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Research Article

Evaluation and Description of Three Grape Cultivars Suitable for Export under Egyptian Conditions

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Abstract:

This study was carried out for two successive seasons, 2021 and 2022, and conducted evaluation for newly introduced grape cultivars namely Early Sweet, Sweet Celebration and Sweet Sapphire, grafted on freedom rootstock under Menoufia Governorate conditions, These varieties were brought and cultivated by El-Beltagy Company for Export and Agricultural Reclamation - Cairo-Alexandria, Desert Road during the grape export season, Menoufia Governorate. Results showed the Sweet grape cultivar was the earliest cultivars with regard to the phenological dates and recorded the highest number of clusters, number of marketable clusters/vine, cluster weight and yield/vine followed by Sweet Celebration, followed by Sweet Sapphire grapevine grape in the two seasons. While, Sweet Sapphire cultivar recorded the highest number of shoots per vine, shoot length , number of leaves/vine, average leaf area berry length and diameter followed by Early Sweet followed by Sweet Celebration grapevine in both seasons. The studied cultivars were characterized by good vegetative growth, yield, and berry quality and proved that Early Sweet grapevine Cv., early ripping. Sweet Celebration grapevine has medium ripping, while, Sweet Sapphire grapevine has late ripping. The production of these three varieties covers the export season from the beginning of May until the end of September.

1. Introduction

Grapes are considered one of the most important fruit crops in the world and in Egypt Among the most crucial elements of agricultural systems are plant variety and cultivar identification. There are more than 13,000 different grape varieties, which indicate a comparatively high level of grape diversity (OIV, 2013). Grape is the third leading fruit crop worldwide, with a harvested area of 7.2 million hectares producing 70.8 million tons annually with an average of 11.23 tons/hectare (OIV, 2023) in Egypt, it ranks fourth after citrus, mango and olive fruit crops concerning the production area and consumption rates. In the last decade, Grape acreage exhibited a remarkable increase in Egypt, reaching a harvested area of 91,633 hectares, producing 1.517,976 tons (FAOSTAT, 2022)

For thousands of years, people have used the grape (*Vitis vinifera* L.), one of the most widely planted fruit trees in the world, to make wine, dried fruit, and fresh fruit. Many of the hundreds of grape varieties in the globe have been crossed with other grape species or kinds to produce new cultivars (Azuma et al., 2011).Effective classification is essential due to the large number of table and wine grape cultivars being produced, as well as the collections of germplasm and private gardens. Familiarity with amplographic albums is essential for understanding phonological features (bud burst time, version, ripening time), genotype resistance or tolerance to pests or diseases, and different vine yard practises (pruning and harvest criteria), (Goussard, 2008) and Robinson et al. (2012).

Early Sweet' is a white seedless table grape cultivar. The berry has good eating quality, with a slight Muscat flavor, creamy color, and crisp texture that add value to its marketability (Uwakiem, 2015).

Sweet Sapphire is a hybrid created by cross-breeding Beitamouni with C 22-121. Learn more about Sweet Sapphire Black Seedless Grapes, the newest grape variety launched by Perfection Fresh Australia (El-Sayed and Fayed 2023). Sweet Celebration is a combination of Red Globe and Princess. Sweet Celebration (IFG Three) is a mid-to-late season brilliant red seedless. A naturally large oval-shaped berry, Sweet Celebration colors well, producing a crispy firm textured berry in medium clusters, with high yields and low production costs. (Akkurt et al., 2019).

For vineyard improvement and optimum production, measurements of grape parameters that affect product quality are necessary. (Carrara et al., 2008). In this regard, numerous studies were conducted for the assessment and features of the grape varieties. El-Morsy et al. (2017), Mohamed and Tarbia (2017), Abousef (2019), Ahmed and Abd ElAziz (2021), El-Sayed and Fayed (2023) and Chupradit et al. (2024). .In recent years, a large number of new varieties with various biological and economic-technological characteristics have been introduced. These varieties have not been studied from the standpoint of their adaptation to the

environmental conditions, so the main aim of this investigation is to study the evaluation of three newly-introduced grape cultivars, namely, Early Sweet, Sweet Celebration and Sweet Sapphire, under environmental Egyptian conditions.

2. Materials and Methods

This study was carried out for two successive seasons, 2021 and 2022, on five-year-old grapevines. Evaluation and characterization of three Egyptian grape cultivars namely, Early Sweet, Sweet Celebration and Sweet Sapphire, grafted on freedom rootstock. The vines were planted in sandy clay loam soil spaced 2x3 meters apart and irrigated by the drip irrigation system. Vines were cane pruned and support by the Spanish Parron system. These varieties were brought and cultivated by El-Beltagy Company for Export and Agricultural Reclamation - Cairo-Alexandria Desert Road during the grape export season, which starts from the first week of May until the end of July. All of the grapevine received the standard agricultural practices used in the vineyard, including soil fertilization, dormex application, irrigation, and pest control. The application of 20 m^3 of fed organic manure, 150 kg of calcium superphosphate (15.5% P_2O_5), 200 kg of ammonium nitrate (33% N), and 150 kg of potassium sulfate (48% K_2O)/feddan is considered soil fertilization. One application of organic manure (0.25% N) occurred during the second week of December. Soil samples were taken for physical and chemical analysis Tables 1 While, some of agro climatological data for the three locations during 2021 and 2022 growing seasons are presented in Table 2.

Table 1: Soil physical and chemical properties of the experimental site

Parameters	Amount	
	2021	2022
Physical properties		
Clay%	6.28	5.87
Silt%	25.54	26.55
Sand%	68.18	67.58
Soil texture	Clay	
Chemical properties		
PH	7.36	7.32
EC(dsm-1)	0.92	0.96
Caco3	-	
Organic matter %	0.19	0.17
Soluble cations meq100-1 g soil		
Ca++	5.37	6.29
Mg++	4.62	3.58
Na++	2.03	2.12
K+	0.48	0.63
Soluble anions meq100-1 g soil		
HCO3	3.97	5.03
Cl-	1.78	1.9
SO4	2.27	2.46

Table 2: Some of the agro-climatological data for the experiment locations during the 2019/2020 and 2020/2021 growing seasons

Month	HC Air temperature (°C)			Relative humidity (%)
	Min	Max	Avg	
2020/2021				
Oct.	17.45	35.90	26.68	77.28
Nov.	16.81	33.69	25.25	76.43
Dec.	11.89	26.10	18.99	82.08
Jan.	12.00	21.57	16.79	89.00
Feb.	13.35	25.11	19.23	88.40
Mar.	14.70	27.48	21.09	89.18
Apr.	17.07	31.30	24.19	88.84
May.	19.29	35.03	27.16	88.03
2021/2022				
Oct.	17.67	35.41	26.54	75.19
Nov.	15.86	32.64	24.25	77.13
Dec.	11.22	25.29	18.26	82.82
Jan.	11.33	20.91	16.12	89.82
Feb.	12.59	24.32	18.46	89.20
Mar.	13.87	26.63	20.25	89.99
Apr.	18.80	31.78	25.29	87.53
May.	20.31	34.30	27.31	82.61

2.1. The experiment layout

Twenty-seven uniform vines free of various physiological and pathological infections were selected, with an average of nine vines of each variety. The age of the vines at that time was five years. The vines of each variety were divided into three replications, each replicate containing three vines. The vines were pruned in mid-December, about 15 days later. Hydrogen cinamide (5%) was sprayed to break the dormancy of the buds, followed by cover vines (white plastic) application during the first week of January until the end of April (Bowen et al., 2004).

2.2. The following characteristics were investigated

2.2.1. Descriptive parameters

In accordance with the International Amelographic Registered Schedule (Cosmo et al., 1958), the morphological investigations were conducted. Many authors (Rodrigues, 1959 and Watt 1983) defined the following evaluations, which were centered around, the leaf (surface, color, pubescence, number of teeth,lobes, and petiole), the growing shoot (opening tip, growing tip color, and attitude (before tying), and the tendril sequence and tip form

2.2.2. Dates of phonological stages

During the growing season, the beginning of the phenological stages of the grapevine was recorded of the three tested genotypes

1. Date of bud burst stage.
2. Date of vegetative growth stage.
3. Date of flowering stage.
4. Date of Harvest stage.

2.2.3. Vegetative growth characteristics

1-Number of shoots per vine.
2-Average shoots length (m).
3-Number of leaves/vine.
4- Average leaf area (cm^2): Average leaf area (cm^2): leaves were taken from

the apical fifth and sixth from the main shoot per vine and average leaf area measured using a CI- 203-Laser Area-meter made by CID, Inc., Vancouver, USA

2.2.4. Yield and its components

At the harvest time of each season, the clusters per vine were recorded. Six clusters/replicate were randomly harvested when the average TSS % attained about 15-16% in the untreated vines and taken to measure the yield components as follows:

-Number of cluster/vine:
-Number of marketable clusters/ vine:
-Cluster weight (g):
-Total cluster yield/vine (kg)
-Berry length and diameter (mm)

2.3. Statistical Analysis

Results were express as mean. The data were subject to one-way ANOVA as described by Snedecor and Cochran (1990) through SPSS 16 (version 4). The treatments means were compare using Tukey′s honestly significance (HSD) test at probability $\leqslant$ 0.05 (Tukey, 1949).

3. Results and Discussion

3.1. The description parameters

Table 3 displays the information pertaining to the evaluation and morphological definitions (Shoot, leaf, Internodes and tendrils) of the of the cultivars of grapes (Early Sweet, Sweet Celebration, and Sweet Sapphire under investigation

As for shoot, all of the evaluated grape cultivars, Early Sweet, Sweet Celebration, and Sweet Sapphire had completely opened tips, an erect attitude, and a purple-tinged green color. With the exception of the green Early Sweet grape variety

As for leaf, all of the evaluated grape cultivars, Early Sweet, Sweet Celebration, and Sweet Sapphire, had a green color on the upper side of the blade. Sweet Sapphire gave the highest leaf teeth number, leaf lobe number, and leaf petiole length than Sweet Celebration and Early Sweet cultivars. All studied grape varieties had smooth leaf surfaces with green color.

As for internodes, Sweet Sapphire gave the highest Internodes length and thickness than Sweet Celebration and Early Sweet cultivars.

As for tendrils, In every grape variety (Early Sweet, Sweet Celebration and Sweet Sapphire grape) under investigation, the tendril sequence was sporadic and had a di-trifid form.

These results are consistent with those obtained by El-Morsy et al. (2017), who studied the black cultivar Arra 24 and the white cultivar Arra 30, noting that these cultivars exhibited thick internodes. According to Gaser et al. (2023), cultivars of starlight and sugrafourteen showed the same tendency and numerous researchers working with various cultivars (Mohamed and Tarbia, 2017 and El-Sayed and Fayed, 2023).

3.2. Dates of phonological stages

The early of phenological stages are an important indicator of export grapes. The dates of phonological stages are shown in Table 4. Early Sweet grape cultivar was the earliest cultivars with regard to the phenological dates represented in bud burst, full bloom, fruit set and grape maturity followed by Sweet Celebration, followed by Sweet Safaier grapevine grape in the two seasons

Early Sweet Grapevine had the first bud burst (1^{st} Feb., 4^{th} Feb.), vegetative growth stage (25^{th} Feb.–^{30}th Feb.), date of flowering stage (1^{st} Apr.–2^{nd} Apr.), date of harvest stage (20^{th} May–26^{th} May). While, Sweet Sapphire recorded the last variety in the first bud burst (1^{st} March, 3^{rd} March), vegetative growth stage (25^{th} March, 27^{th} March), date of flowering stage (24^{th} April, 28^{th} April), and date of harvest stage (15^{th} July, 20^{th} July).

The obtained results are consistent with the results of El-Sayed and Fayed (2023), who discovered that Sweet Sapphire was the latest variety recorded. But the longest cultivar was sweet celebration. The last cultivar was noted by Sweet Celebration. The first coloring came from Sweet Sapphire (the black cultivars), but Sweet Celebration was the best cultivar. Sweet Joy registered the remotest variety, while Sweet Sapphire and Sweet Celebration had the early ripening.. According to Gaser et al. (2023), berry ripening was early for red cultivars such as Starlight and Sugrafourteen, but late for yellowish green and black cultivars such as Autumn Crisp and Midnight Beauty. El-Morsy et al. (2017) also noted that the red cultivar Arra 29 was early ripening, while the red cultivar Arra 13 was mid-early ripening. On the other hand, the white cultivar Arra 15 and the black-skinned Arra 27 were mid-late ripening.

Table 3: Description parameters of Early Sweet, Sweet Celebration and Sweet Sapphire grape cultivars

Characteristics \ Cultivars	Early Sweet	Sweet Celebration	Sweet Sapphire
Shoot			
opening tip	Fully open	Fully open	Fully open
Growing tip color	Green	Green with purple	Green with purple
Attitude(before tying)	Erect	Erect	Erect
leaf			
Color of upper side of blade	Green	Green	Green
Leaf teeth number	72	76	82
Leaf lobes number	3	3	3.5
Leaf petiole length(cm)	6	6	7
Color	Green	Green	Green
Surface	Smooth	Smooth	Smooth
Internodes			
Internodes length(cm)	7	7	8
Internodes thickness(mm)	0.8	0.82	0.85
Tendrils			
Sequence	Intermittent	Intermittent	Intermittent
Tip shape	Di-tri-fid	Di-tri-fid	Di-tri-fid

Table 4: Dates of phonological stages of Early Sweet, Sweet Celebration, and Sweet Sapphire during 2021 and 2022 seasons

	Date of bud burst stage		Date of vegetative growth stage		Date of flowering stage		Date of Harvest stage	
Cultivars	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
Early Sweet grapevine	1st Feb.	4th Feb.	25th Feb.	30th Feb.	1st Apr.	2nd Apr.	20th May	26th May
Sweet Celebration grapevine	20th Feb.	18th Feb.	10th Mar.	7th Mar.	15th Apr.	12th Apr.	25th June	20th June
Sweet Sapphire grapevine	1st Mar.	3rd Mar.	25th Mar.	27th Mar.	24th Apr.	28th Apr.	15th July	20th July
F test	**	**	*	*	**	**	**	**

3.3. Vegetative growth characteristics

Characteristics of vegetative growth as indicators of vine growth and vitality, All three of the cultivars of grapes (Early Sweet, Sweet Celebration, and Sweet Sapphire that were evaluated differed significantly in all growth indicators (Number of shoots per vine, Average shoot length, Number of leaves/vine, and Average leaf area), as shown in Table 5 data.. Sweet Sapphire cultivar recorded the highest Number of shoots per vine, Number of leaves/vine, and Average leaf area), followed by Early sweet followed by Sweet Celebration grapevine in both seasons, respectively. In the contrast of this, Early Sweet grapevine cultivar had the greatest Average shoot length followed by Sweet Sapphire followed by Sweet Celebration grapevine in the first and second seasons, respectively

The obtained results are consistent with the results of El-Sayed and Fayed (2023) revealed that compared to the evaluated cultivars, Sweet Celebration had noticeably less leaf area in both seasons. Nevertheless, the remaining cultivars were not different much from one another. Compared to Sweet Globe and Sweet Sapphire cultivars, Sweet Celebration exhibited noticeably longer shoots throughout the first growing season. Sweet Sapphire's internode length was significantly higher in the first season compared to Sweet Celebration's. Sweet Sapphire had a lot more internodes than Sweet Celebration in the first season. Compared to the other types, Sweet Sapphire's cane length was noticeably shorter during the first growing season According to Gaser et al. (2023), starlight and sugar fourteen (red cultivars) had the same outcome. The findings obtained are in accordance with those of many investigators working on different cultivars, Mohamed and Tarbia, 2017 and El-Morsy et al., 2017)

Table 5: Vegetative growth characteristics of Early Sweet, Sweet Celebration, and Sweet Sapphire during 2021 and 2022 seasons

	Number of shoots per vine		Average shoot length(m)		Number of leaves/vine		Average leaf area (cm^2)	
Cultivars	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
Early Sweet grapevine	156.50 b	152.00 b	1.34 a	1.33 a	1131.50 b	1130.50 b	114.44 b	114.36 b
Sweet Celebration grapevine	143.75 c	141.75 c	1.26 b	1.25 b	1093.75 c	1099.25 c	106.56 c	106.37 c
Sweet Sapphire grapevine	170.25 a	173.75 a	1.30 ab	1.32 a	1288.00 a	1308.00 a	123.95 a	125.17 a

Means followed by the same letters during 2021 and 2022 seasons, respectively are not significantly different at level p ⩽0.05 according to Tukey`s HSD test.

3.4. Yield and its components

Number of clusters, number of marketable clusters/vine, cluster weight and yield/vine

The yield and its components are shown in Tables 6 and 7. Early Sweet grape fared better during the study season than all other grape varieties. Based only on data from the second season,. The Early Sweet cultivar recorded the highest number of clusters, number of marketable clusters/vine, cluster weight and yield/vine followed by Sweet Celebration followed by Sweet Sapphire grapevine during 2021 and 2022 seasons . Table 5 also, shows that there is significant variation in cluster weight between the three grape varieties (Early Sweet, Sweet Celebration, and Sweet Sapphire) in the first season.

These results are in agreement with Pascoal et al. (2022) found that the sweet sapphire cultivar is highly resistant to diseases and pathogens, being an advantage in increasing productivity. El-Sayed and Fayed (2023), Sweet Sapphire recorded the considerably greatest average cluster weight, cluster length, berry length, yield per vine, and productivity per feddan. Meanwhile, these characteristics were not remarkably affected by the other cultivars Moreover, Gaser et al. (2023) indicated that the yield and bunch weight were significantly higher in the Midnight Beauty grape (black colour) than Starlight grape (pink skin) and Sugrafourteen grape (red colour).

Table 6: Number of clusters, number of marketable clusters/vine, cluster weight and yield/vine of Early Sweet, Sweet Celebration, and Sweet Sapphire during 2021 and 2022 seasons

	Number of clusters /vine		Number of Marketable clusters/vine		Cluster weight (g)		Yield/vine (kg)	
Cultivars	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**	**2021**	**2022**
Early Sweet grapevine	56.50 a	55.25 a	35.50 a	35.25 a	528.65	528.1 a	18.75 a	18.61 a
Sweet Celebration grapevine	48.75 b	48.25 b	31.25 b	32.00 b	485.75	479.1 b	15.17 b	15.32 b
Sweet Sapphire grapevine	46.00 b	44.25 b	29.00 b	28.50 c	498.91	468.6 b	14.47 b	13.36 c

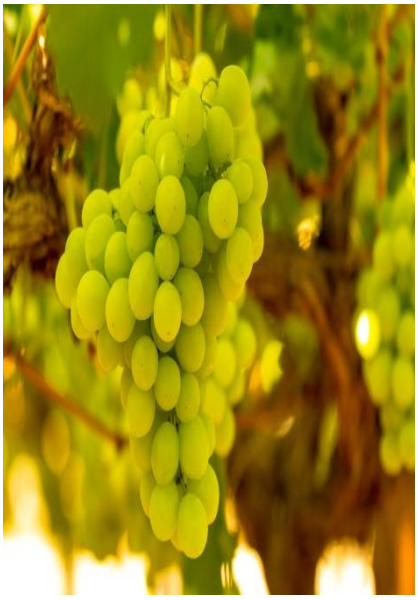
Berry length and diameter

Findings presented in Table 7. In both seasons, Sweet Sapphire was the cultivar with the berry length and diameter (longest and largest) berries, followed by Sweet Celebration. In contrast, the Early Sweet cultivar had the smallest berry diameter and length all the two seasons respectively. However, these parameters values non significantly with those of Early Sweet and Sweet Celebration grape in the two seasons

The findings agree with El-Sayed and Fayed (2023) found that the largest L/D ratio (berry length/berry diameter ratio) was found in Sweet Sapphire. Nonetheless, the remaining cultivars had no effect on the L/D ratio. The results above line up with many studies conducted with different cultivars (Basheer-Salimia, 2015; Mohamed and Tarbia, 2017; El-Morsy et al., 2017; Ahmed and Abd-El-Aziz, 2021; Gago et al., 2022; Gaser et al., 2023 and Chupradit et al., 2024).

Table 7: Berry length and diameter of Early Sweet, Sweet Celebration, and Sweet Sapphire during 2021 and 2022 seasons.

Cultivars	Berry length (mm)		Berry diameter (mm)	
	2021	**2022**	**2021**	**2022**
Early Sweet grapevine	16.85 b	17.10 b	14.88 b	14.75 b
Sweet Celebration grapevine	17.88 ab	17.20 b	15.35 ab	15.20 b
Sweet Sapphire grapevine	18.93 a	19.08 a	16.86 a	17.13 a



Early Sweet grapevine

Sweet Celebration grapevine

Sweet Sapphire grapevine

Photo 1: Clusters shape of three grape cultivars

Conclusion

The evaluated cultivars revealed that Early Sweet grapevine Cv., early ripping, with good vegetative growth, yield, and berry quality, Sweet Celebration grapevine Cv. is medium-ripping. Whereas, Sweet Sapphire grapevine Cv.is late ripping

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