Morphological variations of green peach aphid *Myzus persicae* (Sulzar 1776) (Hemiptera: Aphididae) from different areas of Iraq

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Abstract

The green peach aphid, *Myzus persicae* is one of the most harmful agricultural pests worldwide. Therefore, understanding the morphological variations among populations are important for the management of this pest. samples were collected from 11 locations in Iraq to compare among ten characteristics of collected populations. The most important differentiation characteristics are the length of the antenna, body, mouth parts and femur. The antenna length was greater in the aphids which collected from North areas of Iraq; however, the length of the body was greater in the aphids from locations in the mid of Iraq. the length of mouth parts was larger among the aphids collected from southern locations. Current results offer more evidence suggesting that there may be more than one genotype of *M. persicae* in Iraq. However, further studies on the genetic variations among collected populations are required.

Keywords: *Myzus persicae*, Aphids, appearance difference, classification

Introduction

The green peach aphid, *M. persicae* is a vital species that infest more than 400 plant species within 40 plant hosts, including various economically important crops [1, 2]. This insect can transmit more than one hundred and fifty plant viruses in different plant hosts[3]. Also, its high ability to achieve a population density in newly growing plant tissues due to its short generation time and high fertility [4]. Prompt and precise identification of aphids at the species level is a serious component when it comes to effective pest management and quarantine systems[5].In addition n, reliable identification of aphid species and developmental stages is critical for optimizing border controls and biological surveillance as well as for the success of integrated pest management (IPM) strategies.

Nevertheless, morphologically identifying aphids requires knowledge, training, and skills because numerous species are morphologically identical, and combinations of ecologically contrasting taxa often occur [6]. These difficulties have made it necessary for taxonomists to seek other techniques, such as morphometry, to identify different species and groups [7]. Multivariate morphometric studies were conducted to analyze and characterize populations of

different aphid species [8]. The aim of the current study, A study of the phenotypic differences of the insect from different regions and crops in Iraq.

Materials and Methods

Field survey

Field collection of the green peach aphid *M. persicae* on eggplant, cucumber, vegetables, and bushes from some open and closed fields in Iraqi governorates.

Aphids were collected from eggplant, cucumber, radish plants and their adjacent shrubs in some greenhouses and open fields in Najaf, Baghdad, Babel, Wasit, Erbil, Dohuk, Kirkuk, Basra, Karbala, Thi-Qar and Diwaniya governorates (Figure 1). The targeted area was about (1000 m^2) from different regions of each province. The first sample was taken on 11/20/2021, and the collection process continued until 04/12/2022. Fifteen plants were choicen ramdoly from each area, and leaf samples were taken randomly from each plant. Each specimen was kept in a plastic bag and brought to the insect laboratory in the Department of Plant Protection / College of Agriculture - University of Kufa for examination. All samples of insects were preserved in glass tubes containing 70% ethyl alcohol for next examinations.

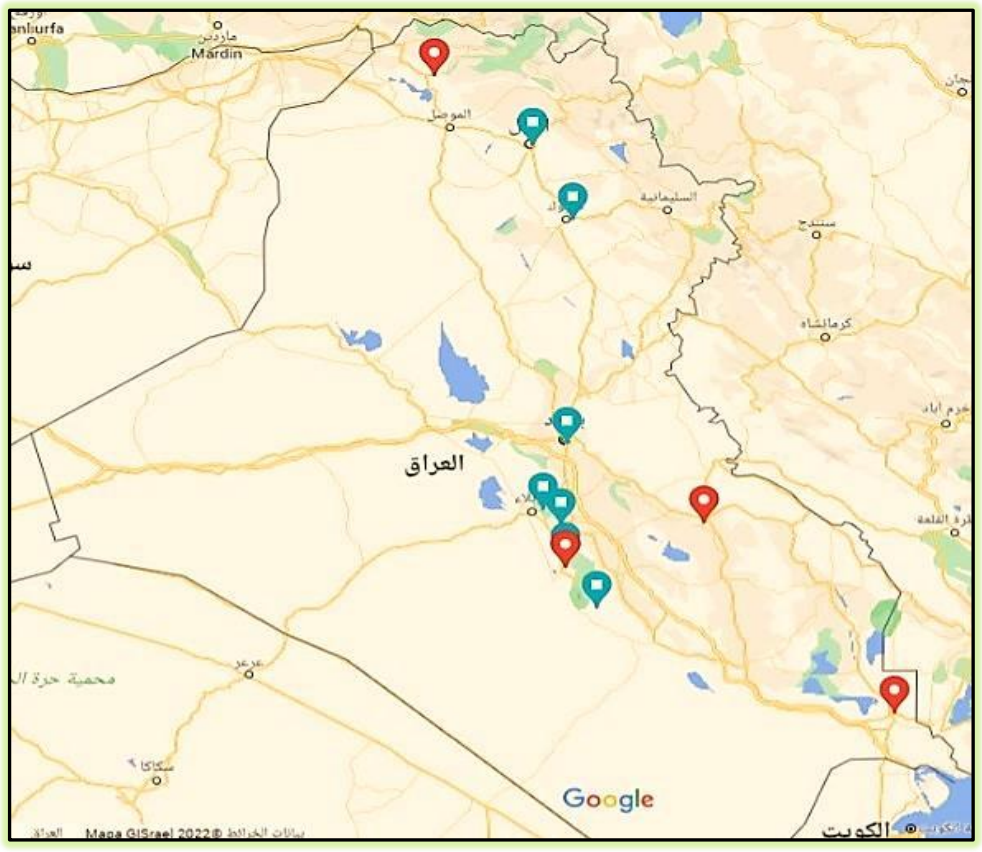


Figure (1): *M. persicae* collection areas from some Iraqi governorates and sampling sites confirmed by GPS

Identification of the green peach aphid *M. persicae*

Several winged adult aphids and nymphs were isolated from the sampled insects, as mentioned in the paragraph (1-1). Aphids were identified by using the taxonomic keys adopted at the Natural History Museum /University of Baghdad. by Dr.. Hana Al-Saffar.

Morphological identification of the green aphid peach *M. persicae*

Morphological differences of *M. persicae* that were sampled from different regions were studied. Ten replicates were taken for each sample of preserved insects. Some characteristics of the body appendages were studied in order to find out the extent of variation between samples by measuring both length of the body, the length of the antennae, the distance of the third ring of the antennae, the length of the corneas, the length of the distance between the tubercles of the antennae, the length of the thigh, the length of the tail, the length of the mouth parts, the length of the second wrist and the length of the third wrist (the claw) and the range between the measurements of each trait was determined. These using a dissecting microscope with a magnification of 4X and with a graduated lens WF 10X (18 mm); after calibration [9]. All samples were preserved separately in a test tube (5 ml) containing 70% ethyl alcohol. Sampling data were placed on each tube, such as the number of samples, sampling date and time, the sampling area and host plant. Taxonomic keys were followed as described in [10 , 11, 12 ,13].

Results and Discussion

Phenotypic variation of appendages of *M. persicae* sampled from different regions in Iraq

Body length of *M. persicae*

The results showed a variation in the body length of *M. persicae* collected from different regions of Iraq (Figure 2,3). The highest range of body lengths of aphids was recorded for samples that were collected from the provinces of Babylon, Waist, and Diwaniyah which were (2.5, 2.4, and 2.4 mm), respectively. The results also showed that the shortest range of aphids' body lengths was recorded for samples collected from the provinces of Dohuk, Dhi Qar, and Basra (2.06, 2.11, and 2.17 mm), respectively.

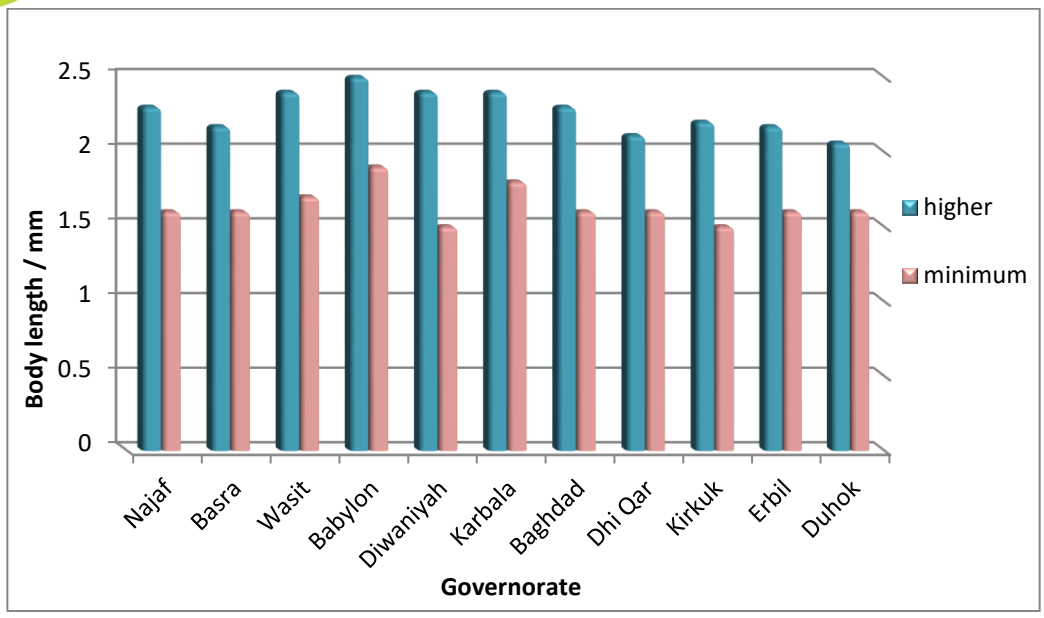


Figure (2):the extent of variation in body lengths for the green peach aphid sampled from different locations in Iraq.

The difference in environmental conditions and geographical areas from one area to another may significantly impact the variation in the length of the body of green peach aphids that have been studied in this study. The *M. persicae* is known to vary morphologically from one environment to another, depending on the plant host, environmental conditions, and geographic regions [14]. The morphological characteristics of aphids are greatly influenced by host plants, nutrition, and environmental conditions such as temperature and relative humidity [15].

B	A

Figure (3): Body length of the green peach aphid (A) Babylon province sample (B) Dohuk province sample. 5x magnification.

These results are consistent with [16]. who revealed that aphids feeding on different plant species are subject to selective pressure to adapt to these

differences. Their study also demonstrated the relationship between the nature of the plant host and survival, feeding behavior and gene expression. In addition, aphids that fed on non-preferred hosts (primary) showed a small size, a low reproduction rate, a slow increase in population, and a long lifespan . Pea aphid strain *M. sativa* showed distinct feeding behaviour. Interestingly, the number of hosts differentially expressed salivary gland genes was negatively related to aphid propensity in this host plant. This study provided important clues in the specialization of the host plant in aphids.

Also consistent with [17]. revealed the effect of Weather conditions on the morphology of aphids using a multivariate approach. Aphid samples were used as groups in the analysis of canonical variance, as the analysis relied on a large set of data obtained by measuring 19 linear variables on insects adults reared at four temperatures (10, 15, 20 and 26.5 °C). The species used, *M. persicae,* in each of the three specimens patted at high and low temperatures reflected a change in 'appearance', comprising in part a relative reduction in the lengths of the body appendages. The variation in which temperature effects are assigned to the first two variables seems to indicate that there are two different aspects of the morphological response to temperature. They reflect the different metabolic pathways through which temperature influences growth patterns.

Antenna length of green peach aphids

Figures (4 and 5) results revealed a discrepancy in the lengths of the antennae of the studied aphid samples. Where a higher range of lengths was determined for the studied samples. Aphid for samples collected from Erbil, Dohuk and Kirkuk provinces were (2.11, 2.02, and 2.00 mm). While samples collected from the provinces of Basra, Dhi Qar, and Najaf showed the shortest lengths of antennae (1.71, 1.77, and 1.82 mm), respectively. Comparison with the range of the shortest lengths for the length of the antennae of green peach aphids for samples taken from Dohuk, Baghdad, Dhi Qar, Basra, Wasit and Najaf, which ranged between (1.55 and 1.24 mm. The reason for the aphids antennae length discrepancy is due to using of antennae by the aphids by hitting on both sides of the body to stimulate the insect's body to erupt wings and form winged individuals to complete the sexual life cycle and lay eggs that hibernate, reduce food competition, or escape from natural enemies, especially in northern regions with low temperatures (18 ± 2 ℃) at the date of sampling.

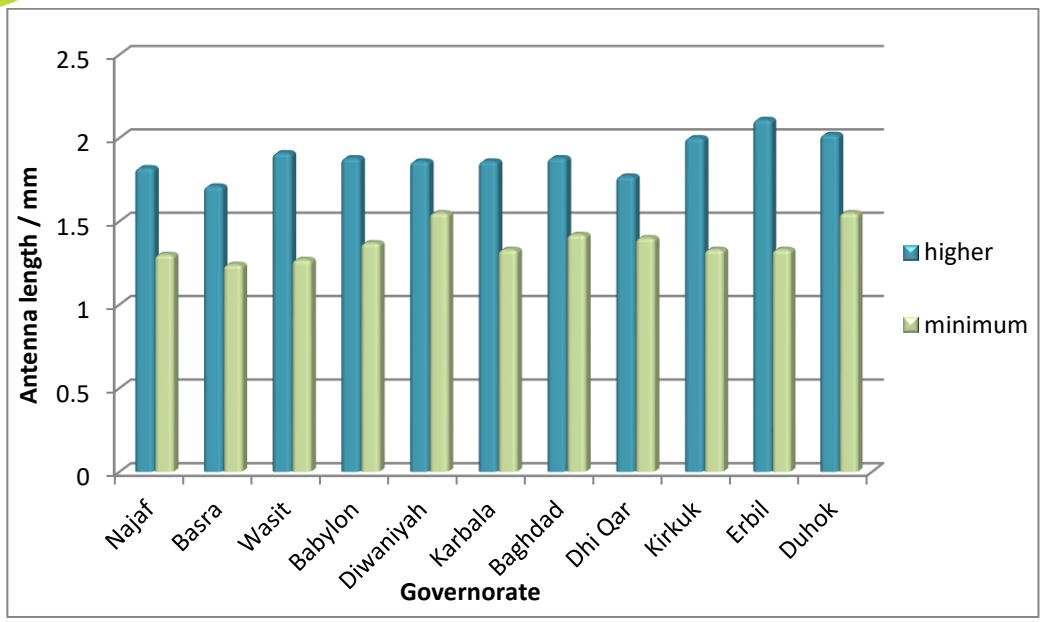
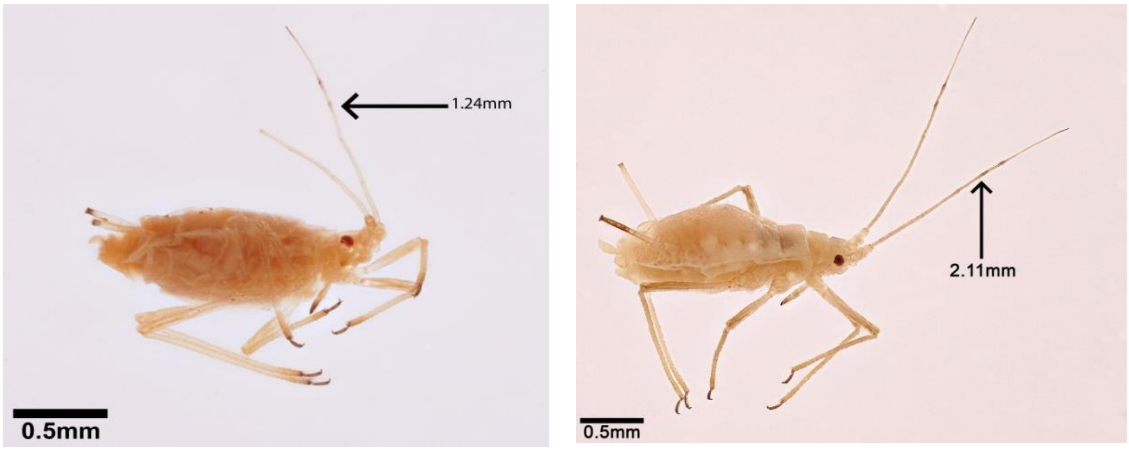


Figure (4) The extent of variation in the antennae lengths of the studied samples of the green peach aphid taken from several provinces in Iraq.



B	A

Figure (5): Antennae length of the green peach aphid (A) Erbil province sample (B) Basra province sample, 5x magnification.

These results are agreed with what was indicated by [18]. who showed that the pea aphid, *Acyrthosiphon pisum*, produces an increased proportion of winged forms among its offspring when exposed to natural enemies. Their results indicate that the formation of wings in the presence of predators and parasitoids is a general response to pea aphids. The signals and mechanisms underlying this response remain unclear. While tactile stimuli, chemical signals, as well as visual signals are appropriate candidates as appropriate alert signals for the presence of natural enemies. The hypothesis that aphid antennae are necessary to stimulate the emergence and growth of wings in the presence of natural enemies was tested by [18]. Pea aphid antennae were removed, and the emergence of winged aphids was recorded when aphids were raised in the presence and

absence of their natural enemies for a period of six days. The eradication of antennae led to a sharp decrease in the proportion of winged forms among the offspring, whether in the presence or absence of a predator, while the presence of natural enemies of the insect led to an increase in the production of winged individuals of aphids with the presence of intact antennae. Antennas are of great importance to instruct the body to grow and form wings in the presence of natural enemies or any other danger, such as colony overcrowding. The results indicate the importance of aphids' antennae as tactile stimuli to stimulate wing growth.

Femur Length

The results shown in figures (6 and 7) showed that there was a discrepancy in the femur lengths of the studied aphids for different provinces. The highest recorded femur lengths recorded were (0.91, 0.80, and 0.77 mm) for the samples taken from the governorates of Basra and Babylon and Najaf, respectively. In addition, femur lengths for samples taken from the governorates of Wasit, Baghdad, and Kirkuk were (0.68, 0.68, and 0.68 mm), respectively. In contrast, the range of the shortest femur lengths was for samples taken from the governorates of Dohuk, Baghdad, Babel, Kirkuk, Wasit, and Dhi Qar, which ranged from 0.55- and 0.31-mm. The Femur length of aphid legs varies according to a few parameters. First is the presence of natural enemies in the existing environment, which is used as a defensive method. Secondly, the host plant that aphids feed on in terms of the structural structure of the surface of the leading containing a layer of hairs or does not contain it, which is due to the presence of the plant host in the environment dry.

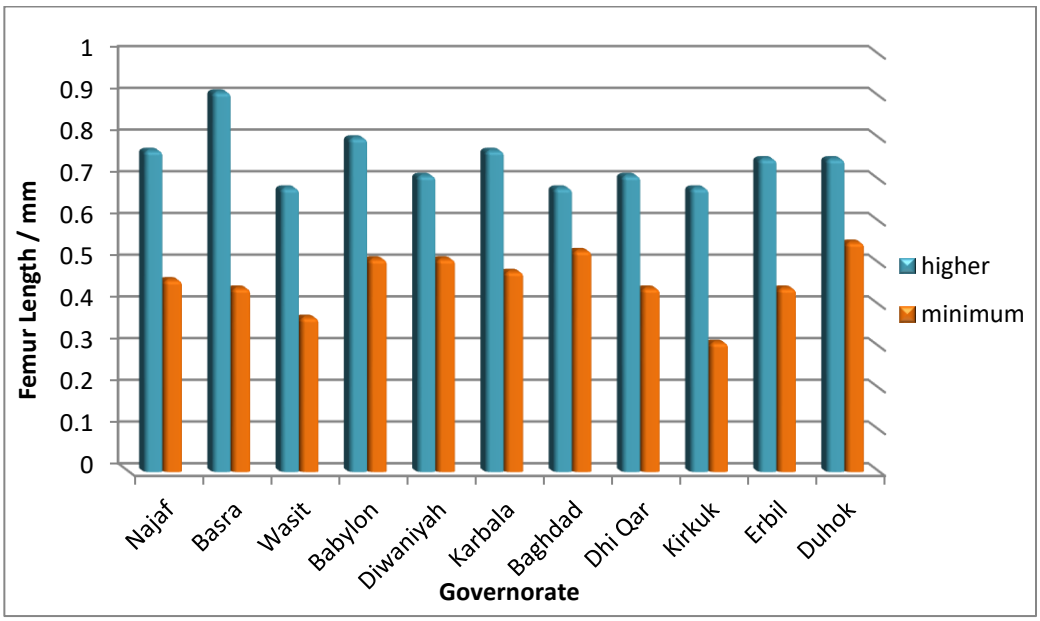


Figure (6) shows the extent of variation in the thigh lengths of the studied samples of the green peach aphid taken from several provinces in Iraq.

B	A

Figure (7): The femur length of *M. persicae* from (A) the Kirkuk province sample and (B) the Basra province sample, 5x magnification.

Understanding the evolutionary process of morphological diversity and associated adaptations and benefits are among the major goals of evolutionary biology. The defensive methods and their components are crucial to the survival of insects, on which life and death depend. Small insects mainly use different defensive tactics to avoid predation [19]. Insects protect themselves with different basics such as coloration, body parts, and modifications of their appendages [20]. As indicated in a study presented by [21]. showed that social aphids have different shapes that are genetically identical but morphologically different.

Mouthpart length

The results shown in figures (8 and 9) showed a discrepancy in the lengths of the mouth parts of the aphid samples studied from different governorates of Iraq. The highest length range was determined for samples taken from the governorates of Babel and Najaf, and Basra, which amounted to 0.51, 0.51, and 0.48 mm, respectively. While samples from the governorates of Kirkuk, Erbil, and Dohuk recorded the shortest range of lengths of the mouth parts, which amounted to 0.40, 0.40, and 0.40 mm, respectively. Alternatively, the shortest lengths of the mouthparts ranged between 0.37 and 0.15 mm for aphid samples taken from the governorates of Basra, Babel, Najaf, Dhi Qar, Wasit and Karbala. Here, we notice a clear discrepancy in the length of the mouthparts of the aphid, where the central and southern governorates were relatively longer than the aphids in the northern governorates. This is due to the thickness of the plant host's epidermis layer due to the formation of waxy layers and the presence of cilia to reduce water evaporation due to higher temperatures in these southern governorates compared to the northern governorates [22].

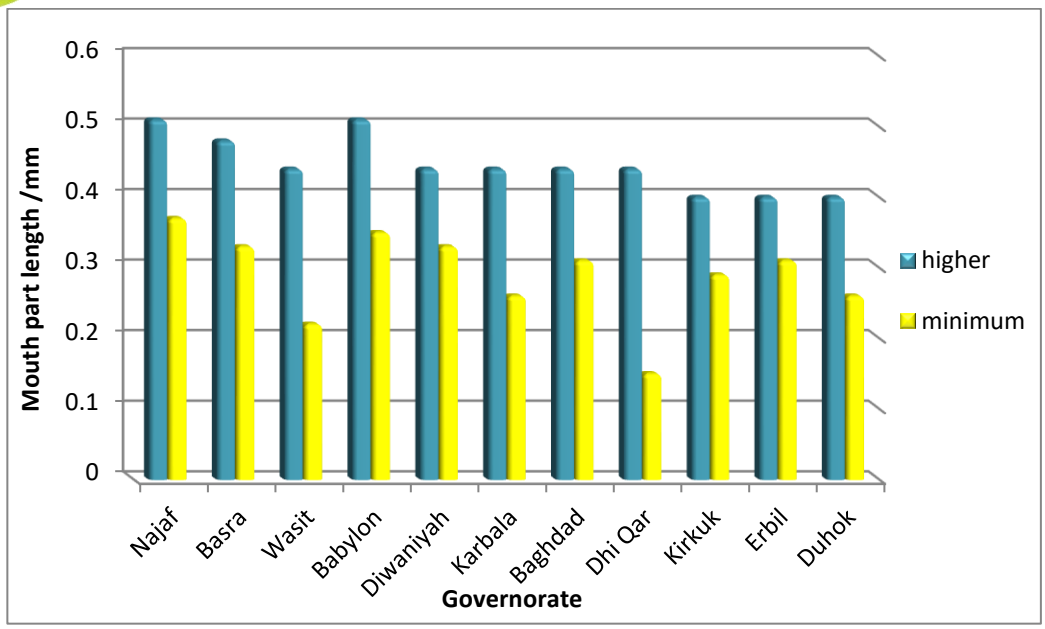


Figure (8): shows the extent of variation in the lengths of the mouth parts of the studied samples taken from several provinces in Iraq.

B	A

Figure (9): mouthparts length of a green peach aphid (A) Babylon province sample (B) Dhi Qar province sample, magnification (5x).

The results are consistent with [23]. in their study that Stomaphis Walker provides an example of very long mouthparts in aphids, with the blades longer than the body length [24],[25]. The very long mouthparts are adaptations due to the thickening of the phloem tissues of the plant host, in which aphid species feed on tree trunks [26],[27]. He detected that during feeding, the mouthparts of Stomaphis are shortened externally so that only the distal parts are visible while two parts are inserted into the body. This seems to be a very specific adaptation. It is known that the morphological characteristics of aphids are affected not only by the genotype [28]. but also by the environmental components [29]. the physiological state of the host plant, temperatures, and natural enemies [30].

Figure (10) provides a clear picture of the total body appendages of aphid insects with variation in body length, antennae length, femur length, and mouthpart length. They were reached through the study and were distinguished by samples from the governorates of Babylon, Erbil, Basra, and Najaf, respectively, compared with samples from other Iraqi governorates. This may be due to the difference in the environment and weather conditions of each governorate, which led to the emergence of this phenotypic variation, one of the insect's manifestations of adaptation.

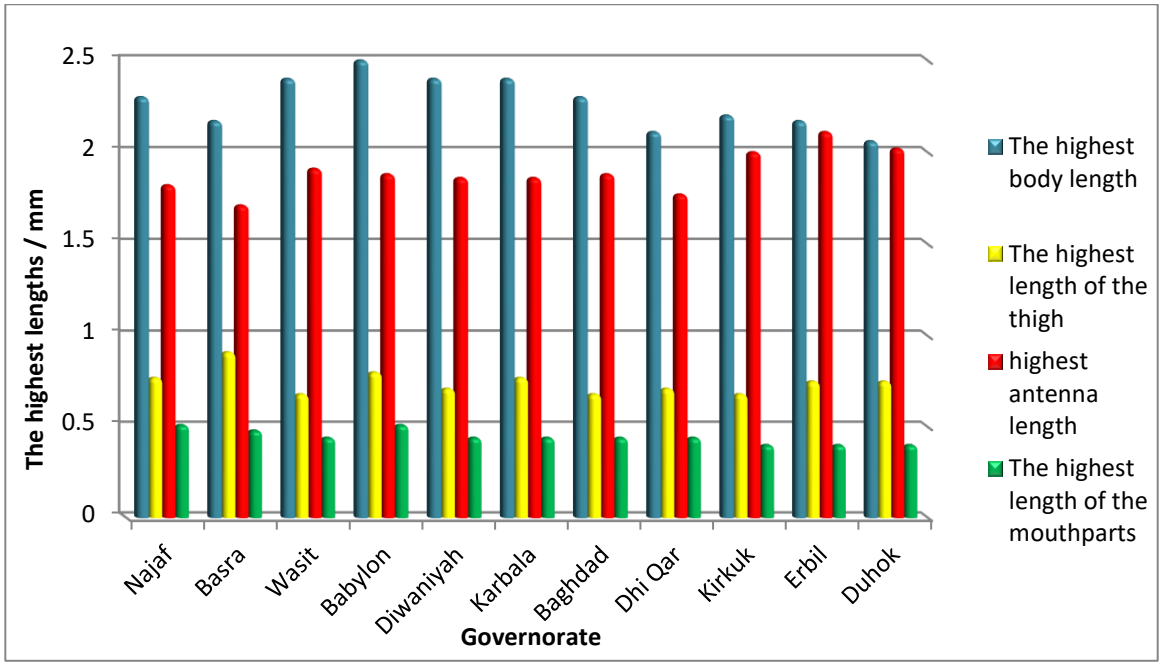


Figure (10): shows the extent of variation in the lengths of the body, antennae, femur length, and mouthpart length of the studied samples of *M. persicae* taken from several provinces in Iraq.

In conclusion, this study experienced the assumption that the morpho-functional basis for defensive behaviours related to specialized body parts using this species as a research model. Field observations were recorded, and a comprehensive morphometric analysis of the studied insects was performed.

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