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Fertilization Biology of Some Grape Varieties (*Vitis vinifera* L.)

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Abstract: In this study, fertilization biology of Burdur dimriti, Sariemin, Tilki kuyrugu, Razaki, Buzgulu, Siyah buzgulu and Siyah gemre grape varieties (*Vitis vinifera* L.) which are grown in Isparta, Turkey ecological conditions was investigated. For this purpose, rates of fruit set obtained from open pollination and isolation experiment were determined in vineyard. Furthermore, pomological analyses were done to determine the effects of experiments on fruit quality. It was determined that fruit set levels varied between 30.0% and 40.6% in open pollination, 15.0% and 34.3% in isolation experiment. In the study, Siyah dimrit, Sariemin, Tilki kuyrugu, Razaki and Siyah gemre varieties with hermaphrodite flowers were self-fertile, but Siyah buzgulu variety having hermaphrodite flower was found partially self-fertile and Burdur dimriti with hermaphrodite flowers and Buzgulu with morphological hermaphrodite-physiological female flowers were found self-unfertile.

Key words: Fruit set, fruit quality, fertilization biology, grape, vitis

Introduction

The low quantity and quality in viticulture is an important problem in many vineyards. The quantity and quality in viticulture relates to vine number per area and number and size of clusters and berries as well. However, these characteristics are affected by several internal and external factors such as variety, rootstock, cultural experiments and ecological conditions (Odabas, 1976). In process from creating primordial clusters to maturation of grapes, there have been many effective factors in quantity and quality. One of the fundamental factors in quantity and quality is characteristics of the fertilization biology of grape varieties.

There are many differences among the grape varieties grown in terms of areas and regions. Among these grape varieties, there may also be self-fertile, partially self-fertile or self-sterile ones. While establishing the vineyards, if there is not a good pollinezer for partially self-fertile or self-sterile varieties, it is not possible to take enough product quantity and quality. For this reason, it is necessary to determine the fertilization biology of grapes for both determining unfertile varieties and success of breeding studies. Therefore, fertilization biology of grapevine have been investigated in many studies (Fidan and Celik, 1979; Saaman *et al.*, 1981; Bindra, 1989; Wang *et al.*, 1993; Ebadi *et al.*, 1995; Tzolava, 1996; Kelen *et al.*, 1996a; Kelen *et al.*, 1996b; Eti *et al.*, 1998; Kimura *et al.*, 1998; Persuric *et al.*, 1998; Hu *et al.*, 1999; Nesmith, 1999). This study was carried out to determine the fertilization biology of eight grape varieties (*Vitis vinifera* L.) grown in Isparta, Turkey. For this reason, flowering periods of these varieties, the effects of isolation and open

pollination on fruit set and quality were investigated.

Materials and Methods

This study was carried out in a twenty-year-old vineyard, trained with the middle high goblet system, in Isparta, Turkey. In this study, Burdur dimriti, Siyah dimrit, Sariemin, Tilki kuyrugu, Razaki, Siyah buzgulu and Siyah gemre and Buzgulu varieties were used as materials. This study was conducted on four healthy vines selected from per variety.

In order to determine the fruit set capacity, 25x30 cm of cloth bags were used in the isolation experiments and nothing was done for the open pollination. For both of the pollination experiments, eight clusters were chosen from each variety when there was no blooming on clusters but they were just about to bloom. The flowers on these clusters were counted and the clusters were labelled. Four of those labelled clusters were put in cloth bags while the rest of clusters were left for the open pollination. In flowering season, the clusters in cloth-bags were sometimes shaken by hands. The clusters were counted four times in twenty-day periods to determine the changes in fruit set capacity and the fifth counting was done during the harvest. Statistical analysis was performed on angle values of percentages and the averages were compared according to the Duncan's Multiple Range Test. The real numbers were used in the tables of articles. In order to determine the effects of pollination experiment on fruit quality, the berry width and length (mm), berry weight (g), seed numbers (n), seed weight (mg), TSS (Total Soluble Solid) (%) and titratable acidity capacity (g L⁻¹) were determined. The experiment was established

according to the randomized design with four replication and 50 berries in each replication. The data obtained were analysed statistically and the differences were evaluated according to the Duncan's Multiple Range Test.

Results

Phenological Observations: The flowering and harvest date were varied for varieties. The earliest flowering date was the first of June for the Burdur dimriti and the latest was the sixteenth of June for the Buzgulu. The shortest flowering period in varieties was thirteen days in the Siyah dimrit and the longest period was seventeen days in the Burdur dimriti (Table 1).

The Effects of the Open Pollination and Isolation Experiment on Fruit Set: In the counting 20 days after flowering, it was found that the highest fruit set were 78.6 and 72.0%, in the Burdur dimriti and Sariemin,

respectively in the open pollination. The lowest fruit set levels were determined 44.3, 48.0 and 51.3% in the Buzgulu, Razaki and Siyah buzgulu, respectively in the isolation experiment. In the counting 40 days after flowering, the highest fruit set were found 52.0, 51.6, 51.3 and 49.6% in the Siyah gemre, Buzgulu, Siyah buzgulu and Razaki, respectively in the open pollination and 49.3% in the Sariemin in the isolation experiment. The lowest fruit set were determined 31.6% and 33.6% in the Burdur dimriti and Siyah buzgulu, respectively in the isolation experiment. In the counting 60 days after flowering, the highest fruit set rates were found 46.3, 42.3 and 42.3%, in the Buzgulu, Razaki and Siyah gemre, respectively in the open pollination. The lowest fruit set level was determined 23.3% in the Burdur dimriti in the isolation experiment. At harvest time, the fruit set of varieties changed between 30.0 and 40.6% in the open pollination and 15.0 and 34.3% in the isolation experiment. The highest fruit set

Table 1: Flower types, flowering season and harvest date of the grape varieties (1999)

Varieties	Flower types	Beginning flowering	Full flowering	End of flowering	Harvest date
Burdur dimriti	h*	01.06	11.06	17.06	08.09
Siyah dimrit	h	11.06	16.06	23.06	19.09
Sariemin	h	11.06	19.06	26.06	06.09
Tilki kuyruğu	h	14.06	22.06	28.06	09.10
Razaki	h	13.06	21.06	28.06	06.09
Buzgulu	mhpf**	16.06	23.06	29.06	13.10
Siyah buzgulu	h	12.06	20.06	26.06	08.09
Siyah gemre	H	07.06	16.06	22.06	27.09

* hermaphrodite ** morphological hermaphrodite-physiological female

Table 2: Fruit set levels in the pollination experiments (%)

Varieties	Counting Dates							
	20 Days after flowering		40 Days after flowering		60 Days after flowering		Harvest time	
	Open	Isolation	Open	Isolation	Open	Isolation	Open	Isolation
Burdur dimriti	78.6a*	55.3efg	43.6cd	31.6f	33.6cde	23.3f	32.3 abcd	15.0e
Siyah dimrit	51.6 fgh	55.4efg	35.3ef	39.3de	33.7cde	36.0 bcde	30.3bcd	28.0bcd
Sariemin	72.0ab	62.4cde	42.3d	49.3abc	32.3de	34.0 cde	30.0bcd	27.3cd
Tilki kuyruğu	70.6b	67.3bc	45.0bcd	44.0cd	38.6bcd	37.3 bcde	34.3 abcd	34.3abcd
Razaki	66.0 bcd	48.0gh	49.6abc	40.0de	42.3ab	35.6 bcde	36.3abc	33.0 abcd
Buzgulu	53.6fg	44.3h	51.6ab	40.3de	46.3a	34.0 cde	40.6a	29.6bcd
Siyah buzgulu	59.3def	51.3fgh	51.3ab	33.6ef	39.6bc	31.3e	38.0ab	24.6d
Siyah gemre	67.0bc	57.3ef	52.0a	44.2cd	42.3ab	35.3cde	36.6abc	30.6 abcd

*Mean separation within columns by Duncan Multiple Range Test, p<0.05

Table 3: The effects of pollination experiments on berry width, length and weight

Varieties	Fruit Quality Criteria					
	Berry width (mm)		Berry length (mm)		Berry weight (g)	
	Open	Isolation	Open	Isolation	Open	Isolation
Burdur dimriti	18.04b*	09.02f	21.19d	12.62g	4.13cd	1.41f
Siyah dimrit	14.11e	13.88e	15.71g	15.79f	2.20e	2.17e
Sariemin	17.98bc	18.36ab	18.27e	18.83e	3.56d	3.99cd
Tilki kuyruğu	17.79bc	18.28ab	23.66ab	24.77a	4.59bc	4.90ab
Razaki	18.73ab	19.70a	22.82bc	23.81ab	5.08ab	5.43a
Buzgulu	17.83bc	06.16g	21.63cd	08.45h	4.07cd	0.49g
Siyah buzgulu	15.79d	16.58cd	15.96f	16.73f	3.44d	4.06cd
Siyah gemre	17.98bc	18.36ab	18.27e	18.83e	3.56d	3.99cd

*Mean separation within columns by Duncan Multiple Range Test, p<0.05

Table 4: The effects of pollination experiments on seed number, seed weight, TSS and acidity

Varieties	Pollination Experiments and Fruit Quality Criteria							
	Seed number (n)		Seed weight (mg)		TSS (%)		Acidity (g L ⁻¹)	
	Open	Isolation	Open	Isolation	Open	Isolation	Open	Isolation
Burdur dimriti	1.32fg*	0.61h	27.6bcd	28.4bc	12.8b	12.5b	4.60cde	5.04bcde
Siyah dimrit	1.33fg	1.33fg	27.2bcde	28.5bc	15.8a	15.5a	5.56bcde	6.78abc
Sariemin	2.04cd	1.92d	28.0bcd	28.3bc	13.1b	12.2b	6.09bcd	4.26de
Tilki kuyruğu	2.21b	2.16bc	23.4e	25.3cde	13.0b	12.5b	6.87ab	5.70 bcde
Razaki	1.65e	1.20g	43.9a	44.5a	13.3b	12.6b	8.61a	8.49a
Buzgulu	2.00cd	0.02i	27.2bcde	29.8b	11.8b	11.6b	5.64bcde	6.14bcd
Siyah buzgulu	2.16bc	2.61a	24.2de	24.1de	13.3b	12.7b	3.60e	5.58 bcde
Siyah gemre	1.32fg	1.48f	45.2a	42.3a	13.1b	12.2b	5.70bcde	6.76abc

*Mean separation within columns by Duncan Multiple Range Test, p<0.05

rates were found 40.6, 38.0, 36.6, 36.3, 34.3 and 32.3% in the Buzgulu, Siyah buzgulu, Siyah gemre, Razaki, Tilki kuyruğu and Burdur dimriti, respectively in the open pollination and 34.3, 33.0 and 30.6% in the Tilki kuyruğu, Razaki and Siyah gemre, respectively in the isolation experiment. The lowest fruit set level was found 15.0% in the Burdur dimriti in the isolation experiment (Table 2). In the isolation experiment, it was determined that most of berries of the Buzgulu and Burdur dimriti varieties were set parthenocarpic, but berries of the other varieties were set normally.

The Effects of the Open Pollination and Isolation Experiment on Fruit Quality:

The highest berry widths were found 19.70, 18.36, 18.36 and 18.28 mm in the Razaki, Siyah gemre, Sariemin and Tilki kuyruğu, respectively in the isolation experiment and 18.73 mm in the Razaki in the open pollination. The lowest berry width was determined 6.16 mm in the Buzgulu in the isolation experiment. The highest berry length were determined in the Tilki kuyruğu and Razaki with 24.77 mm and 23.81 mm, respectively in the isolation experiment and in the Tilki kuyruğu with 23.66 mm in the open pollination. The lowest berry length was found in the Buzgulu with 8.45 mm in the isolation experiment. The highest berry weight were determined in the Razaki and Tilki kuyruğu with 5.43 g and 4.90 g, respectively in the isolation experiment and in the Razaki with 5.08 g in the open pollination. The highest and the lowest seed number were found in the Siyah buzgulu with 2.61 and in the Buzgulu with 0.02, respectively in the isolation experiment. The highest seed weight were determined 45.2 mg and 43.9 mg in the Siyah gemre and Razaki, respectively in the open pollination and 44.5 mg and 42.3 mg in the Razaki and Siyah gemre, respectively in the isolation experiment. The highest TSS were found in the Siyah dimrit with 15.8% and 15.5% in the open pollination and in the isolation experiment, respectively. The highest acidity were determined in the Razaki and Tilki kuyruğu with 8.61 and 6.87 g L⁻¹, respectively in the open pollination and in the Razaki, Siyah dimrit and Siyah

gemre with 8.49, 6.78 and 6.76 g L⁻¹, respectively in the isolation experiment.

Discussion

In the study, it was determined that fruit set levels varied with regard to variety and pollination experiment. Similar conclusions were drawn in the studies of Wang *et al.* (1993); Kelen (1996a); Tsoleva (1996); Kimura *et al.* (1998); Persuric *et al.* (1998); Nesmith (1999). Fruit set levels were found 30.0 – 40.6% in the open pollination and 15.0 – 34.3% in the isolation experiment. In the Burdur dimriti and Buzgulu, fruit set levels were considerably decreased and berries were mostly set parthenocarpic in the isolation experiment, but berries were set normally in the open pollination. Fruit set rates of the Burdur dimriti and Buzgulu were found 32.3% and 40.6% in the open pollination and 15.0% and 29.6% in the isolation experiment. This case shows that those varieties are self-unfertilized. In addition, Fruit set level of Siyah buzgulu was clearly decreased in the isolation experiment, but berries set normally. Siyah buzgulu may be accepted partially self-fertile.

After corolla fall, it was determined that there was a general heavy shedding of undeveloped fruitlets of varieties. Fruit drops were heavily in the first counting. These are presumed to be mostly from unfertilized flowers. Although later drops were decreased considerably, those drops were continued to harvest date. It is thought that those drops must be affected such as insufficient of fertilization and nutrition, physiological causes, growth regulators factors and environmental factors. The selective shedding of some fruits and the retention of others is, at present, not understood (Westwood, 1995). Fruit quality with regard pollination experiment were not changed in varieties except from Burdur dimriti and Buzgulu. In isolation experiment, berry width, length, weight and seed number of Burdur dimriti and Buzgulu were decreased considerably. It is thought that this decrease in those varieties took from parthenocarpic set of berries.

In the open pollination experiment, the berry width of the Burdur dimriti and Buzgulu varieties were 18.04 and 17.83 mm, respectively while they were 9.02 and 6.16 mm, respectively in the isolation experiment. In the open pollination experiment, the berry length of the Burdur dimriti and Buzgulu were 21.19 and 21.63 mm, respectively while they were 12.62 and 8.45 mm, respectively in the isolation experiment. In the isolation experiment, the berry weights of these varieties were 1.41 and 0.49 g, respectively while they were 4.13 and 4.07 g in the open pollination experiment. The seed numbers of the Burdur dimriti and Buzgulu were 1.32 and 2.00 in the open pollination experiment while they were 0.61 and 0.02 in the isolation experiment (Table 3 and 4). However, there were no any statistically differences between the isolation and open pollination experiments in terms of seed weight, TSS and acidity in Burdur dimriti and Buzgulu. Furthermore, it was determined that there were no any statistically differences between isolation and pollination experiment in the other varieties in terms of fruit quality characteristics.

Results obtained from this research summarised as follows;

1. Among grape varieties was determined 15 and 35 day differences in respect of starting of flowering and harvest date, respectively.
2. Fruit set levels varied 30.0 – 40.6% and 15.0 – 34.3% in open pollination and isolation experiment, respectively.
3. Burdur dimriti with hermaphrodite flowers and Buzgulu with morphological hermaphrodite-physiological female flowers were found self-unfertile, Siyah buzgulu variety having hermaphrodite flower was found relatively self-fertile, but the others varieties were determined self-fertile with regard to fruit set and quality.
4. Berries of Buzgulu and Burdur dimriti were mostly set parthenocarpic in isolation experiment.
5. In isolation experiment, berry width, length, weight and seed number of Burdur dimriti and Buzgulu were decreased considerably, however there were not any statistically differences in terms of seed weight, TSS and acidity.
6. Any differences between open pollination and isolation experiment was not found in respect of fruit quality in the Siyah dimrit, Sariemin, Tilki kuyrugu, Razaki, Siyah buzgulu and Siyah genre varieties.
7. In order to have berry at adequate amount and quality from Buzgulu and Burdur dimriti varieties, it is necessary to determine appropriate pollinizers and to pay attention to these results while establishing vineyard.

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