Proceeding of the Third International & the Fifth Scientific Conference of College of Science - Tikrit University
Int.3, Loc.5, Article ID:2022-P3-05

Purposeful scientific research is a basic pillar for the advancement of Iraq

Detection of the genetic relationship and dimension based on the phenotypic characteristics of a number of domestic and cultivated varieties of *Solanum melongena* L. in Salah al Din in Iraq

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ABSTRACT

Phenotypic traits (quantity and quality) were studied of eleven of (Solanum melongena L.) local and cultivar varieties. The local include four varieties (Iraqi Wisam, Iraqi Mahaly, Iraqi Nasr, Iraqi Al-Rafidain) the cultivated contained four Turkish and three Italian. Eggplant seeds collecting from specialized offices of the Iraqi Ministry of Agriculture, the seeds planted in agricultural dishes that have holes filled with special soil called Peitmos, it was planted on the date of 14th/Oct. /2021 in Tikrit, and after two weeks the seeds were started to germinate, it was transferred to the plastic house a month after it germinated where it the seedlings are planted with three replictors with a distance 30 cm between the seedlings, and it`s watered by distillation. After plant reached the flowering and fruiting stage the phenotypic traits of the varieties of eggplant were studied, which contained; root traits, stem traits, leaves traits, flower traits and fruit traits, where traits were studied in the field. the taxa show high variation in the numerical classification, where the genetic distance differed between (0.198438-0.914063) So the two closest appearance varieties appeared (Iraqi Wisam – Iraqi Nasr) while (Iraqi Al-Rafidain – Turkey 2) were the move further morphological. And draw the Dendogram of morphological studied values where the diagram showed the taxa branching out in to two main groups and another sub-branches of the two major groups.

Keywords: *Solanum melongena*, phenotypic traits, numerical classification, Dendogram

Introduction

Eggplant (*Solanum melongena L.*) also known as Brinjal is a common plant that grows around the world , especially in Asian countries and the Middle East, Belongs to a Solanaceae family which includes other species like Tomatoes, Potatoes, Tobacco and Pepper, and eggplants belongs to the Solanum genus(1) Historical documents dating back 300 B.C. mention this plant as popular as food and medicine (2) , worldwide eggplant production is estimated at 64 million tons per year, it`s an important food and economic crop in Asia and southern Europe (3),phenotypic markers have been used to study the genetic diversity of plants for decades they are easy and inexpensive and depends on quantitative qualities in the study(4) the phenotypic variation of eggplant crop provides an important breeding ground for improving plant characteristics and increasing plant production. Phenotypic profiling is a set of techniques used to accurately calculate a plant`s geometric shape ,such as plant growth ,stem height and diameter, leaf area and dimensions, fruit color and weight .number of leaves and fruits, and plant biomass. The morphological study of plants is done by various method in order to make precise measurements, such as spectroscopy, imaging and high computing(5) .In a previous study(6) of the varieties of Spanish eggplant, it was concluded that the fruit had different shapes in terms of peak shape, skin, color and fruit dimensions, they also noticed difference in leaf characteristics of the species studied in terms it`s color, dimensions and texture In addition, there were differences in the flowering of the eggplant and the color of the plant stem.

Materials and Methods

The study included 11 varieties of *(Solanum melongena L.)* local and cultured ,the local varieties included (Iraqi Wisam, Iraqi Mahaly, Iraqi Nasr, Iraqi Al-Rafidain),while the cultivated included four Turkish and three Italian **as a table 1**. These seeds were planted in Salah Al din- Tikrit in October with special dishes that contain pits filled with Peitmos soil, after two weeks the seeds starting to germinate, after month from germination the seedlings were translated to plastic house that contained parentheses

arches on the floor 80 cm high and 150 cm width this parentheses covered with material with a clear plastic warp that, allowed the sunlight to enter and protects the plant from unsuitable environmental conditions. The seedlings planted on three repeaters,30 cm between seedlings and another ,and watered by distillation.

A number of subjects were used to study outward appearance including tape measure, scissors, tongs, marker tape, white paper, digital scale and camera).

Table 1: The studied samples

NO.	Varieties
1	Iraqi Wisam
2	Iraqi Mahaly
3	Iraqi Nasr
4	Iraqi Al-Rafidain
5	Turkish 1
6	Turkish 2
7	Turkish 3
8	Turkey 4
9	Italian 1
10	Italian 2
11	Italian 3

Morphological characterization & Statistical analysis:

1. Root: The characteristics studied in the root included color, length, diameter and the nature of branching**,** as in the **table 2.**

2. stem: The characteristics studied in the stem included color, height ,the nature, the type and diameter , as in the **table 3.**

3. leaves: The characteristics studied in the leaves color, length, width, lamina shape, leaf base shape, leaf apex, leaf border, the venation arranging leaves on stem, the texture of leaves, stipules, length ,texture, and color of the leaves petiole.as in the **table4**

4. flowers: include four floral rings, Calyx, Corolla, Stamens and Pistils. The studied phenotypes of the parts of the flower are shown in **table5**.these characters includes apex, color, surface covering, shape, nature, type and leaves number of calyx and corolla. In addition of stamens and pistils characters that include; number, color, shape, length, width and surface covering.

5. Fruit: the inner and outer color of the fruit, the fruit shape ,the base fruit shape, internal and external consistency ,weight and dimensions of the fruit .as in the **Table 6**

The phenotypic studying results were took and converted in to (0,1) table depending on presence or absence of the trait ,the symbol for the presence of the traits is the number one while the symbol for the absence of the traits is denoted by the number Zero. The ratio and coefficient of similarity among studied samples were calculated according Nei's 72 coefficient (7) Then, a computer-mediated statistical analysis was performed using (NTSYS) program (8).

Table 2: phenotypic characters of the roots of the species studied

Character	Particulars	Samples studied										
		1	2	3	4	5	6	7	8	9	10	11
Root color	**Dark brown**	1	0	0	1	0	1	1	0	0	0	0
	Average brown	0	0	1	0	1	0	0	1	1	1	0
	Light brown	0	1	0	0	0	0	0	0	0	0	1
Root length cm	**A**	1	0	0	1	0	0	1	0	0	0	0
	B	0	0	0	0	0	1	0	0	0	0	0
	C	0	1	1	0	1	0	0	1	1	1	1
Root diameter mm	**A**	0	0	0	1	0	0	0	0	0	0	0
	B	0	0	1	0	1	1	1	0	0	0	1
	C	1	1	0	0	0	0	0	1	1	1	0
Root branching	**Branchless**	1	0	1	0	0	0	0	1	1	0	0
	Average branching	0	0	0	0	1	0	1	0	0	1	0
	Poorly branched	0	1	0	1	0	1	0	0	0	0	1

Table 3: phenotypic characters of the stems of the species studied

Character	Particulars	Studied samples										
		1	2	3	4	5	6	7	8	9	10	11
Stem color	Light green	0	1	0	1	1	1	1	1	0	1	0
	Dark green	0	0	1	0	0	0	0	0	0	0	0
	Yellow green	1	0	0	0	0	0	0	0	1`	0	1
Stem height	A	0	0	0	1	1	0	1	1	0	0	1
	B	0	1	1	0	0	1	0	0	1	1	0
	C	1	0	0	0	0	0	0	0	0	0	0
Stem diameter	A	0	0	0	0	0	0	1	0	0	1	0
	B	0	0	0	1	1	0	0	0	0	0	0
	C	1	1	1	0	0	1	0	1	1	0	1
Stem type	Branched erect	1	1	1	1	1	1	1	1	1	1	1
Stem nature	Herbaceous	1	1	1	1	1	1	1	1	1	1	1
Surface coating	Small hairs	1	1	1	1	1	1	1	1	1	1	1

Table 4: phenotypic characters of the leaves of the species studied

Character	Particulars	Studied samples										
		1	2	3	4	5	6	7	8	9	10	11
Leaf color	Dark green	1	1	0	1	1	0	0	0	1	0	0
	Yellow green	0	0	1	0	0	0	0	1	0	0	0
	Light green	0	0	0	0	0	1	1	0	0	1	1
Leaf length	A	1	1	1	0	1	0	0	0	0	1	0
	B	0	0	0	1	0	0	0	1	0	0	1
	C	0	0	0	0	0	1	1	0	1	0	0
Leaf width	A	1	0	1	0	0	0	0	0	0	0	0
	B	0	1	0	1	0	0	1	1	1	1	1
	C	0	0	0	0	1	1	0	0	0	0	0
Lamina shape	Oval	1	1	1	1	1	1	1	1	1	1	1
Leaf apex	Acute	1	1	1	1	1	1	1	1	1	1	1
Leaf base shape	Spherical	1	0	0	0	0	1	0	1	0	0	0
	Cordate	0	1	1	1	1	0	1	0	1	1	1
Leaf border	Lobbed	1	1	1	1	1	1	1	1	1	1	1
Venation	Reticulate-Parallel	1	1	1	1	1	1	1	1	1	1	1
Leaf arrangement on stem	Alternative	1	1	1	1	1	1	1	1	1	1	1
Upper texture of leaf	Rough with microvilli	1	1	1	1	1	1	1	1	1	1	1
Bottom texture of leaf	Rough	1	1	1	1	1	1	1	1	1	1	1
Stipules	present	1	1	0	0	1	1	1	1	0	0	1
	non	0	0	1	1	0	0	0	0	1	1	0
leaf Petiole length	A	0	0	0	1	0	1	1	1	0	0	1
	B	0	0	0	0	0	0	0	0	1	1	0
	C	1	1	1	0	1	0	0	0	0	0	0
leaf Petiole color	Dark green	1	0	0	0	0	0	0	0	0	1	1
	Light green	0	0	0	0	1	1	0	1	1	0	0
	Yellow green	0	1	1	1	0	0	1	0	0	0	0
leaf Petiole texture	Rough with microvilli	1	1	1	1	1	1	1	1	1	1	1

Table 5: phenotypic characters of the flowers of the species studied

Character	Particulars	Studied Samples										
Calyx apex	Acute	1	2	3	4	5	6	7	8	9	10	11
		1	1	1	1	1	1	1	1	1	1	1
Calyx color	Light green	0	0	0	0	1	1	0	0	1	1	1
	Medium green	1	1	1	1	0	0	1	1	0	0	0
Calyx surface covering	Many microvilli	1	1	1	1	1	1`	1	1	1	1	1
Calyx shape	pikey	1	1	1	1	1	1	1	1	1	1	1
Calyx nature	meaty	1	1	1	1	1	1	1	1	1	1	1
Calyx type	Permanent	1	1	1	1	1	1	1	1	1	1	1
Number of calyx leaf	A	0	1	0	0	0	0	0	1	1	0	0
	B	1	0	1	0	0	0	1	0	0	1	0
	C	0	0	0	1	1	1	0	0	0	0	1
Corolla apex	peaked	1	1	1	1	1	1	1	1	1	1	1
Corolla surface covering	smooth	1	1	1	1	1	1	1	1	1	1	1
Corolla shape	rotate	1	1	1	1	1	1	1	1	1	1	1
Corolla arrangement	Ambricate	1	1	1	1	1	1	1	1	1	1	1
Number of corolla	A	0	1	0	1	0	0	0	1	1	0	0
	B	1	0	1	0	0	0	1	0	0	1	0
	C	0	0	0	0	1	1	0	0	0	0	1
Corolla color	White	1	1	1	0	0	0	0	0	1	0	1
	Rosy	0	0	0	1	1	1	1	1	0	1	0
Corolla diameter	A	1	0	1	1	1	0	0	0	1	1	1
	B	0	1	0	0	0	0	1	1	0	0	0
	C	0	0	0	0	0	1	0	0	0	0	0
Stamens number	A	0	1	1	1	0	0	0	1	1	0	0
	B	1	0	0	0	0	0	1	0	0	1	0
	C	0	0	0	0	1	1	0	0	0	0	1
Anther color	Light yellow	1	1	0	0	0	1	1	1	1	1	1
	Dark yellow	0	0	1	1	1	0	0	0	0	0	0
Anther shape	Tall oval	1	1	1	1	1	1	1	1	1	1	1
Anther length	A	1	1	0	0	1	1	1	1	1	1	1
	B	0	0	0	1	0	0	0	0	0	0	0
	C	0	0	1	0	0	0	0	0	0	0	0
Anther width	A	0	0	0	0	0	0	0	0	1	1	1
	B	0	0	0	0	0	1	1	1	0	0	0
	C	1	1	1	1	1	0	0	0	0	0	0
Filament color	white	0	0	0	0	0	1	1	0	1	0	1
	Light yellow	1	1	1	1	1	0	0	1	0	1	0
Filament shape	Filament	1	1	1	1	1	1	1	1	1	1	1
Filament length	A	0	0	0	0	1`	0	0	1	0	0	0
	B	1	0	1	0	0	1	0	0	0	1	0
	C	0	1	0	1	0	0	1	0	1	0	1
Stigma shape	Spotted ball	1	1	1	1	1	1	1	1	1	1	1
Stigma color	green	1	1	1	1	1	1	1	1	1	1	1
Style shape	Thin tall	1	1	1	1	1	1	1	1	1	1	1
Style color	Light green	1	1	1	1	1	1	1	0	0	0	0
	White	0	0	0	0	0	0	0	1	1	1	1
Style surface covering	Small hairs	1	1	1	1	1	1	1	1	1	1	1
Style length	A	0	0	0	0	0	0	1	0	0	0	1
	B	0	1	0	1	0	1	0	0	0	0	0
	C	1	0	1	0	1	0	0	1	1	1	0
Ovary shape	Spotted globular	1	1	1	1	1	1	1`	1	1	1	1
Ovary length	A	0	0	0	0	0	1	1	0	0	1	0
	B	1	1	0	1	1	0	0	0	1	0	1
	C	0	0	1	0	0	0	0	1	0	0	0
Ovary width	A	0	0	1	0	0	1	1	0	0	1	0
	B	0	1	0	1	1	0	0	1	1	0	1
	C	1	0	0	0	0	0	0	0	0	0	0

Table 6: phenotypic characters of the fruits of the species studied

		Studied samples										
Character	**Particulars**	1	2	3	4	5	6	7	8	9	10	11
Fruit shape	Prolonged	1	0	0	0	1	0	0	0	1	0	0
	Round	0	0	0	0	0	0	0	1	0	0	1
	Oval	0	1	1	1	0	1	1	0	0	1	0
Fruit base shape	Peaked	1	0	1	0	0	1	0	0	0	1	0
	Rotund	0	1	0	1	1	0	1	1	1	0	1
The inner color of the fruit	White	1	1	1	1	1	1	1	1	1	1	1
The outer color of the fruit	Bright black	1	1	1	1	0	1	1	1	1	1	0
	Purple	0	0	0	0	1	0	0	0	0	0	1
Inter structure of the fruit	Squishy	1	1	1	1	1	1	1	1	1	1	1
Outer structure of the fruit	Smooth leather	1	1	1	1	1	1	1	1	1	1	1
Fruit weight	A	0	0	0	0	0	0	1	0	1	0	0
	B	0	0	0	0	1	1	0	0	0	1	1
	C	1	1	1	1	0	0	0	1	0	0	0
Fruit length	A	0	0	0	1	0	0	1	0	1	0	0
	B	1	0	0	0	0	1	0	0	0	0	0
	C	0	1	1	0	1	0	0	1	0	1	1
Fruit width	A	0	0	0	0	1	0	0	0	0	1	0
	B	0	1	1	0	0	1	1	1	1	0	0
	C	1	0	0	1	0	0	0	0	0	0	1

Analysis of results of phenotypic study:

The phenotypic results of samples were used to find genetic dimension values for the genetic similarity and variation of eggplant species studied. (**As the table7**), where it had the lowest genetic dimension (0.198438) is between the two varieties (Iraqi Wisam & Iraqi Nasr), which of these two varieties is the most genetically similar. While the biggest genetic dimension (0.914063) is between (Iraqi Al-Rafidain& Turkey 2), which of these two varieties is the least genetically similar. The rest of the varieties varied between these two dimension (0.198438-0.914063).It turn out that the more traits the two classes share, the more similar they are genetically (9).

Table 7: Indicates the genetic dimension values of the varieties studied

ت	1	2	3	4	5	6	7	8	9	10	11
1	0.0000	0.398438	0.320313	0.335938	0.34375	0.367188	0.382813	0.351563	0.351563	0.25021	0.28125
2	0.265625	0.0000	0.265625	0.265625	0.265625	0.265625	0.265625	0.265625	0.265625	0.265625	0.265625
3	0.198438	0.335938	0.0000	0.429688	0.273438	0.328125	0.3125	0.382813	0.398438	0.335938	0.335938
4	0.304688	0.296875	0.390625	0.0000	0.34375	0.390625	0.320313	0.304688	0.296875	0.390625	0.296875
5	0.351563	0.34375	0.390625	0.375	0.0000	0.265625	0.3125	0.351563	0.34375	0.390625	0.375
6	0.28125	0.34375	0.34375	0.914063	0.382813	0.0000	0.34375	0.34375	0.623063	0.382813	0.28125
7	0.296875	0.351563	0.320313	0.34375	0.296875	0.351563	0.0000	0.34375	0.296875	0.351563	0.320313
8	0.335938	0.265625	0.320313	0.335938	0.265625	0.320313	0.335938	0.0000	0.320313	0.335938	0.265625
9	0.28125	0.289063	0.26125	0.28125	0.289063	0.200063	0.28125	0.289063	0.0000	0.28125	0.289063
10	0.28125	0.34375	0.27625	0.30986	0.23459	0.28050	0.24732	0.34375	0.24700	0.0000	0.34375
11	0.34375	0.390625	0.375	0.57800	0.265625	0.3125	0.351563	0.34375	0.390625	0.375	0.0000

Depending on the genetic dimension results had been accessed to Dendrogram that show in **figure 1**, in which it turns out there are two main groups:

First group: Includes two varieties (Turkish2 & Turkish3) they go back to the same environment.

Second group :which branched in a two main secondary groups, the **first** included four secondary branches ;first two branches include the varieties (Italian 1,Italian2) second two branches include (Iraqi Nasr and Iraqi Wisam).**the second** included five secondary branches; first **two** branches included (Turkish 1and Italian 3) , second one branch includes (Iraqi Al Rafidain)only, the third two branches include (Turkey4 and Iraqi Mahaly.

Notes with Dendrogram **figure 1** that a phenotypic varieties appeared, in spite of it`s environmentally differentiated because these varieties have adapted to the new environment (10), while some varieties are unaffected by the environment, So their genetic content haven't changed with economic factors (11).

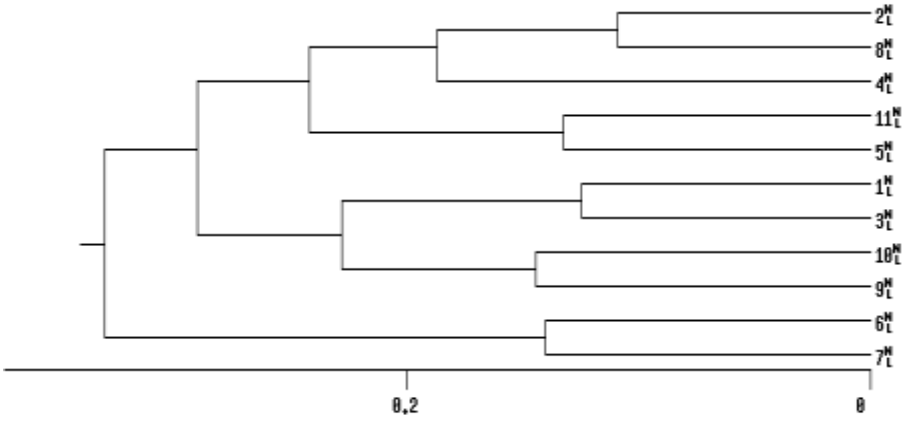

Fig. 1: The Dendrogram of genetic dimension results of studied samples

1=Iraqi Wisam, **2**=Iraqi Mahaly,**3**=Iraqi Nasr,**4**=Iraqi Alrafidain,**5**=Turkish1,**6**=Turkish2,**7**=Turkish3,**8**=Turkish4,**9**=Italian1,**10**=It-alian2,**11**=Italian3.

Conclusion

Morphological study is important in classification depending on quantitative and qualitative traits. Characteristics that are less environmental are important in field isolation and diagnosis of species. Numerical classification of phenotypic traits is of great importance in distinguishing phenotypic relationships. Differences in a appearance are caused by differences in environmental factors and influence of environmental factors. The Iraqi Al Rafidain variety appeared with a lot of phenotypic features that are not the same as the other traits of studied samples, both varieties (Iraqi Wisam &Iraqi Nasr) were distinguish that they are the most visually similar, while (Iraqi Al Rafidain &Turkish2) varieties had the higher genetic dimension.

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تحديد العلاقة والبعد الوراثي بالاعتماد على الصفات المظهرية لعدد من الاصناف المحلية والمستوردة لنبات الباذنجان في العراق- صلاح الدين

غادة جمال ابراهيم الدحام ، رافع زيدان مخلف السكماني

الملخص

تم دراسة الصفات التنميطية (الكمية والنوعية) من أحد عشر من الباذنجان (الأصناف المحلية والأصناف المستوردة) وتشمل الأصناف المحلية أربعة أصناف (وسام – محلي – نصر، الرافدين) اما المستوردة فتشمل أربعة أصناف تركية وثلاثة إيطالية. بذور الباذنجان جمعت من المكاتب المتخصصة التابعة لوزارة الزراعة في العراق، وقد زرعت البذور في ألواح زراعية تحتوي حفر مملوءة بتربة خاصة تسمى بيتموس، في تاريخ 14 تشرين الأول/أكتوبر . /2021 في تكريت، وبعد أسبوعين بدأت البذور في الإنبات، تم نقلها إلى المنزل البلاستيكي بعد شهر من إنباتها حيث يتم زرع الشتلات مع ثلاثة مكررة بمسافة 30 سم بين الشتلات، وتم سقيها بالتقطير. وبعد أن وصل النبات إلى مرحلة الإزهار والإثمار، دُرست الصفات المظهرية لأصناف الباذنجان، التي تضمنت ما يلي ؛ صفات جذرية، صفات للساق صفات الاوراق وصفات الزهور، وصفات الثمار، حيث تمت دراسة الصفات في الحقل. اظهرت الاصناف المدروسة تباين كبير في التصنيف العددي، حيث تباين البعد الجيني بين (0.198438- 0.914063) حيث ظهرا الصنفان تركي ٢ والرافدين بانهما الابعد مظهريا بينما الصنفان المحليان نصر ووسام الاقرب مظهريا وبعد رسم المخطط الشجيري لقيم البعد الوراثي للدراسة المظهرية ظهر ان المخطط قد تفرع الى مجموعتين رئيسيتين ومن ثم تفرعهما الى محاميع ثانوية وثالثية .