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A Research on the Adaptation of Some Raspberry Cultivars in Ayaş (Ankara) Conditions

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Abstract: This study was carried out on 11 cultivars of raspberries in Ayaş (Ankara) ecology between 2002-2005 years. For this objective, Phenological observations, plant characteristics and pomological characteristics for the cultivars were observed. Between 2002-2005 years in point of plant characteristics, phenological observations and, pomological characteristics, Willamette, Summit and Tulameen are fruitful cultivars in the condition. Not only autumn but also spring is productive cultivar is Heritage.

Key words: Raspberry, growing, adaptation, Ayaş (Ankara)

INTRODUCTION

Ağaoğlu (1986) informs that when we say gramble fruits, grape, strawberry, blackberry, gooseberry, bektaşi grape, blueberry and oleaster the ones that come to mind at first.

Pomologists, call the species of *Rubus* as shrubby plants. According to some classifications, it is stated that there are 740 *Rubus* species and these also have 12 subspecies (Ying *et al*., 1990). On the other hand, according to Jennings (1988), it is stated that there are 15 subspecies of *Rubus*.

For Turkey, it is a new matter to grow gramble fruits when it is compared with growing different types of it. We can say that the species, except strawberry, are hardly grown; and we come across with most of them in different regions of Turkey in their wild forms. This variety in wild population shows us that the ecological conditions of our country are completely convenient to grow also culture sorts of this species. But the low potential level of our country in production is mostly because of the technical deficiency of producers. Also the difficulties in getting the suitable materials and the insufficiency in adaptation studies according to the agricultural informations are the courses of low potential level in production (Ağaoğlu *et al*., 1990).

According to Jennings (1988), red raspberries are grown in; Northern Europe, Eastern Europe, Northeastern Pacific, Northern America, Southern America, Southern Africa, Italy, Scandiavian Countries, Argentina, New Zealand and Chile; black raspberries are grown in the Eastern parts of Oregon region and Northeastern Pacific; purple raspberries are grown in North parts of Northern America. Besides these, raspberries with yellow fruits are becoming increasingly important throughout the world. These are observed in the fields of red fruit species and formed by the end of mutations.

Sullivan *et al*. (1994), made researches between 1988 and 1989, in order to designate the fruitfulness in the species of raspberry, at the terms of cultivation in spring and autumn. In these researches, Heritage and Redwing, sorts of culture that gives product in autumn, were used. Apart from its fenological observations, these plants' pomological observations were also investigated. As a result, in terms of the amounts of the product between the first and second year, it was seen that, there had been 52% increase in second year's favour.

The growing conditions of Autumn Bliss, Fallred, Heritage, Scepter, September and Zeva Herbsternte, the species of raspberry which give product in autumn (*Rubus Idaeus*), were investigated. According to the research results, it is found that Autumn Bliss get accustomed to the climate conditions much easier than the other species, when it is compared. It is fixed that, Autumn Bliss' and Fallred's harvest periods are wider than the others. It is also fixed that, Heritage, Scepter, September and Zeva Herbsterne species are more fruitfull (Garcelen *et al*., 1993)

Redalen (1990), made an experiment and as a result he designated the fruitfulness of the Balder species as 335 g/shoot; the weight of the fruit as 3.3 g; the amount of soluble substance as 8.9%. What's more, it is reported

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that, the grape doesn't shelling, their color is dark red, soft and suitable for industry and for harvesting with machine and apart from all of these it is also reported that it gives large amounts of root shoots that develops perpendicularly.

According to a study that has been carried out in Samsun ecological conditions, the soluble substance amounts of species were found as 14.00% (Meeker) - 11.00 (Willamette); in Yalova ecological conditions, the soluble substance amount were found as, 11.63% (Nuburg)- 10.40% (Cola II) (Kaplan *et al*., 2000; Erenoğlu and Baş, 2000)

Özdemir (2001), In the studies that has been carried on countrywide in Tokat, the place where constitutes a part of the project about raspberry and blackberry adaptation, the species of the raspberry in that region, which we also worked on 11 species of, were investigated. According to averages of the two years; the fruitfulness of the species for each shoot 92.29 g (Bursa Short)-767.84 g (Rubin); the fruit weights 1.14 g (Bursa Short)-2.98 g (Tulameen); soluble substance amount 9.39% (Holland short) - 14.75% Meeker and the total acid amount has been fixed as 13.21 g L^{-1} (Aksu Red)-20.42 g L^{-1} (Willamette). According to the findings of the researches, for the region, Willamette, Rubin and Summit are proposed to be the best species of raspberries. Present study was to examine production, quality and phenological criteria of raspberry species which were used for adaptation experiments in Ayaş condition in Ankara as a part of adaptation and breeding projects carried out in Turkey.

MATERIALS AND METHODS

The study between the years of 2002-2005, was carried out in Ayaş (Ankara), the field where raspberry species such as Cola II, Rubin, Summit, Meeker, Holland Short, Heritage I, Heritage II, Tulameen, Aksu Red, Nuburg, Canby and Willamette were planted with 1.5×2 m spaces. The phenological observations and plant characteristics and pomological characteristics of raspberry species were investigated and compared with each other. What's more, it was searched whether the single or double product of Heritage is more economical.

After the experiment, data which include the features such as soluble substances weight, total acid were analyzed with randomized complete design (one-way). When features were statistically significant, different between two species were evaluated with Duncan Multiple Comparison test and Kruskal Wallis Test was used for the features having discrete measurement (Düzgüneş *et al*., 1983).

Phenological observations: Swelling date of vegetative buds, burst date of vegetative buds, appearing date of flower clusters, first flowering, last flowering, first fruit formation date, first harvest date, last harvest date, end of maturity and leaf shedding date criteria were investigated.

Plant characteristics: The number of shoots for each plant, height of shoot, diameter of shoot and the average fruitfulness criteria for each shoot were investigated.

Pomological characteristics: Weight of fruit, color of fruit, shape of fruit, shelling, toughness of fruit, taste of fruit, aroma, the soluble substance that can be soluted in water, acids criteria were investigated.

RESULTS AND DISCUSSION

Phenological observations: When the fenologies of raspberry species are investigated, which are grown in Ayaş (Ankara) ecology; it is found that, the swelling date of vegetative buds is between the middle of March and first of April, the burst date of vegetative buds is between the first of April and end of April, appearing date of flower clusters is between the end of April and first of May. The first flowering is in the middle of May and the last flowering is between the end of May and the first of June. It is also fixed that the first fruit maturing is at the first of June and the first harvesting is between the end of June and the first of July. Besides it was seen that, the last harvesting is in the middle of August and the finish of maturity is at the end of August. The shedding of the leaves were also seen to be at the end of November.

The results can be similar or different; because the fenological observations can change especially at the time of flowering, depending on the sort and ecology (Ağaoğlu *et al*., 2001). After observing these results, no negative ecological effects were come across in growing raspberries, in Ayaş (Ankara).

Table 1: Plant Characteristics of Raspberry species belonging the year of 2002

Species	No. of shoots for each plant	Height of shoot (cm)	Diameter of shoot (mm)
Cola II	12.20±0.115G	76.60±0.115L	7.20±0.0577H
Rubin	19.70±0.115E	160.70±0.115E	13.10±0.115A
Summit	20.20±0.115E	88.30±0.115K	8.30±0.0333F
Meeker	14.30±0.115I	186.00±0.577B	9.40±0.115E
Holland short	22.20±0.115D	111.50±0.0577I	6.20± 0.115I
Heritage I	15.20±0.0577H	107.20±0.115J	9.70±0.115DE
Heritage II	52.00±0.577B	114.27±0.115H	11.30±0.115B
Tulameen	27.80±0.0577C	139.80±0.0577F	8.50± 0.115F
Aksu red	16.20±0.115G	178.40±0.115C	9.70±0.115DE
Nuburg	18.50±0.115F	121.00±1.15G	7.60±0.115G
Canby	13.00±0.577J	171.10±0.115D	9.80±0.0577D
Willamette	75.60±0.115A	196.90±0.115A	10.90±0.0577C

*The values with different letter(s) differ significantly at $p<0.05$

Table 2: Plant characteristics of Raspberry species belonging the year of 2003

Species	No. of shoots for each plant	Height of shoot (cm)	Diameter of shoot (mm)
Cola II	14.20±0.0577I	82.30±0.115L	7.80±0.115J
Rubin	20.80±0.115F	165.40±0.115E	14.20±0.115A
Summit	23.00±0.577E	98.60±0.115K	9.60±0.115G
Meeker	16.00±0.577H	195.20±0.0577B	10.10±0.0577EF
Holland short	25.00±0.577D	120.10±0.0577I	7.10± 0.0577K
Heritage I	18.30±0.115G	116.30±0.115J	10.20±0.0577E
Heritage II	55.80±0.115B	133.20±0.115G	11.70±0.0577C
Tulameen	31.00±0.577C	152.50±0.115F	9.10± 0.0577H
Aksu red	20.30±0.115F	180.80±0.0577C	10.60±0.577D
Nuburg	23.50±0.0577E	130.00±0.577H	8.50±0.0577I
Canby	15.60±0.115H	178.60±0.115D	9.90±0.0577F
Willamette	78.40±0.115A	198.60±0.115A	12.30±0.115B

*The values with different letter(s) differ significantly at p<0.05

Table 3: Plant characteristics of Raspberry species belonging the year of 2004

Species	No. of shoots for each plant	Height of shoot (cm)	Diameter of shoot (mm)
Cola II	13.30±0.115F	69.50±0.0577L	8.00±0.0577GH
Rubin	16.70±0.0577DEF	129.20±0.115C	11.80±0.0577A
Summit	20.00±0.577DE	78.10±0.0577K	8.40±0.0577G
Meeker	16.00±0.577EF	123.50±0.0577D	8.10±0.0577G
Holland short	22.00±0.577D	94.10±0.0577J	10.20± 0.0577CD
Heritage I	16.20±0.115EF	110.50±0.0577F	9.30±0.115EF
Heritage II	49.70±0.0577B	107.80±0.0577G	9.70±0.0577DE
Tulameen	30.00±0.577C	120.60±0.115E	7.90± 0.0577GH
Aksu red	19.50±0.577DE	133.80±0.0577B	11.20±0.115B
Nuburg	21.30±0.115DE	99.80±0.0577I	9.10±0.0577F
Canby	13.70±0.115F	105.50±0.115H	7.50±0.0577H
Willamette	72.40±0.115A	158.60±0.115A	10.30±0.115C

*The values with different letter(s) differ significantly at p<0.05

Table 4: Plant characteristics of Raspberry species belonging the year of 2005

Species	No. of shoots for each plant	Height of shoot (cm)	Diameter of shoot (mm)
Cola II	12.50±0.0577L	61.50±0.0577L	7.50±0.0577GH
Rubin	15.80±0.0577J	97.20±0.115I	10.90±0.0577B
Summit	23.70±0.577E	90.10±0.0577J	8.50±0.0333DE
Meeker	17.50±0.0577I	115.20±0.0577E	7.20±0.0577H
Holland short	21.20±0.0577F	85.60±0.115K	11.00± 0.577B
Heritage I	30.30±0.115D	100.30±0.115G	8.90±0.0577D
Heritage II	47.60±0.115B	121.80±0.115D	9.70±0.0333C
Tulameen	35.30±0.115C	105.50±0.0577F	8.30±0.115EF
Aksu red	18.10±0.0577H	142.70±0.0577C	11.60±0.115A
Nuburg	19.40±0.115G	97.60±0.115H	8.50±0.0577DE
Canby	14.10±0.0577K	165.10±0.0577B	7.80±0.115FG
Willamette	80.50±0.577A	181.40±0.115A	11.40±0.115AB

*The values with different letter(s) differ significantly at p<0.05

Plant characteristics: Number of shoots and the factors like fruitfulness can change depending on the ecology. What's more, variety features are effective on this issue (Hall, 1990). For raspberry species, different results were found when the herbal features of 2002, 2003, 2004 and 2005 are compared (Table 1-4).

When the conditions of Ayaş (Ankara) evaluated from the point of the fruitfulness of raspberries between the years of 2002-2005, at first, there are Willamette, Tulameen, Heritage species. As the second group there are Summit, Canby and Aksu Red and as the third group there are Rubin, Nuburg and Holland Short species. Cola II and Meeker species are known not to give fruit in terms of economy, in the conditions of Ayaş (Ankara) (Table 5).

When the species which give both spring and autumn product are compared, the first is Heritage, the second is Summit and the third is Holland Short (Table 6). When Heritage I and Heritage II are compared, from Heritage II, we can take both spring and autumn product, but from Heritage I, we can only take double product (Table 6).

Pomological characteristics: When we looked the pomologic features of raspberry species between the years of 2002-2005, we didn't come across with change in fruit, in terms of the color, shape, shelling, toughness, taste and aroma (Table 7).

When we look at the weight of the fruits between the years of 2002-2005, we can find that the species which owns the heaviest fruit is Willamette, the species which owns the softest fruit is Summit (Table 8).

Between the years of 2002-2005, when we look at the soluble substance amounts of raspberry species, the species that has the most soluble substance is Willamette and the species that has the least soluble substance is Summit (Table 9).

When we look at the acid rate in the species between the years of 2002-2005, we can see that the species which has the most acid, is Willamette; and the species which has the least acid is Tulameen (Table 10).

Table 5: Fruitfulness of raspberry species for each shoot in 2002-2005

Species	Fruitfulness for each shoot (2002)	Fruitfulness for each shoot (2003)	Fruitfulness for each shoot (2004)	Fruitfulness for each shoot (2005)
Cola II *	-	-	-	-
Rubin	30.90±0.0577I	46.70±0.115I	34.70±0.115I	55.60±0.0577G
Summit	53.10±0.0577D	65.30±0.0577D	56.10±0.0577D	48.20±0.0577J
Meeker *	-	-	-	-
Holland short	45.90±0.0577G	50.80±0.115G	48.30±0.115G	52.70±0.115H
Heritage I	42.60±0.115H	48.70±0.115H	46.10±0.0577H	78.30±0.115E
Heritage II	58.80±0.115C	70.60±0.115C	61.20±0.115C	82.60±0.115C
Tulameen	65.30±0.0577B	75.30±0.0577B	63.50±0.0577B	88.70±0.0577B
Aksu red	47.40±0.115F	61.20±0.0577F	52.60±0.115E	80.50±0.0577D
Nuburg	26.30±0.115J	20.50±0.0333J	32.30±0.0577J	49.10±0.0577I
Canby	49.80±0.0333E	64.10±0.0577E	51.20±0.115F	60.80±0.0577F
Willamette	103.90±0.115A	105.90±0.0577A	92.60±0.115A	105.60±0.115A

*The species that cannot be taken any product

Table 6: Fruitfulness of raspberry species, which give autumn product, for each shoot in 2002-2005

Species	2002	2003	2004	2005
Summit	41.20±0.115B	45.20±0.0577B	40.10±0.0577B	30.50±0.0577D
Holland short	33.70±0.115C	40.2±0.115C	32.10±0.0577C	34.60±0.115C
Heritage II	45.80±0.115A	49.30±0.115A	42.80±0.115A	45.30±0.115A

Table 7: Pomological characteristics of raspberry species in 2002-2005

Species	Color of the fruit	Shape of the fruit	Shelling	Toughness of the fruit	Taste of the fruit	Aroma
Cola II *	-	-	-	-	-	-
Rubin	Dark	Round	No	Average	3	3
Summit	Dark	Conical	No	Tough	3	3
Meeker *	-	-	-	-	-	-
Holland short	Dark	Long-Conical	No	Tough	4	4
Heritage I	Dark	Round	Low	Tough	4	4
Heritage II	Dark	Round	Low	Tough	4	4
Tulameen	Average	Long-Conical	No	Tough	5	5
Aksu red	Dark	Short-Conical	No	Average	5	5
Nuburg	Dark	Short-Conical	No	Tough	4	4
Canby	Average	Long-Conical	No	Tough	4	4
Willamette	Dark	Conical	Low	Average	4	4

*Species that cannot be taken any product economically

Table 8: Fruit weights of raspberry species in 2002-2005

Species	2002	2003	2004	2005
Cola II *	-	-	-	-
Rubin	15.60±0.0577G	15.80±0.115H	14.80±0.0577I	11.50±0.0577I
Summit	11.60±0.115I	12.30±0.115I	10.40±0.115J	9.60±0.115J
Meeker *	-	-	-	-
Holland short	15.30±0.0577H	16.40±0.115G	16.30±0.115H	18.20±0.0577G
Heritage I	17.80±0.115E	18.70±0.115D	16.80±0.0577G	19.40±0.115F
Heritage II	18.20±0.115D	19.50±0.115D	17.70±0.0577F	20.30±0.115D
Tulameen	24.60±0.115B	25.30±0.115B	25.20±0.0577B	24.50±0.115B
Aksu red	18.20±0.115D	17.70±0.115F	18.10±0.0577E	17.80±0.0577H
Nuburg	16.10±0.0577F	16.50±0.0577G	19.50±0.115D	19.70±0.0577E
Canby	21.10±0.0577C	21.80±0.0577C	22.90±0.0333C	21.80±0.115C
Willamette	29.90±0.0577A	30.20±0.0577A	29.90±0.0577A	29.80±0.0577A

*Species that cannot be taken any product economically

Table 9: Soluble substance amounts of raspberry species in 2002-2005

Species	2002	2003	2004	2005
Cola II *	-	-	-	-
Rubin	16.20±0.0577E	17.00±0.577E	21.70±0.0577E	20.30±0.115E
Summit	13.80±0.115F	14.10±0.0577G	22.10±0.0577E	23.40±0.115B
Meeker *	-	-	-	-
Holland short	18.80±0.115BC	19.30±0.115D	19.00±0.577FG	18.90±0.0577F
Heritage I	15.80±0.115E	16.20±0.115F	24.80±0.115B	24.10±0.0577B
Heritage II	17.60±0.115CD	18.60±0.115D	21.50±0.0577E	21.00±0.577DE
Tulameen	20.20±0.0577A	21.50±0.0577C	18.50±0.0577G	19.20±0.115F
Aksu Red	16.40±0.115DE	17.40±0.0577E	19.50±0.115F	21.70±0.0577CD
Nuburg	20.00±0.577AB	23.40±0.115B	23.40±0.115D	22.00±0.577C
Canby	17.00±0.115DE	18.70±0.0577D	24.10±0.0577C	23.90±0.0577B
Willamette	20.50±0.0577A	25.00±0.577A	27.60±0.115A	28.30±0.0577A

*Species that cannot be taken any product economically

Table 10: Total acid rate of the raspberry species in 2002-2005

Species	2002	2003	2004	2005
Cola II *	-	-	-	-
Rubin	24.30±0.0577E	25.50±0.0577F	28.20±0.115E	29.00±0.577C
Summit	29.40±0.0577B	33.80±0.115B	31.20±0.115B	31.00±0.577B
Meeker *	-	-	-	-
Holland Boduru	23.00±0.577F	26.00±0.577F	26.20±0.115H	23.20±0.0577G
Heritage I	27.30±0.0577D	28.60±0.115E	29.60±0.115D	28.50±0.577CD
Heritage II	28.10±0.0577C	29.70±0.0577D	27.50±0.0577F	26.40±0.115E
Tulameen	21.20±0.115H	22.20±0.115H	26.80±0.115G	25.10±0.115F
Aksu red	22.10±0.0577G	23.40±0.115C	25.70±0.115I	24.80±0.0577F
Nuburg	22.90±0.0577F	23.90±0.677G	29.30±0.0577D	27.70±0.0577D
Canby	29.00±0.577B	32.40±0.115C	30.40±0.115C	29.30±0.115C
Willamette	32.10±0.577A	35.30±0.115A	34.70±0.115A	33.50±0.115A

*Species that cannot be taken any product economically

Examined in all Tables, it could be said as to this study that in point of plant characteristics, phenological observations and, pomological characteristics, the cultivars having superior values were Willamette, Summit, Tulameen, respectively. Besides, the best cultivar in both Spring and Autumn were Heritage. It was reported that the values of the fruit weight of Tulameen, Willamette and Meeker cultivars in Canada conditions between 1986-1989 years were ranged from 3.40 to 5.38 g (Daubeny and Anderson, 1991). However, as to Table 8, corresponding value for all cultivars between 2002 and 2005 were found as 1.04-2.99. It could be suggest that the difference was due to climate, ecology and various years.

As shown in Table 6, Heritage was determined the best of fruitfulness of raspberry species, which give autumn product, for each shoot in 2002- 2005. The finding was consistent with results of the experiment carried out in Washington (Dale *et al*., 2001).Thus, the adaptation of the cultivar was more superior and better to others.

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