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Selection for Quality Attributes in Date Palm under Toshka Conditions

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ABSTRACT

This study was conducted during the 2024 and 2025 seasons to evaluate eleven seedling date palm strains (1–11) derived from Bartamoda date palm seeds and grown in Toshka Research Station, Desert Research Center, Aswan, Egypt. The selected strains, locally designated as strains 1–11 and Toshka 1, were evaluated in comparison with the Bartamoda cultivar, a commercially important dry date cultivar. The investigation included yield components, fruit physical and chemical quality and numerical evaluation. The results revealed considerable variation among the studied strains in yield and fruit quality. Toshka 1 recorded the highest yield (33.16 kg/palm), followed by Bartamoda (28.57 kg/palm) and strain 4 (23.81 kg/palm), whereas strain 3 recorded the lowest yield (2.60 kg/palm). Toshka 1 and strain 6 exhibited favorable physical fruit characteristics, particularly in terms of fruit weight, fruit length, flesh percentage, and moisture content. Regarding chemical characteristics, Toshka 1, strains 7 and 2 showed relatively favorable values, particularly for total soluble solids and sugar contents. The numerical evaluation further confirmed considerable variation among the investigated genotypes, with Toshka 1 (90.0), strain 7 (84.9), strain 6 (83.7), and strain 1 (80.2) recording the highest overall scores. Overall, the findings identified Toshka 1 and strains 7, 6, 1, 2, and 9 as promising seedling-derived genotypes for further evaluation, selection, and vegetative propagation under the environmental conditions of Toshka, Aswan.

Keywords: Date palm, Bartamoda cultivar, seedling strains, yield; fruit quality, genetic characterization.

1. Introduction

Palm (*Phoenix dactylifera* L.) is one of the oldest domesticated fruit crops in the Middle East. Its fruits constitute an important component of the diet of many populations and represent a strategic crop for food and various biotechnological and industrial applications (Khayyat *et al*., 2007). Based on fruit moisture content, date palm cultivars are generally classified into three groups: soft cultivars, with more than 30% moisture; semi-dry cultivars, with 20–30% moisture; and dry cultivars, with less than 20% moisture. Aswan Governorate is one of the important date-producing regions in Egypt, particularly for dry date cultivars (Zaid and de Wet, 2002). Egypt is also considered one of the leading date-producing countries in the Arab region (FAO, 2021). According to the Bulletin of the Agricultural Statistics (2022), Egypt had approximately 14,681,131 fruitful female date palms, producing about 1,713,610 tons of dates.

In Aswan Governorate, seedling palms account for approximately 70% of the total fruitful female date palms. The predominance of seedling palms and the decline in the number of superior cultivars represent important challenges for the conservation and improvement of date palm production. Since seedling-derived palms exhibit considerable phenotypic variability, the systematic evaluation and characterization of these populations may provide an opportunity to identify promising genotypes with desirable agronomic and fruit characteristics. Therefore, the characterization of unknown seedling palms growing within large populations is an important preliminary step in date palm improvement programs. The morphological characteristics of palms, together with the physical and chemical properties of their fruits, provide valuable criteria for identifying and selecting promising genotypes

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that could serve as potential sources for the development of new cultivars. Such characterization may also contribute to a better understanding of date fruit diversity and support the propagation and utilization of superior genotypes that meet the requirements of both producers and consumers (Jaradate and Zaid, 2004; Ismail *et al*., 2006; Gadalla, 2013; Madboly *et al.,* 2021; Ayub *et al*., 2023 and Khan *et al*., 2025).

Date palm germplasm represents a considerable reservoir of genetic diversity, comprising numerous cultivars and seedling-derived genotypes with potential commercial value. Hundreds of date palm clones may possess desirable characteristics that could qualify them for cultivation as commercial cultivars. In addition, the historical exchange and introduction of date palm germplasm among different countries have resulted in the cultivation of genetically similar materials under different local names, further emphasizing the need for accurate characterization and identification of date palm genetic resources.

The genetic improvement of crop species largely depends on the effective identification and selection of superior plant materials. In this context, molecular markers associated with important agronomic and quality traits can serve as valuable tools for genetic characterization and selection. Such markers can facilitate the construction of genetic maps, enhance marker-assisted selection in breeding programs, and provide valuable information for genetic diversity and systematic studies (Soliman *et al*., 2006; El-Kosary *et al*., 2023; Yahya *et al*., 2024). In addition to molecular approaches, the assessment of phenotypic diversity remains essential for germplasm characterization, particularly in perennial and vegetatively propagated crops such as date palm.

The extent to which phenotypic diversity is associated with geographic origin, environmental plasticity, and long-term germplasm exchange remains insufficiently characterized at the regional scale. Addressing these aspects is important for effective germplasm conservation, management, and utilization in breeding programs. Identifying the morphological and fruit descriptors that contribute most strongly to the differentiation of genotypes can facilitate the development of efficient characterization protocols, improve the early identification of promising genotypes, and assist in the selection of suitable parental materials for breeding. Furthermore, distinguishing phenotypic similarity from true cultivar identity is particularly important in vegetatively propagated fruit crops, where synonyms, homonyms, and closely related or near-duplicate materials may occur within germplasm collections (Nybom and Lácis, 2021; Testolin *et al.,* 2022).

Several studies have demonstrated the usefulness of morphological and fruit characteristics in differentiating date palm cultivars and assessing their phenotypic diversity. The characterization of these traits provides valuable information for researchers, breeders, and farmers and contributes to the effective conservation, management, and utilization of date palm germplasm. Morphological descriptors and fruit characteristics have therefore been widely employed to investigate the diversity and relationships among date palm cultivars and genotypes (Aly *et al*., 2019; Abd *et al*., 2019; Bedjaoui and Benbouza, 2020; Ahmed *et al*., 2023; Ahmad *et al*., 2023; Al Rashidi *et al*., 2023; Kadri *et al*., 2025).

Therefore, the present study aimed to evaluate the physical and chemical characteristics of the fruits of twelve date palm strains, comprising eleven seedling-derived strains designated from 1 to 11, in addition to the Toshka strain, which was registered as a cultivar derived from a Bartamoda seedling, along with Bartamoda cultivar of Aswan. The study was conducted to characterize and compare these genotypes and to rank them according to their fruit quality attributes, with the ultimate objective of identifying promising genotypes that may have potential for cultivation, propagation, and future use in date palm improvement programs.

2. Materials and Methods

This study was carried out through 2024 and 2025 to evaluate twelve strains of date palm grown in Toshka Research Station, Desert Research Center, Aswan, Egypt, ($22^0$28'18.8"N $31^0$32'19.8"E), comparing with Bartamoda date palm meteorological data in Toshka region for of 2024 and 2025 seasons are presented in Table (1).

In 2016, 64 seeds were initially planted using fruits collected from the Bartamoda date palm cultivar. By 2020, the seedlings began to exhibit their first signs of production. Among the resulting seedlings, one strain showed notable superiority in its productive performance and was subsequently registered as “Toshka 1.” The selected seed source subsequently produced a total of 64 seedlings,

consisting of 29 female and 35 male seedlings. Several of the female seedlings, together with Toshka 1, were selected for further evaluation and comparison with the original Bartamoda cultivar.

These strains included twelve strains were assigned numbers from 1 to 11, in addition to the Toshka strain, which was registered as a cultivar derived from a Bartamoda seed.

Table 1: Maximum, Low and average temperatures and relative humidity for Toshka, Aswan governorate during the two studied season (2024 & 2025)

Months	Aver. temperature (°C)	Min. air temperature (°C)	Maxi. air temperature (°C)	Aver. relative humidity (%)	Total precipitation (mm)	Aver. wind speed (m/s)
			2024			
January	16.26	9.69	23.93	40.35	0.00	2.93
February	17.26	10.06	25.15	35.77	0.20	3.17
March	23.34	15.35	31.68	25.48	0.00	3.25
April	28.10	19.93	36.03	22.79	0.00	3.39
May	31.35	23.17	39.13	19.45	0.00	3.82
June	35.62	27.60	43.36	16.94	0.00	3.86
July	36.04	28.91	42.55	21.32	0.00	3.58
August	36.52	30.32	42.15	28.81	2.90	3.64
September	33.87	27.05	40.53	26.30	0.20	3.91
October	28.00	20.74	35.78	27.81	0.00	3.35
November	20.77	13.98	28.21	39.24	0.00	3.28
December	17.03	10.53	24.69	42.55	0.00	2.98
Average and Sum	27.01	19.78	34.43	28.90	3.30	3.43
			2025			
January	18.32	11.40	26.12	43.26	0.00	3.36
February	17.38	10.58	25.12	32.79	0.00	3.56
March	22.67	14.68	31.02	28.25	0.00	3.30
April	27.83	19.34	36.12	19.90	0.00	3.69
May	30.82	22.64	38.78	19.37	0.00	3.75
June	31.84	23.75	39.29	19.72	0.00	3.83
July	34.71	27.24	41.55	20.17	0.00	3.49
August	35.34	28.43	41.93	23.48	0.00	4.19
September	31.80	24.68	38.73	25.79	0.00	3.97
October	28.50	21.25	36.35	27.80	0.00	3.52
November	24.52	17.96	31.89	34.73	0.00	3.04
December	18.06	11.82	25.09	42.66	3.40	2.95
Average and sum	26.81	19.48	34.33	28.16	3.40	3.55

Weather data of Egypt-Aswan- Abo Simbel -Monthly-2024-2025

All strains of date palms were used. Mother's female palms were propagated by Bartamoda seeds. All palms of each strain received the normal agricultural practice. The palms of each strain under study were near similar in age and growth. The chosen female palms were subjected to the same horticulture practices and hand pollinated using pollen grains of a selected male date palm. In each experimental season, aspects and parameters of the field and laboratory work were as follows:

2.1. Yield

All time of harvesting at tamer stage, number of bunch per palm and weight of all bunches were counted and recorded, then the yield/palm was calculated.

2.2. Fruit quality

After harvesting samples each of 30 fruits per date palm tree for each clones (as a replicate) were sent to the laboratory, the standard physical and chemical fruit properties were studied including the following:

2.3. Physical parameters

Physical characteristics of fruits were carried out during two successive fruiting seasons; the physical properties studied were fruit weight (g), pulp percentage and fruit dimensions (cm) were calculated.

2.4. Chemical parameters

Chemical characteristics such as total soluble solids (TSS) was deter-mined by hand refractometer, total acidity was determined (as g. Malic acid/100 g pulp), total soluble sugars, reducing sugars, non-reducing sugars and fruit moisture content was determined according to the methods of A.O.A.C. (1985).

2.5. General evaluation of the tested strains of date palms cultivars was calculated on the basis of 100 units which were divided among the vegetative growth and fruiting. Hundred units were shared between the following seedling and Bartamoda cv. 40 units for the average yield components (No. bunch, Spadix branch, fruit set and fruit weight /bunch), 30 units for physical fruit traits (fruit weight, flesh percentage and moisture %) and 30 units for chemical fruit traits (total soluble solids, reducing sugar and acidity) (10 units for each). Each palm that gave the best results in any character was tested and took lower units equal to their quantities.

2.6. Statistical analysis

The methods outlined by Steel and Torrie (1980) were followed in the statistical analysis of all recorded data. The differences between treatment means were compared by Duncan's multiple range tests at 5% level of probability to Duncan (1955).

3. Results

Traits of the Studied Seedling Palms and Bartamoda Cultivar the evaluated traits of the studied seedling date palm strains and the Bartamoda cultivar included yield components and fruit quality characteristics.

3.1. Yield components

The results obtained from the evaluation of the seedling female date palm strains and the Bartamoda cultivar during the 2024 and 2025 seasons are presented in Tables (2 and 3). The results revealed significant variations among the studied palm types in terms of number of bunches per palm, bunch length, strand length, fruit retention, fruit weight per bunch, and total yield per palm.

Table 2: Bunch No, bunch length and strands length of some seeded strains dry palm and Bertmade cv during 2024 & 2025 seasons.

Parameters	Bunch no.			Bunch length (cm)			Strands length		
Seasons	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**
1	5	7	6.0	80.2 A	79.6 A	79.9 A	41.6 BB	40.3 B	41.0 B
2	5	5	5.0	65.8 C	67.8 C	66.8 C	40.1 B	39.4 B	39.8 B
3	4	4	4.0	51.7 E	50.4 E	51.1 E	30.3 DE	28.2 E	29.3 E
4	5	6	5.5	46.0 F	45.8 EF	45.9 EF	28.9 DE	26.1 E	27.5 E
5	4	5	4.5	56.8 DE	55.4 DE	56.1 D	33.5 CD	32.8 D	33.2 D
6	5	7	6.0	59.1 D	60.2 D	59.7 D	36.2 C	35.4 CD	35.8 C
7	4	4	4.0	51.2 E	50.7 E	51.0 E	28.4 E	27.8 E	28.1 E
8	4	5	4.5	61.3 CD	60.0 D	60.7 D	32.1 D	30.3 DE	31.2 DE
9	4	4	4.0	80.5 A	83.3 A	81.9 A	37.5 BC	36.4 C	37.0 C
10	4	4	4.0	70.0 BC	79.2 A	74.6 B	38.4 BC	34.6 CD	36.5 C
11	4	4	4.0	42.4 F	40.8 F	41.6 F	25.6 E	22.9 F	24.3 F
Toshka1	6	7	6.5	73.9 B	75.3 B	74.6 B	46.2 A	45.1 A	45.7 A
Bart (cont.)	6	7	6.5	43.6 F	40.1 F	41.9 F	28.9 DE	26.1 E	27.5 E

Means followed by the same letter (s) within a column are not significantly different

Table 3: Fruit retention %, Fruit weight/ Bunch and Yield / palm of some seeded strains dry palm and Bertmade cv during 2024 & 2025 seasons.

Parameters	Fruit retention (%)			Fruit weight/bunch (kg)			Yield /palm (kg)		
Seasons	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**
1	86.52 A	83.33 AB	84.93 AB	2.45 E	2.52 C	2.49 D	12.25 E	17.64 E	14.95 E
2	73.80 B	76.92 B	75.36 C	2.82 D	2.40 C	2.61 D	11.40 E	12.00 F	11.70 F
3	54.61 D	59.38 CD	57.00 E	0.64 G	0.66 E	0.65 G	2.56 H	2.64 I	2.60 J
4	66.18 C	63.11 C	64.65 D	4.11 B	4.51 B	4.31 B	20.55 C	27.06 C	23.81 C
5	73.93 B	74.68 B	74.31 C	1.62 F	1.80 D	1.71 F	6.48 G	9.00 G	7.74 H
6	54.86 D	57.86 CD	56.36 E	3.55 C	4.18 B	3.87 C	17.75 D	29.26 BC	23.51 C
7	86.18 A	85.67 A	85.93 A	4.98 A	5.74 A	5.36 A	19.92 C	22.96 D	21.44 D
8	82.25 AB	79.76 AB	81.01 B	2.32 E	1.94 D	2.13 E	8.93 FG	9.70 EG	9.32 G
9	48.90 E	82.91 AB	65.91 D	1.42 F	1.63 D	1.53 F	5.68 G	6.52 H	6.10 I
10	78.11 B	78.67 B	78.39 BC	1.79 F	1.65 D	1.72 F	7.16 G	6.60 H	6.88 HI
11	76.15 B	78.77 B	77.46 BC	2.39 E	2.55 C	2.47 D	9.56 F	10.20 FG	9.88 G
Toshka1	49.81 DE	53.81 D	51.81 F	5.12 A	5.37 A	5.25 A	30.72 A	35.59 A	33.16 A
Bart (Cont.)	81.36 AB	80.78 AB	81.07 B	4.33 B	4.45 B	4.39 B	25.98 B	31.15 B	28.57 B

Means followed by the same letter (s) within a column are not significantly different

The number of bunches per palm ranged from 4.0 to 6.5 bunches, depending on the studied palm type. Bunch length ranged from 41.6 to 79.9, while strand length varied from 24.3 to 75.7. Fruit retention ranged from 51.81 to 84.94%. Accordingly, fruit weight per bunch ranged from 0.65 to 5.36 kg, whereas total yield per palm ranged from 2.60 to 33.16 kg, based on the average values of the two studied seasons.

The highest number of bunches per palm (6.5 bunches) was recorded for Toshka 1 and the Bartamoda cultivar, which was used as the control. These were followed, in descending order, by strains 6 and 1, which produced 6.0 bunches per palm, strain 4 with 5.5 bunches per palm, and strains 5 and 8 with 4.5 bunches per palm. The remaining strains produced an average of 4.0 bunches per palm over the two studied seasons.

Regarding fruit weight per bunch, the highest value was recorded for Toshka 1 (5.25 kg), followed by strain 7 (5.36 kg) and the Bartamoda cultivar (4.39 kg), based on the average values of the two seasons. In contrast, strains 3, 9, and 10 recorded the lowest fruit weights per bunch, with average values of 0.65, 1.35, and 1.72 kg, respectively.

The remaining strains produced intermediate fruit weights per bunch, ranging from 2.13 to 4.31 kg. In general, most of the studied strains produced bunches with fruit weights ranging from 2.5 to 4.0 kg. No significant differences were observed among strains 2, 8, and 11, which recorded fruit weights per bunch ranging from 2.13 to 2.68 kg, based on the average values of the two studied seasons.

The results further indicated that total yield per palm was closely associated with fruit weight per bunch. Since the number of bunches per palm showed relatively limited variation among the studied strains, differences in total yield were largely reflected by differences in fruit weight per bunch and the number of bunches produced per palm.

The highest total yields were recorded for Toshka 1, Bartamoda, and strain 4, with average values of 33.16, 28.57, and 23.81 kg/palm, respectively, across the two studied seasons. In contrast, strain 3 recorded the lowest total yield, with an average of 2.60 kg/palm. The remaining seedling date palm strains showed intermediate yield values.

No significant differences were observed among strains 4, 6, 8, and 11, which recorded average yields of 23.81, 23.51, 9.32, and 9.88 kg/palm, respectively, over the two studied seasons. The other strains produced average yields ranging from 6.10 to 14.95 kg/palm. Overall, most of the studied strains produced yields ranging from 6.88 to 11.70 kg/palm.

Overall, the results demonstrated that Toshka 1, Bartamoda, and seedling strains 1, 2, 4, and 6 exhibited relatively high yield performance compared with the other investigated seedling date palm strains.

3.2. Fruit quality:

3.2.1. Fruit physical characteristics

The data concerning the various physical fruit characteristics of the studied seedling date palm strains and the Bartamoda cultivar grown under Toshka, Aswan conditions during the 2024 and 2025 seasons are presented in Table (4). The results revealed significant differences among most of the studied seedling date palm strains with respect to the evaluated physical fruit characteristics.

Fruit weight, flesh percentage, fruit length, fruit diameter, and moisture content ranged from 2.71 to 9.79 g, 81.43 to 88.00%, 2.73 to 4.44 cm, 1.50 to 2.20 cm, and 11.44 to 14.01%, respectively, based on the average values of the two studied seasons.

Toshka 1 and strain 6 exhibited superior fruit characteristics compared with the other studied seedling strains and the Bartamoda cultivar. Toshka 1 recorded the highest fruit weight (9.79 g), whereas strain 6 recorded a fruit weight of 9.63 g. The longest fruits were recorded for Toshka 1 and strain 6, with values of 4.16 and 3.82 cm, respectively. Moreover, strain 6 recorded the highest flesh percentage (88.00%), followed by Toshka 1 (86.09%). Both Toshka 1 and strain 6 also recorded relatively low moisture contents, with values of 11.44 and 12.03%, respectively, based on the average of the two studied seasons.

In contrast, fruits of strain 8 recorded the lowest fruit weight (2.71 g) and a low flesh percentage (81.84%), whereas strain 10 produced the shortest fruits, with an average fruit length of 2.73 cm. The Bartamoda cultivar recorded the highest moisture content (14.01%) compared with the other studied seedling strains.

Table 4: Some fruits physical characteristics of seeded strains dry and Bertmade cv dates during 2024 & 2025 seasons.

Parameters	Fruit weight (g)			Flesh (%)			Fruit length (cm)			Fruit diameter (cm)			Moisture contents (%)		
Seasons	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**
1	5.02D	5.26E	5.14F	86.31AB	85.88AB	86.10AB	2.90D	2.96E	2.93FG	1.59C	1.62C	1.61C	13.87A	13.42AB	13.65AB
2	3.80F	4.00G	3.90H	82.10B	80.75B	81.43 C	2.96D	3.04DE	3.0F	1.63C	1.66C	1.65BC	12.39BC	12.28 BC	12.34C
3	4.38E	4.67F	4.53G	82.93B	83.68B	83.31 B	3.29CD	3.38D	3.34E	1.47C	1.52C	1.50C	12.96B	13.21AB	13.10B
4	5.85C	6.93BC	6.39D	83.61B	85.33AB	84.47 B	2.75D	3.16DE	2.96FG	1.69BC	1.94B	1.82B	12.18C	12.13BC	12.16C
5	5.63CD	6.74CD	6.19D	84.52B	84.90AB	84.71 B	4.15AB	4.72A	4.44A	1.63C	1.86BC	1.75BC	12.65BC	12.46BC	12.56BC
6	8.98A	10.28A	9.63A	88.90A	87.10A	88.00 A	3.64BC	4.0BC	3.82C	1.91B	2.10AB	2.01A	12.10C	11.95B	12.03C
7	5.29D	6.46D	5.88E	83.81B	85.52AB	84.67 B	3.33D	3.92C	3.63CD	1.55C	1.81BC	1.88C	11.59CD	11.78C	11.69D
8	3.06G	2.35I	2.71J	82.71AB	80.97B	81.84 C	3.05D	2.66E	2.86FG	1.60C	1.86BC	1.73BC	12.23C	11.88BC	12.10CD
9	7.22B	8.66B	7.94B	86.75A	87.31A	87.03AB	3.86B	4.46AB	4.16B	1.59C	1.81BC	1.70BC	12.38BC	12.25BC	12.32C
10	3.60F	3.00H	3.30I	85.18B	82.33B	83.76BC	2.84D	2.62E	2.73G	1.63C	1.50C	1.57C	12.44BC	12.10BC	12.27C
11	7.18B	3.93G	5.56E	84.15B	85.62AB	84.89 B	3.44C	3.66CD	3.55D	1.81BC	1.52C	1.67BC	12.99B	12.68BC	12.84BC
Toshka1	9.25A	10.33A	9.79A	85.36B	86.81A	86.09AB	4.01AB	4.30B	4.16B	2.16A	2.22A	2.19A	11.35D	11.52C	11.44D
Bart (Cont.)	6.80B	7.06C	6.93C	85.89AB	85.22AB	85.56 B	4.26A	4.42AB	4.34AB	1.63C	1.70C	1.67	14.16A	13.85A	14.01A

Means followed by the same letter (s) within a column are not significantly different

The remaining seedling date palm strains exhibited intermediate values for the evaluated physical fruit characteristics. Regarding fruit weight, no significant differences were observed between Toshka 1 and strain 6, as well as between strains 4 and 5 and strains 7 and 11. The corresponding average fruit weights were 9.79 and 9.63 g, 6.39 and 6.19 g, and 5.88 and 5.56 g, respectively, over the two studied seasons.



Fig. 1: Fruits of strains Toshka, 6, 7, 5, 9, 11 and control (Bartamoda) photos



Fig. 2: Fruits of strains 1, 2, 3, 4, 8, 10 and control (Bartamoda) photos

The images in Figures 1 and 2 demonstrate significant differences in fruit weight and dimensions attributable to variations among the strains and the Toshki and Bertamoda cultivars. Specifically, the images highlight the superiority of the Toshki cultivar and strains 5, 6, and 7 over the Bertamoda cultivar (control), while showing no significant differences between strains 9 and 11 and the Bertamoda cultivar. Conversely, the images in Figure 2 indicate the superiority of the Bertamoda cultivar over strains 1, 2, 3, 8, and 10, as the latter recorded the lowest values compared to the Bertamoda cultivar.

Overall, the results indicated that Toshka 1, strain 7 and 6 exhibited superior physical fruit characteristics compared with the other investigated seedling date palm strains and the Bartamoda cultivar. These strains were characterized by relatively high fruit weight, greater fruit length, high flesh percentage, and relatively low moisture content.

3.2.2. Fruit chemical characteristics

Regarding the chemical characteristics of the fruits, the data presented in Table (5) revealed significant variations among most of the studied seedling date palm strains in the evaluated chemical fruit characteristics. The results showed that total soluble solids (TSS), total sugars, reducing sugars,

Table 5: Some fruit juice chemical characteristics of seeded strains dry and Bertmade cv dates during 2024 & 2025 seasons.

Parameters	Total Soluble Solids (TSS) (°Brix)			Total sugar (g/100 g FW)			Reducing Sugar (g/100 g FW)			Non Reducing (g/100 g FW)			Acidity (%)		
Seasons	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**	**2024**	**2025**	**Mean**
1	67.9B	69.2B	68.6B	50.9G	51.6F	51.21F	33.1DE	33.3D	33.2D	18.8F	18.3G	18.6G	0.250AB	0.241B	0.246B
2	70.7A	69.6B	70.2A	65.8A	66.3A	66.1A	38.7B	39.6A	39.12A	27.0A	26.7A	26.9A	0.240B	0.221BC	0.231B
3	66.3B	66.0C	66.6C	63.4B	62.7B	63.1B	40.1A	37.2B	38.7A	23.3C	25.5B	24.4C	0.236B	0.255AB	0.246B
4	69.6AB	69.0B	69.3B	56.2D	54.9E	55.6E	32.7E	31.9E	32.3DE	23.5C	23.0D	23.3D	0.267A	0.281A	0.274A
5	65.4B	66.0C	65.7C	58.3C	59.9CD	59.1CD	34.9C	35.5C	35.2C	23.4C	24.7C	24.1C	0.260AB	0.255AB	0.258AB
6	67.2B	67.5BC	67.4B	55.8E	56.6DE	56.2E	34.1D	35.4CD	34.8C	21.6E	21.2EF	21.5EF	0.273A	0.281A	0.277A
7	66.7B	67.5BC	67.1B	59.8C	60.6C	60.2C	35.3C	36.8BC	36.1B	24.5B	23.8D	24.2C	0.185C	0.175CD	0.180D
8	58.9C	60.0D	59.5D	50.5G	49.3G	49.9G	30.8F	30.7E	30.8F	19.7F	18.6G	19.2G	0.169C	0.161D	0.165D
9	70.2AB	69.0B	69.6B	53.1F	51.6F	52.4F	32.2E	31.8E	32.0E	20.9E	19.8F	20.4F	0.216BC	0.221BC	0.219C
10	66.8B	67.0BC	66.9C	58.4C	59.1C	58.8CD	35.5C	36.3BC	35.9BC	22.1DE	22.8E	22.5E	0.211BC	0.201C	0.206C
11	67.5B	69.0B	68.3B	58.8C	60.9B	59.9C	35.6C	36.8BC	36.2B	23.2C	24.1C	23.7CD	0.260AB	0.255AB	0.258AB
Toshka1	71.4A	72.3A	71.9A	57.9D	58.3D	58.1D	31.6EF	32.8DE	32.2F	26.4A	25.5B	25.9B	0.236B	0.241B	0.239B
Bart (Cont.)	56.4C	57.0E	56.7E	51.3FG	51.8F	51.6F	30.7F	31.3E	31.0F	20.6E	20.5F	20.6F	0.199C	0.195C	0.197CD
New L.S.D	2.65	2.43	1.91	1.76	1.88	1.39	1.06	1.28	0.88	0.75	0.63	0.52	0.023	0.024	0.018

Means followed by the same letter (s) within a column are not significantly different

non-reducing sugars, and acidity ranged from 56.7 to 71.9%, 51.6 to 66.1%, 30.8 to 39.12%, 18.6 to 26.9%, and 0.165 to 0.277%, respectively, based on the average values of the two studied seasons.
The fruits of the Bartamoda cultivar generally recorded the lowest values for most of the evaluated chemical characteristics compared with the fruits of the studied seedling strains. In contrast, Toshka 1 recorded the highest total soluble solids content (71.9%), while strain 2 exhibited the highest total sugar content (66.1%), reducing sugar content (39.12%), and non-reducing sugar content (26.9%), based on the average values of the two studied seasons.

Conversely, Bartamoda fruits recorded the lowest TSS content (56.7%). Strain 8 recorded the lowest total sugar content (49.9%) and reducing sugar content (30.8%), whereas strain 1 recorded the lowest non-reducing sugar content (18.6%), based on the average values of the two studied seasons.
With respect to acidity, strain 4 recorded the highest value (0.274%), whereas strain 8 recorded the lowest value (0.165%). The other studied seedling strains exhibited intermediate values for the evaluated chemical constituents.

Regarding TSS, no significant differences were detected among Toshka 1 and strain 2, which recorded values of 71.9 and 70.2%, respectively. Similarly, no significant differences were observed between strains 1 and 11 (68.6 and 68.3%, respectively) or among strains 3, 5, and 10, which recorded values of 66.6, 65.7, and 66.9%, respectively, based on the average values of the two studied seasons
For total sugar content, no significant differences were observed between strains 5 and 7 (59.1 and 60.2%, respectively), strain 10 and Toshka 1 (58.8 and 58.1%, respectively), strains 4 and 6 (55.6 and 56.2%, respectively), or strain 9 and the Bartamoda cultivar (52.4 and 51.6%, respectively), based on the average values of the two studied seasons.

Overall, the results demonstrated considerable variation in the chemical fruit characteristics among the studied seedling date palm strains and the Bartamoda cultivar. Toshka 1, strain 7, and strain 2 exhibited relatively favorable chemical characteristics, particularly with respect to total soluble solids and sugar content, compared with the other investigated seedling strains.

These findings further demonstrate that fruiting and fruit-quality characteristics are influenced by the genetic background of the cultivar or seedling type. The observed differences among date palm cultivars and seedling types may be attributed to cytological differences and/or genetic variation resulting from the transmission of parental genotypes through sexual propagation by seeds.

3.2.3. General evaluation of the studied date palm strains

The numerical evaluation of the studied date palm strains, as presented in Table (6), revealed considerable variation in the overall scores among the investigated genotypes. Toshka 1 and strain 7 recorded the highest overall evaluation scores, with values of 90.0 and 84.9 units, respectively. Strain 6 ranked third, with a score of 83.7 units, followed by strain 1, which recorded 80.2 units. These strains recorded higher overall scores than the Bartamoda cultivar, which is widely cultivated under the environmental conditions of Toshka, Aswan.

Based on the average values of the two studied seasons, the studied date palm strains and the Bartamoda cultivar were ranked according to their total scores as follows: Toshka 1 (90.0), strain 7 (84.9), strain 6 (83.7), Bartamoda (82.7), strain 1 (80.2), strain 2 (79.0), strain 4 (78.7), strain 9 (77.1), strain 5 (75.0), strain 10 (74.7), strain 8 (74.4), strain 11 (74.0), and strain 3 (68.6) units. These overall scores were calculated based on the combined evaluation of yield components and fruit-quality characteristics.

The total score allocated to yield components was 40 units and included bunch number, strand length, fruit set, and fruit weight per bunch. Significant variation was observed among the studied seedling date palm strains for these traits. Toshka 1, strain 7, strain 1, and strain 6 recorded relatively high scores compared with the Bartamoda cultivar. Based on the total yield-component score (40 units), the strains were ranked as follows: Toshka 1 (35.1), strain 1 (32.0), strain 7 (31.8), and strain 6 (30.2), based on the average values of the two studied seasons. The remaining strains recorded lower scores, ranging from 1.2 to 4.9 units.

The total score assigned to the physical fruit characteristics was 30 units and included fruit weight, flesh percentage, and moisture content. Significant differences were observed among the studied seedling date palm strains for these characteristics. Toshka 1, strain 6, strain 7, strain 9, strain 5, and strain 4 recorded relatively high scores compared with the Bartamoda cultivar. Based on the total physical fruit-quality score (30 units), the highest scores were recorded by Toshka 1 (29.8), strain 6

Table 6: General evolution of the studied seedling strains and Bartamuda cv grown under Toshka condition as average of the two studied seasons.

Parameters	Yield component					Physical fruit characteristic				Chemical fruit characteristic				
Sub. cher Seedling type	Bunch Number	Strand length (cm)	Fruit Set %	Fresh weight /bunch (g)	Total	Fruit weight (g)	Flesh %	Mois. %	Total	Total Soluble Solids (°Brix)	Reducing Sugar (g/100 g FW)	Acidity %	Total	Genetic total
Score units	**10**	**10**	**10**	**10**	**40**	**10**	**10**	**10**	**30**	**10**	**10**	**10**	**30**	**100**
1	8.6	8.9	9.9	4.6	32	5.3	9.8	8.4	23.5	9.5	8.5	6.7	24.7	80.2
2	7.1	8.7	8.8	4.9	29.5	4.0	9.3	9.3	22.6	9.8	10	7.1	26.9	79.0
3	5.7	6.4	6.6	1.2	19.9	4.6	9.5	8.7	22.8	9.3	9.9	6.7	25.9	68.6
4	7.9	6.0	7.5	8.0	29.4	6.5	9.6	9.4	25.5	9.6	8.2	6.0	23.8	78.7
5	6.4	7.3	8.6	3.2	25.5	6.3	9.6	9.1	25.0	9.1	9	6.4	24.5	75.0
6	8.6	7.8	6.6	7.2	30.2	9.8	10	9.5	29.3	9.4	8.9	5.9	24.2	83.7
7	5.7	6.1	10	10	31.8	6.0	9.6	9.8	25.4	9.3	9.2	9.2	27.7	84.9
8	6.4	6.8	9.4	4.0	26.6	2.8	9.3	9.5	21.6	8.3	7.9	10	26.2	74.4
9	5.7	8.1	7.7	2.9	24.4	8.1	9.9	9.3	27.3	9.7	8.2	7.5	25.4	77.1
10	5.7	8.0	9.1	3.2	26.0	3.4	9.5	9.3	22.2	9.3	9.2	8.0	26.5	74.7
11	5.7	5.3	9.0	4.6	24.6	5.7	9.6	8.9	24.2	9.5	9.3	6.4	25.2	74.0
Toshka1	9.3	10	6.0	9.8	35.1	10	9.8	10	29.8	10	8.2	6.9	25.1	90.0
Bart (Cont.)	10	6.0	9.4	8.2	33.6	7.1	9.7	8.1	24.9	7.9	7.9	8.4	24.2	82.7

(29.3), strain 9 (27.3), strain 4 (25.5), and strain 7 (25.4), compared with the Bartamoda cultivar, which recorded 24.9 units, based on the average values of the two studied seasons.

Regarding the chemical fruit characteristics, a total score of 30 units was assigned based on total soluble solids (TSS), reducing sugars, and acidity. Significant variation was observed among the studied seedling date palm strains. All studied strains, except strain 4, recorded higher total chemical-quality scores than the Bartamoda cultivar. The strains were ranked according to their chemical fruit-quality scores as follows: strain 7 (27.7), strain 2 (26.8), strain 8 (26.2), strain 10 (26.5), strain 3 (25.9), strain 9 (25.4), strain 11 (25.2), Toshka 1 (25.1), strain 1 (24.7), and strain 5 (24.5), compared with the Bartamoda cultivar, which recorded 24.2 units, based on the average values of the two studied seasons. Overall, the numerical evaluation indicated that Toshka 1, strains 7, 6, 1, 2, and 9 exhibited relatively high overall performance across the evaluated yield and fruit quality characteristics. These seedling strains, which originated from seeds of the Bartamoda cultivar and were grown under Toshka, Aswan conditions, may therefore be considered promising candidates for further evaluation and characterization as potential new date palm strains.

4. Discussion

The differences observed among the studied date palm strains can be attributed to several factors, the most important of which are genetic factors. Some strains possess distinct genetic characteristics that may contribute to differences in their productive potential and fruit quality compared with other strains. In addition, the observed variation may be related to the adaptability of each strain to the prevailing environmental conditions, particularly temperature and climatic conditions. The suitability of these environmental conditions for a particular strain depends on its specific climatic and thermal requirements for optimum growth, productivity, and fruit quality.

Such results emphasized the fact that fruiting traits depend on cultivar. The differences between cultivars or seedling types of date palm may be due to either cytological differences between them or to the genotypes that are transmitted via seeds. These results are in line with those obtained by El-Sharabasy *et al*., 2003; Jaradate and Zaid, 2004; Ismail *et al*., 2006; Ibrahim, 2008; Abdalla, 2012; Gadalla, 2013, Madboly *et al*., 2021; El-Kosary *et al*., 2023; Kadri *et al*., 2025 and Khan *et al*., 2025 Who mentioned that there was a wide and great variation on vegetative growth and fruiting of most date palm strains or cultivars.

In general, the dry date palm strains under study were widely different in their growth, yield and physiochemical properties. Variations among these strains could be mainly due to their genetically and adaptability differences. Hence these results are important from economic and horticultural point of view. The best one must be selected for vegetative propagation and planting.

5. Conclusion

The results demonstrated that the seedling date palm genotype Toshka 1 and strains 7, 6, 1, 2, and 9 exhibited relatively superior overall performance with respect to the evaluated yield components and fruit quality characteristics. These genotypes showed promising potential as new date palm strains, combining relatively high yield with favorable fruit quality compared with the Bartamoda cultivar. Therefore, Toshka 1 and strains 7, 6, 1, 2, and 9 are recommended for further evaluation and selection for vegetative propagation and subsequent cultivation under the environmental conditions of Toshka, Aswan.

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