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Evaluation of some apricot strains El Amar Qalyubia Governorate

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Abstract

The research aims to select distinctive local apricot strains before they disappear due to their limited area and lack of spread. The selection was 6 strains that were valuable and had high traits; the selected strain was given abbreviated names Am_1, Am_2, Am_3, Am_4, Am_5 and Am_6. The study showed the following results, Strain Am_1 was early in flowering and harvesting, while strain Am_5 was the most delayed. Strain Am_2 was distinguished by a reddish color with greenish sepals and the presence stipules for leaves from the rest of the strains. It also gave the highest yield and highest measurements of vegetative growth. Strain Am_4 had the highest fruit weight and size. The highest fruit hardness was for strain Am_5. The highest fruit TSS were for the Am_1 strain. The genetic relationships among six strains and total bands with SCoT-ISSR primers revealed a sum of 68 bands. These bands were identified as 29 monomorphic and 39 polymorphic ones with polymorphic % (57.35%) and the polymorphic bands were scored as 17 unique markers.

Keywords: Strains of El Amar apricot, yield, TSS, SCoT and ISSR Molecular Markers

Introduction

One of the major objectives of the research aspects of the Horticulture Research Institute is to introduce new varieties and strains that are suitable for the Egyptian markets.

Apricots (*Prunus armeniaca* L.; 2n = 2x = 16) are among the more significant seasonal fruits of the Rosaceae family. Despite reaching almost 21,000 feddan in 2003, the total planted area of apricot trees in 2021 decreased to 10829 feddan, with a production of 66207 tons, according to Ministry of Agricultural Statistical Reports. The reasons for this decrease area is due to the cessation of cultivation and propagation of widespread local strains which are distinguished by excellent quality characteristics that suit the taste of the Egyptian consumer, compared to imported apricot varieties such as Canino. As it lacks quality characteristics and is not suitable for fresh consuming quality as it is rather a cultivar dedicated for manufacturing (Ennab et al., 2020 and also it is a late-ripening variety (Guillamón et al.,2022). However, despite the high eatind quality of these strains, the cultivated area in the El Amar region is decreasing due to their limited supply in the markets, which does not exceed two weeks. They are soft fruits of low firmness and thus difficult to handle (Awad et al, 2019).

El Amar apricot strains are distinguished by their high TSS content, distinctive taste and marvelous eating quality. These strains readily decline and thereby losing a valuable germplasm; thus, it was necessary to evaluate these strains for the purpose of selecting what is suitable with respect to cropping in terms of quality, quantity and harvest time in order to keep and propagate them to spread them.

It is well recognized in Egypt that a portion of the apricot-growing region known as Baladi, El Amar, and Hamwi is seed-planted. Trees vary widely in size, production, fruit quality and maturity date (Bakr et al., 1985; Saif and Hassan, 1992). Because these varieties lacked firm, fleshy fruits and only have a two-week commercial presentation time, they a limited and poor selling potential (Awad et al., 2019).These genetic differences can be taken advantage of by selecting early, medium, and late apricot strains from locally grown trees to increase the supply of these distinctive strains in the markets, Also selecting strains with high firmness and long fruit shelf life.

El Amar apricot strains have few cold requirements, in line with Egyptian weather conditions, related to other varieties such as the “Canino” variety which reaches his needs chilling requirement 806 Chilling Units accoding to Fadón et al., 2020.

Scientists have shed light on the genetic differences of these local apricot strains. In comparison to the "Canino" cultivar, Mohamed et al. (2015) revealed that 19 distinct bands were discovered as genotype-specific markers and are helpful identifiers for the chosen local apricot lines of El Amar apricot strains. This recommended propagating these selected strains in desert land conditions and using these strains in breeding programs with the “Canino” variety. Also, this shows that these markers can be utilized as markers that aid selection in enhancing salt tolerance in the origin of El Amar apricots rootstock (El-Aziz, et al., 2019).

Genetic variety evaluations are offered by molecular markers, using RAPD and ISSR (Zhang et al., 2015; Etminan et al., 2016 and Aswathy et al., 2017). Higher polymorphism and improved marker resolution capability distinguish SCoT from other dominant DNA marker systems such as RAPD and ISSR (Gorji et al., 2011).

The objective of this study was to assess the pomological features of the six strains that originated at El Amar region Qalyubia Governorate in terms of flowering dates, setting and harvesting dates, fruit set percentage and cropping and its’ attributes Also their vegetation. Additionally, the six strains were analyzed for their molecular genetic traits in order to compare them, determine which one is older than the others, and determine which one produces better fruit and is better for marketing.

Materials and Methods

This study was carried out to evaluate some apricot strains that were locally selected from seedy mother trees grown under El-Amar region- Qaliubia governorate. The outstanding Strains of high crops and supreme quality were propagated by budding on seedling rootstocks and planted in a private orchard in El Amar region. Six strains were considered and given the abbreviated names of Am1, Am2, Am3, Am4, Am5 and Am6.Trees were 20 years old at the beginning of this investigation which extended from 2020 through 2022 growing seasons. Trees were planted at 5*6 m in loamy soil. From each strain 3 trees were selected, each acting as a replicate. All selected trees were uniform in size and growth vigour as much as possible.

For well evaluation the following traits were assessed:

Time of phonological dates: (beginning of bloom, Full bloom, Fruit harvest and number of days from beginning of bloom to harvest) was recorded periodically.

Cropping attributes

Fruit set (%): It was calculated 2 weeks after full bloom using the following equation.

Fruit set percent = (Number of fruit set*100)/ Total number of flowers

Fruit yield (Kg /tree): it was calculated by multiplying number of fruits per tree x Average fruit weight.

Quality attributes: At harvest a representing sample of 10 fruits per tree were picked to evaluate following physical and chemical attributes:

Physical attributes: fruit weight (g) using a digital scale, fruit size (cm^3) by water displacement, fruit dimensions using a vernier caliper, firmness Fruit firmness ($Lb/Inch^2$): It was determined from the two sides of fruits by using a pressure tester (Advance Force Gorge RH13, UK), Flesh thickness (cm using a vernier caliper. Seed weight (g)

Chemical attributes: juice TSS% by hand refractometer model (Portable Refractometer ATC), Total acidity (%): determined as anhydrous malic acid as a percentage after titration by 0.1 N sodium hydroxide using phenolphthalein as an indicator (A.O.A.C., 2000).

Vegetative growth parameters were measured on October$^{1st\ on\ 4}$ current season's shoots per tree located at the four directions to assess the following: Shoot **length (cm):** using a ruler. **Shoot diameter (cm):** At the base of shoot by using a vernier caliper. **number of leaves/shoots, Leaf area (cm^2):** was measured for the $5^{th\ and}$ 6^{th} leaves from the base by using a leaf area meter.

Molecular Genetic Markers

Fresh leaves were used to obtain genomic DNA. Using six SCoT and six ISSR primers, genomic DNA was amplified using Polymerase Chain Reaction (PCR). Operon Technologies, located in Alameda, California, provided the ISSR primers. The consensus sequence used to create the SCoT primers was obtained from Biobasic Com and came from earlier research conducted by Joshi et al. (1997), Collard and Mackill (2009), and Mohamed et al. (2015). The procedures outlined by Fathi et al. (2013) and Xiong et al. (2011) were followed to perform the amplification reactions for the ISSR and SCoT approaches. **Statistical analysis:** Three replicates, each of a single tree from each strain, were used in this experiment, which was set up as a randomized full-block design. Snedecor and Cochran (1990) provided the statistical analysis for the data acquired. The least significant difference (LSD) test was used to compare treatment means at $P < 0.5$.

Results and Discussion

Table (1) shows the differences between 6 strains in the timing of the beginning of bloom, full bloom, and harvest. Strain Am1 was the earliest and the rest of the strains were average for these parameters, with slight differences between them according to the seasons, except for strain Am5, which was late during the three seasons of the study.

From the apparent appearance in Figure No. 1, it was noted that all strains flowers had a reddish color, while strain Am_2 has a reddish color with greenish sepals for flower and hearty toothed with stipules for leaves.

Table (1): Time of date of beginning of bloom, full bloom and fruit harvest for El Amar apricot strain during three seasons

Strain	Beginning of bloom			Full bloom			Harvesting date			N of days from beginning of bloom to harvest		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Am_1	8/2	15/2	3/2	15/2	23/2	19/2	10/5	20/5	24/5	92	95	111
Am_2	15/2	18/2	16/2	26/2	28/2	5/3	12/5	28/5	1/6	87	100	106
Am_3	17/2	18/2	19/2	26/2	27/2	5/3	12/5	26/5	28/5	85	98	99
Am_4	17/2	20/2	12/2	26/2	28/2	23/2	12/5	26/5	4/6	85	96	113
Am_5	20/2	23/2	20/2	28/2	2/3	8/3	15/5	30/5	7/6	85	96	108
Am_6	15/2	18/2	13/2	26/2	27/2	25/2	12/5	25/5	28/5	87	97	104

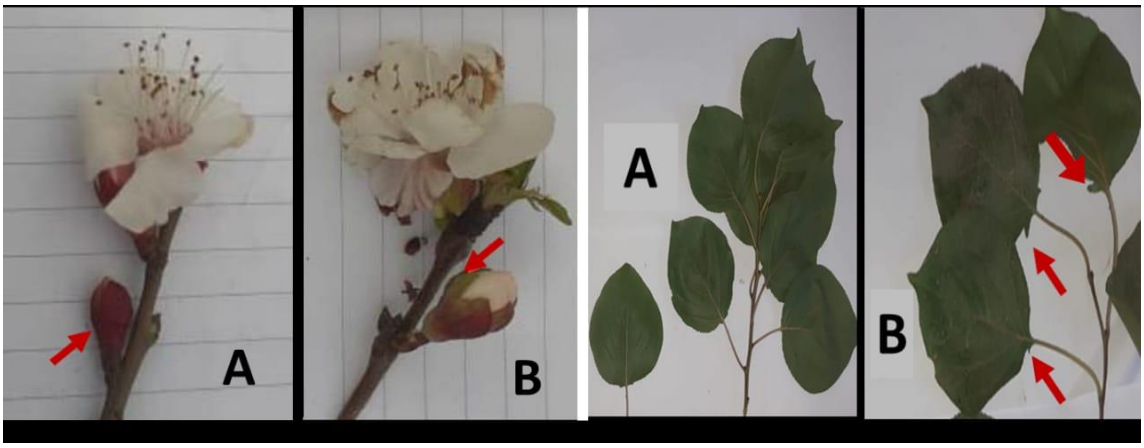

Figure (1): Color of flower sepals and the shape of the leaf in strains.
A =a model for other strains and B =Am_2.

Fruit Set (%): Data in Table (2) reveal that fruit set percentage for Am1 had significantly the highest fruit set percentage followed by Am_2 strain. While Am_5 had the lowest significant fruit set percentage during the three seasons.

Yield (kg/tree): Am2 strain given the highest significantly yield per tree (Table 2) despite the lower percentage of fruit set than the Am_1 strain, this increase in the yield is due to the higher fruit weight of the Am_2 strain fruits compared Am1 strain (Table 3). This result is due to lower competition for assimilates which led higher fruit weight and thus an higher final yield (Pawar and Rana, 2019). While Am_5 El Amar apricot strain given the lowest significant of yield during three seasons.

Table (2): Fruit set and yield (Kg/tree) for El Amar apricot strains during three seasons

Strain	Fruit Set (%)			Yield (Kg/tree)		
	2020	2021	2022	2020	2021	2022
Am_1	18.95 A	6.95 A	18.95 A	44.30 E	37.14 D	56.01 D
Am_2	15.33 B	6.90 A	15.33 B	75.03 A	70A	90.50 A
Am_3	7.000 C	6.56 AB	7 C	56.25 B	50 B	67.75 B
Am_4	7.000 C	5.83 B	7 C	47.03 D	40 C	56.89 D
Am_5	4.690 D	5.74 B	4.70 D	35.50 F	30 E	44.97 E
Am_6	8.200 C	6.45 AB	8 C	53.33 C	40 C	60 C
LSD at 0.05	1.77	0.95	1.83	1.04	0.68	1.55

Fruit attributes

Physical attributes: The presented results showed that strain Am4 was the best strain in terms of fruit weight and size (Table 3& Figure 2) and length, while strain Am_2 was the highest in fruit diameter (Figure 2), seed weight and flesh thickness compared to the rest of the strains (Table 4& 5), especially Am_6, which scored the lowest values.

Table (3): Fruit weight and volume for El Amar apricot strain during three seasons

Strain	Fruit Weight (g)			Fruit Volume (cm3)		
	2020	2021	2022	2020	2021	2022
Am_1	20.81 D	24.41 E	17.44 E	22.22 D	25.25 E	18.38 E
Am_2	46.70 A	49.62 B	39.25 B	44.11 B	49.29 B	39.51 B
Am_3	39.00 B	41.83 C	31.33 C	41 B	42.77 C	32.17 C
Am_4	48.11 A	56.63 A	42.17 A	48.61 A	57.89 A	42.50 A
Am_5	31.50 C	36.89 D	24.83 D	32.33 C	37.41 D	25.08 D
Am_6	15.57 E	20.50 F	18 E	19.40 D	19.36 F	17 E
LSD at 0.05	1.48	1.666	1.88	4.40	1.87	1.81

Table (4): Fruit length and diameter for El Amar apricot strain during three seasons

	Fruit length			Fruit diameter		
	2020	**2021**	**2022**	**2020**	**2021**	**2022**
Am_1	3.55 C	3.98 B	3.45 B	3.34 C	3.50 C	3.26 B
Am_2	4.37 A	4.58 A	3.90 AB	4.25 A	4.88 A	4 A
Am_3	3.97 B	3.85 B	3.82 AB	3.27 C	3.41 C	3.18 B
Am_4	4.51 A	4.73 A	4.22 A	3.86 B	4.74 A	3.77 A
Am_5	4.35 A	4.47 A	3.81 AB	3.74 B	4.33 B	3.17 B
Am_6	3.47 C	3.48 C	3.45 B	2.94 D	3.39 C	3 B
LSD at 0.05	0.37	0.34	0.61	0.3044	0.33	0.43

Figure (2): Fruit size and shape for 6 strains

Table (5): Seed weight and flesh thickness for El Amar apricot strain during three seasons

Strain	Seed weight			Flesh thickness		
	2020	**2021**	**2022**	**2020**	**2021**	**2022**
Am_1	2.15 C	2.43 C	1.53 C	0.527 C	0.597 F	0.457 D
Am_2	3.62 A	4 A	3.183 A	1.110 A	1.227 A	0.940 A
Am_3	2.46 B	2.69 BC	2.400 B	0.773 B	0.787 D	0.710 C
Am_4	2.71 B	2.73 BC	2.357 B	0.897 B	0.993 B	0.850 B
Am_5	2.50 B	2.87 B	2.300 B	0.777 B	0.873 C	0.663 C
Am_6	1.48 D	1.63 D	1.51 C	0.590 C	0.68 E	0.610 C
LSD at 0.05	0.27	0.35	0.17	0.16	0.057	0.084

The results in Table 6; show significantly highest fruit firmness for strain Am5 compared to the rest of the strains, and the least firmness was acquired by Am6 strain.

Chemical attributes: As presented in Table 6, strain Am1 attained the highest TSS percentage and least acidity compared to the rest of the strains during the three study seasons. While the Am_6 strain had the lowest percentage of TSS, the strain also recorded the highest percentage of fruit acidity.

Table (6): Firmness, TSS and acidity for El Amar apricot strain during three seasons

Strain	Firmness			TSS			Acidity		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
Am_1	9.72 B	7.67 B	9.83 B	19 A	18 A	21.00 A	0.073 D	0.180 AB	0.051 C
Am_2	11.67 A	6.33 B	12.33 A	15.50 CD	14.50 B	17.83 B	0.134 B	0.165 B	0.060 C
Am_3	9.50 B	4.50 C	7.50 C	17.50 B	16.83 A	19.00 B	0.096 C	0.090 C	0.077 B
Am_4	10.95 AB	7 B	12.50 A	16 CD	14 B	18.00 B	0.102 C	0.192 AB	0.083 B
Am_5	12.06 A	9.33 A	13 A	16.50 BC	15 B	17.50 B	0.308 A	0.224 A	0.102 A
Am_6	2.83 C	2.17 D	2.5 D	15 D	13.83 B	16.60 C	0.109 C	0.147 BC	0.085 B
LSD at 0.05	1.86	1.41	1.21	1.14	1.19	1.78	0.024	0.058	0.018

Vegetative Growth Measurements: Strain Am_2 attained the significantly highest values for shoot length, diameter, and leaf area, while strain Am5 had the highest number of leaves per shoot due to shorter internodes and closeness of the leaves for this strain.

Table (7): Shoot length and shoot diameter for El Amar apricot strain during three seasons

Strain	Shoot length			Shoot diameter		
	2020	2021	2022	2020	2021	2022
Am_1	11.25 E	14 D	9.03 E	0.350 DE	0.433 CD	0.317 C
Am_2	35 A	39 A	34 A	0.580 A	0.630 A	0.517 A
Am_3	27.03 B	30.10 B	24.01 B	0.513 B	0.557 AB	0.487 A
Am_4	22 D	28.50 C	22.03 C	0.450 C	0.477 BC	0.440 AB
Am_5	23 C	29.50 B	20 D	0.390 D	0.440 CD	0.397 BC
Am_6	7 F	10 E	8 E	0.307 E	0.367 D	0.310 C
LSD at 0.05	0.55	0.64	1.30	0.058	0.100	0.084

Table 8: Shoot length and shoot diameter for El Amar apricot strain during three seasons

Strain	N. leaves			Leaf area		
	2020	2021	2022	2020	2021	2022
Am_1	17.17 C	16 C	12 D	33.67 C	32.03 C	36.03 C
Am_2	25 B	26.97 B	22.50 B	51.90 A	49.00 A	56.55 A
Am_3	23.03 B	27.38 B	20 C	34.47 C	31.67 C	36.00 C
Am_4	24 B	28 B	18.67 C	39.83 B	36 B	42.00 B
Am_5	37 A	46 A	29.67 A	34 C	28.50 D	36.19 C
Am_6	7 D	10 D	6 E	24.67 D	33 C	26 D
LSD at 0.05	5.48	1.18	1.86	2.26	1.96	0.88

Molecular genetic evaluation of El Amar apricot strains: SCoT-PCR molecular genetic evaluation: Using SCoT primers, a total of 35 bands with molecular widths ranging from 170 to 2680 bp are shown in Figure 3 and Table 9 of the molecular genetic analysis of the six strains of El Amar Apricot that were the subject of the study. Despite a polymorphism proportion of 51.42%, the results show that there were 18 total polymorphic bands. Primers SCoT15 and SCoT 5 provided the greatest and least polymorphic percentages, respectively, at 80% and 25%, respectively. Primer SCoT 5 had a minimal enhanced band count (4 bands), whereas primer SCoT 14 had the greatest enhanced band count (9 bands).

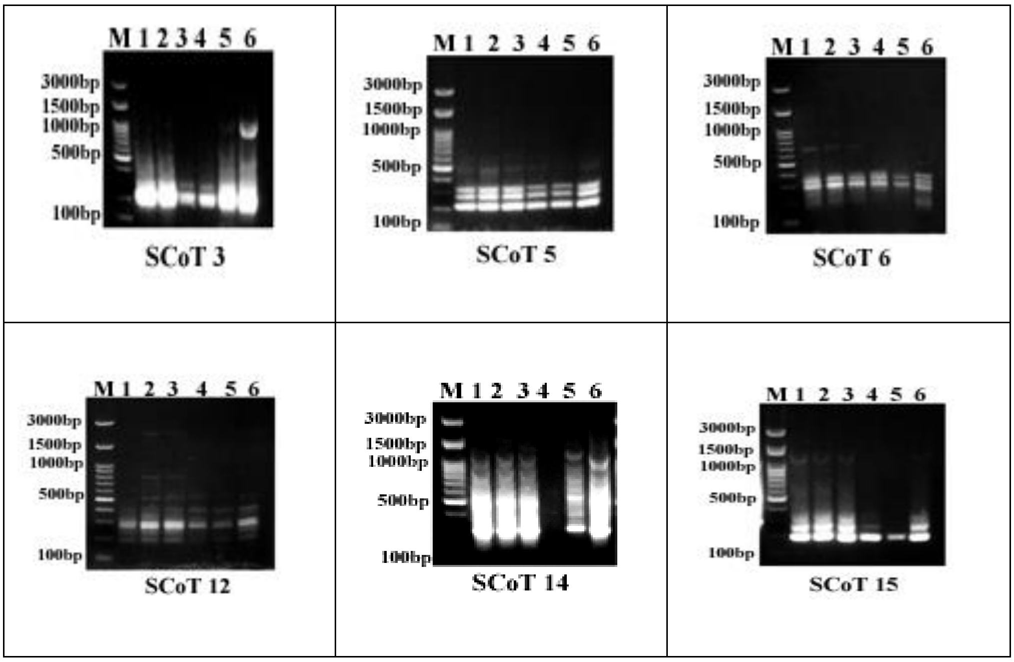

Figure (3): Banding patterns of SCoT -PCR products for six strains of El Amar Apricot produced with six primers

Table 9: Banding patterns data as estimated for six strains of El Amar Apricot using SCoT technique

Primer Name	Sequences	Total Band	Monomorphic Band	Polymorphic band	Unique Band	Polymorphic %
SCoT 3	ACG ACA TGG CGA CCC ACA	5	2	3	-	60.00
SCoT 5	CAA TGG CTA CCA CTA GCG	4	3	1	1-	25.00
SCoT 6	CAA TGG CTA CCA CTA CAG	5	3	2	-	40.00
SCoT 12	CAA CAA TGG CTA CCA CCG	7	4	3	-	42.85
SCoT 14	ACC ATG GCT ACC AGC GCG	9	4	5	3	55.55
SCoT 15	CCA TGG CTA CCA CCG GCT	5	1	4	2	80.00
Total		35	17	18	6	51.42

ISSR-PCR molecular genetic evaluation

The ISSR molecular genetic analysis of six strains of El Amar Apricot was acquired as 33 bands overall, with molecular weights ranging from 230 to 2340 bp. Figure 4 and Table 10 illustrate this result. The results show that just one total polymorphic band with a polymorphism percentage of 63.63%. The primer HB-12 produced the highest polymorphic percentage of 80%, while primer HB-8 generated a minimum polymorphic percentage of 25%. In contrast, primer 89B had a minimal number of amplified bands (3 bands) while primer HB-10 had the maximum number (8 bands). However, all six primers showed 12 monomorphic bands and 11 unique bands.

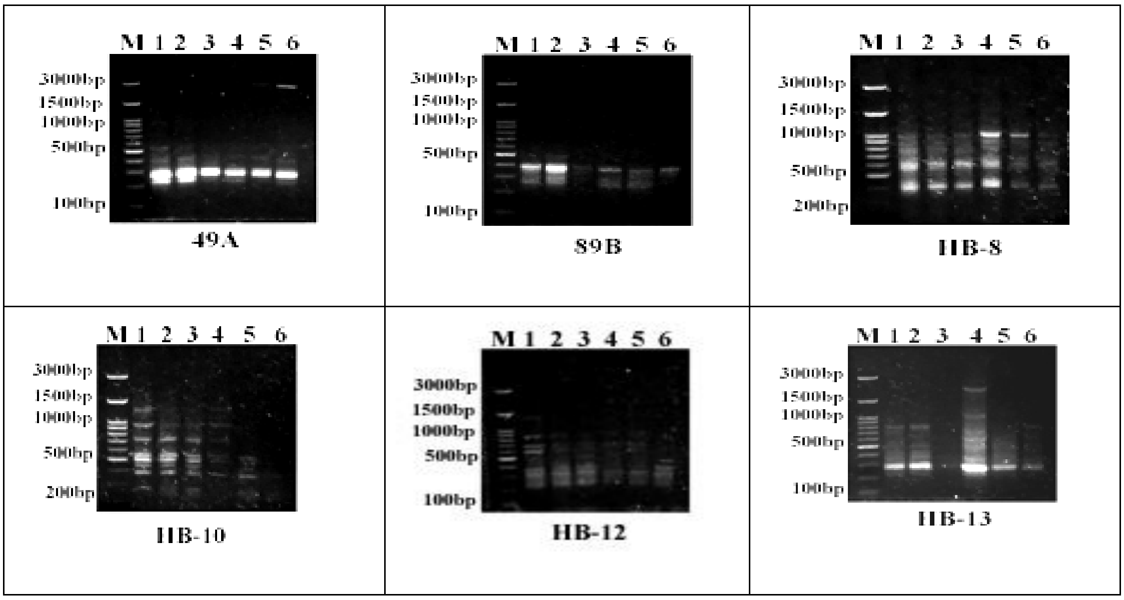

Figure (4): **Banding patterns of ISSR-PCR products for** six strains of El Amar Apricot **produced with six primers**

Table (10): Molecular banding patterns data estimated for six strains of El Amar Apricot using ISSR technique

Primer Name	Sequences	Total Band	Monomorphic Band	Polymorphic band	Unique Band	Polymorphic %
49A	5` CAC ACA CAC ACA AG 3`	4	2	2	1	50.00
89B	5` CAC ACA CAC ACA GT 3`	3	1	2	-	66.66
HB-8	5` GAG AGA GAG AGA GG 3`	4	3	1	-	25.00
HB-10	5` GAG AGA GAG AGA CC 3`	8	1	7	4	50.00
HB-12	5´ CAC CAC CAC GC 3`	7	2	5	3	87.50
HB-13	5` GAG GAG GAG GC 3`	7	3	4	3	57.14
Total		33	12	21	11	63.63

Combination evaluation of SCoT and ISSR data analysis

Table 11 displays the combined information on SCoT and ISSR primers for the six strains of El Amar Apricot, which totaled 68 bands. These bands were classified as 29 monomorphic and 39 polymorphic, with the polymorphic bands scoring 17 unique markers and the polymorphic bands having a polymorphism percentage of 57.35%. Given that the ISSR marker is derived from a functional area of the genome, genetic investigations utilizing this marker are likely to yield greater insights for agricultural improvement initiatives.

Table (11): Polymorphic, Monomorphic, Specific Markers and Polymorphic percentage generated by the (SCoT and ISSR) analysis for six **strains of El Amar Apricot**

Primer Name	Total Band	Monomorphic Band	Polymorphic band	Unique Band	Polymorphic %
SCoT	35	17	18	6	51.42%
ISSR	33	12	21	11	63.63%
Total	68	29	39	17	57.35%

Genetic similarity and cluster analysis based on SCoT and ISSR markers: The variation of molecular similarities (MD) determined by SCoT and ISSR ranged from 0.74 (between Am4 and Am6 strains) to 0.95 (between Am_1 and Am_2 strains), as shown in Table 12, which reflected the MD among six strains of El Amar Apricot according on SCoT and ISSR results.

In line with Xanthopoulou et al. (2015), Figure 5 depicts the dendrogram of the AHC analysis produced from the UPGMA method using the Dice dissimilarity measure for combined data of SCoT and ISSR methodologies. Six strains of El Amar Apricot were separated into two main groups on this dendrogram. One main cluster was further divided into two sub main groups: the first sub-main group comprised the Am_1 and Am_2 strains, while the second sub-main band contained the Am_3 strain individually. Conversely, the remaining three strains were part of the second main group; Am_5 and Am_6 strains were each part of a sub-main group, while strain Am_6 was kept apart. Since they accurately report genetic diversity, this demonstrates that the combined data from SCoT and ISSR approaches were appropriate for assessing the genetic relationships among the studied strains of El Amar apricot.

Table (12). **Molecular distances (MD) between six strains of El Amar Apricot based on Dice-dissimilarity index for SCoT and ISSR combined data**

	Am1	Am2	Am3	Am4	Am5
Am1	1				
Am2	0.95	1			
Am3	0.87	0.92	1		
Am4	0.81	0.77	0.80	1	
Am5	0.77	0.78	0.76	0.81	1
Am6	0.82	0.82	0.79	0.74	0.82

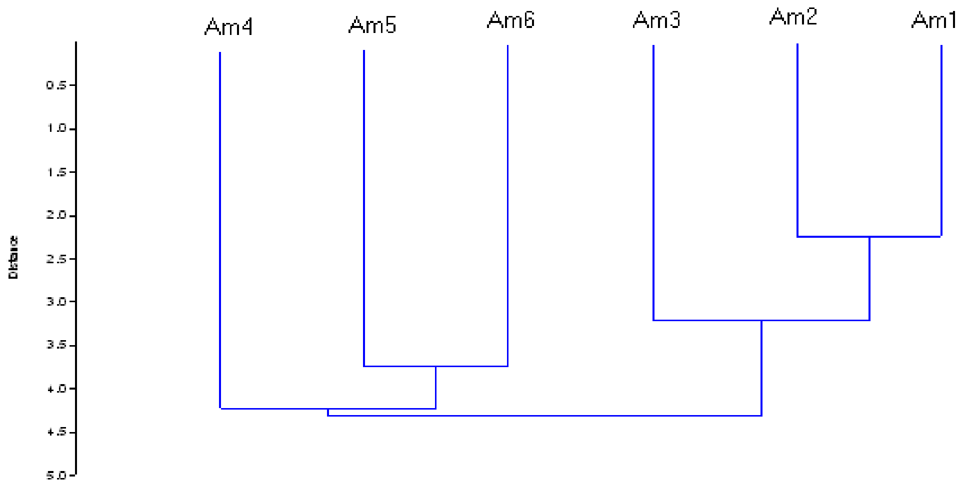

Figure (5): Dendrogram derived by UPGMA method using Dice-dissimilarity coefficient for combined binary data of SCoT and ISSR techniques for six **strains of El Amar Apricot**

In this study, the high quality of the nutritional characteristics of these apricot strains was found, with TSS ranging from 14 to 21% between different strains and seasons, and the maximum acidity of the fruits was 0.308% compared to Canino, where its TSS were reduced to 12.61%, and the acidity of the fruits increased to 1.22% (Ennab et al., 2020). Therefore, we find that the nutritional characteristics are more suitable to the taste of the Egyptian consumer.

Also, the “Canino” has high cold requirements (806 Chilling Units accoding to Fadón et al., 2020), so it blooms late and needs dormancy breakers (Guillamón et al.,2022), but these strains bloom early and regularly without spraying any dormancy breakers, so they are more suitable for the weather conditions of Egypt and are more adaptable.

Conclusion

From the attained data we could conclude that strains Am_1 and Am_2 were the most distinguished strains, as strain Am_1 was early and had the highest levels of fruit set and sugars, while strain Am_2 was the most productive. There are genetic differences between some strains.

Recommendations

Based on previous results, it is recommended to disperse these strains under study, especially Am_1 and Am_2 strains, into arid environments. These strains could also be used in future breeding and hybridization programs, due to genetic variation.

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تقييم بعض سلالات المشمش العمار بمحافظة القليوبية

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هدف البحث هو اختيار سلالات المشمش المحلية المميزة قبل اختفائها بسبب محدودية مساحتها وقلة انتشارها. تم اختيار 6 سلالات كانت ذات قيمة وذات صفات عالية؛ أعطيت السلالة المختارة أسماء مختصرة Am_1 وAm_2 وAm_3 وAm_4 وAm_5 وAm_6. أظهرت الدراسة النتائج التالية: السلالة Am_1 كانت مبكرة في التزهير والحصاد، في حين كانت السلالة Am_5 هي الأكثر تأخراً. تميزت السلالة Am2 بلون محمر مشوب بخضرة للسبلات واذينات للأوراق عن باقي السلالات. كما أعطت أعلى إنتاجية وأعلى قياسات للنمو الخضري. كانت السلالة Am_4 هي الأعلى وزنا وحجما للثمرة. أعلى صلابة للثمار كانت للسلالة Am_5. أعلى نسبة TSS للفاكهة كانت لسلالة Am_1. كشفت العلاقات الوراثية بين ست سلالات، إجمالي النطاقات مع الاشعال SCoT-ISSR عن مجموع 68 نطاقًا. تم تحديد هذه النطاقات على أنها 29 أحادية الشكل و39 متعددة الأشكال مع نسبة متعددة الأشكال (57.35٪) وتم تسجيل النطاقات متعددة الأشكال كـ 17 علامة فريدة.

الكلمات الدالة: Strains of El Amar apricot, yield, TSS, SCoT and ISSR Molecular Markers