausdt, 1981). Foliar application of sucrose with concentrations of 1% & 2% on lettuce significantly increased the plant height, and number and weight of the leaves (Bassiouny, 1993; Bassiouny et all, 1993). Greek people were successful in increasing the pistachio weight and rate of shell dehiscence by 85-95 percent through foliar application of a sugar compound containing 3% sucrose, 2% glucose, 1% raminose and 1% inositol, at two time blocks (Zakinthions and Rouskas, 1995). In 2001, use of bio-regulators positively influenced the morphogenesis in kiwifruit pomace (Costa et al., 2001). In California, effect of Ascophyllum nodosum (seaweed) extracts on yield and quality of Thompson grape resulted in increased yield and number of bunches, and also larger grape seeds (Norrie et al., 2000). The effect of seaweed extract on yield and quality of apple fruit, Mondial Gala cultivar, improved the color and color distribution in this cultivar (Rombola et al, 2001). In 2001, foliar application of humic acid during the blooming stage of strawberry resulted in increased quality of fruit and reduced Botrytis fungus (Neri at al., 2001). Therefore, according to the findings resulted from this experiment, it can be concluded that, due to the physiologic structure and leaf type of pistachio, the absorption of amino acids in pistachio is not as easy as minerals; otherwise, the absorption of these compounds would certainly had remarkable effects.

Results indicated that foliar application of two compounds of amino acids only improved the rate of protein content of nut by 10%; however, this rate of increase in protein content could not influence the quantitative and qualitative properties of pistachio.

Foliar application of these compounds did not result in increased photosynthesis parameters.

These compounds had no effect on the qualitative properties of pistachio including rate of shell dehiscence, number of blank pistachios, buds abscission, and percentages of sugar and fat contents of nut.

Compounds containing amino acids may not be absorbed by pistachio plant as easily as minerals.

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