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Promising Cornelian Cherries (*Cornus mas* L.) from the Northeastern Anatolia Region of Turkey

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Abstract

The objective of this research was to select valuable genetic resources of cornelian cherry (*Cornus mas* L.) grown in Northeastern Anatolia, Turkey from 1990 to 1996 for fruit size and yield. Approximately 1000 seedling trees were examined and 224 phenotypes having a fruit weight of 2.9 g and yield per cm^2 of trunk cross section area over 0.15 kg/cm^2 were selected in the first years (1990-1992). Thirty-one of these, found to be superior, were selected and evaluated for fruit characteristics. The ranges of the measured fruit characteristics for the selected phenotypes varied from 2.9 to 5.2 g for fruit weights, 6.0 to 9.4 for flesh/stone ratio, 11.5 to 16.8% for total soluble solids (TSS), 35.6 to 106.3 mg vitamin C/100 g, 1.5 to 4.7 % for total acidity (as malic acid) and 3.0 to 9.2 for TSS/acid ratio. These results suggest that the cornelian cherries selected may be suitable for commercial cultivation in the region. Many phenotypes were evaluated as promising for further breeding efforts.

Cornelian cherry is one of the commonly grown fruit species in Turkey. Most of trees are feral, but some are under cultivation. Cornelian cherry growing areas in the Northeastern Anatolia region are generally located around the river valleys. The Coruh river valley and its branches (Artvin and Erzurum provinces) have a large cornelian cherry population. Turkey grows 1,380,000 cornelian cherry trees, yielding approximately 12,800 metric tons per year. In the Artvin and Erzurum regions where this study was conducted, about 750 metric tons are annually harvested from the nearly 77,000 trees (2).

The cornelian cherry fruits have juicy, sour and sweetish taste. Fruits of this species are consumed fresh and are used to produce jam, jelly, stewed fruit, marmalade, pestil (a locally dried fruit pulp product), syrup and several types of soft drinks. The plant is also used for medicinal purposes due to the anti-diarrhetic properties of leaves and fruits (4). Ascorbic acid (Vitamin C) content of *Cornus mas* is 97.4 to 120.4 mg/100 g, over twice that of the orange (5).

In cornelian cherry culture areas of Turkey, there is a large number of native (seedling) phenotypes. These landrace trees have been selected from seed propagated trees for centuries. Because cornelian cherry is a cross-pollinated species (4, 5), many types have naturally occurred in different regions. Hence, Turkey has a wide genetic variation for this species. If high yielding and high quality fruit phenotypes were selected and propagated, cornelian cherry production could be increased.

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The spreading area of cornelian cherry includes Middle and Southeast Europe and Southwest Asia (8). Some studies have been done on the selection of naturally grown cornelian cherry in these areas. In Russia, Rudkovsky (17) selected two rather fruitful types of cornelian cherry having large fruits and cold resistance. In Yugoslavia, five superior types were selected (13). Imamaliev (10) selected 47 wild cornelian cherries that had different morphological characteristics in Azerbaijan. Similar selection studies were also reported in Czechoslovakia and Australia (9, 16). Some studies related to the cornelian cherry selection have been carried out in Turkey. Some of the selection studies conducted include those by Eris et al. (7) in Bursa and vicinity, Yalcinkaya and Kaska (21) in Malatya, Elazig, South and North Anatolia and Kalkisim and Odabas (11) in the Vezirköprü district of Samsun.

The objective of this study was to select fruitful and high quality wild cornelian cherry phenotypes from Northeastern Anatolia to be used in the future breeding studies and to increase the yield of cornelian cherry with the aid of vegetative propagation.

Materials and Methods

This study was conducted in the Coruh Valley from 1990-1996. Two hundred and twenty-four trees were selected as research material in 1990, 1991 and 1992.

The yield of trees was considered as yield per cm^2 of trunk cross sectional area (TCSA). Yield per tree was weighed and the diameter of tree was measured at 20 cm above the soil. Average fruit weight and fruit size were determined on randomly chosen 25 fruit samples, and flesh/stone ratio was calculated using a formula (fruit weight-stone weight/stone weight). Fruit and stone length/width ratios were calculated separately for each sample of 25 fruit. Fruits identified as ripe or otherwise ready for harvest and preparation were picked to get a minimum 500 g. Fruit samples were shipped frozen by air (2 h) to the laboratory in well-packed insulated boxes and kept at - 20°C until analysis. Total soluble solids (TSS) of the fruits was determined using a hand refractometer. Vitamin C content and titratable acidity (as malic acid) were determined as percent by titration method (1).

Results and Discussion

The yield of 224 trees studied was between 0.09 to 0.23 kg/cm^2 TCSA. Of these, 31 trees which had a yield more than 0.15 kg/cm^2 were selected. The yield of selected 31 phenotypes was from 0.16 to 0.23 kg/cm^2. The highest yields were obtained with the 08-A-10 and 25-U-133 phenotypes. No evaluation of yield has been found in previous studies on cornelian cherry.

Fruit weights of 224 trees studied was found between 2.0 to 5.2 g and those having fruit weight more than 2.9 g were selected. Fruit weights of these phenotypes were between 2.9 (08-A-12) and 5.2 g (25-U-53) (Table 1). However, the average fruit weight reported by some other researchers was between 0.5 to 5.6 g in Turkey. When the fruit weights in this study were compared to previous studies, the results were within normal limits or even higher than those reported in the literature (7, 11, 13, 16, 18, 21). One of the significant breeding goals for cornelian cherry is to have larger and more attractive fruit characteristics (14).

The flesh/stone ratio was the lowest in 08-Y-01 (6.0) and the highest in 08-A-03 (9.4) types (Table 1). However, Eris et al. (7) reported flesh/stone ratios between 2.2 to 6.8 and Kalkisim and Odabas (11) reported a range of 2.1-7.4. When our results are compared to the reported studies, the selected phenotypes in Coruh valley had a higher flesh/stone ratio. Again, in the selection of cornelian cherry, flesh/stone ratio is considered as a main criterion (5).

Fruit length and fruit width ranged between 1.7 and 2.5 cm and 1.3 and 1.9 cm, respectively (Table 1). Fruit length/width ratio ranged from 1.2 (08-Y-03) to 1.7 (25-U-20). Also, 08-A-10 had the lowest stone weight (0.3 g) while 25-U-53 had the highest stone weight (0.6 g). Stone length and

Table 1. Some fruit characteristics of native cornelian cherry phenotypes selected from Coruh Valley.

Phenotypes	Fruit weight (g)	Flesh/ stone ratio	Fruit length (cm)	Fruit width (cm)	Fruit L/W ratio	Stone weight (g)	Stone length (cm)	Stone width (cm)
08-M-05*	3.1±0.04	7.7	2.0±0.02	1.5±0.01	1.3	0.4±0.00	1.4±0.01	0.7±0.01
08-M-06	3.3±0.05	7.8	2.0±0.03	1.5±0.02	1.3	0.4±0.00	1.4±0.02	0.7±0.01
08-M-07	3.2±0.11	7.4	2.2±0.02	1.4±0.01	1.5	0.4±0.00	1.6±0.01	0.6±0.01
08-M-08	3.5±0.08	8.4	2.0±0.03	1.5±0.02	1.3	0.4±0.00	1.3±0.01	0.6±0.02
08-S-01	3.0±0.09	7.1	1.9±0.01	1.4±0.02	1.5	0.4±0.01	1.5±0.02	0.7±0.01
08-A-02	2.9±0.07	8.3	1.9±0.01	1.3±0.01	1.4	0.3±0.01	1.3±0.01	0.6±0.02
08-A-03	3.2±0.07	9.4	2.2±0.02	1.5±0.02	1.5	0.3±0.00	1.5±0.01	0.6±0.01
08-A-09	3.5±0.08	7.4	2.0±0.03	1.5±0.01	1.4	0.4±0.01	1.5±0.02	0.6±0.02
08-A-10	3.1±0.09	8.2	1.9±0.01	1.4±0.01	1.4	0.3±0.00	1.3±0.01	0.6±0.00
08-A-12	2.9±0.12	8.2	1.9±0.03	1.4±0.02	1.4	0.3±0.01	1.5±0.02	0.6±0.02
08-A-15	3.2±0.08	7.9	2.0±0.02	1.5±0.02	1.3	0.5±0.01	1.4±0.01	0.7±0.01
08-Y-01	3.7±0.11	6.0	2.5±0.04	1.5±0.01	1.6	0.5±0.01	1.7±0.01	0.7±0.01
08-Y-02	3.1±0.15	7.0	2.0±0.03	1.4±0.01	1.5	0.4±0.01	1.5±0.01	0.6±0.00
08-Y-03	3.1±0.08	8.9	1.7±0.01	1.5±0.02	1.2	0.4±0.00	1.2±0.02	0.6±0.01
08-Y-05	3.4±0.11	9.4	2.0±0.02	1.5±0.01	1.3	0.3±0.00	1.4±0.02	0.6±0.01
25-U-03	3.7±0.11	6.8	2.2±0.04	1.6±0.02	1.3	0.5±0.00	1.4±0.01	0.7±0.01
25-U-11	3.7±0.06	9.1	2.1±0.03	1.6±0.01	1.3	0.4±0.01	1.3±0.01	0.7±0.02
25-U-20	3.2±0.04	6.7	2.3±0.03	1.4±0.02	1.7	0.4±0.01	1.5±0.02	0.7±0.01
25-U-33	3.4±0.13	7.9	2.1±0.02	1.5±0.01	1.4	0.4±0.01	1.4±0.01	0.7±0.01
25-U-34	3.7±0.07	7.2	2.2±0.04	1.6±0.01	1.4	0.4±0.00	1.5±0.02	0.7±0.01
25-U-39	4.0±0.09	8.6	2.2±0.03	1.7±0.01	1.3	0.4±0.00	1.5±0.01	0.7±0.01
25-U-43	3.9±0.10	8.3	2.1±0.04	1.7±0.01	1.2	0.4±0.01	1.3±0.01	0.7±0.02
25-U-53	5.2±0.08	7.3	2.5±0.02	1.9±0.03	1.3	0.6±0.01	1.6±0.01	0.7±0.00
25-U-61	4.0±0.06	9.0	2.3±0.03	1.6±0.02	1.4	0.4±0.00	1.4±0.02	0.6±0.01
25-U-69	3.7±0.07	6.8	2.2±0.03	1.7±0.02	1.3	0.5±0.01	1.4±0.01	0.7±0.01
25-U-97	3.9±0.06	6.4	2.1±0.02	1.7±0.02	1.2	0.5±0.00	1.3±0.03	0.7±0.01
25-U-119	4.2±0.12	8.2	2.3±0.04	1.8±0.01	1.3	0.5±0.01	1.5±0.01	0.7±0.01
25-U-133	4.1±0.11	8.4	2.2±0.03	1.7±0.02	1.3	0.4±0.01	1.3±0.02	0.7±0.01
25-U-139	4.3±0.12	8.9	2.2±0.03	1.8±0.02	1.3	0.4±0.01	1.5±0.01	0.7±0.02
25-U-140	4.1±0.11	8.6	2.2±0.02	1.8±0.01	1.2	0.4±0.00	1.4±0.03	0.7±0.01
25-T-35	3.3±0.10	6.3	2.0±0.01	1.5±0.01	1.3	0.5±0.01	1.3±0.02	0.7±0.02

*; In giving the numbers for cornlian cherry phenotypes, traffic code of the city, the first letter of town name and the number of type were used, respectively.

width were between 1.3-1.7 cm and 0.6-0.7 cm, respectively (Table 1).

Our fruit samples had 11.6 to 16.8% TSS (Table 2), compared to between 9.2 to 19.9% in other reports (7, 11, 13, 14, 16, 17). These differences could be the natural result of different environmental conditions and genotypes since TSS is greatly influenced by those factors (12).

Titratable acidity (as malic acid) in the selected phenotypes varied from 1.5 to 4.7 % while it was between 1.2 to 6.8 % in reports by Eris et al (7); Kalkisim and Odabas (11); Krgovic (13), and Tekeli (19).

The ratio of TSS/acidity affects fruit taste (20). TSS/Acid ratio ranged from 3.0 to 9.2 in the selected phenotypes grown in Coruh valley, but Kalkisim and Odabas (11) reported TSS/Acid ratios between 8.3 and 9.1 in their research material.

Cornelian cherry is one of the fruit species rich in vitamin C (5, 12). The vitamin C con-

Table 2. Some chemical characteristics of native cornelian cherry phenotypes selected from Coruh Valley.

Phenotypes	TSS (%)	Titratable acidity(%)	TSS/acid ratio	Vitamin C (mg/100 g)
08-M-05	13.9	3.0	4.7	47.9
08-M-06	13.3	2.5	5.4	46.5
08-M-07	13.2	2.4	5.6	57.7
08-M-08	11.6	3.3	3.5	59.5
08-S-01	14.1	3.1	4.6	58.1
08-A-02	15.2	3.5	4.4	60.5
08-A-03	12.5	3.2	3.9	67.4
08-A-09	16.8	3.8	4.5	57.7
08-A-10	15.6	4.0	3.9	54.9
08-A-12	15.0	4.4	3.4	65.1
08-A-15	14.3	4.7	3.0	45.3
08-Y-01	13.5	3.0	4.5	56.1
08-Y-02	14.3	3.8	3.8	58.1
08-Y-03	12.4	2.9	4.3	55.3
08-Y-05	13.2	2.7	4.8	59.5
25-U-03	15.6	2.4	6.4	97.9
25-U-11	15.4	1.8	8.4	106.3
25-U-20	15.5	2.1	7.5	63.2
25-U-33	15.2	2.0	7.6	96.4
25-U-34	14.6	2.2	6.6	70.9
25-U-39	13.6	1.5	9.0	72.2
25-U-43	13.7	2.8	4.9	35.6
25-U-53	14.3	2.0	7.2	66.1
25-U-61	14.3	1.6	9.2	50.2
25-U-69	16.3	2.2	7.3	68.2
25-U-97	15.0	2.4	6.3	89.6
25-U-119	15.9	2.2	7.2	71.6
25-U-133	16.6	2.0	8.5	69.9
25-U-139	14.2	2.4	6.0	64.8
25-U-140	16.4	2.0	8.1	47.2
25-T-35	14.0	1.9	7.5	72.1

tent ranged between 35.6 (08-U-43) and 106.3 mg/100 g (08-U-11) in our selected phenotypes. These results are similar to those of the others who reported from 31.7 to 99.5 mg/100 g (3, 6, 11, 14, 15, 16, 19).

As a result of our study, thirty-one cornelian cherry phenotypes naturally grown in Coruh valley were determined to be suitable for commercial table fruit production. However, further studies are suggested on these cornelian cherry types for other characteristics under similar conditions of land, climate and maintenance.

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Harvest Maturity and Storage of Pink Lady® Apples

In a three-year study, 'Cripps Pink' (Pink Lady®) apples harvested at two maturities were stored under regular cold storage (RA) or controlled atmosphere storage (CA). Fruit at starch indices of either 2 or 4 stored well under both RA and CA storage. The lack of detectable fruit size increase between starch indices of 2 and 4 was thought to be the result of short days, cool and cloudy weather, and deteriorating foliage. From: Drake, S.R., D.C. Elfving, and T.A. Eisele. 2002. HortTechnol. 12:388-391.