

Evaluation of Fruit Characteristics of Blackberry Genotypes Grown in Eastern Mediterranean

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ABSTRACT: Fruit characteristics of some blackberry genotypes such as erect, semierect and trailing thornless and one thorny blackberry were evaluated at Kahramanmaras province in Eastern Mediterranean region of Turkey. Six cultivars ('Jumbo', 'Nessy', 'Navaho', 'Chester Thornless', 'Arapaho' and 'Cherokee' (thorny) and four selections ('Bursa1', 'Bursa2', 'Bursa3' and 'Bartın') were characterized during 2002 and 2003 growing seasons. In this study fruit weight, total soluble solid (TSS) content, fruit acidity, pH, flavor, firmness, first flowering date and harvest period were observed. The first date of flowering was observed in the second week of May. 'Jumbo' cultivar showed wider harvesting period than other cultivars. Heaviest fruit set was shown by 'Navaho' in 2002 while 'Jumbo' and 'Arapaho' in 2003.

Key Words: *Rubus sp. L.*, fruit characteristics, Kahramanmaras

Do u Akdeniz'de Yeti en Bö ürtlen Genotiplerinin Meyve Karakterlerinin De erlendirilmesi

ÖZET: Türkiye'nin Do u Akdeniz Bölgesi'nde Kahramanmara ilinde dik, yarı dik ve sürüncü 9 dikensiz ve 1 dikenli bö ürtlen çe idinin meyve karakterleri de erlendirildi. 2002-2003 de 6 çe it ('Jumbo', 'Nessy', 'Navaho', 'Chester Thornless', 'Arapaho' ve 'Cherokee' (dikenli) ve 4 seleksiyon ('Bursa1', 'Bursa2', 'Bursa3' ve 'Bartın') çe idi ara tırıldı. Verim, meyve a ırlı ı, suda çözünebilir toplam kuru madde, meyve asitli i, pH, tad, sertlik, çiçeklenme ba langıcı ve hasat periyodu kayıt edildi. İlk çiçeklenme mayısın ikinci haftası görüldü. 'Jumbo' çe idinin hasat periyodunun di erlerinden daha uzun oldu u belirlendi. 2002 yılında en iri meyveler 'Navaho' çe idinden elde edilirken, 2003 yılında 'Jumbo' ve 'Arapaho'dan elde edildi.

Anahtar Kelimeler: *Rubus sp. L.*, meyve karakterleri, Kahramanmara

INTRODUCTION

Blackberries (*Rubus sp. L.*) are native to Asia, Europe, North and South America. There are many blackberry cultivars with different characteristics such as thorny or thornless, trailing, erect or semi-erect growth habit (Gough and Poling, 1996). Most growers prefer erect canes, as these plants do not require as much care in trelling and tying canes as the semi-erect cultivars (Clark, 2005).

Consumption of fresh and frozen blackberries has increased in the past few years in Turkey. Blackberries are considered to be a high value crop in the search for alternative crops for farmers Turkey is one of the origins of blackberries, thus, blackberry culture can be done in all parts of Turkey where irrigation is possible. Cultivation of this crop started as a new crop in the Mediterranean region (Türemi et al., 2003), where there has been a little study comparing fruit quality characteristics of blackberry cultivars.

In Turkey, there are many regions such as Kahramanmaras where blackberry cultivation is climatically suitable. Kahramanmaras is famous for its ice cream in which blackberry fruits are often added as a natural flavor. Kahramanmaras Sutcu Imam University (KSU) has started a research program to introduce new varieties to the region and established an experimental station for blackberry cultivar adaptation. The objective of the present study was to evaluate performance of

some of the blackberry cultivars to Kahramanmaras region.

MATERIAL and METHODS

The research was conducted in Kahramanmaras province located in 37° 56' north latitude and 36 ° 56' east longitudes.

Ten genotypes (9 thornless, 1 thorny) were used in the study. They were: 'Bursa1', 'Bursa2', 'Bursa3', 'Bartın', 'Jumbo', 'Nessy', 'Navaho', 'Chester Thornless', 'Arapaho', 'Cherokee(thorny). 'Bursa1', 'Bursa2', 'Bursa3' and 'Bartın' genotypes are selections from Marmara and Black Sea regions of Turkey.

The experiment was started in February 1999 and experimental plots set up as complete randomized block design with three replications, each containing two plants. Shrubs were irrigated with drip irrigation system. Fruiting of all cultivars started in 2000 and the results presented here were from 2002 and 2003 growing seasons.

Dates for flower set and fruit maturity were recorded. Fruits were harvested twice a week and fruit analysis was performed every other harvest. The fruits were evaluated for fruit weight, total soluble solid contents (TSS), pH, titratable acidity (TA). Randomly chosen 100 fresh fruit were used for fruit analysis. Yield data was also obtained by sum of all harvests.

Average fruit weight (g) of 100 berries was determined. The percentage of TSS was measured with a hand-held refractometer, using drops of homogenized

juice from 100 fruits. The pH value from homogenized juice was measured with the aid of a pH meter. Acidity expressed as percentage of citric acid, was obtained from 1 ml sample of fruit juice titrated until pH 8.2 with 0.1 N NaOH.

A group of people joined the sensory analysis as recommended by Stevens and Albright (1980). A 5-point hedonic scale was used: 1; dislike extremely; 3; either like or dislike and 5; like extremely. Each person was asked to note two main components of berry quality: Firmness and flavor together with overall berry quality.

Costat Package Programme was used for statistical analysis which was designed as complete randomized block design with three replications. Duncan's mean procedure (HSD, p 0.05) was performed to test for significant differences among the blackberry genotypes.

RESULTS and DISCUSSION

Flowering period for all cultivars was around May 12- June 6 (data not shown). Harvest period and starting date varied according to years and the genotypes. 'Cherokee' was the first one harvested in both years (7/2 and 7/5 in 2002 and 2003, respectively). The full harvest season of 'Jumbo', 'Bursa1', 'Chester Thornless' and 'Navaho' were longer than the others (Table 1). Türemis et al., (2003) reported longer harvest period for the same cultivars in Adana region. The harvest period of 'Navaho' was 34-41 days in Arkansas (Moore, 1989; Moore and Clark, 1993). Arapaho had a shorter harvest period than the other cultivars in both years. The similar finding for these cultivars was also reported by Clark and Moore (2005). The yield data of the genotypes are shown in Figure 1. 'Bursa1' had the highest yield in 2002 whereas 'Jumbo' produced the highest yield in 2003. 'Cherokee' produced the lowest yield in 2002, whereas 'Arapaho' had lowest in 2003.

Table 1. Harvest periods of nine thornless and one thorny blackberry cultivars.

Genotype	Harvest 2002			Harvest 2003		
	First harvest	Final harvest	Duration of harvest	First harvest	Final harvest	Duration of harvest
	A	B	(days)	A	B	(days)
Bursa2	7/17	7/31	15	7/21	8/7	18
Bursa3	7/17	7/31	15	7/21	8/8	19
Bursa1	7/3	7/30	28	7/6	8/11	37
Jumbo	7/3	7/31	29	7/12	8/15	40
Bartın	7/19	7/31	13	7/15	8/11	29
Nessy	7/6	7/30	26	7/7	8/4	29
Navaho	7/3	7/30	28	7/12	8/10	30
C.Tornless	7/10	8/7	29	7/19	8/18	31
Arapaho	7/6	7/19	14	7/13	7/25	13
Cherokee	7/2	7/20	19	7/5	7/31	27

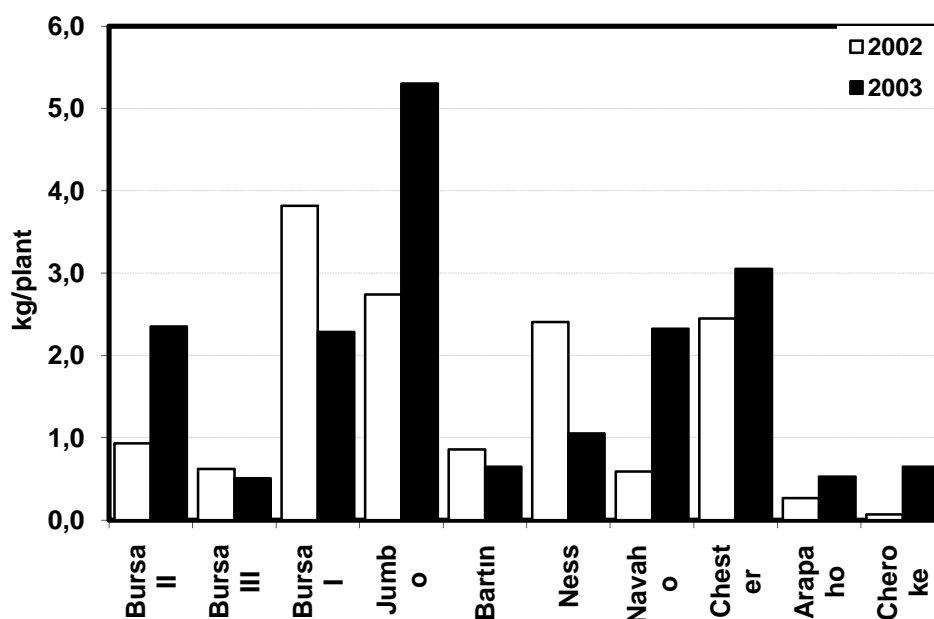


Figure 1. The yield of nine thornless and one thorny blackberry genotypes in 2002 and 2003

Türemis et al., (2003) reported very low yield in cultivar 'Jumbo' in Adana region which was contrary to our data. They obtained the highest yield from the cultivars 'Chester Thornless' and 'Bursa2'.

In this study the biggest fruit was obtained from 'Navaho' (8.26 g/fruit), followed by 'Jumbo' (7.25 g/fruit) in 2002, 'Jumbo' and 'Arapaho' had the highest fruit weight (with 4.76 and 4.71 g/fruit respectively) in 2003. In both years the lowest fruit weight was obtained from 'Bursa3' (Table 2, 3).

In a study made in Arkansas, the fruit weight of Arapaho and Navaho were determines as 4.2 g and 3.8 g respectively in 2002 (Clark and Moore, 2005). However, in our study the average fruit weights of these two cultivars were better in the same year. According to the research results from Adana region (Türemis et al., 2003), the lowest fruit weight was obtained from 'Navaho' contrarily to our data.

Table 2. Fruit characteristics of nine thornless and one thorny blackberry genotypes in 2002

Genotype	2002			
	Berry weight (g/fruit)	Total soluble solids (%)	Titrateable acidity (%)	pH
Bursa 2	3.18d*	14.9b	0.54a	2.91cd
Bursa 3	2.94d	14.7b	0.43b	2.85d
Bursa 1	4.03d	12.6c	0.39bcd	2.57e
Jumbo	7.25ab	15.1b	0.39bcd	3.07bc
Bartın	6.33abc	13.2c	0.39bcd	3.08bc
Nessy	4.62cd	17.1a	0.24e	3.69a
Navaho	8.26a	15.4b	0.34cd	3.08bc
C.Thornless	6.28abc	12.8c	0.42bc	2.89cd
Arapaho	5.00bcd	15.0b	0.36cd	2.85d
Cherokee	3.67d	14.9b	0.42bc	3.21b

*Means within a column not followed by the same letter differs at 0.05 level by Duncan' multiple range test.

The highest TSS was obtained from Nessy (17.1%) in 2002 while Bursa1 was the lowest (12.6%). The highest TSS content was found in 'Arapaho' (16.3%) in 2003.

Breeding goal is to enhance blackberry flavor, human health benefits, and convenience. Breeding sweeter berries can largely be achieved by selecting for

higher levels of soluble solids or reduced acidity, or both. However, very low acidity levels can lead to berries having a 'flat' flavor.

Table 3. Fruit characteristics of nine thornless and one thorny blackberry genotypes in 2003

Genotype	2003			
	Berry weight (g/fruit)	Total soluble solids (%)	Titrateable acidity (%)	pH
Bursa2	2.27de	15.4ab	0.55a	2.88abc
Bursa 3	1.77e	15.4ab	0.36cd	3.08ab
Bursa 1	3.55bc	10.4bc	0.49ab	2.54cde
Jumbo	4.76a	11.4bc	0.34cd	2.84bdc
Bartın	3.14cd	9.2c	0.32cd	2.50de
Nessy	3.50bc	9.7c	0.41bc	2.60cde
Navaho	4.28ab	10.3bc	0.47ab	2.69cde
C.Thornless	3.26bcd	8.9c	0.47ab	2.45e
Arapaho	4.71a	16.3a	0.21e	3.24a
Cherokee	3.45bc	13.0abc	0.41bc	3.24a

* Means within a column not followed by the same letter differs at 0.05 level by Duncan' multiple range test.

In the research program in Adana in 2002, the highest TSS value was found 11.3% in 'Navaho' (Türemis et al., 2003). In our study, 'Bursa2' had the most acidic berries in both years. The berries from 'Nessy' were the least acidic in 2002 whereas 'Arapaho' showed the similar features in 2003 (Table 2, 3). The differences between Kahramanmaraş and Adana could be resulted from the ecological factors.

The differences in pH of the berries were significant in both years. The data ranged from 3.69 to 2.57 in Nessy and Bursa1 respectively in 2002. The highest pH values were obtained from Arapaho and Cherokee in 2003 (Table 2, 3).

Fruit characteristics are summarized in Table 4. Based on the flavor, 'Navaho', 'Jumbo' and 'Arapaho' can be categorized as the most promising cultivars.

According to Stevens and Albright (1980) 'Cherokee', 'Chester Thornless', and 'Bartın' is considered to promising and 'Bursa1' and 'Nessy' as average quality.

In this study the highest fruit firmness were obtained from 'Nessy', 'Navaho', 'Chester Thornless' (Table 4). 'Chester Thornless' displayed a good level of firmness and shelf life (Clark, 2005). The Arkansas-released cultivar 'Navaho' was found to have excellent shelf life (Moore and Clark, 1989; Perkins-Veazie et al., 1997).

Table 4. Means of sensory analysis scores assessed in the middle of harvest seasons in 2002 and 2003

Genotype	Flavor	Firmness
Bursa2	2.8	4.5
Bursa3	2.3	3.5
Bursa1	3.0	4.5
Jumbo	4.0	4.0
Bartın	3.3	3.0
Nessy	3.0	4.7
Navaho	4.3	4.7
C.Thornless	3.3	4.7
Arapaho	4.0	3.8
Cherokee	3.7	4.0

Additionally, people joined in sensory analysis indicated that cultivars 'Bursa3' and 'Bursa1' have big seeds. Seed size and "presence in mouth feel" are the concern for many consumers, in that smaller seeds (pyrenes) are more desirable. Seed can also vary in surface smoothness and pulp adherence, both traits that are preferred to make the seeds less noticeable when consumed (Hall, 1990).

The results of the present study provide important information about fruit characteristics of nine thornless and one thorny blackberry genotypes grown in the Eastern Mediterranean climate. Among the tested genotypes, 'Jumbo' seems to have better yield and fruit characteristics than the others, followed by 'Navaho' and 'Chester Thornless'.

In conclusion, in some countries, small fruits have been cultured and bred for 150 years. Yet, despite the fact that wild small fruits are found in most part of Turkey, their culture and breeding studies have largely been neglected. On the other hand, in Turkey, small fruits collected from wild populations are found irresistible. This indicates a great market demand and a great need to promote culture of small fruits in Turkey. Blackberry has good potential as a commercial crop in the Eastern Mediterranean region of Turkey for fresh and processing markets.

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