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المجلة العراقية لبحوث السوق
وحماية المستهلك

USING PHENOTYPIC INDICATORS TO STUDY GENETIC DIVERSITY OF SOME ARABIAN DATE PALM CULTIVARS

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ABSTRACT

Ten Cultivrs of Arabian date palms were selected from palm stations affiliated to Ministry of Agriculture. The study included 14 phenotypic indicators, such as trunk, leaves, and fruit traits. The trait of Shoot tip shape was distinguished by giving the highest value for the genetic diversity index Plymorphism information content (PIC), which amounted to About 0.642, while the lowest value for genetic diversity index PIC was for Fruit stalk color and the Khalal test, which amounted to 0.268.The results of the genetic dimension analysis, using the Euclidean guide, showed that the highest Euclidean dimension among the varieties was between the Sultani and Khalas varieties, which amounted to 0.66071, while the lowest genetic dimension was between the two varieties, Nabtat sayf, and Khalas, which amounted to 0.13095. The results from cluster analysis, based on the Euclidean guide using the UPGMA method, show that date palm varieties were divided into two main groups with a Euclidean dimension of 0.24. The Eajwat Almadina variety was only one in the first group, and the second group included the rest of the varieties, which in turn were divided into two groups with a Euclidean dimension of 0.3. The first group was divided into Two sections with a Euclidean dimension of 0.35, as the variety Eanbara was included in the first section, while the second section included both varieties Medjool and Alsaqi with a Euclidean dimension of 0.53.

Kaywords: Date palm, Genetic Diversity, Morphological Marker. Plymorphism information content.

أستخدام المؤشرات المظهرية لدراسة التنوع الوراثي لبعض اصناف نخيل التمر العربية

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الخلاصة

تم اختيار عشرة اصناف من نخيل التمر العربية من محطات النخيل التابعة لوزارة الزراعة وشملت الدراسة 14 مؤشر مظهري مثل الجذع والاوراق وصفات الثمار، تميزت صفة رأس النخلة بأعطائها اعلى قيمة لدليل التنوع الوراثي PICالذي بلغ حوالي 0.642 اما اقل قيمة لدليل التنوع الوراثي PIC كانت لصفة لون حامل العذق وطعم الخلال اذ بلغ 0.268. اوضحت نتائج تحليل البعد الوراثي وباستخدام دليل Euclidean أن أعلى بعد إقليدي بين ألاصناف كان بين الصنف سلطاني وخلاص والذي بلغ 0.66071 في حين كان أقل بعد وراثي بين الصنفين نبتة سيف وخلاص الذي بلغ 0.13095، تبين نتائج التحليل العنقودي (Cluster analysis) بالاعتماد على دليل Euclidean بطريقة UPGMA الى انقسام اصناف نخيل التمر الى مجموعتين رئيسيتين ببعد إقليدي 0.24، انفرد الصنف عجوة المدينة في المجموعة

*This article is taken from the first researcher's master's thesis.

الاولى وشملت المجموعة الثانيه باقي الاصناف والتي انقسمت بدورها الى مجموعتين ببعد اقليدي 0.3 اذ تفرعت المجموعة الاولى الى قسمين ببعد اقليدي 0.35 اذ انفرد الصنف عنبرة في القسم الاول اما القسم الثاني فشمل كل من الصنفين مجهول وصكعي ببعد اقليدي 0.53.

الكلمات المفتاحية: نخيل التمر، التنوع الوراثي، العلامة المورفولوجية,pic.

INTRODUCTION

Date palm (Phoenix dactylifera L) is one of the evergreen fruit trees that humans have been interested in since ancient times. It was planted in Mesopotamia about 5,000 years ago, and is believed to have originated in the regions of the Arabian Gulf and southern Iraq, the date palm belongs to the order of palms and to the palm family Arecaceae, which includes different palm species, the most important of which is the date palm, which is widely cultivated in tropical and subtropical regions (**Johnson, 2011**). It is one of the oldest trees from which man has derived benefit, and it has been cultivted since ancient time (**Alturki, 2021**).AS It can tolerate adverse environmental conditions of desert regions such as high temperature (**Mansour & khalil, 2019**) What distinguishes the date palm species from other species is its production of offshoots (**Abdel-Ghani & Zayed, 2019**). The date palm has an important economic impact in the countries where it is grown, as it is considered a major source of income and a basic food for the residents of those countries (**Taha & Abood, 2018**).

The palm tree is considered one of the most important fruit trees in many countries of the world because of its high nutritional importance. Dates are used in the industry, the most important of which are sugar, molasses, and vinegar. The cultivation of palm trees also contributes to improving the environment and combating desertification. They are distinguished by their ability to grow in desert environments and are used as windbreaks on the outskirts of the country (**Hamza & Naji, 2019**). In addition to their economic value, they play an essential role in arid desert areas in terms of providing the appropriate climate for growing vegetables and fruit trees (**Kadhim & Kadhim, 2021**). **Ismail & Altuwairki (2016)** stated that palm fruits contain tannin, which is an astringent and is therefore used as a treatment for intestinal problems, colds, and fevers.

As **Mahamod & Mohammed (2020)** mentioned, the growing top of the palm tree has a high nutritional value because it contains the nutrients that humans need, including iron and vitamin A. It is also considered an effective treatment for many health problems that affect humans, such as anemia, because it is rich in iron, which helps raise the level of hemoglobin. It also contains fibers that improve the functioning of the digestive system. **Mahamed (2019)** used the growing top in many food industries, such as jam and cakes. and dates are used in the manufacture of silver nanoparticles **(Hasson *et al*,2021)**. The shoot tip is used for vegetative propagation using tissue culture technology to produce large numbers offshoot in a relatively short time **(Hussein &Jawad,2021)** . Date palm safflowers were also used by **Mahdi *et al*. (2018)** in the manufacture of artificial silk because it comprises cellulose in high percentage.

Hasan & Zainulabdeen (2022) extracted the hormone melatonin from palm fibers. This hormone is considered a nutritional supplement for humans and is used as a treatment for many diseases such as Alzheimer's and depression. **Sadaght *et al*** (2017) studied different packing methods and different storage temperatures to clarify their effect on the storage of Barhi fruits. The results showed that the highest temperature was 5°C better in terms of fruit quality**. Hamza & Naji (2019)** recommended the necessity of continuing the agricultural

initiative by launching a new initiative specifically for developing palm groves similar to the agricultural initiative to advance the palm sector.

The date palm is considered one of the plants that has the ability to adapt to environmental pressures such as high temperatures, drought, and salinity. However, these conditions greatly affect the quality of the dates, as these changes can be used as an indicator to determine the type of interaction between the plant and the environment **(Al-najjar *et al*, 2022)** .**Ben Saleh & Ibrahim (2018)** explained that over time there have been changes in the physiological, phenotypic, and genetic characteristics that require their distinction and classification under the concept of variety.

There are large numbers of different varieties, reaching 2000 varieties. Each palm growing area is specialized in a group of varieties that are most widespread in it. However, some varieties have moved from their cultivation areas to new areas with the same names or perhaps with new names. Therefore, we find that one variety has more From a name or we may find one of the common names given to two or more different varieties in different regions. As a result, there is overlap in the nomenclature of the different date palm varieties **(Gros-Balthazard *et al*, 2018).**

Sweid (2012) used the nature of the fruits to distinguish between three varieties of date palm, which included the Breem, Khadrawi and Lilawi varieties to compare the anatomical characteristics of the outer and middle fruit coats. The anatomical sections of the fruits of the studied cultivars varied, as the Lilawi variety showed a significant superiority over the Breem variety in the average thickness of the outer cover, while the Khadrawi variety did not differ. In this respect, the studied Cultivars did not differ significantly from the lilawi and Breem cultivars in the average thickness of the cuticle layer, while the Breem and khadrawi varieties significantly differed from the lilawi variety in the average thickness of the middle outer shell layer, and the value was, respectively, (0.61, 0.82, 1.13).

Simozrag *et al* (2016) used phenotypic indicators on 89 cultivars over a period of 3 years to identify their distinctive phenotypic characteristics. The results showed wide variation with different significant degrees between the cultivars, as the fruiting traits outweighed the visual traits, and the cultivars were divided into three homogeneous groups. The aim of this study is to use phenotypic traits to evaluate genetic diversity in some Arabian palm Cultivars.

MATERIALS AND METHODS

Ten Gulf Arabian Cultivars were selected (Medjool, Khalas, Eajwat Almadina, Siltani, Sukari, Alsaqi, Furid, Alshiyshi, Nabtat sayf, Eanbara).

Table (1): Phenotypic characterization of date palm cultivars under study.

No.	Phenotype	Marker	Symbol	No.	Phenotype	Marker	Symblo
1	Trunk size	Thin	1	8	Fruit texture	Soft	1
		thin-medium	2			Semi dry	2
		Medium	3				
		medium-thick	4			Dry	3
		Thick	5				
2	Leaf length	Short	1	9	Fruit maturation	Early	1
		Short-medium	2			Early-medium	2
		Medium	3			Medium	3
		Medium-long	4			Medium	4
		Long	5			Late	5
3	Leaf base	Narrow	1	10	Fruit (khalal) color	Yellow	1
		Narrow-medium	2				
		Medium	3			Yellow-red	2
		Medium-wide	4			Red	3
		Wide	5				
4	Shoot tip Shape	Pyramidal small	1	11	Fruit (khalal) test	Sweet	1
		Pyramidal medium	2			Medium	2
		Pyramidal wide	3			Bitter	3
		Spheral small	4				
		Spheral medium	5				
		Spheral large	6				
		Interminable	7				
5	Leaf bending	Little erect	1	12	Fruit shield	Adherent	1
		Medium erect	2			Separated	2
		Erect	3				
		Erect in sides	4				
		Level	5				
6	Fruit shape	Oval	1	13	Fruit stalk color	Green	1
		Interminable	2			Yellow-green	2
		Inverse	3			Yellow	3
		Cylindrical	4			Orang	4
		Taper	5				
7	Fruit size	Small-medium	1	14	Fruit stalk Length Fruit stalk lenght	Short	1
		Medium	2			Medium	2
		Medium-large	3			Long	3
		Large	4				

The data was analyzed as follows:

First: According to the frequency of the main alleles, the number of alleles, genetic diversity, and the Polymorphsim Information Content PIC genetic diversity index for phenotypic indicators using the Power Marker 3.7 program, the Euclidean distances matrix was created,

after determining the genetic similarity values (Similarity index between these varieties using Jaccard Biodiversity Handbook (**Jaccard, 1908**)

Dendrogram of the taxa under study according to the Euclidean dimensions between these individuals, using the unweighted pair group method with arithmetic average (UPGMA), in order to show the distribution of taxa into major and secondary groups or clusters depending on the distance between them. In a kinship tree diagram

A two-dimensional Principle Component AnalysisP (PCA) diagram was drawn for the varieties under study, for the purpose of confirming the results of the genetic kinship tree diagram. The value of the variances between the principal axes and the eigenvalues were calculated, and the results were analyzed according to the previously prepared characterization tables using the biostatistical program PAST version 1.62 **(Hammer *et al*., 2001).**

Results of phenotypic indicators parameters

Table (2) shows some of the parameters of the phenotypic traits studied. The frequency of the main alleles ranged between 0.8 for the Khalal test trait and 0.5 for the fruit shield trait. The highest number of alleles reached 5 for the Shoot tip shape trait, which gave the highest genetic diversity of 0. 68, while it The Khalal test, fruit shield, Fruit stalk color had the lowest number of alleles, amounting to only two alleles. As for the trait of the Khalal test and the Fruit stalk color, it gave the lowest genetic diversity, amounting to 0.32. The trait of the Shoot tip shape was distinguished by giving it the highest value for the genetic diversity index (PIC), which amounted to about 0.642. The lowest value for the genetic diversity index, PIC, was for the color of the bud holder. And the Khalal test reached 0.268.

Table (2): The number of alleles, main allele frequency, genetic diversity and genetic diversity index (PIC) for phenotypic indicators of some date palm cultivars.

Marker	Major.Allele .Frquency	GenotypeNo	SampleSize	No. of obs.	AlleleNo	Availability	Gene Diversity	Heterozygosity	PIC
Trunk size	0.6	3	10	10	3	1	0.56	0	0.4992
Leaf length	0.6	3	10	10	3	1	0.54	0	0.4662
Leaf base	0.5	3	10	10	3	1	0.58	0	0.4918
Shoot tip Shape	0.5	5	10	10	5	1	0.68	0	0.642
Leaf bending	0.6	3	10	10	3	1	0.54	0	0.4662
Fruit Shape	0.6	3	10	10	3	1	0.54	0	0.4662
Fruit size	0.5	3	10	10	3	1	0.62	0	0.5478
Fruit texture	0.5	3	10	10	3	1	0.62	0	0.5478
Fruit muturaton	0.5	3	10	10	3	1	0.62	0	0.5478
Khalil color	0.7	3	10	10	3	1	0.46	0	0.4102
Kahlal test	0.8	2	10	10	2	1	0.32	0	0.2688
Fruit Shield	0.5	2	10	10	2	1	0.5	0	0.375
Fruit stalk color	0.8	2	10	10	2	1	0.32	0	0.2688
Fruit stalk length	0.5	3	10	10	3	1	0.62	0	0.5478
Mean	0.585714	2.928571	10	10	2.928571	1	0.537143	0	0.467543

The results of the genetic dimension analysis shown in Table 3, using the Euclidean guide, show that the highest Euclidean dimension among the varieties was between the Siltani and Khalas varieties, which amounted to 0.66071, while the lowest genetic dimension was between the two varieties, Nabtat sayf , and Khalas, which amounted to 0.13095.

Table (3): Euclidean dimensions among the study groups, depending on the phenotypic indicators.

	Medjool	**Khalas**	**Eajwat Almadina**	**Siltani**	**Sukari**	**Alsaqi**	**Furid**	**Alshiyshi**	**Nabtat sayf**	**Eanbara**
Medjool	0									
Khalas	0.32738	0								
Eajwat Almadina	0.38095	0.35119	0							
Siltani	0.61905	0.66071	0.47619	0						
Sukari	0.4881	0.3869	0.58333	0.4881	0					
Alsaqi	0.33333	0.25595	0.38095	0.64286	0.44048	0				
Furid	0.29762	0.19643	0.39286	0.53571	0.35714	0.36905	0			
Alshiyshi	0.36905	0.41071	0.29762	0.46429	0.45238	0.32143	0.35714	0		
Nabtat sayf	0.35119	0.13095	0.375	0.56548	0.25595	0.23214	0.22024	0.27976	0	
Eanbara	0.36905	0.39881	0.41667	0.58333	0.54762	0.32143	0.45238	0.33333	0.41071	0

The results of the cluster analysis, based on the Euclidean manual using the UPGMA method and shown in Figure (1), show that the date palm varieties were divided into two main groups with a Euclidean dimension of 0.24. The, Eajwat Almadina variety was unique in the first group, and the second group included the rest of the varieties, which in turn were divided into two groups with a Euclidean dimension. 0.3, as the first group was divided into two sections with a Euclidean dimension of 0.35, as the variety Eanbara belonged to the first section, while the second section included both varieties Anonymous and Alsaqi with a Euclidean dimension of 0.53. As for the second group, it was divided into two sections, as the Siltani variety was unique in the first section, with a Euclidean dimension of 0.46. As for the second section, it was divided into two branches, which included the Sukari variety, with a Euclidean dimension of 0.59, in the first branch. The second branch was separated into two groups. The first group included the Furid and Alshiyshi varieties, with a Euclidean dimension of 0.62. As for the group For a second, it included two categories, Khalas and Nabatat sayf, with a Euclidean dimension of 0.78.

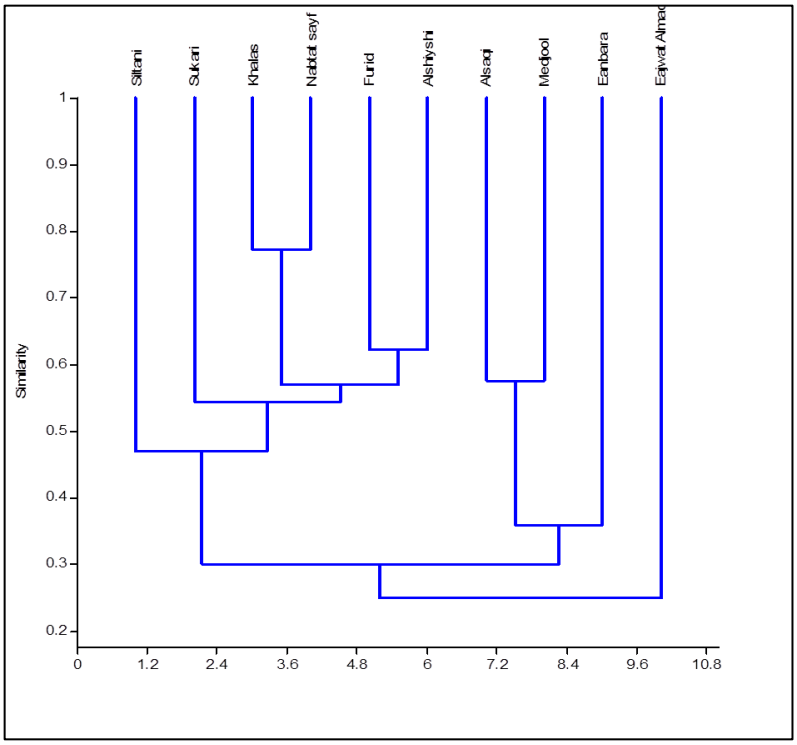

Figure (1): Dendrogram of the genetic kinship tree according to the UPGMA method for some ARABIAN plam.

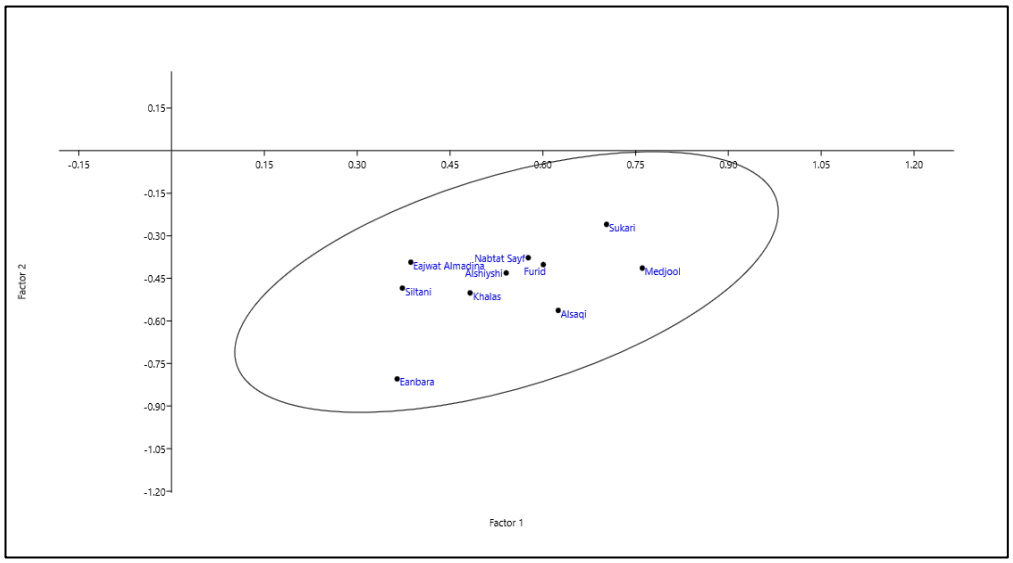

Figure (2): The distribution of date palm cultivars on the orthogonal plane of principal component analysis (pca) based on phenotypic indicators.

Phenotypic indicators are easiest and least complicated way to distinguish between individuals and are among the first and oldest indicators used that cannot be dispensed with. These indicators depend on finding differences between individuals based on their phenotypic characteristics such as: flower color, leaf shape and distribution, and nature of vegetative growth (**Jin *et al,* 1993**).

study is consistent with the results reached by **Khierallah & Azhar (2016)**, in which they used 14 phenotypic indicators to characterize 40 Iraqi date palm varieties. And with **Baharmoz & Bahwerth (2020)** in their study to characterize three varieties of date palm using phenotypic traits. We can conclude that there are differences between Arab Cultivated in phenotypic indicators, which can be used as evidence of genetic diversity.

CONCLUSION

Differences between arabian cultivars in phenotypic traits can be considered indicators that can be used in phenotypic diagnosis. Also the possibility of finding the genetic dimension by calculating the Euclidian distance, the genetic kinship tree, and analyzing the main component between the studied arabian varieties based on the vegetative traits.

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