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Comparison of Some Raspberry Cultivars' Herbal Features by Repeated Random Complete Design Statistic Technique

¹S. Peral Eyduran, ¹Y. Sabit Ağaoğlu, ²Ecevit Eyduran and ²Taner Özdemir

¹Department of Horticulture, Faculty of Agriculture, Ankara University, 06110 Ankara, Turkey

²Department of Animal Science, Faculty of Agriculture, Yüzüncü Yıl University, 65080 Van, Turkey

Abstract: The aim of this study was comparatively to examine herbal traits of the cultivars such as Rubin, Summit, Holland Dwarf, Heritage, Tulameen, Aksu Red, Nuburg, Canby and Willamette red raspberries cultivated at Ankara Condition, in the capital of Turkey between 2002 and 2005. According to Repeated Random Complete Design (RRCd) (which was composed of four random plot design experiments) used in the experiment, the effects of cultivar, year and cultivar by year interaction on herbal traits such as the height of shoot, diameter of shoot, number of shoot, fruitfulness of shoot and weight of fruit were further more significant ($p < 0.0001$). Besides, determination coefficients of RRCd for traits ranged from 95.60 to 99.94% (very-high). As a result, we concluded in Ankara condition that as to herbal traits such as the height of shoot, diameter of shoot, number of shoot, fruitfulness of shoot and weight of fruit, Willamette cultivar were more superior to others. In addition, we can suggest that researchers should analyze using RRCd because Determination Coefficients of RRCd for all traits were much more found.

Key words: Raspberry, farming, repeated random complete design

INTRODUCTION

Raspberry is a thorny shrub, the height of which is about 1-1.5 m and has red fruits, efflorescences in June and July and run into in the areas where there are mountains and groves. It is a common plant in European continent and Northern Anatolia. The best places for raspberry growth are the places which are cold in summer and do not have rain in harvest period. In the places in where the summers are hot and windy, the growth decreases and the fruits start to begin small and with much seed. Farming should not be done in very hot regions. Because hot weathers before the harvest time causes the fruits to mellow before maturing. The best farming can be done in the regions where it rains between 750-800 mm. The earthen is not a big problem. But if it is grown in suitable earthen, fruitfulness increases. The best earthen are the ones which are rich in terms of organic substances, keep the water more and have good drainage. In our country raspberries are grown in the regions over 1000 m and have much humidity. The raspberry, which grows brutal especially in Black Sea region and Bursa, is commonly produced in England and America (www.ziraatci.com).

In order to spot the herbal features of raspberry, several researches were carried out. For example, in 1999

and 2000, in Tokat, an adaptation research was done with some raspberry cultivars. As a result, the average shoot amount was found to be between 3.0 (Summit)-17.1 (Willamette). When we have a look the weight of fruits in Tokat ecology in 1999 and 2000, the species Bursa Dwarf (1.27 g), Heritage (1.54 g) and Nuburg (1.70 g) are the ones which have the smallest fruits. Summit, Willamette, Canby, Cola II, Aksu Dwarf, Meeker and Holland Dwarf kinds' fruit weight are found to be 2.0 g and over (Gerçekçioğlu *et al.*, 2003).

In another research, carried out in Bursa ecology, with seven raspberry kinds, the average shoot numbers are declared to be 7.2 (Bursa Dwarf)-2.5 (Aksu Red) and the found data was measured between 1999 and 2000. In the adaptation research, done in Bursa, the shoot weights are declared to be found between 121.45 (Aksu Red)-80.15 cm (Summit) (Barut, 1999).

According to results of another research, carried out in Giresun, with 12.0 mm shoot diameter, the Heritage kind is found to be the most and with 6.3 mm Cola II kind was found to be the worst (Kurt *et al.*, 2003).

Raspberry fruits divide into 4 groups, when they evaluated about the color. These are red, black, purple and yellow. According to Jennings (1988) red raspberries are grown in; Northern Europe, Eastern Europe, Northeast Pacific, Northern America, Western America, Western

Africa, Italy Scandinavia Countries, Argentina, New Zealand and Chile, the black raspberries are grown in eastern parts of Oregon region and Northeast Pacific, the purple raspberries are grown in northern parts of Northern America. Apart from all these, raspberries with yellow fruits is gaining a significance day by day. These are examined under the species with red fruits and these plants grew as a result of a mutation.

When somebody wants to form a raspberry garden, he has to prefer northern parts. The western parts are dangerous in terms of spring frosts. Raspberry plants can stand on the temperature at most -25°C . Ankara (Ayaş) is very suitable region for growth because there is a microclimate condition. In our tests Rubin, Summit, Holland Dwarf, Heritage, Tulameen, Aksu red, Nuburg, Canby and Willamette red raspberry kinds were used.

Present research was carried out in Ankara (Ayaş) conditions during 2002-2005. There were 9 raspberry cultivars and our aim was to determine which of them would show the best adaptation. We made two different experiments on Heritage cultivar. From Heritage I, we could get the fruit only in autumn and from Heritage II we got fruit both in autumn and spring. Our aim was to determine whether it is advantageous to get single product or double product from Heritage kind (Atila *et al.*, 2006).

MATERIALS AND METHODS

The experiments on adaptation of different ten cultivars (Rubin, Summit, Holland Dwarf, Heritage I, Heritage II, Tulameen, Aksu Red, Nuburg, Canby and Willamette) were carried out throughout 2002-2005 in Research Station of Horticulture, Faculty of Agriculture, Ankara University. Two rows of each shrub plants set at 1.5×2 m spacing. Raspberries were harvest at twice a year for each year; pre-harvest 4th July and post-harvest 15th August and pre-harvest were merely based on because yield of the raspberries in post-harvest were little. At pre-harvest, the raspberries were weighed fresh fruit and average fruit weight were calculated from a-50 fruit sample randomly selected from every one of three plots of each raspberry variety. Soluble solids of berries ($^{\circ}\text{Brix}$) were measured by digital refractometer. Using 15 shrub plants in each plot, Cane diameter was determined by means of cumpase and cane height was measured. Cane number was determined by dividing the number of root shoots by six in each plot because six shrub plants were in each row (1.5×2 m). Cane fruitful were found. Fruit weight of average \times side cane numbers of average \times side cane which was being fruit cluster numbers of average \times each cluster to grain numbers of average. As a result, the experiments

were conducted on 3 replicates for every cultivar as regards each pomological trait in every year.

The experiment was designed as Repeated Random Complete Design (RRCD), composed of 3 replicates and balanced-design (10 varieties \times 4 year \times 3 replicates), Data of each trait at Repeated Random Complete Design (RRCD) were evaluated by GLM procedure of SAS program (SAS, 1998).

The statistic model of experiment design can be written as follows:

$$Y_{ijk} = \mu + a_i + b_j + (ab)_{ij} + e_{ijk} \quad (1)$$

Where,

- Y_{ijk} : the product amount in j. year of k. replication in I. cultivar (Rubin, Summit, Holland Dwarf, Heritage I, Heritage II, Tulameen, Aksu Red, Nuburg, Canby, Willamette)
 μ : General mean
 a_i : i^{th} cultivar effect
 b_j : j^{th} year (2002, 2003, 2004 and 2005) effect
 $(ab)_{ij}$: i^{th} cultivar by j. year, interaction effect
 e_{ijk} : Random error

Besides, Determination Coefficient, Model R-Square, of statistic model mentioned above for each trait was calculated as %. When the hypothesizes regarding between cultivars, between years and cultivar by year interaction were statistically significant, comparisons of sub-groups regarding cultivar and year effects were evaluated by Duncan's Multiple Range Test in GLM procedure of SAS program (SAS, 1998).

RESULTS AND DISCUSSION

There were extremely significant the effects of cultivar, year and cultivar by year interaction on pomological traits such as the number, height, diameter, yield of cane and fruit weight ($p < 0.001$) (Table 1). Besides, corresponding Model R-square values for each trait were highly found (almost 100%) as: 99.03, 99.69, 95.60, 99.56 and 99.94%, respectively.

As a result of statistical studies, when the shoot numbers are examined in terms of species in Ankara conditions, when the Willamette (76.73), Heritage II (51.28) and Tulameen (31.03) takes the first three, the Canby (14.10) kind took attention by getting the least shoot number. When the years are compared in terms of the shoot numbers per plant, the order of years with the most shoot numbers are spotted to be 2003, 2005, 2004 and 2002 (Table 2).

Table 1: ANOVA tables regarding the number, height, diameter, yield of shoot and fruit weight traits

Source	df	Sum of squares	Mean square	F-value	Prob.
Cane number trait					
Year	3	235.24300	78.41433	14.98	<0.0001
Cultivar	9	41623.53800	4624.83756	883.56	<0.0001
Year* Cultivar	27	711.35200	26.34637	5.03	<0.0001
Error	80	418.74667	5.23433		
Corrected total	119	42988.87967			
Model R ² : 99.03% Coefficient of variation : 7.76%					
Cane height trait					
Year	3	23154.07500	7718.02500	1521.77	<0.0001
Cultivar	9	93188.85300	10354.31700	2041.57	<0.0001
Year* Cultivar	27	14829.10500	549.22611	108.29	<0.0001
Error	80	405.7400	5.0718		
Corrected total	119	131577.7730			
Model R ² : 99.69% Coefficient of variation : 1.736%					
Cane diameter trait					
Year	3	12.9262500	4.3087500	22.24	<0.0001
Cultivar	9	221.5387500	24.6154167	127.05	<0.0001
Year* Cultivar	27	102.9562500	3.8131944	19.68	<0.0001
Error	80	15.5000000	0.1937500		
Corrected total	119	352.9212500			
Model R ² : 95.60% Coefficient of variation : 4.509%					
Cane yield trait					
Year	3	6237.80625	2079.26875	816.76	<0.0001
Cultivar	9	36458.94675	4050.99408	1591.28	<0.0001
Year* Cultivar	27	3735.80625	138.36319	54.35	<0.0001
Error	80	203.66000	2.54575		
Corrected total	119	352.9212500			
Model R ² : 99.56% Coefficient of variation : 2.666%					
Fruit weight					
Year	3	0.05390250	0.01796750	72.35	<0.0001
Cultivar	9	30.84156750	3.42684083	13799.4	<0.0001
Year* Cultivar	27	1.20922250	0.04478602	180.35	<0.0001
Error	80	0.01986667	0.00024833		
Corrected total	119	32.12455917			
Model R ² : 99.94% Coefficient of variation : 0.822%					

Table 2: Mean and standard error values of shoot number trait of 10 raspberry cultivars during 2002-2005

Cultivars	2002	2003	2004	2005	Row average
Aksu red	16.2±0.12efg	20.30±0.12ef	19.50±0.58de	18.10±0.06fg	18.53±0.49F
Canby	13.0±0.58g	15.60±0.06g	13.70±0.58f	14.10±0.06h	14.10±0.34G
Heritage I	15.2±0.12fg	17.97±0.44fg	16.20±0.12ef	30.30±0.06d	19.92±1.83EF
Heritage II	52.0±0.58b	55.80±0.06b	49.70±0.06b	47.60±0.06b	51.28±0.93B
Holland dwarf	22.2±0.12d	25.00±0.06d	22.00±0.58d	21.20±0.12ef	22.60±0.45D
Nuburg	18.5±0.12def	23.50±0.12de	21.30±0.06d	19.40±0.12fg	20.68±0.58DE
Rubin	19.7±0.06de	20.80±0.06ef	16.70±0.06ef	15.80±0.12gh	18.25±0.62F
Summit	20.2±0.12de	23.00±0.58de	20.00±0.58de	23.70±0.12e	21.73±0.53DE
Tulameen	27.8±0.12c	31.00±0.58c	30.00±5.77c	35.30±0.12c	31.03±1.49C
Willamette	75.6±0.12a	78.40±0.12a	72.40±0.12a	80.50±5.77a	76.73±1.54A
Column average	28.04±3.54B	31.14±3.55A	28.15±3.32B	30.60±3.61A	29.48±1.74

^{ab} Difference between two means with different small letter(s) in same year were significant at p<0.05 (comparison of varieties for each year or interaction), ^{A,B} Difference between two means with different capital letter(s) in the row of column average were significant at p<0.05 (comparison of years), Difference between two means with different capital letter(s) in the column of row average were significant at p<0.05 (comparison of cultivars)

In the research, when we look to the average of shoot weight in terms of kinds; when the Willamette (183.88 cm), Aksu Red (158.93 cm) and Canby (155.08 cm) takes the first three, the Summit (88.78 cm) took attention to be the one which got the least shoot weight. When we make a comparison in terms of years, the order from the most to the least is 2003, 2002, 2005 and 2004 (Table 3).

Between 2002 and 2005, when we look to the average of shoot diameter, the first three is Rubin (12.50 mm), Willamette (11.23 mm) and Heritage II (10.65 mm) and the last was the Nuburg (8.43 mm). When we make a comparison in terms of years, the order is 2003, 2005, 2004 and 2002 (Table 4).

In the research, when the fruitfulness of shoots per plant is compared in terms of species, the first three is

Table 3: Mean and standard error values of shoot height (cm) trait of 10 raspberry cultivars during 2002-2005

Cultivars	2002	2003	2004	2005	Row average
Aksu red	178.4±0.12b	180.80±5.77b	133.80±0.06b	142.70±0.06c	158.93±6.43B
Canby	171.1±0.06c	178.60±0.12b	105.50±0.06f	165.10±0.06b	155.08±8.75C
Heritage I	107.2±0.06h	116.30±0.12g	110.50±0.06e	100.30±0.12f	108.58±1.74H
Heritage II	114.3±0.06g	133.20±0.06e	107.80±0.12ef	121.80±0.06d	119.28±2.85F
Holland dwarf	111.5±0.12g	120.10±0.06f	94.10±0.06h	85.60±0.12h	102.83±4.12I
Nuburg	121.0±0.58f	130.00±5.77e	99.80±0.06g	97.60±0.12f	112.10±4.34G
Rubin	160.7±0.12d	165.40±0.06c	129.20±0.12c	97.20±0.06f	138.13±8.27D
Summit	88.3±0.12i	98.60±0.12h	78.10±0.58i	90.10±0.06g	88.78±2.20J
Tulameen	139.8±0.12e	152.50±0.06d	120.60±0.12d	105.50±0.06e	129.60±5.42E
Willamette	196.90±0.06a	198.60±0.12a	158.60±0.12a	181.40±0.12a	183.88±4.84A
Column average	138.92±6.35B	147.41±5.81A	113.80±4.01D	118.73±5.87C	129.72±3.04

^{a,b}Difference between two means with different small letter(s) in same year were significant at p<0.05 (comparison of cultivars for each year or interaction), ^{A,B}Difference between two means with different capital letter(s) in the row of column average were significant at p<0.05 (comparison of years), Difference between two means with different capital letter(s) in the column of row average were significant at p<0.05 (comparison of cultivars)

Table 4: Mean and standard error values of shoot diameter (mm) trait of 10 raspberry cultivars during 2002-2005

Cultivars	2002	2003	2004	2005	Row average
Aksu red	9.7±0.12c	10.60±0.12c	11.20±0.12a	11.60±0.12a	10.78±0.22C
Canby	9.8±0.06c	9.90±0.58cd	7.50±0.58f	7.80±0.12d	8.75±0.38E
Heritage I	9.7±0.12c	10.20±0.12cd	9.30±0.06c	9.90±0.06b	9.53±0.15D
Heritage II	11.3±0.12b	11.70±0.06b	9.70±0.06bc	8.90±0.06c	10.65±0.26C
Holland dwarf	6.2±0.12f	7.10±0.06g	10.20±0.12b	11.00±0.58a	8.63±0.62E
Nuburg	7.6±0.12e	8.50±0.58f	9.10±0.06cd	8.50±0.58cd	8.43±0.24E
Rubin	13.1±0.06a	14.20±0.06a	11.80±0.06a	10.90±0.06a	12.50±0.38A
Summit	8.3±0.12de	9.60±0.06de	8.40±0.06de	8.50±0.58cd	8.70±0.20E
Tulameen	8.5±0.12d	9.10±0.06ef	7.90±0.06ef	8.30±0.12cd	8.45±0.14E
Willamette	10.90±0.06b	12.30±0.06b	10.30±0.58b	11.40±0.06a	11.23±0.25B
Column average	9.51±0.35B	10.32±0.36A	9.54±0.25B	9.68±0.27B	9.76±0.16

^{a,b}Difference between two means with different small letter(s) in same year were significant at p<0.05 (comparison of cultivars for each year or interaction) ^{A,B}Difference between two means with different capital letter(s) in the row of column average were significant at p<0.05 (comparison of years), Difference between two means with different capital letter(s) in the column of row average were significant at p<0.05 (comparison of cultivars)

Willamette (102.0 g), Tulameen (73.20 g) and Heritage II (68.30 g) and the kind which has the least shoot fruitfulness was found to be Nuburg (37.05 g). When we make a comparison in terms of the years, the order is 2005, 2003, 2004 and 2002 (Table 5).

Between 2002 and 2005, when the kinds' fruit weights are compared, the first three is Willamette (3.00 g), Tulameen (2.49 g) and Canby (2.19 g) and the kind which has the least fruit weight is Summit (1.10 g). When we make a comparison in terms of years, the order is 2003, 2005, 2004 and 2002 (Table 6).

In 1999 and 2000, with some raspberry species, an adaptation research was carried out in Tokat. As a result, the average shoot numbers were found to be between 3.0 (Summit)-17.1 (Willamette)(Gerçekçioğlu *et al.*, 2003). The result of our studies, carried out in Ankara conditions between 2002 and 2005, have similarities with the researchers studies' results (Atila *et al.*, 2006). At the result of our study, the average shoot number was found to be between 14.0 (Canby)-76.73 (Willamette). In another try, carried out in Bursa ecology, with seven raspberry kinds, the average shoot numbers were declared to be between 7.2 (Bursa Dwarf)-2.5 (Aksu Red) and these data were measured between 1999 and 2000 (Barut, 1999). These data, found in Bursa ecology have similarities with the ones which we found.

In the adaptation test in Bursa, the average shoot height was found to be between 121.45 (Aksu.Red)-80.15 cm (Summit)(Barut, 1999). These results of our research, carried out between 2002-2005, have half similarities with the ones of the researcher (Atila *et al.*, 2006).

According to Ankara conditions, the kind which have the least shoot height was spotted to be Summit with 88.78 cm. And the kind which has the most shoot height was spotted to be Willamette with 183.88 cm.

In another research, done in Giresun, with 250 cm shoot height, Tulameen kind gave the tallest shoot and with 110 cm height, Cola II showed the least development in shoot growth (Kurt *et al.*, 2003). Results that Kurt and friends found are totally different from ours.

In a research, carried out in Tokat, when we consider the cumulative fruitfulness of the four year aged shoots, the cultivars such as; Rubin (2703.49 g), Nuburg (1415.08 g), Aksu Red (1375.08 g), Tulameen (1280.61 g) and Cola II (1296.65 g) are spotted to be the best (Gerçekçioğlu *et al.*, 2003). The results that we found are different from this research. According to our findings, Willamette (102.00 g), Tulameen (73.20 g), Heritage I (53.95 g), Aksu Red (60.43 g) and Canby (56.48 g) cultivars are found to be the best.

According to the results of the research that Güleriyüz *et al.* (1999) carried out with the raspberry

Table 5: Mean and standard error values of shoot yield (g) trait of 10 raspberry cultivars during 2002-2005

Cultivars	2002	2003	2004	2005	Row average
Aksu red	47.4±0.06ef	61.20±0.06e	52.60±0.12d	80.50±5.77cd	60.43±3.99D
Canby	49.8±0.58e	64.10±0.06d	51.20±0.12d	60.80±0.06e	56.48±1.85E
Heritage I	42.7±0.06g	48.70±0.06fg	46.10±0.06e	78.30±0.12d	53.95±4.29F
Heritage II	58.8±0.12c	70.60±0.12c	61.20±0.12b	82.60±0.12c	68.30±2.82C
Holland dwarf	45.9±0.06f	50.80±0.12f	48.30±0.06e	52.70±0.06g	49.43±0.77G
Nuburg	26.3±0.12i	40.50±0.06h	32.30±0.06f	49.10±0.06h	37.05±2.59I
Rubin	30.9±0.06h	46.70±0.06g	34.70±0.06f	55.60±0.12f	41.98±2.95H
Summit	53.1±0.06d	65.30±0.12d	56.10±0.06c	48.20±0.12h	55.68±1.88E
Tulameen	65.3±0.12b	75.30±0.12b	63.50±0.06b	88.70±0.06b	73.20±3.02B
Willamette	103.9±0.06a	105.9±0.06a	92.60±0.12a	105.6±0.06a	102.0±1.65A
Column average	52.41±3.79D	62.91±3.31B	53.86±2.99C	70.21±3.49A	59.85±1.81

^{a,b}Difference between two means with different small letter(s) in same year were significant at p<0.05 (comparison of cultivars for each year or interaction),

^{A,B}Difference between two means with different capital letter(s) in the row of column average were significant at p<0.05 (comparison of years), Difference between two means with different capital letter(s) in the column of row average were significant at p<0.05 (comparison of cultivars)

Table 6: Mean and standard error values of fruit weight (g) trait of 10 raspberry cultivars during 2002-2005

Cultivars	2002	2003	2004	2005	Row average
Aksu red	1.82±0.01d	1.77±0.01f	1.81±0.01e	1.78±0.01h	1.80±0.01F
Canby	2.11±0.01c	2.18±0.01c	2.29±0.00c	2.18±0.01c	2.19±0.02C
Heritage I	1.78±0.01e	1.87±0.01e	1.68±0.01g	1.94±0.01f	1.82±0.03E
Heritage II	1.82±0.01d	1.95±0.01d	1.77±0.01f	2.03±0.01d	1.89±0.03D
Holland dwarf	1.53±0.01h	1.64±0.01g	1.63±0.01h	1.82±0.01g	1.66±0.03G
Nuburg	1.61±0.01f	1.65±0.01g	1.95±0.01d	1.97±0.01e	1.80±0.05F
Rubin	1.56±0.01g	1.58±0.01h	1.48±0.01i	1.15±0.01i	1.44±0.05H
Summit	1.16±0.01i	1.23±0.01i	1.04±0.01j	0.96±0.01j	1.10±0.03I
Tulameen	2.46±0.01b	2.53±0.01b	2.52±0.01b	2.45±0.05b	2.49±0.01B
Willamette	2.99±0.01a	3.02±0.01a	2.99±0.01a	2.98±0.01a	3.00±0.01A
Column average	1.88±0.09D	1.94±0.09A	1.92±0.10C	1.93±0.10B	1.92±0.05

^{a,b} Difference between two means with different small letter(s) in same year were significant at p<0.05 (comparison of cultivars for each year or interaction),

^{A,B}Difference between two means with different capital letters in the row of column average were significant at p<0.05 (comparison of years), Difference between two means with different capital letters in the column of row average were significant at p<0.05 (comparison of cultivars)

cultivars, used in Oltu/Erzurum, the fruitfulness for per shoot is found to be 62.47 (Bursa Dwarf)-316.94 g (Nuburg). Our results and researchers' findings are totally different from each other. According to our findings, 37.05 g (Nuburg) has the least fruitfulness and 102.0 g (Willamette) has the best fruitfulness.

According to research results, carried out in Giresun, with 12.0 mm shoot diameter, Heritage cultivar was found to be the best and with 6.3 mm, Cola II cultivar was found to be the worst (Kurt *et al.*, 2003). Our findings are different from the researches. According to our results, with 12.50 mm, Rubin cultivar has the biggest shoot diameter and with 8.43 mm, Nuburg cultivar has the smallest shoot diameter. Besides, in Bursa ecology, the thickest shoot diameter is in Rubin and the smallest shoot diameter was spotted in Bursa Dwarf (Barut, 1999). The similar issue between our research and the one, carried out in Bursa ecology, is the Nuburg, that have the thickest shoot diameter.

When we have a look to the fruit weight of raspberry, for Tokat ecology, in 1999 and 2000, Bursa Dwarf (1.27 g), Heritage (1.54 g) and Nuburg (1.70 g) cultivars were found to be the ones which have the smallest fruit. Summit, Willamette, Canby, Cola II, Aksu Dwarf, Meeker and Holland Dwarf cultivars' fruit weight were found to be 2.0 g and over (Gerçekçiöglü *et al.*, 2003). We found

different results from the other researches, in the study, carried out in Ankara ecology, between 2002-2005. According to our tests, Willamette, Canby and Tulameen cultivars' fruit weight were found to be 2.0 g and over and the other cultivars were found to be less.

In the research, being carried out Samsun and Yalova ecology, according to 1999, the cultivar, which has the largest fruit, is Tulameen and fruit weights were spotted to be 4.80 and 3.83 g with order (Erenoğlu and Baş, 2000). For Ankara conditions, the cultivar which has the most fruit weight was observed to be Willamette with 3.00 g, when we take the average of 4 years.

In a research, carried out in Samsun, raspberry cultivars' fruit weights were found that they can be until 4.4 g (Kaplan *et al.*, 2003). Our findings are totally different from the other researchers' because none of our fruits reached at a weight of 4.0 g.

In a research, carried out in Giresun ecology, between 2000-2003, Tulameen with 4.48 g weight and Holland Dwarf with 3.02 g became the cultivars that took attention. The cultivar which has the least fruit weight was Nuburg with 1.80 g weight (Kurt *et al.*, 2003). Our test results are totally different from the other researchers' findings. According to our results, cultivar which has the heaviest fruit weight was Willamette with 3.00 g and with 1.10 g weight, Summit was spotted to be least fruit weight.

According to results of present study, it was concluded that pomological traits mentioned in the above were effected by variation among cultivars and years ($p < 0.0001$). RRCD was effective statistical design due to high determination coefficients for all traits (95.6-99.94%).

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