Nut Quality of 'Kirmizi', 'Siirt' and 'Ohadi' Pistachio Cultivars as Affected by Different Pollinators

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Abstract

This study was conducted in Ceylanpinar State Farm in Sanliurfa province of Turkey. The aim of the study was to determine influence of pollens of 3 different pollinators on the nut quality of 'Kirmizi', 4 different pollinators on 'Siirt' and 2 different pollinators on 'Ohadi' cultivars. Three different male types (Male 1, 16 and 23) synchronized to 'Kirmizi', 4 different male types (Male 7, 12, 13 and 25) synchronized to 'Siirt' and 2 male types (Male 18 and 22) synchronized to 'Ohadi' cultivars were used as pollinators and open pollination was used as control. Pomological characteristics were compared to determine the nut quality with respect to the used pollinators on the nuts. 100 nuts weight, split nut ratio, kernel ratio, blank nut ratio, kernel oil and protein content were determined as quality characteristics.

According to the average results of 3 consecutive years; 100 nuts weight ranged from 74.00 to 79.40 g for 'Kirmizi', 84.48 to 96.34 g for 'Siirt' and 75.20 to 76.65 g for 'Ohadi'; split nut ratio ranged between 25.31 and 36.92% for 'Kirmizi', 17.53 to 35.01% for 'Siirt' and 3.90 to 9.71% for 'Ohadi'; kernel ratio ranged from 47.12 to 49.38% for 'Kirmizi', 43.24 to 45.10% for 'Siirt' and 43.85 to 46.07% for 'Ohadi'. Blank nut ratio ranged between 29.68 and 37.02% for 'Kirmizi', 27.82 to 38.90% for 'Siirt' and 11.85 to 33.50% for 'Ohadi'. Kernel oil content ranged from 39.73 to 43.51% for 'Kirmizi', 38.61 to 44.16% for 'Siirt' and 45.52 to 48.00% for 'Ohadi'. Protein content ranged from 18.23 to 19.09% for 'Kirmizi', 17.51 to 18.08% for 'Siirt' and 18.38 to 20.39% for 'Ohadi' with respect to pollinators. Results demonstrated clearly that pollinators affect nut quality in pistachio.

INTRODUCTION

Pistachio is a wind-pollinated and dioecious fruit species, that the pistillate and staminate flowers are formed on different trees. Commercial pistachio orchards usually contain one male tree for each 8 to 11 females. While information is becoming available on the performance of female pistachio cultivars, little is known about the behavior of male clones as pollinators. Determination of pollinators for important pistachio cultivars is an important problem for pistachio production. Because, the marketable is the seed and to obtain a good fruit set, suitable pollinators have to be interplanted in the orchards considering the wind and rain conditions (Acar and Eti, 2007). Some suitable pollinators have been determined in Tunisia, U.S.A., Syria, Greece and Turkey for female cultivars (Ak, 1992; Acar, 2004).

Pistachio has high nutritional value for having proper contents of proteins, vitamins, minerals and fats. The fruits can be consumed as salted or roasted appetizers. Besides, it has a wide range of use in food industry, in particular for cream cakes, desserts, candies, chocolate and ice cream (Okay, 2002). The seed of pistachios consists of low carbohydrate content of approximately 10% (Barghchi and Alderson, 1989), protein content of more than 20% (Garcia et al., 1992; Agar et al., 1995; Kucukoner and Yurt, 2003) and lipid content varies between 40 and 63% (Garcia et al., 1992; Agar et al., 1995, 1998; Yildiz et al., 1998; Kucukoner and Yurt 2003; Acar et al., 2008), all on a dry weight basis.

'Kirmizi' and 'Siirt' are important cultivars in respect of yield and nut quality

characteristics among the Turkish pistachio cultivars and types. 'Ohadi' is an Iranian cultivar and it has high yield and round nut. The aim of this study was to compare the effect of pollens of different pollinators on nut quality, fat and protein content of some important pistachio cultivars.

MATERIALS AND METHODS

This research was carried out at the Ceylanpinar State Farm in Sanliurfa province of Turkey from 1998 to 2000 years. Average climatic data of research area are given in Table 1. Nine different male types synchronized to 'Kirmizi', 'Siirt' and 'Ohadi' female pistachio cultivars were used as pollinator. The male types were Males 1, 16 and 23 for 'Kirmizi'; Males 7, 12, 13 and 25 for 'Siirt'; and Males 18 and 22 for Ohadi cultivar.

Open pollination was used as control for each cultivar. Inflorescences were selected and tagged on each tree, and they were bagged prior to anthesis to exclude pollens.

Pollens from selected males were collected and used in artificial pollination for fertilization and fruit set, in order to compare the effect of male genotypes on nut quality, fat and protein content. Inflorescences that had some flowers with dehiscent anthers were removed from trees, brought into the laboratory, and spread over tissue paper. Pollens shed overnight was sieved and collected in laboratory conditions. Flowers were hand pollinated with fresh pollen of each male tree at anthesis, and pollinated flowers were re-bagged.

The fruits obtained from the pollinations were compared as to 100 nuts weight (g), split nut ratio (%), kernel ratio (%, kernel weight / nut weight x 100), blank nut ratio (%), kernel oil (%) with Soxholet method (Anonymous, 1970) and protein content (%) with Kjeldahl method (Kacar, 1982) for quality characteristics.

The data were analyzed by ANOVA test from the statistical package MSTAT. Fischer's Least Significant Difference (LSD) test was used for mean separation. Significant differences were determined at $p \leq 0.05$.

RESULTS AND DISCUSSION

Different Pollinators' Effects on Nut Quality of 'Kirmizi' Cultivar

According to the pomological characteristics, 100 nuts weight of Kirmizi crossed with males 1, 16 and 23 were higher than in which of 'Kirmizi' x open pollination. The highest split nut and kernel ratio values were obtained from 'Kirmizi' x open pollination and 'Kirmizi' x 23, respectively. The least blank nut had been found in 'Kirmizi' x 1. Total fat and protein content of Kirmizi cultivar was generally low. The highest fat content was observed in 'Kirmizi' x 23, and the highest protein value obtained from 'Kirmizi' x 16 (Table 2).

Different Pollinators' Effects on Nut Quality of 'Siirt' Cultivar

The highest 100 nuts weight was observed in 'Siirt' x 13. While the least 100 nuts weight value had been found in 'Siirt' x open pollination, the highest split nut was obtained from the same combination. The highest kernel ratio was obtained from 'Siirt' x 25 and the least blank nut ratio obtained from 'Siirt' x open pollination. Total fat ratio of 'Siirt' cultivar pollinated with different males ranged between 38.61 and 44.16%. The highest fat content detected in 'Siirt' x 25 and the least fat ratio had been found in 'Siirt' x 12. According to protein content, the highest value was obtained from 'Siirt' x open pollination (Table 3).

Different Pollinators' Effects on Nut Quality of 'Ohadi' Cultivar

With respect to 100 nuts weight in 'Ohadi' cultivar, there were no statistically significant differences between the pollinators, However, the highest split nut and kernel ratio, and the least blank nut ratio were obtained from Ohadi x 22. The fat ratio of 'Ohadi' was higher than of 'Kirmizi' and 'Siirt' cultivars. Fat and protein contents of 'Ohadi'

ranged between 45.52 and 48.00% in fat (%), and 18.38 and 20.39% in protein (%). The highest fat and protein contents were obtained from 'Ohadi' x open pollination (Table 4).

Experiment was conducted in the Ceylanpinar State Farm under the very low annual precipitation conditions, this is because the drought in 1998 to 2000 years (Table 1), which has adversely affected the nut quality.

In the Ceylanpinar State Farm conditions, average 100 nuts weight was 78.7 g in 'Kirmizi', 105.1 g in 'Siirt' and 107.6 g in 'Ohadi'; average kernel ratio was 41.8% in 'Kirmizi', 39.6% in 'Siirt' and 41.3% in 'Ohadi'. Blank nut formation affected by insufficient fertilization, severe drought conditions, lack of nutrition etc., and effects of different *Pistacia* species' pollens were unstable on protein and fat content of pistachio (Ak, 1992). Karaca and Nizamoglu (1995) reported that, splitting rate was 67% in 'Kirmizi', 86% in 'Siirt' and 95% in 'Ohadi'; fat content was 58.9% in 'Kirmizi', 56.7% in 'Siirt' and 58.9% in 'Ohadi', and protein content was 24.8% in 'Kirmizi', 20.9% in 'Siirt' and 23.2% in 'Ohadi'. Atli (1995) investigated the effect of different pollinators on 100 nuts weight of 'Uzun', 'Siirt' and 'Ohadi' pistachio cultivars, and he reported that the values ranged from 98.7 to 106.0 g for 'Uzun', 122.5 to 134.1 g for Siirt and 120.0 to 128.4 g for 'Ohadi'.

Splitting rate was 43.8% in 'Kirmizi', 66.5% in 'Siirt', 47.0% in 'Ohadi', 41.9% in Bilgen, 57.6% in Mumtaz and 32.4% in Vahidi, and blank nut ratio was 11.9% in Kirmizi, 11.4% in Siirt, 12.4% in Ohadi, 6.7% in Bilgen, 16.4% in Mumtaz and 17.3% in Vahidi pistachio cultivars grown in the Ceylanpinar State Farm (Ak, 1998).

Ak and Kaska (1998) reported that, effect of different *Pistacia* species pollens on fat and protein content of pistachio could change from year to year. They had found average fat and protein content in Kirmizi as 54.2% and 23.9%, in Siirt as 49.8% and 21.8% and in Ohadi as 50.6% and 21.0%, respectively. Agar et al. (1998) reported that, fat content ranged from 48.55% to 58.50% for domestic pistachio cultivars, and from 47.65% to 63.31% for Iranian cultivars.

Pontikis (1975) reported that, pollen of different *Pistacia* species and cultivars couldn't affect the protein content of pistachio. According to Acar et al. (2008), total fat ratio of pistachio cultivars ranged between 35.38 and 51.68 %. The highest lipid content detected in Sel-5 (51.68 %) and it was followed by Vahidi (50.56 %). The least lipid ratio had been found in Mumtaz (35.38%) and Barak Yildizi (38.83 %) cultivars. The fat ratio of Uzun, Siirt and Ohadi were 41.74%, 42.11% and 42.12%, respectively.

In general, nut quality values of the Kirmizi, Siirt and Ohadi pistachio cultivars were lower than those reported by the previous researches. This could be related to poor soil conditions, insufficient care, high temperatures and rainfed conditions at Ceylanpinar during the experiments. Results of our study showed that pollinators affect nut quality in pistachio.

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Tables

Table 1. Average climatic data of research area during three years (1998-2000) in Ceylanpinar State Farm in Sanliurfa.

Months	Temperatures (°C)			Relative Humidity (%)	Annual Precipitation (mm)
	Minimum	Average	Maximum		
January	-5.1	5.7	17.3	68.8	45.2
February	-5.0	6.7	19.7	57.8	26.4
March	-2.3	10.3	25.7	56.7	35.8
April	3.3	17.2	33.1	55.7	35.6
May	9.6	23.8	33.4	40.7	6.0
June	14.9	30.0	43.4	33.0	0.5
July	17.3	33.7	46.6	33.7	0.0
August	17.8	31.7	45.9	34.0	0.0
September	11.0	25.9	38.8	37.3	0.0
October	4.1	19.3	35.7	41.5	7.3
November	-0.8	13.1	27.1	44.9	8.5
December	-2.9	8.3	19.7	65.6	43.3

Table 2. Nut quality characteristics of 'Kirmizi' cultivar pollinated with different male types averaged over three years.

Combinations	100 nuts weight (g)	Split nut ratio (%)	Kernel ratio (%)	Blank nut ratio (%)	Fat content (%)	Protein content (%)
Kirmizi x 1	79.40 a	32.95 b	48.65 ab	29.68 b	39.73 b	18.99 a
Kirmizi x 16	78.77 a	25.31 c	47.12 c	37.02 a	42.06 a	19.09 a
Kirmizi x 23	78.32 a	27.60 c	49.38 a	31.34 b	43.51 a	18.23 b
Kirmizi x Open Poll	74.00 b	36.92 a	47.93 bc	30.15 b	42.32 a	19.08 a
LSD ($p \leq 0.05$)	1.58	3.69	0.93	2.74	1.92	0.52

Letters next to numbers indicate different groups determined by LSD test ($p \leq 0.05$), NS: Not significant

Table 3. Nut quality characteristics of 'Siirt' cultivar pollinated with different male types averaged over three years.

Combinations	100 nuts weight (g)	Split nut ratio (%)	Kernel ratio (%)	Blank nut ratio (%)	Fat content (%)	Protein content (%)
Siirt x 7	90.85 b	23.79 b	44.48	35.15 ab	40.54 b	17.83
Siirt x 12	90.39 b	17.53 b	44.01	38.90 a	38.61 c	17.68
Siirt x 13	96.34 a	24.59 b	43.24	34.13 ab	43.54 a	17.51
Siirt x 25	90.86 b	23.90 b	45.10	37.05 a	44.16 a	17.71
Siirt x Open Poll.	84.48 c	35.01 a	44.77	27.82 b	43.56 a	18.08
LSD ($p \leq 0.05$)	5.12	7.79	NS	7.81	1.38	NS

Letters next to numbers indicate different groups determined by LSD test ($p \leq 0.05$), NS: Not significant

Table 4. Nut quality characteristics of 'Ohadi' cultivar pollinated with different male types averaged over three years.

Combinations	100 nuts weight (g)	Split nut ratio (%)	Kernel ratio (%)	Blank nut ratio (%)	Fat content (%)	Protein content (%)
Ohadi x 18	75.20	3.90 c	44.32 b	23.91 b	45.52 c	18.38
Ohadi x 22	76.65	9.71 a	46.07 a	11.85 c	46.64 b	18.38
Ohadi x Open Poll.	76.53	6.84 b	43.85 b	33.50 a	48.00 a	20.39
LSD ($p \leq 0.05$)	NS	0.88	1.49	3.09	0.48	NS

Letters next to numbers indicate different groups determined by LSD test ($p \leq 0.05$), NS: Not significant