

Morphological Characterization of Grape Genotypes Grown Under Kandahar Province of Afghanistan for Quality Traits

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ABSTRACT: This study was conducted in 2023 at Kohkaran Research Farm, established by the Perennial Horticulture Development Center, Ministry of Agriculture, Irrigation and Livestock, in Kandahar, Afghanistan, to characterize the morphological traits of 22 grape genotypes. The evaluated genotypes comprised six seedless and 16 seeded genotypes: T₁: Kandahari Sorkh, T₂: Exotic, T₃: Sahibi Sra 488, T₄: Fantasy, T₅: Perlette, T₆: Keshmeshi Sia, T₇: Tashkandi, T₈: Black Emerald, T₉: Aqa Ali 876, T₁₀: Manaqa 801, T₁₁: Lokh Shetor, T₁₂: Shirahmadi Heart, T₁₃: Husaini, T₁₄: Awi, T₁₅: Lal Sia, T₁₆: Typi, T₁₇: Loghi, T₁₈: Shaker, T₁₉: Lal Katadana, T₂₀: Mahmodi, T₂₁: Lal Maida Dana, and T₂₂: Flame Seedless. Considerable variation was observed in bunch length, width, weight, volume and density, as well as berry length, width, length-to-width ratio, weight, volume, shape, seed presence, skin colour, and pulp colour. T₁₆ (Typi) recorded the maximum bunch length (26.00 cm) and bunch volume (620.00 mL), while T₄ (Fantasy) had the greatest bunch width (16.50 cm). The highest bunch weight (522.60 g) was recorded in T₁₁ (Lokh Shetor). Dense bunches were observed in T₁₄ (Awi), T₁₅ (Lal Sia), T₁₇ (Loghi), and T₁₈ (Shaker), whereas loose bunches were recorded in T₂ (Exotic), T₄ (Fantasy), T₅ (Perlette), T₆ (Keshmeshi Sia), T₉ (Aqa Ali 876), T₁₁ (Lokh Shetor), T₁₃ (Husaini), T₁₆ (Typi), T₂₀ (Mahmodi), T₂₁ (Lal Maida Dana), and T₂₂ (Flame Seedless). For berry characteristics, T₁₁ (Lokh Shetor) had the maximum berry length (23.50 mm), T₁₀ (Manaqa 801) had the maximum berry width (17.40 mm), and T₁₃ (Husaini) recorded the highest length-to-width ratio (1.70). These findings demonstrate substantial morphological diversity among the evaluated grape genotypes and provide a basis for their characterization and selection in future grape improvement programmes in Afghanistan.

KEYWORDS: grape, morphological, genotypes, yield and quality.

INTRODUCTION

Present the scientific or scholarly background, identify the problem or knowledge gap, and clearly articulate the rationale for the study. State the overall aim and, where appropriate, specific objectives or hypotheses. Support the introduction with current and relevant literature.

Grape is one of the important fruit crops of sub-tropical and temperate regions of Afghanistan. Grape improvement has been made for the development of quality, attractive colour, and sugar content for fresh consumption and processing, etc. The varietal or genetic differences are masked due to several factors and hence lead to confusion towards varietal identification in all available genotypes in Afghanistan. In this regard, knowledge of genetic diversity of different genotypes is important to form a basis for conservation, genetic improvement and promotion of domestication of population with desirable traits. A study of the literature indicates the much fewer studies were made to reveal morphological characterization of grape genotypes grown under Kandahar province (Afghanistan). In this chapter, an attempt has been made to review the literature relevant to the present investigation "Morphological Characterization of Grape Genotypes grown under Kandahar Province of Afghanistan for Quality Traits". Grape (*Vitis vinifera* L.) is one of the most nutritious, valuable and demandable remunerative fruit crops. It belongs to the family Vitaceae. Grape (*Vitis* sp.) is divided into two sub - genera, *Euvitis* Planch. (2n=38) and *Muscadinia* Planch. (2n=40) (Einset and Pratt, 1975). Grapevine is one of the worlds. major fruit crops and has the earliest recorded history. It has also been praised in "The Holy Quran" and "The Bible" and in the old authentic literatures indicating extent of antiquity. Grape is believed to have originated in Armenia near the Black and Caspian seas in Russia.

Botanically, the grapevine is a liana, a climbing vine. Grapevine has spreading, descending and deep root system. Feeder roots are mostly available at 25 cm depth and up to 60 – 120 cm away from trunk. Trunk is everlasting and stable stem of vine on which whole framework is based. After pruning, succulent current season's growth arises from buds called as „shoots. Which

when become woody, mature, and dormant are called as „cane“. Leaves of grapevine are cordate shaped and palmately lobed. The *Vitis vinifera* has intermittent tendrils having same origin with clusters. Flowers are born in racemose panicle opposite to leaves on current season's growth. The individual flower, or floret, can be hermaphrodite, pistillate and staminate though on cultivated vines it is always perfect which allows for self-pollination. Flowers, open from the base rather than the tip, form a cap (known as calyptra), which burst at anthesis. The fruit of grape vine is a true berry and a cluster of berries on main rachis and secondary rachis are referred to as "bunches". In Afghanistan, grape growing area and production during 2018 was 87,517 ha and 9, 84,081 MT, respectively (FAO, 2020) with a productivity of 11.24 MT/ha. Afghanistan grapes growing area mainly located in the provinces of Kandahar, Helmand, Northern and Central zones. The productivity of the grapes in the Afghanistan is very low as compared to other grape growing countries in the world. However, commercial viticulture in Afghanistan is several decades old and is currently being considered as one of the most remunerative horticulture enterprises. Major quantity of grapes is generally being dried to produce Munnaka and Kishmish. Farmers dry 20 to 25% of their grape harvest for raisin production. However, the percentage of grapes dried differs greatly by region and year (Bunnell and Safi, 2013). Many farmers sell their produce as fresh grapes, but with minimal benefit because local fresh markets are saturated at the time of grape harvesting, and this greatly decreases prices (Yousufi, 2016). In spite of this, grapes are the most cultivated fruit crop as it is the most remunerative compared to the other fruit crops grown in the Afghanistan. Indigenous and exotic varieties are commonly cultivated in Afghanistan basically for table and raisin purpose. Indigenous varieties include Hussaini, Taifi, Kasendra, Lal, Kata, Gholafan, Red Kandahari, Red Raucha, Green Raucha, Shondakhanai, Keshmeshi, Black Keshmeshi, Kandahari sorkh, Ayta, Lal Sorkh, Cheshi Gao, Sahibi, Sherahmadi, Tandyan, Gerdak, Toran and Mer Ahmadi. The major exotic varieties which are imported from USA doing well include Flame Seedless, Black Emerald, Red Globe, Crimson Seedless, Cardinal, Ribier and Perlette. Despite the large number of cultivars available, three local varieties namely Shindokhani, Kishmishi and Taifi, provide the maximum returns. Among the exotic varieties, „Flame Seedless“ is found very promising in terms of yield and returns under Afghanistan agroclimatic conditions (Anon. 2016). As a result, the exotic varieties are now replacing the local varieties due to higher yield potential.

Large numbers of varieties are being grown from temperate to subtropical climate. Vines are dormant during winter under temperate and subtropical climate and evergreen in tropical climate. For the best berry growth and development, grapes require long warm to hot dry summer and cool rainy winter (Winkler et al., 1974). The climatic variation is more pronounced to alter the berry composition as compared to rest of the factors (Coombe, 1987; White et al., 2009). This was also obviously emphasized by Amerine et al. (1967) that the temperature, sunshine duration, sunlight intensity occurrence of rains during berry maturity, soil type and soil temperature has more pronounced effect on chemical composition of grape berry. Among all these factors, temperature alone is the important factors which greatly influences the berry composition.

MATERIALS AND METHODS

The study entitled "Morphological Characterization of Grape Genotypes Grown in Kandahar Province, Afghanistan, for Quality Traits" was conducted in 2023 in the main orchard of Kohkaran Research Farm, established by the Perennial Horticulture Development Center (PHDC) in coordination with the Ministry of Agriculture, Irrigation and Livestock (MAIL), Kandahar, Afghanistan. The experimental site was located in the western part of Kandahar Province, within the 6th Zone, at 65°35'49.5" E longitude and 31°36'58.8" N latitude, at an elevation of 997 m above mean sea level. The region is characterized by a subtropical climate, with hot, dry summers and cool winters. Summer temperatures may reach 40–45°C, while temperatures may decline to approximately –0.3°C during February. The site received 207 mm of annual rainfall in 2023, with most precipitation occurring during January, February, and March.

A total of 22 grape (*Vitis vinifera* L.) genotypes, comprising six seedless and 16 seeded genotypes, were evaluated. The genotypes were Kandahari Sorkh (T₁), Exotic (T₂), Sahibi Sra 488 (T₃), Fantasy (T₄), Perlette (T₅), Keshmeshi Sia (T₆), Tashkandi (T₇), Black Emerald (T₈), Aqa Ali 876 (T₉), Manaqa 801 (T₁₀), Lokh Shetor (T₁₁), Shirahmadi Heart (T₁₂), Hussaini (T₁₃), Awi (T₁₄), Lal Sia (T₁₅), Typi (T₁₆), Loghi (T₁₇), Shaker (T₁₈), Lal Katadana (T₁₉), Mahmodi (T₂₀), Lal Maida Dana (T₂₁), and Flame Seedless (T₂₂). The vines were approximately 12 years old and had been established and maintained by PHDC. Five vines were selected from each genotype, giving a total of 110 selected vines. The vines were planted at a spacing of 2 m × 3 m and trained using a trellis system. According to the experimental records, the vines were pruned in January 2020, retaining three to four buds per spur. Vineyard management included the application of farmyard manure (FYM) and nitrogen (N), phosphorus (P), and potassium (K) fertilizers, scheduled irrigation, and the use of fungicides and insecticides for pest and disease management.

At harvest, ten uniform bunches were selected from each genotype. The bunches were harvested, sorted to remove unsuitable or visibly damaged samples, placed in plastic crates, and transported to the laboratory for evaluation. The samples were kept under ambient laboratory conditions, and the morphological, physical, and other quality-related observations were recorded on the same day. Ten bunches per genotype were used for bunch-related measurements, while five bunches per genotype were selected for berry-related assessments. Bunch weight was determined by weighing the ten sampled bunches individually using an electronic precision balance (Aslor and AND HT-500), and the measurements were expressed in grams (g). Bunch length and width were measured using a measuring scale and recorded in centimetres (cm). Bunch volume was also included among the evaluated traits, although the specific measurement procedure was not documented in the available experimental records. Bunch density, or compactness, was assessed according to the arrangement and adherence of berries along the rachis. Based on the descriptor categories cited in the experimental records from IPGRI and Bioversity International, bunches were classified as very loose, loose, medium, dense, or very dense.

Berry characterization was performed using samples obtained from five selected bunches per genotype. The assessed berry traits included length, width, length-to-width ratio, weight, volume, shape, seed presence or absence, skin colour, and pulp colour. These characteristics were recorded to describe morphological and physical variation among the evaluated genotypes. In addition to morphological and physical traits, total soluble solids (TSS), titratable acidity, ascorbic acid content, juice percentage, and pH were recorded on the day of sample collection to assess grape quality. However, the specific instruments, analytical procedures, measurement units, and protocols used for bunch volume, berry measurements, and physicochemical analyses were not specified in the available experimental records.

The experiment was reported to have been conducted using a randomized block design (RBD). The collected data were analysed using univariate analysis of variance (ANOVA) in SAS software. Treatment means were compared using the least significant difference (LSD) test, and differences were considered statistically significant at $p \leq 0.05$. The specific number of blocks, randomization procedure, SAS version, and experimental unit used in the statistical model were not documented in the information provided.

Table 1: Meteorological data (monthly values) for years 2020 at Kohkaran Research Farm, Kandahar, Afghanistan

Month	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Maximum	Minimum	
January	16.4 °C	-1.5 °C	94 %	29 %	66.55 mm
February	26.9 °C	-0.3 °C	94 %	15 %	42.42 mm
March	28.5 °C	3.7 °C	92 %	12 %	59.94 mm
April	36.2 °C	9.3 °C	91 %	11 %	14.73 mm
May	39.1 °C	14.8 °C	73 %	4 %	2.79 mm
June	45.5 °C	19.8 °C	42 %	2 %	0.25 mm
July	44.9 °C	22.1 °C	43 %	4 %	0.00 mm
August	44.5 °C	20.1 °C	62 %	5 %	0.00 mm
September	37.5 °C	13.5 °C	41 %	5 %	0.00 mm
October	33.5 °C	5.9 °C	46 %	7 %	0.00 mm
November	28.3 °C	2.2 °C	93 %	8 %	15.24 mm
December	25.7 °C	-4.2 °C	94 %	15 %	5.08 mm

Reference: <https://www.wunderground.com/history/airport/OAKN>

Table 2: Grape genotypes and categories used in the study

Sr. No	Seedless genotypes	Sr.No	Seeded genotypes
1	Keshmeshi Sia	1	Kandahari Surkh
2	Flame Seedless	2	Lal Katadana
3	Fantasy	3	Lal Sia
4	Perlette	4	Sherahmadi Heart
5	Tashkandi	5	Loghi
6	Black Emerald	6	Sahibi Sra 488
		7	Shaker
		8	Typi
		9	Awi
		10	Exotic
		11	Manaqa 801
		12	Aqa Ali 876
		13	Husaini
		14	Lokh Shetor
		15	Mahmodi
		16	Lal Maida Dana

RESULTS

Bunch Length (cm)

Significant variation in bunch length was observed among the 22 grape genotypes. Bunch length ranged from 11.60 to 26.00 cm. The maximum bunch length (26.00 cm) was recorded in T₁₆ (Typi), followed by T₁₃ (Husaini) at 23.70 cm, whereas the minimum bunch length (11.60 cm) was recorded in T₅ (Perlette).

Bunch Width (cm)

Bunch width differed significantly among the evaluated grape genotypes. The maximum bunch width (16.50 cm) was recorded in T₄ (Fantasy), whereas the minimum bunch width (7.80 cm) was observed in T₈ (Black Emerald).

Bunch Weight (g)

Significant differences in bunch weight were observed among the grape genotypes. T₁₁ (Lokh Shetor) recorded the maximum bunch weight of 522.60 g, followed closely by T₁₇ (Loghi) at 521.10 g. The minimum bunch weight (129.20 g) was recorded in T₆ (Keshmeshi Sia).

Bunch Volume (ml)

Bunch volume varied among the evaluated grape genotypes. The maximum bunch volume (620.00 mL) was recorded in T₁₆ (Typi), whereas the minimum bunch volume (255.00 mL) was observed in T₇ (Tashkandi).

Bunch Density

Variation in bunch density was observed among the grape genotypes. The bunches of T₁₄ (Awi), T₁₅ (Lal Sia), T₁₇ (Loghi), and T₁₈ (Shaker) were classified as dense. In contrast, the bunches of T₂ (Exotic), T₄ (Fantasy), T₅ (Perlette), T₆ (Keshmeshi Sia), T₉ (Aqa Ali 876), T₁₁ (Lokh Shetor), T₁₃ (Husaini), T₁₆ (Typi), T₂₀ (Mahmodi), T₂₁ (Lal Maida Dana), and T₂₂ (Flame Seedless) were classified as loose.

Table 3: Bunch Physical Characteristics

Sl No.	Varieties	Bunch Length (cm)	Bunch Width (cm)	Bunch Weight (g)	Bunch Volume (ml)	Bunch Density
1	Kandahari Sorkh	18.90 ^f	12.50 ^{fg}	296.70 ^{hi}	330.00 ^{jk}	Medium dense
2	Exotic	21.00 ^c	10.10 ^k	188.10 ^l	335.00 ^{jk}	Loose
3	Sahibi Sra 488	18.50 ^{fg}	11.30 ^j	380.00 ^e	425.00 ^g	Medium dense



4	Fantasy	21.70 ^{de}	16.50 ^a	229.90 ^k	410.00 ^g	Loose
5	Perlette	11.60 ^k	11.60 ^j	163.50 ^m	320.00 ^k	Loose
6	Kishmeshi Sia	22.20 ^{cd}	10.20 ^k	129.20 ⁿ	260.00 ^l	Loose
7	Tashkandi	22.00 ^{cd}	13.70 ^{bc}	252.10 ^j	255.00 ^l	Medium dense
8	Black Emerald	21.50 ^{de}	7.80 ^m	301.40 ^h	420.00 ^g	Medium dense
9	Aqa Ali 876	16.10 ⁱ	11.90 ^{hi}	261.60 ^j	430.00 ^g	Loose
10	Manaq 801	21.10 ^c	11.20 ^{hij}	439.10 ^c	590.00 ^b	Medium dense
11	Lokh Shetor	20.90 ^c	13.80 ^b	522.60 ^a	520.00 ^c	Loose
12	Shirahmadi Heart	22.30 ^{bcd}	13.30 ^{cd}	290.30 ^{hi}	360.00 ^h	Medium dense
13	Husaini	23.70 ^b	11.50 ^j	412.30 ^d	470.00 ^f	Loose
14	Awi	18.70 ^{fg}	13.20 ^{de}	336.40 ^h	355.00 ^{hi}	Dense
15	Lal Sia	12.60 ^j	8.60 ^{lm}	137.50 ⁿ	420.00 ^g	Dense
16	Typi	26.00 ^a	12.80 ^{ef}	456.10 ^b	620.00 ^a	Loose
17	Loghi	22.70 ^c	12.40 ^{fg}	521.10 ^a	500.00 ^d	Dense
18	Shaker	17.70 ^{gh}	10.50 ^k	360.40 ^f	510.00 ^{cd}	Dense
19	Lal Katadana	22.60 ^c	8.90 ^{lm}	352.50 ^{fg}	340.00 ^j	Medium dense
20	Mahmodi	21.70 ^{de}	12.20 ^{gh}	284.30 ⁱ	270.00 ^l	Loose
21	Lal Maida Dana	17.40 ^h	8.00 ^m	164.60 ^m	320.00 ^k	Loose
22	Flame Seedless	21.70 ^{de}	9.20 ^l	288.60 ^{hi}	330.00 ^{jk}	Loose
	General Mean	20.12	11.42	307.65	399.55	-
	LSD at 5%	0.81	0.45	16.77	17.86	-

SUMMARY AND CONCLUSION

The present investigation entitled “Morphological characterization of grape genotypes grown under Kandahar Province of Afghanistan for quality traits” was carried out during on 2020 at Kohkaran Research Farm which was established by Perennial Horticulture Development Center (PHDC), Ministry of Agriculture, Irrigation and Livestock (MAIL), based on Kandahar, Afghanistan. There were 22 grape varieties namely Kandahari Sorkh, Exotic, Sahibi Sra 488, Fantasy, Perlette, kishmeshi Sia, Tashkandi, Black Emerald, Aqa Ali 876, Manaq 801, Lokh Shetor, Shirahmadi Heart, Husaini, Awi, Lal Sia, Typi, Loghi, Shaker, Lal Katadana, Mahmodi, Lal Maida Dana and Flame Seedless.

The salient features of the experimental results are being summarized as below:

- Results indicated that the different varieties have a significant effect on bunch length. The maximum bunch length (26.00 cm) was noted in Typi followed by Husaini (23.70 cm) while minimum bunch length (11.60 cm) was recorded in Perlette. The maximum bunch width (16.50 cm) was noted in Fantasy variety of grape while lowest bunch width (7.80 cm) was recorded in Black Emerald.
- The highest bunch weight (522.60 g) was noted in Lokh Shetor, followed by Loghi (521.10 g). Whereas minimum bunch weight (129.20 g) was recorded in kishmeshi Sia.
- The experiment shows that the different varieties have a significant effect on bunch volume. The maximum bunch volume (620.00 ml) was recorded in Typi. Whereas the minimum bunch volume (255.00 cm) was recorded in Tashkandi.
- The varieties Awi, Lal Sia, Loghi, and Shaker produced the dense bunch. while, Exotic, fantasy, Perlette, Kishmeshi sia, Aqa Ali 876, Lokh Shetor, Husaini, Typi, Mahmodi, Lal Maida Dana, and Flame Seedless had loose bunch.

CONCLUSION

Based on results obtained from the present investigation, it can be concluded that different result achieved from different varieties, bunch length was highest in Typi variety and the lowest in Perlette, bunch width was highest in Perlette and lowest in Black Emerald, bunch weight was highest in Lokh Shetor and lowest in Kishmeshi Sia, bunch volume was maximum in Typi but minimum in Tashkandi, bunch density was maximum in Awi, Lal Sia, Loghi and Shaker.

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