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Phenotypic and Numerical Characterization and Detection of the Genetic Relationship of a Number Ants Species of Hymenoptera: Formicidae in Iraq

Mohammed Ahmed R Al-Rubaye[1], Ahmed Ali Issa[2] and Rafea Zaidan Mukhlif Al-Sugmiany[3]
[1]Department of Biology, College of Science, University of Tikrit, IRAQ.
[2]Department of Biology, College of Science, University of Tikrit, IRAQ.
[3]Department of Biology, College of Science, University of Tikrit, IRAQ.

[1]Corresponding Author: ?

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ABSTRACT

The study aimed at the phenotypic characterization of a number of species of real ants, Hymenoptera: formicidae, in some governorates of central and northern Iraq, as well as revealing similarities and genetic differences depending on the phenotypic characteristics of 16 samples of real ants. The samples were collected from the governorates (Salah al-Din, Kirkuk, Sulaymaniyah, Erbil) using Collection kit, ants samples were diagnosed in the Research Center and Natural History Museum \ University of Baghdad, and the study was conducted in the laboratories of the College of Science \ University of Tikrit in the period 12/15/2021 – 5/1/2022. Samples were collected and preserved according to the methods used in preserving insects. A phenotypic study was conducted for (38) phenotypic characteristics of the general shape of the head, thorax, abdomen, legs and wings in detail using a anatomical microscope. Temporary sections were photographed using a digital camera and kept until the results are studied. Numerical classification and phenotypic genetic dimension were conducted based on the results of the studied phenotypic traits. The results showed a clear discrepancy between the species, it was shown from the results of the statistical analysis of the values of the phenotypic genetic dimension, which ranged between (0.230-0.958), where the least genetic dimension was between sample No. 1 (Camponotint xerxes Erbil 1) and No. 8 (Camponotint xerxes Kirkuk 2), as it reached 0.230, and that is It is the highest percentage of similarity between the two samples within the studied species. As for the highest genetic dimension, it was 0.958 between sample 14 (Camponotint xerxes Salah al-Din 1) and samples No. 9 and 10 (9-Messor sp Kirkuk, 10- Messor sp Sulaymaniyah 1). There is no match in the traits studied between these two samples, while the values of the genetic dimension for the rest of the species ranged between those values.

Keywords- phenotypic Characterization, numerical, genetic relationship, ants, formicidae.

I. INTRODUCTION

Ants are one of the most successful groups of insects in the animal group, and they receive great attention because they form a social insect in the form of colonies or nests (dens) that sometimes contain millions of individuals. Colonies of some invasive ant species may work together to form giant colonies that extend over very large areas, and sometimes ant colonies may be described as a superorganism because they function as one coherent organism (Ward *et al*, 2005).

Ants are social insects that exist in all geographic regions, from arctic regions to the tropics, from the woods on the highest mountains to the shifting sands of sand dunes and seashores, and from the wettest forests to the driest deserts, their preferred habitats are the tropics with an abundance of animals More than 12,467 species have been described worldwide. About fifty live in Britain, 772 in the United States, and 1,350 in Australia (Reimer, 2021).

The population of the Formicidae family is an essential part of terrestrial biodiversity. Due to its great diversity, abundance, important role in the ecosystem

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and ease of sampling, ants are model organisms for a wide range of experimental studies including: behavior, environmental sciences and biology. evolutionary (Andersen *et al*., 2003).

There are a number of morphological studies on ants that have been initiated by scientists, but there are very large numbers that have not been classified yet. The phenotypic classification often depends on the color in the body and the structure of the body, which consists of three main sections: the head, the thorax, and the abdomen, and its external structure is solid And tough, which makes it waterproof, and this structure is made of a substance called chitin that gives ants great strength, as the ant is distinguished by its strength compared to its very small size, as one ant can carry a piece of food weighing 10 times the weight of the basic ant (Branstetter *et al*., 2017).

Numerical classification is considered part of the multivariates analyzes and in parallel with the advent of the computer, so it enabled quantitative approximation and the ability to perform rapid processing of a huge amount of data. Numerical phenolic analysis (7) Quantitative methods for isolating taxonomic ranks and diagnosing them based on a few selected traits within a population group gave important results based on this small number of traits (8) Entomologists have used numerical classification in many Taxonomic studies, especially in the classification of flies, such as study (9). The current study aimed to characterize the phenotypic, numerical and genetic relationship of a number of phenotypic traits of 16 samples of real ants collected from a number of Iraqi governorates.

II. MATERIALS AND METHODS

Collection and preservation of samples: Samples were collected from Kirkuk Governorate, Sulaymaniyah Governorate, Salah al-Din Governorate, and Erbil Governorate during the period between 1/7/2021 to 1/10/2021 from different regions of the above-mentioned governorates, using soft forceps, as well as by hand (Kiran and Karaman, 2012).) and the samples were preserved using 70% ethanol alcohol and placed in plastic tubes marked with the date of collection and the area from which they were collected until the study was conducted (Meier, 2016).

Diagnosis of samples: The ant species mentioned in Table 1 were diagnosed at the Natural History Museum Research Center / University of Baghdad, on 4/4/2022.

Table 1: Species under study

Number	The Place of Sample Collection	Scientific Name	Number	The Place of Sample Collection	Scientific Name
1	***Camponotint xerxes***	Erbil1		Kirkuk	***Messor sp.***
2	***Cataglyphis***	Erbil		Sulaymaniyah1	***Messor sp.***
3	***Messor sp.***	Erbil		Sulaymaniyah2	***Messor sp.***
4	***Camponotint xerxes***	Erbil2		Sulaymaniyah1	***Camponotint xerxes***
5	***Messor aralocaspius***	Erbil		Sulaymaniyah2	***Camponotint xerxes***
6	***Lepisiota Formicidae***	Kirkuk		Salah Alden 1	***Camponotint xerxes***
7	***Camponotint xerxes***	Kirkuk1		Salah Alden 2	***Camponotint xerxes***
8	***Camponotint xerxes***	Kirkuk2		Salah Alden 3	***Camponotint xerxes***

The method of work: The insect was removed from the alcohol in which it was kept and then washed using distilled water and left in it for 5 minutes to get rid of the alcohol and impurities attached to the external structure of the insect's body, after which it was left to dry, then placed in plastic tubes containing a solution of potassium hydroxide KOH at a concentration of 10% and the insect was left in the solution for 2 days to soften it and acquire the necessary transparency (then the samples were passed with ethyl alcohol in ascending concentrations of 100-90-80-70% for one day for each concentration, respectively (Karaman and Aktaç ,2013).Where a white gelatinous substance appears at the bottom of the tube and in large quantities It is a substance C2H5OK (potassium ethoxide), which was formed as a result of the reaction of ethyl alcohol with potassium hydroxide.

The sample was placed in a funnel containing filter paper to get rid of the alcohol and the gel. The samples were collected in filter paper using tweezers and transferred to a higher concentration of alcohol, and so on. Then they were placed in a xylol solution and left for two days. Then they were examined under a microscope at 10×4 and 10×10 magnifications to obtain A clear picture of the ant (Mortazavi *et al*., 2015).

1- The shape of the head.
2- Antennas (type and number of cuttings).
3- The number of chest rings.

It was described and diagnosed using a microscope, and pictures of samples were taken using a digital camera to clarify the insect to be able to describe it accurately.

Numerical classification: Select (38) traits for the phenotypic study and they were compared numerically. These traits were entered into the computer by coding the traits with the two numbers (0,1)) when the trait is present or not in the studied species, respectively. As we

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mentioned earlier, in this study, an approved method was used in analyzing molecular data, then calculating the similarity ratio as well as the similarity coefficient between the studied species using Nei's coefficient 79 (13), all statistical analyzes were conducted by computer using the program: (NTSYS-pc) (14) The samples were given symbols for ease of handling, and they were arranged sequentially from (1) to (16).

III. RESULTS AND DISCUSSION

The phenotypical characteristics are considered the basis in the process of classifying organisms, including insects, and the methods used in diagnosing these characteristics are characterized by easy, fast and complex methods, as these phenotypical characteristics can be studied by making temporary or permanent slides and determining the degree of similarity and difference between the characteristics through these slides. Through the results of collecting samples of ants that included four Iraqi governorates (Salah al-Din, Kirkuk, Erbil, Sulaymaniyah) for 16 samples from those governorates and recorded in the third chapter, table (1) sample code, collection site and scientific name for each sample, the presence of seven types of ants according to Diagnosis of the Museum of Natural History at the University of Baghdad, which are shown in Table (1).

Laboratory Diagnostic Results: The results of the phenotypic diagnosis using the anatomical microscope and the inserted lens showed a clear discrepancy in a number of phenotypic characteristics that were studied for the studied samples of ants between different species, in terms of samples of the same species in different regions, and the differences were very clear. The diversity in the species, and this is consistent with what was mentioned by (McArthur, 2014) that the variation in the shape, color and size of the colonies in the ant colony makes identifying the species more difficult compared to identifying the species within the colony due to the different environment:

Head and accessories:

Head color: Through the diagnosis under the anatomical microscope, the results shown in Table (2) and Figure (2-4) showed a clear variation in the head color in the studied species. The color of the head was black in the samples (1,5,6,11,12,13). ,14,15,16) The samples (2,3,7,8) were distinguished by walnut color and light and dark walnut color, then sample 4 was distinguished by honey color and sample 10 by coffee color.

Head shape: The head shapes in the studied samples were distinguished by several shapes, so the head shape was oval in the samples (1,4,5,6,8,9), while the shape of the head was apical in the samples (3,7,10,11,12,13, 14,15,16) The shape was square in sample 2 as shown in Table (2) and Figure (1).

The color of the mouth and appendages: The colors of the mouth and appendages were distinguished according to the species and regions, so the color of the samples (1, 3, 7, 8, 10, 11, 14, and 15) was nutty, while the samples (2, 12, and 13) were black, then followed by samples (9 and 6) in brown color, and finally samples (4,16) in honey color, as shown in the table (2) and Figure (1).

Head hairs: The studied samples were distinguished by the presence of hairs in the head, and some of them did not have these hairs. The samples (1, 3, 4, 5, 9, 11, 15, and 16) were distinguished by the presence of hairs in the head, while the rest of the samples were distinguished by the absence of hairs in the head region, as shown in Table (2) and Figure (1).

Length and width of the head: Through the results, the sizes of the heads of the samples varied. With regard to length, the longest head in sample No. 16 was 12.0 mm long, and the shortest head in sample No. 4 was 0.3 mm long. As for width, the widest head of sample No. 14 was 0.8 mm and the least wide. In samples No. 1 and 4, it reached 0.3 mm, as shown in Table (2) and Figure (1).

Mouth length: The samples varied in the characteristic of the length of the mouth, so the longest mouth was in sample No. 13 with a length of 0.6 mm, and the shortest mouth in samples No. 2, 9, and 14 with a length of 0.2 mm, as shown in Table (2) and Figure (1).

The results of this study agree with previous studies of some ant species, especially in Iraq, such as the study of AL-Umrani (2017), which dealt with the taxonomic and phenotypic aspects of worker ants belonging to the Formicinae family, order Hymenoptera, family Formicidae ants, which were collected from some regions of Iraq for the period from January to November of 2016, in addition to studying some undiagnosed samples preserved in the Iraqi Natural History Museum and Research Center / University of Baghdad, as well as the study (Aldawood and Sharaf, 2009) in diagnosing two types of ants In the Kingdom of Saudi Arabia through records, the number of Monomorium species known in Saudi Arabia increases from thirty-eight to thirty-nine species, and those Tetramorium species increase from fifteen to sixteen, and in the study of (Sharaf , 2009) in diagnosing new types of ants In the Kingdom of Saudi Arabia, where the new species Technomyrmex albipes was diagnosed by studying and drawing female workers that were collected from Wadi Abha. This new species has similarities with species within the genus except for differences in the characteristics of the head.

Table 2: Phenotypic characteristics of the head in the studied ant samples

Color of the mouth and appendages,	length of the mouth	shape of the head	bristles, head	color of the head	length of the head	width of the head	n
Light nutty	0.4mm	oval	There is	black	5 mm	3 mm	1

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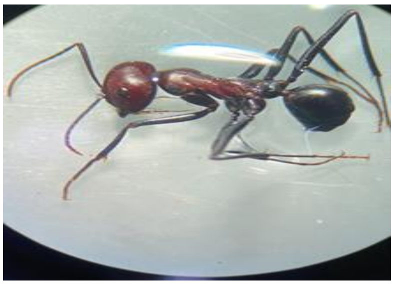
black	0.2mm	Square	nothing	walnut	4 mm	5 mm	2
Josie Toukh	0.4mm	apical	There is	Josie Toukh	5 mm	4 mm	3
Hazel	0.3mm	oval	There is	Hazel	3 mm	3 mm	4
black	0.3mm	oval	There is an average	black	6 mm	0.6 mm	5
Dark brown	0.3mm	oval	nothing	black	5 mm	5 mm	6
Light nutty	0.4mm	apical	nothing	Light nutty	4 mm	6 mm	7
nutty	0.3mm	oval	nothing	nutty	5 mm	5 mm	8
Dark brown	0.2mm	oval	There is a density	nutty	6 mm	7 mm	9
nutty	0.3mm	apical end	There is a density	coffee	4 mm	5 mm	10
nutty	0.4mm	apical	There is	black	5 mm	6 mm	11
black	0.5mm	apical	nothing	black	4 mm	5 mm	12
black	0.6mm	apical	nothing	black	6 mm	6 mm	13
nutty	0.2mm	apical	nothing	black	1.3 mm	8 mm	14
nutty	0.5mm	apical	There is	black	8 mm	6 mm	15
Dark brown	0.4mm	apical	There is	black	1.4 mm	7 mm	16

-3 ***Messor sp.*** Arbel	-2 ***Cataglyphis*** Arbel	-1***Camponotint xerxes*** Arbel1
-6 ***Messor aralocaspius***Kirkuk	-5 ***Messor aralocaspius*** Arbel	-4Arbel ***Camponotint xerxes*** 2
-9 ***Messor sp.*** Kirkuk	-8 ***Camponotint xerxes***Kirkuk2	-7Kirkuk ***Camponotint xerxes***1
-12 ***Camponotint xerxes*** Sulaymaniyah1	-11 ***Messor sp.*** Sulaymaniyah2	-10 ***Messor sp.*** Sulaymaniyah1
-15- Camponotint xerxes Salah aldin3	14- 1Salah aldin Camponotint xerxes	Sulaymaniyah 2Camponotintxerxes-13
		3-16 ***Camponotint xerxes*** Salah aldin

-3 ***Messor sp.*** Erbil



-2 ***Cataglyphis*** Erbil

-1***Camponotint xerxes*** Erbil

-6 ***Messor aralocaspius*** Kirkuk

-5 ***Messor aralocaspius*** Erbil

-4 ***Camponotint xerxes*** Erbil

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-9 ***Messor sp.*** Kirkuk


-8 ***Camponotint xerxes*** Kirkuk


-7 ***Camponotint xerxes*** Kirkuk


-12 ***Camponotint xerxes*** Sulaymaniyah1


-11 ***Messor sp.*** Sulaymaniyah2


-10 ***Messor sp.*** Sulaymaniyah1


-15 ***Camponotint xerxes*** Salah Alden2


-14 ***Camponotint xerxes*** Salah Alden1


-13 ***Camponotint xerxes*** Sulaymaniyah2


-16 ***Camponotint xerxes*** Salah Alden3

Figure 1: pictures of the general description of the studied ants, representing 16 samples under a microscope at 40X magnification

Antenna Antenna*:* The results show the antennas of the samples studied in Table (2) and Figure (3) that there is a clear discrepancy in the characteristics of the antennae that are useful in distinguishing the studied species, and this characteristic is also important in separating the species.

Horn length: The samples varied in the length of the antenna, so the longest antenna in sample 16 was 2.0 mm long, and the shortest antenna in sample No. 4 was 0.4 mm long, as shown in Table (3) and Figure (1).

Horn color: The samples varied in the color of the horn, so the color of the horn was nutty for the samples (2, 3, 5, 6, 9, and 11), while the honey color of the horn belonged to the samples (1, 7, 8, 12, 13, 14, and 16), while sample No.The share of sample No. 15.

Presence of hairs on the antennae*:* The studied samples were divided into two groups according to the characteristic of the presence of hairs on the antennae. The samples (3, 6, 9, 10, 11, and 15) were distinguished by the presence of hairs on the antennae, while the rest of the samples were distinguished by the absence of hairs in the antennae.

The shape and apex of the horn*:* The studied samples were characterized by three shapes of the apex of the horn, where the shape of the apex was the apical end in the samples (1, 2, 3, 5, 6, 7, 8, 9, and 10), while sample No. 4 was characterized by an apical shape and a pointed end, while samples (11, 12, 13, 14, 15, and 16) were distinguished.

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Number of horn rings: The samples varied in the number of antennae rings. The samples (13, 14, and 15) were distinguished by ten rings, while the samples (1, 2, 3, 4, 5, 7, 8, 9, 10, 11, and 12) were distinguished by eleven rings. Finally, sample No. 6 was distinguished by twelve rings.

Horn type: The type of horns did not show any differences between the studied samples, as all samples were characterized by the elbow touch.

The results of the antennae are consistent with what was mentioned by most researchers in the field of ant studies, such as the study of Al-Umrani (2017) and the study of (Fadl *et al*,.2007) on six species of ants in Egypt, in which a survey was conducted for a full year of ants for structural pests by the Pest Management by specialists in San Diego , California, and Phoenix, Arizona I have. As well as in the study of Abdulqader (2015) on ants in Iraqi Kurdistan, which dealt with the morphological and taxonomic form of ants (Hymenoptera; Formicidae) in the Kurdistan region of Iraq. Fourteen species representing ten genera Monomorium, Crematogaster, Messor, Pheidole, Tetramorium, Camponotus, Cataglyphis, were studied. Lepisiota, Liometopum, and Tapinoma under three subfamilies, Myrmicinae, Formicinae, and Dolichoderinae, were sampled and described in detail.

Table 2: Antenna characteristics of the studied samples

Horn type	number ofepisodes	shape and top	ipl	horn color	century length	n
Touch my elbow	11	apical end	nothing	Hazel	6 mm	1
Touch my elbow	11	apical end	nothing	nutty	5 mm	2
Touch my elbow	11	apical end	There is	Josie Toukh	7 mm	3
Touch my elbow	11	Pointed apex	nothing	yellow	4 mm	4
Touch my elbow	11	apical end	nothing	nutty	5 mm	5
Touch my elbow	12	apical end	There is	Dark nutty	6 mm	6
Touch my elbow	11	apical end	nothing	light hazel	7 mm	7
Touch my elbow	11	apical end	nothing	Hazel	7 mm	8
Touch my elbow	11	apical end	There is	nutty	6 mm	9
Touch my elbow	11	apical end	There is	coffee	6 mm	10
Touch my elbow	11	apical	There is	Light nutty	7 mm	11
Touch my elbow	11	apical	nothing	Hazel	6 mm	12
Touch my elbow	10	apical	nothing	Hazel	.14 mm	13
Touch my elbow	10	apical	nothing	Hazel	1.5 mm	14
Touch my elbow	10	apical	There is	black	1.3 mm	15
Touch my elbow	11	apical	nothing	Hazel	1.4 mm	16

Chest and accessories:

Through the results shown in Table (3) regarding the characteristics of the chest in the types of ants studied, it was found that there are clear differences between the studied samples that can be adopted as descriptive characteristics of the studied types of ants, and the characteristics can be summarized as follows:

Chest width: From the results of measuring the chest width of the studied samples, there were clear differences between the samples, as the widest chest was found in sample No. 14 with a distinct width of 1 mm, followed by the two samples (12 and 15) with a width of 0.6 mm, then followed by samples (3, 5, 8, 11 and 13) with a width of 0.6 mm. 0.5 mm, then samples (2, 7, 9, 10, and 16) with a width of 0.4 mm, then came after them samples (4 and 6) with a width of 0.3 mm, and the lowest width in sample No. 1 was 0.2 mm, as shown in Table (3) and Figure (1).

Chest length: The results of chest length showed that there was a high discrepancy between the studied samples. The longest chest was in sample No. 8 with a length of 2.5 mm, then followed by sample No. 12 with a length of 2.4 mm, and then followed by samples (1, 3 and 14) with a length of 2 mm. Then it was followed by (15, 16, 5, 9, 7, and 10) with a length of 1.8, 1.7, 1.6, 1.6, 1.5, and 1.4 mm, respectively. The shortest length was in sample No. 4 with a length of 1.3 mm, as shown (3) and Figure (1).

Chest color: The results of the chest color showed a clear discrepancy between the studied samples. The samples (1, 4, 7, and 16) were distinguished by a honey color, while the samples (2, 3, 5, 9, 13, 14, and 15) were distinguished by a walnut color of varying intensity in some samples, while the samples (6, 8, and 12) were distinguished by black color, then sample No. 10 was isolated It has a distinct coffee color that differs from all samples, as shown in Table (3) and Figure (1).

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The presence of hairs on the chest: The characteristic of the presence of hairs on the chest of the studied ants is a distinctive characteristic. The samples were divided into two main parts, represented by the presence of hairs on the chest. The samples (1, 3, 4, 5, 7, 8, 9, 10, 12, 13, and 15) were distinguished by the presence of hairs on the parts of the chest. Within this group, samples No. 9 and 10 were distinguished by the density of the hairs compared to the rest of the samples, while the rest of the samples were distinguished by the absence of hairs in the chest, which is a discriminatory characteristic, as shown in Table (3) and Figure (1).

The shape of the chest: The shapes of the chest varied in the studied samples for several shapes, including the oval shape for the share of the samples (1, 2, 4, 5, 8, and 9), while the samples (3, 7, 10, 11, 12, 13, 14, 15, and 16) were distinguished by the apical shape, and from that group, sample No. 10 was distinguished by the apical end type, as shown in Table (3) and Figure (1).

Number of chest rings: The studied samples were distinguished by the number of chest rings. Sample No. 14 had five rings forming the chest, followed by the two samples (2 and 15) with four chest rings, while samples (1, 3, 6, 7, 9, 10, 11, 12, and 13) were distinguished by three rings each, while samples (4, 5, 8, and 16) were distinguished by two chest rings. As shown in Table (3) and Figure (1).

The presence of wings: the characteristic of embryos is one of the rare characteristics in ants, or it is almost specific to certain species. Sample No. 14 was characterized by the presence of wings, while the rest of the samples did not have any wing or wing-like structure, as shown in Table (3) and Figure (1).

Most of the results of this study agree with most researchers in this field, such as the study (Collingwood *et al.*, 2004) in which the ant insect was studied on Socotra Island and recorded within the flora, and information related to the environment inhabited by ants of the island was studied based on new research and diversity, and it was diagnosed in the study, There are 28 species belonging to 10 genera and four subfamilies collected from the main island of which 17 (61%) are successful invasive species, seven are indigenous (25%) and four are endemic (14%). As well as the study of Abdul-Rassoul et al. (2013) in the survey study of unknown unrecorded species and the collection of Iraqi spaces preserved in the Museum of Natural History, and nine species of stored collection samples of the unknown worker ants, (Hymenoptera: (Formicidae: Myrmicinae) were recorded from the Museum Iraqi natural history for the first time, and a new key with numbers was introduced here to separate female workers.As well as the study of Jabbar, (2020)The environmental study of ant species was conducted during the period 2008-2009 in seven regions of Basra Governorate: Qurna, Al-Zubayr, Al-Madinah Center, Abu Al-Khasib, The Marshes, Shatt Al-Arab, Al-Faw.Through this study, it was found that there are thirteen species of ants, which originated in two subfamilies, Myrmicinae and Formicinae, in addition to that five species of ants were recent in Iraq. In the study of McArthur and Shattuck (2001) In the diagnosis of new species of ants in Australia, in this study, species of the genus Camponotus maccephalus were identified. The group was identified here for the first time and contains eleven species, including three new species and one that was raised from R.T. In addition, five new subspecies have been discovered. Species included in this group are: C. anderseni sp., C. annetteae sp., C. conithorax Emery, C. howensis Wheeler, C. gasseri (Forel), C. janeti Forel, C. janforrestae sp.

Table 3: represents the thorax and appendages of the studied samples

wings	The number of rings issued	appearance	ipl chest	ipl chest	Chest length	chest width	n
nothing	3	oval	There is	There is	2.0mm	5 mm	1
nothing	4	oval	nothing	nothing	1.5mm	4 mm	2
nothing	3	apical	There is	There is	1.0mm	5mm	3
nothing	2	oval	There is	There is	1.3mm	3mm	4
nothing	2	oval	There is	There is	1.1mm	5mm	5
nothing	3	oval	nothing	nothing	1.2mm	3 mm	6
nothing	3	apical	There is	There is	1.1mm	4mm	7
nothing	2	oval	There is	There is	1.5mm	5mm	8
nothing	3	oval	There is a density	There is a density	1.6mm	0.4mm	9
nothing	3	apical end	There is a density	There is a density	1.4mm	0.4mm	10

ISSN: 2583-4053
Volume-1 Issue-5 || December 2022 || PP. 209-218
https://doi.org/10.55544/jrasb.1.5.24

nothing	3	apical	nothing	nothing	1.5mm	5mm	11
nothing	3	apical	There is	There is	1.4mm	6mm	12
nothing	3	apical	There is	There is	1.6mm	5mm	13
There is	5	apical	nothing	nothing	1.3mm	1.0mm	14
nothing	4	apical	There is	There is	1.8mm	6mm	15
nothing	2	apical	nothing	nothing	1.7mm	4 mm	16

Estimating the genetic dimension based on phenotypic traits:

An estimate of the phenotypic genetic dimension based on the results of the studied phenotypic traits of 16 samples of ants as shown in Table (4), using the genetic program (NTSYS-PC. Version 2.20i) and based on the analysis of the equation of Nei, 1979)) shows that the values of the genetic dimension referred to in Table (4-9) ranged between 0.230- 0.958, as it was the least genetic dimension between sample No. 1 and No. 8, as it amounted to 0.230. In most of the studied phenotypic traits, the two types were identical in several phenotypic traits. As for the highest genetic dimension, it reached 0.958 between sample 14 and samples No. 9 and 10. This indicates that it is the least similar between the two samples within the studied samples. between those values.

The cluster analysis group dendrogram was formed in Scheme (1) based on the values of the phenotypic genetic dimension of the 16 ant samples using the results of the cluster analysis. The genetic relationship showed through the scheme that it was divided into: The first main group: This group included one sample No. 14. The second main group: This group included all samples except sample No. 14, then this group was divided into two secondary groups, group (A, B), as group A included samples 3 and 10 only, while the second group (B) included the rest of the other samples, group (B) was divided into two subgroups They are B1 and B2, and the subgroup B1 included samples 1, 4, and 8 only, while group B2 was divided into two subgroups, B2a, which included sample number 2 only, and B2b, it was divided into three subgroups, the first subgroup, B2b1, included samples 5, 6, and 9, and the second subgroup, B2b2, included Samples 12, 13, and 15, and the third subgroup B2b3 included samples 7, 11, and 16, and this group has the highest percentage of similarity among the studied groups, and this is consistent with the results reached by Al-Mashhadani (2021) in his study Phenotypic and molecular characterization of a number of real ants species in some governorates of central and northern Iraq, as well as detecting similarities and genetic differences based on phenotypic and molecular characteristics, determining the genetic fingerprint using RAPD-PCR indicators, and finding a correlation between the two indicators for 16 samples of real ants. And in the study of Al-Abbasi (2023), the study sought to know the extent of lice prevalence and the areas of infection in herds of buffaloes, sheep and goats for three governorates: Baghdad, Salah al-Din (Samarra), and Kirkuk, and to know the genetic relationship and genetic distance between the same species for each of them and other species using RAPD-PCR indicators.

Table 4: The values of the phenotypic genotype of the studied ant samples

0.000															
0.615	0.000														
0.553	0.553	0.000													
0.305	0.546	0.628	0.000												
0.448	0.364	0.574	0.391	0.000											
0.433	0.566	0.553	0.642	0.405	0.000										
0.489	0.489	0.520	0.560	0.461	0.580	0.000									
0.230	0.506	0.492	0.405	0.391	0.378	0.566	0.000								
0.475	0.475	0.506	0.642	0.287	0.279	0.489	0.378	0.000							
0.566	0.615	0.419	0.747	0.587	0.433	0.489	0.506	0.315	0.000						
0.433	0.475	0.462	0.642	0.492	0.392	0.366	0.553	0.353	0.392	0.000					
0.366	0.489	0.432	0.706	0.461	0.405	0.460	0.352	0.489	0.580	0.489	0.000				
0.489	0.533	0.720	0.560	0.378	0.580	0.379	0.520	0.580	0.791	0.533	0.305	0.000			
0.758	0.601	0.944	0.915	0.797	0.889	0.720	0.875	0.958	0.958	0.601	0.777	0.475	0.000		
0.666	0.520	0.462	0.693	0.364	0.475	0.533	0.707	0.433	0.666	0.392	0.328	0.328	0.653	0.000	
0.502	0.593	0.579	0.405	0.431	0.642	0.432	0.733	0.642	0.804	0.459	0.560	0.355	0.579	0.502	0.000

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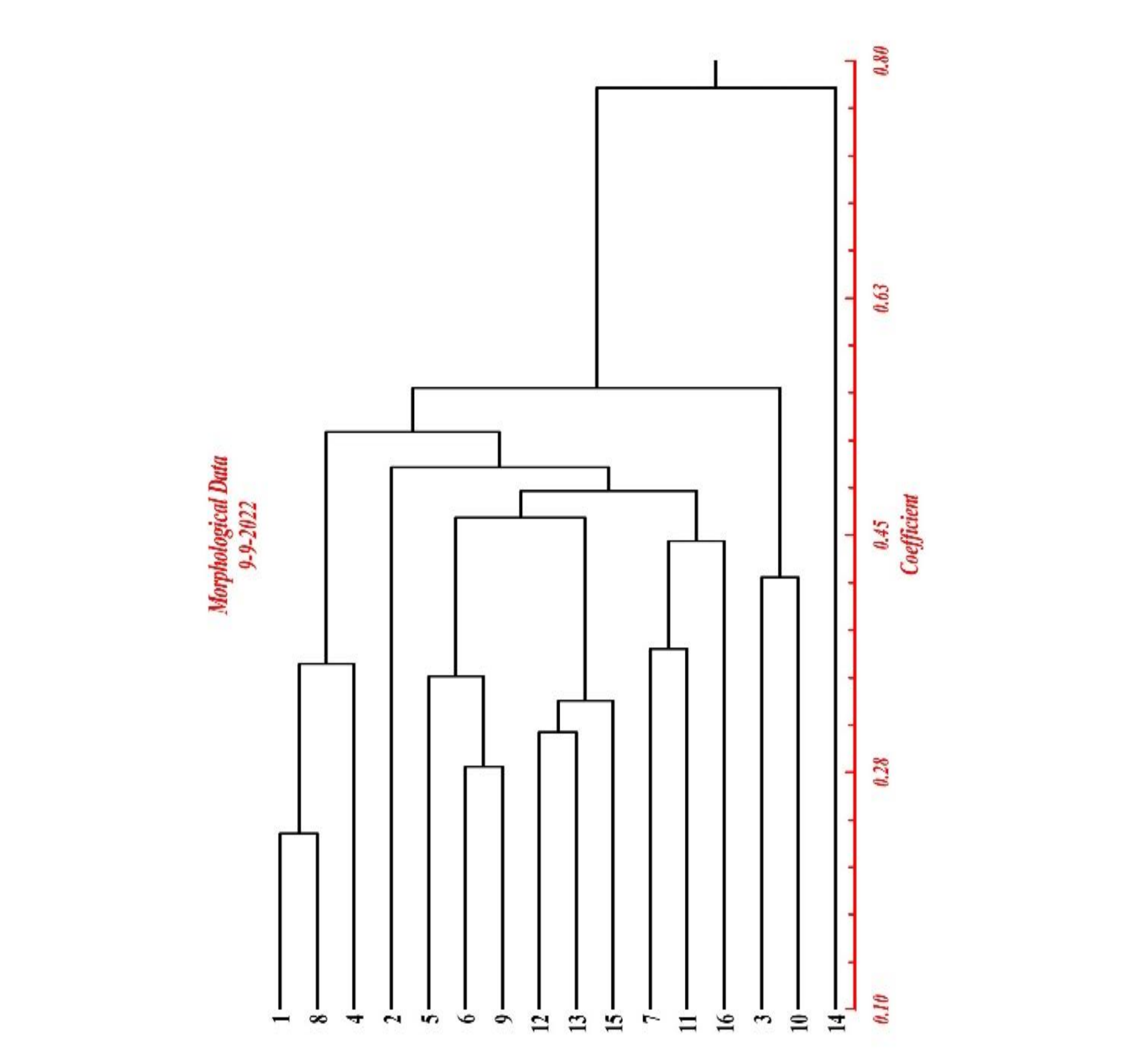

Scheme (1) represents the genetic tree based on the values of the phenotypic genetic dimension

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