Morphological characterization of some species of aphids belonging to the Aphididae family on some ornamental plants in Karbala Governorate

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Abstract

Given the importance of the aphid, its many species, the multiplicity of its families, and its rapid spread on ornamental plants in the Holy Governorate of Karbala City Iraq, this study was conducted and it aimed to diagnose some of the most important types of aphids belonging to the Aphididae family on ornamental plants in the Karbala Governorate. of the Aphididae family on ornamental plants in Karbala Governorate by selecting a group of nurseries distributed over six areas of the governorate, which comprised (the city center, Imam Aoun area, Al-Husseiniyah area, Al-Boubiyat area, Al-Har area and Al-Hindiya area). This study was conducted during the year 2023-2024 AD in one of the laboratories of the Plant Protection Department - College of Agriculture - University of Karbala. this study showed the presence of a large group of aphid colonies on ornamental plants, including the fine plum aphid (Hyalopterus pruni). This species was found on the Ruilia bretoniana plant. It is registered in Iraq The oat or bird cherry aphid (Rhopalosiphum padi) was found on the Damascus rose plant and was not recorded in Iraq. The black citrus or camellia aphid (Toxoptera auranti) was found on the African rose plant and was not recorded in Iraq. The hawthorn aphid (Dysaphis crataegi) was found on the Sanchezia plant. It is registered in Iraq ornamental plants in most nurseries.

Keywords: Aphids, Aphididae, Nurseries, Ornamental plants, Karbala.

Introduction

Ornamental plants are among the important plants that humans benefit from, such as medicinal plants, aromatic plants, wood, food, fiber, and others [1]. However, ornamental plants should be evaluated in botany on symbolic dimensions through the human relationship with these plants and away from a non-utilitarian perspective [2] . Ornamental plants are characterized by their important role in coordinating and beautifying public places, gardens, and playgrounds, them a popular hobby for society [3]. Interest in these plants has increased in our current era, Because of the wide spread of these plants and the ease of raising them, they have helped humans demonstrate their high capabilities in achieving creativity, the desire for entertainment, and enjoying

their beauty, among the basics of saving and multiplying them [4, 5]. These plants that have a close connection with cultural aspects due to their aesthetic value are nurseries. [6]. Insects are found in nurseries, including ornamental plants. although these insects have important roles in the ecosystem, some of them may cause great dangers to ornamental plants, affecting the growth and beauty of these plants through their exposure to insect pests that cause serious damage through feeding and transmitting pathogens [7]. to plants the aphid is one of the most common and important insects that infect plants in nurseries and outdoor environments [8].

Aphids belong to the Aphididae family and are one of the widespread insect groups that greatly affect ornamental plants through the damage they cause to host plants by feeding on plant juices and their toxic effect and transmitting pathogens by injecting their proboscis into plant tissues for feeding [9]. Some aphids feed on leaves, others target branches and twigs, others flowers and fruits, and others are found on the roots, causing various symptoms while feeding on plants, such as hindering growth or distorting and twisting the leaves of the plant, as well as leading to yellowing and stopping the growth of the plant [10]. Aphids also secrete honeydew, a sticky sugar, on plant leaves and branches [11] . Black sooty mold also grows on the honeydew, covering plant parts. It reduces the beauty of ornamental plants and the process of making food for plants [12] .

Aphids are characterized by their small size, depending on their life stages and types, and with soft bodies. They are among the insects characterized by piercing, absorbent mouthparts that enable them to absorb plant juices [13]. The aphid can be distinguished by its pear-shaped shape and the pair of short, tubular-shaped anthers on the back end of its body. Antennae of different lengths also characterize it, and its colors vary, including green, black, red, and purple [14]. Aphids are of many types and live on more than one plant host by spending part of their development on one plant and the other part on another plant [15]. Ornamental plants are infected with approximately 250 species of aphids, as this insect has undergone some adaptations through the multiplicity of plant hosts and is characterized by a complex life cycle that enjoys. It contains the types of these insects [16]. Its females can produce large numbers of individuals, reaching from 2 to 10 individuals per day and for short periods, although there is great variation between these species [17] . The aphid lays fertilized eggs during the cold winter to avoid unsuitable conditions for its growth, and these eggs hatch as spring approaches. Nymphs resemble adults but are smaller in size. These nymphs quickly mature into wingless females, and each individual of these females is responsible for forming a large colony of insects [18]. It produces new individuals without mating its reproduction is parthenogenetic, and continues to produce many wingless generations until this colony is completely populated. After that, the females work to produce winged generations, the latter of which migrate to other new plants to form new colonies, and so on, until the end of the summer, when these females produce males and females to They mate and lay fertilized eggs that spend the winter [19]. As for greenhouses and closed areas, aphids reproduce asexually, meaning that mothers

do not produce males [20]. It is unnecessary to produce eggs to spend the winter period because greenhouses have a constant temperature and are not affected by the cold of winter [21]. There are types of aphids. They are many, and it is difficult to generalize their external appearance due to their small size, as their length ranges from 1 to 6 mm, depending on the stages of their life, as well as the diversity of their types, as most of them are not covered with a waxy covering, Some are covered with white waxy threads, and some contain white spots or white waxy powder. [22]. There are few studies on the diversity of aphid species in Iraq [23, 24]

Materials and Methods

A diagnostic study was conducted for aphids on ornamental plants for six regions distributed in the Holy Governorate of Karbala (Imam Aoun region, Al-Husseiniyah region, City Center region, Al-Boubiyat region, Al-Harr region, and Al-Hindiyah region) (Table 1) . Two nurseries were identified for each of the six regions to conduct the study through inspection. Meticulous and periodic monitoring of ornamental plants distributed in nurseries, and the time of aphid appearance.

Table (1): Locations and coordinates of the areas of Karbala Governorate from which samples were collected for the study.

Area Name	Easting	Southing
Imam Aun Area	758 376 °32	938 170 °44
City Center Area	333 604 °32	002 037 °44
Al-Husseinia Area	270 637 °32	830 075 °44
Al-Bubiyat Area	190 635 °32	966 012 °44
Al-Hur Area	826 617 °32	820 005 44°
Al-Hindiya Area	670 532 °32	619 214 °44

Periodic visits were made to the nurseries that had been identified in advance, and a set of sticky traps was set up in each of the nurseries identified in the study to identify the time of the appearance of the winged aphids. Careful examination of these traps continued using a manual magnifying glass, where ornamental plants that had appeared infested with aphids were obtained. Parts of these infected plants were brought in plastic containers filled with bags filled with ice to protect these specimens from damage until a careful examination of the insects was carried out . These samples were brought to the laboratory in the Department of Plant Protection at the College of Agriculture, University of Karbala, and the aphids were isolated and frozen to kill and preserve their composition and color. Some were also preserved in small plastic containers

containing 70% alcohol. Information for each group was also added by writing the date of collection, the name of the area from which the samples were brought, the name of the nursery where the infection was found, and the name of the infected plant. It is permissible to write this information on a small label and stick it on each plastic container, As for the other group of models, some of them were dyed by loading them onto small pieces of cardboard after placing a few drops of glue on them. After that, the insect is placed on the drops of glue, and the information regarding the place of collection, the plant host, the date of collection, the name of the collection area, and the name of the nursery are mentioned below these models afterwards. The models are placed in a special box for storing the models, Some models are kept in the form of slides, where concave glass slides were used to avoid damage and deformation when placing the special glass cover for each slide after applying Canada balsam to preserve the model and prevent air from entering it.

The models were taken using (Binocular Dissecting Microscope) and (Compound Microscope) with magnification power (40 - 80X) to study and clarify the taxonomic characteristics of each type of aphid, including body color, length and shape of the antennae, spiny tubercles, open tubes, as well as the shape of the tail and the number of hairs on it, based on the taxonomic keys. The diagnosis of the models was also confirmed by the supervisor, Mr. Taha Musa. Muhammad Al-Suwaidi . Specimens were photographed and documented using a HONOR X9b 5G mobile phone camera mounted on the microscope with a dedicated adapter at 40X magnification. Ornamental plants infected with aphids in each nursery were also photographed using the same camera.

Results and Discussion

The taxonomic key found in the book Aphids of Herbaceous Plants and Shrubs in the world was adopted to classify the species of this insect, which was written by two scientists [25].

Hyalopterus pruni [26]

Mealy plum aphid

Hyalopterus amygdali [27]

Scientific names and botanical families in Iraq:

Ruellia brittoniana (Acanthaceae)(Fig.1)

Common names of infected plants:

Wild petunia , Mexican petunia , Prairie ruellia , Trumpet ruellia and Britton's ruellia (Fig .1)

Figure (1): Plants infested with Dandelion aphid Hyalopterus pruni (Geoffroy, 1762)

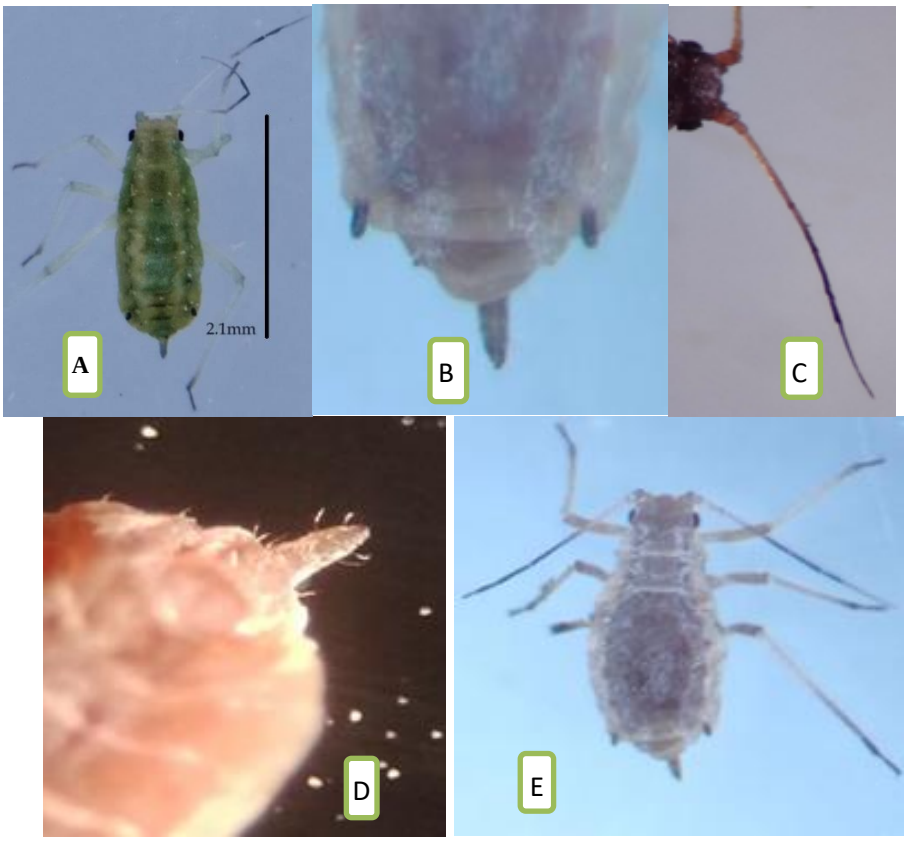

Figure (2): Taxonomic characteristics of Mealy plum *aphid Hyalopterus pruni* (Geoffroy, *1762)*

Taxonomic characteristics of aphids:

1. The body is pale green mottled with dark green and is covered with a white.waxy coating. Body.length between 1.5 to 2.6 mm. (Figure.2A) .

2. Siphunculi (SIPH) are pale or dark, thin, cylindrical, with a narrow base. (Figure 2B) .
3. The ratio,of Antennal (ANT VI) Base to processesوTerminals (PT) (ANT PT/BASE) 2.5 or more.(Figure 2C) .
4. Cauda.with 4–6 hairs (Figure 2D) .
5. Antennal flagellum (ANT III).without rhinaria. Siphunculi,(SIPH) (at least distally) and cauda'dusky/dark. SIPH not broad-based. Cauda'with 4–6 hairs. Abdominal tergites(ABD TERG) 1,and 7 always have (small) Marginal'tubercles (Mtu.)(Figure 2D,E) .
6. Siphunculi (SIPH) are very small, thin and.flangeless, less than 0.7× cauda (Figure 2B,E) .

This insect lays its near the bases of the flower buds during the winter period. The eggs hatch when these buds open, and the mature insects are wingless, for a period of 3-13 generations after that, during warm weather, adult winged insects appear and these winged insects move to herbs and other plants. As for the adult insects The wingless insects remain on the fruit trees, and when the fall season arrives, the adult winged insects return to the fruit trees to lay eggs again to spend the winter [28] These insects feed by sucking plant sap and secreting amounts of honeydew on the plant surfaces of host plants. A group of insects are attracted to them, which can negatively affect plant growth [29] .

Rhopalosiphum padi
Bird cherry - oat aphid, grain aphid
Scientific names and botanical families in Iraq:
Rosa damascena (Rosaceae)(Figure 3)
Common names of infected plants:
Damask rose , Attar of roses , Turkish rose , Rose of Castile , Rose otto , Kazanlik rose and Damask rose (Figure 3)

Figure (3): Plants infested with Dandelion aphid *Rhopalosiphum padi*

Figure (4): Taxonomic characteristics of oat aphid *Rhopalosiphum padi*

Taxonomic characteristics of aphids:

1.On Gramineae , it is broadly oval, green mottled yellowish green or olive green, or dark olive to greenish. Black, often with rust-colored patches around the bases of Siphunculi (SIPH) (Figure 4 A).

2.Body length (BL) 1.2–2.4 mm. (Figure 4A)

3.Siphunculi (SIPH) 0.12–0.14× BL, Siphunculi (SIPH) dusky/dark , almost cylindrical for most of the length or with slight swelling on distal half, with a marked subapical constriction and large flange. Hairs on abdominal tergites(ABD TERG) 7 and 8 are short , like those on more anterior tergites. (Figure 4B,D)

1.Cauda is dark and short and with similar pigmentation to Siphunculi (SIPH), which are slightly swollen distally .(Figure 4D)

2.The ratio of Antennal VI Base to processes terminals (ANT PT/BASE) 3.0–4.0 (Figure 4C) .

3.Small marginal tubercles (MTu) present only on abdominal tergites (ABD TERG) 1 and 7. (Figure 4F)

4.Hind tibia (HT II) with all hairs more spine-like and maximally 24–40µm. (Figure 4E)

5.Antennal 6 segmented - , Antennal VI (processes terminals PT) 1.2–1.9× antennal III (antennal flagellum). (Figure 4F)

6.Longest hairs on antennal III (antennal flagellum). Are shorter than the base diameter of antennal III (BD III). (Figure 4F).

The first documented discovery of the aphid Rhopalosiphum padi [30]. It is native to Europe, and has since spread throughout the world. Although its name refers to Prunus padus (bird cherry) as its primary host [31], the aphid uses various hosts, colonizing many plants and grasses. In the colder months, it overwinters where it deposits eggs On cherry trees, with the advent of spring, this disease attacks a wide range of plants, including major cereals, grasses, and ornamental plants [32] .

***Toxoptera auranti* (Boyer de Fonscolombe)**
Camellia aphid, Black citrus aphid, Tea aphid
Scientific names and botanical families in Iraq:
Osteospermum fruticosum (Asteraceae) (Fig.5).
Common names of infected plants:
Osteospermum, Freeway daisy , Transvaal daisy , Trailing African daisy , Blue-eyed daisy and Shrubby daisy bush (Figure 5) .

Figure (5): Plants infested with Dandelion aphid *Toxoptera auranti* (Boyer de Fonscolombe)

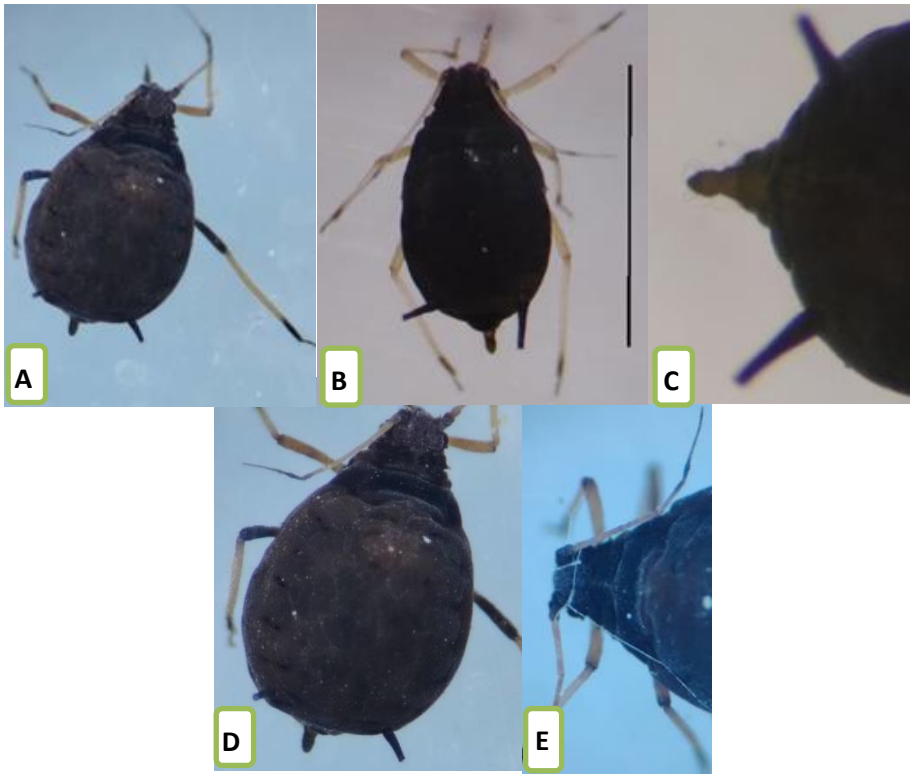

Figure (6): Taxonomic characteristics of camellia aphids *Toxoptera auranti* (Boyer de Fonscolombe)

Taxonomic characteristics of aphids:

1. Shiny reddish- brown, brown-black , or black, with black and white banded Antennal (ANT) and black Siphunculi (SIPH) and cauda. No sclerotic dorsal shield. (Fig.6A)
2. Body length (BL) 1.1 - 2.0 mm (Figure 6B)
3. Cauda with 10–26 hairs.(Figure 6C)
4. Siphunculi (SIPH) less than 1.5× cauda. Siphunculi (SIPH) tubular, dark, much longer than wide (Figure 6C)
5. Antennal tubercles weakly developed .(Figure 6D)
6. Sclerotic ridges on abdominal tergites (ABD TERG) 5 and 6 and a row of short, peg-like hairs on each hind tibia (HT11). (Figure 6E)
7. Antennae 6 is segmented,with the ratio of Antennal V1 Base to processes terminals (ANT PT/BASE) 3.5–5.0 .(Figure 6D,E)
8. Abdominal tergites (ABD TERG) 7 without long processes. (Figure 6E)

Known as black citrus or brown citrus. An insect that sucks plant juices from a plant. The insect can also feed on more than 150 species of plants. This insect is black in color and is one of the unique types of aphids that can produce audible sounds [33]. This type is unique from other types of aphids in that it produces an audible scraping

sound resulting from movements. The rhythmicity of the colonies. In one of the recordings, the aphids were shown to move 15 times within 21 seconds. The average period was calculated as (1-4) seconds between emissions, and this rate continued for nearly a full hour. The frequency range was clear at 4-6 kHz and the last 1-800 kHz and possibly The presence of an ultrasonic range is thought to function as a defense mechanism or means of communication between species [34]. Their life cycle is less complex than the life cycle of most aphids, as it was observed in Japan that there is no sexual cycle in the fall, which leads to the absence of males and eggs. All individuals are female and reproduce parthenogenetically throughout the year. As seen in Africa, the host range expands. The insect is not limited to citrus fruits but also tends to feed on pink plants [35].

Dysaphis crataegi [36]

Hawthorn-carrot aphid

Scientific names and botanical families in Iraq:

1. *Sanchezia* (Acanthaceae)(Fig .7A) .
2. *Amaryllis belladonna* (Amaryllidaceae) (Fig . 7B).

Common names of infected plants:

1. Tongue plant ,Butterfly plant ,Wax plant , Sanchezia plant , Bird-of-paradise plant , Firecracker plant and Prayer plant (Fig .7) .

Amaryllis , Elephant candle , winter's Flower , Eid flower and Lily flower (Fig .7B)

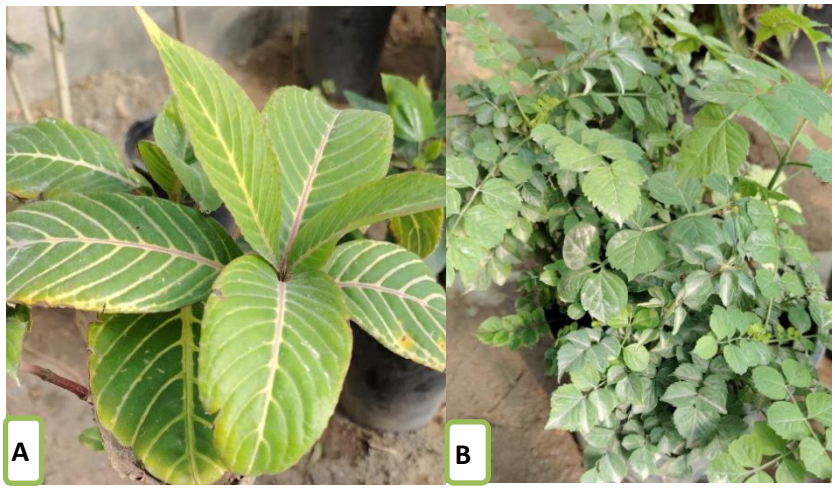

Figure (7): Plants infested with carrot aphid *Dysaphis crataegi* (Kaltenbach 1843)
A. *Sanchezia* B. *Amaryllis belladonna*

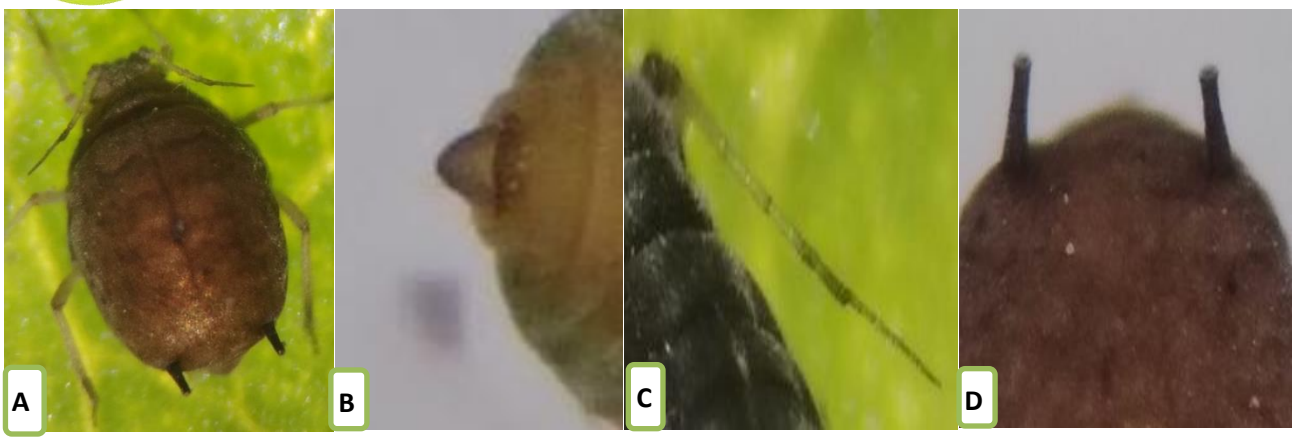

Figure (6): Taxonomic characteristics of hawthorn aphids *Dysaphis crataegi* (Kaltenbach 1843)

Taxonomic characteristics of aphids:

1. The body is pale yellow, greenish, or gray to bluish-gray.(Fig . 8A)
2. The tail is helmet-shaped and not longer than its basal width in dorsal view. (Fig .8B)
3. Dome-shaped aerial tubercles elongated on the ventral ridges.(Fig .8A)
4. The longest hair on the third antennal ring does not exceed the diameter of the base of the third antennal ring. (Fig .8C) .
5. The Siphunculi (SIPH) is tubular and usually transparent or brown. (Fig .8D).

The German scientist [37] described a hawthorn insect first. This insect spends the winter period on the primary host, hawthorn trees, and migrates to the secondary host during the summer period and works to produce offspring. When the nymphs mature and become adults, they produce new, unchanged offspring [38] . Winged, and when the numbers crowd together, it works to produce new winged individuals so that the latter can move to new hosts. However, in late summer, the females work to produce males in addition to the females, which are winged and migrate to hawthorn trees [39].

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