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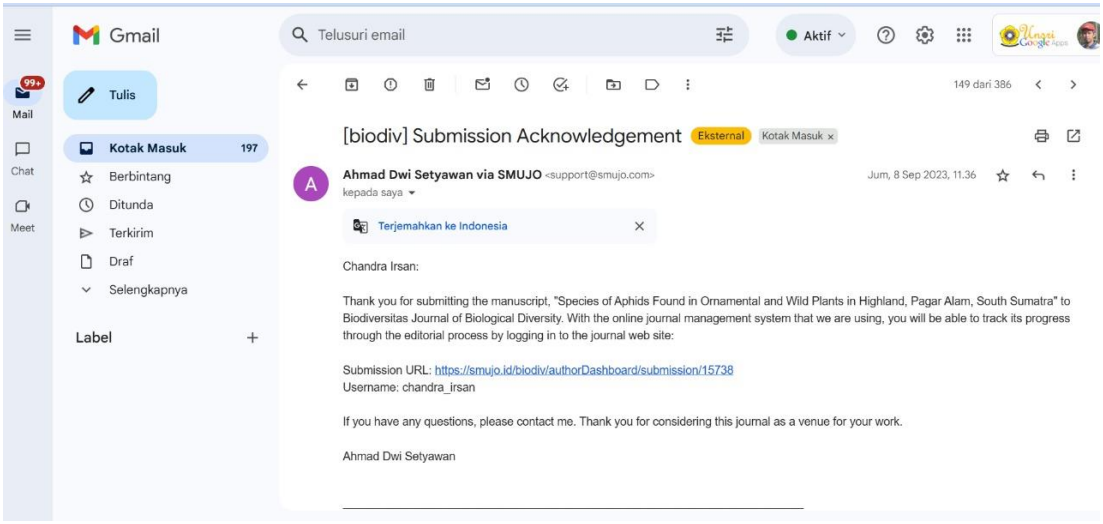

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**Title:**

**Species of Aphids Found in Ornamental and Wild Plants in Highland, Pagar Alam, South Sumatra**

**Author(s) name:**

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☐ Biodiversitas Journal of Biological Diversity

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This paper described the alternative host of aphids in high land, South Sumatera. The knowledge regarding the alternative of insect pest could be beneficial resource for basic control of aphids.

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**Place and date:**

Palembang, 5 October 2023

**Sincerely yours,**
(fill in your name, no need scanned autograph)

Dr. Chandra Irsan

# Species of Aphids Found in Ornamental and Wild Plants in Highland, Pagar Alam, South Sumatra

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**Abstract**

Aphids are one of the crucial pests in the tropical and sub-tropical regions. The presence of aphids in a plant can be very detrimental due to their role as vectors. Aphids exhibit species diversity, but not much information has been reported about the species diversity of aphids associated with essential crops such as ornamental plants. Furthermore, many aphid species were found on plants that were not actually hosts such as wild plants. Therefore, this study reported the species of aphids found in ornamental plants and the wild plants. This study revealed that 15 species of aphids were found in Pagaralam, namely *Aphis gossypii, Uroleucon* sp., *Toxoptera odinae, Macrosiphum rosae, Aphis citricola, Aphis craccivora, Toxoptera aurantii, Pentalonia nigronervosa, Hystenura* sp., *Aphis glycine, Greenidae* sp., *Rhopalosiphum padi, Rhopalosiphum maidis, Hyperomyzus* sp. *Lipaphis erysimi.*

**Keywords**: aphids, ornamental plants, wild plants

**Running title:** Aphids Found in Ornamental and Wild Plants

## INTRODUCTION

Aphids are one of the crucial pests in the tropics and sub-tropics, exhibiting various polyphagous, oligophagous, and monophagous characteristics (Kennedy & Stroyan, 1959). One species of aphids can host more than 400 species from 40 families (Bass et al., 2014). In addition to pests, aphids can also be vectors of plant viral diseases (Gadhave et al., 2020). Aphids can transmit 275 viruses (Ertunc, 2020). In tropical areas, aphids can always be found throughout the year due to their parthenogenetic nature of reproduction (Blackman & Eastop, 2017). Aphids consume young leaves sap, which can deplete essential nutrients for healthy growth (Cao et al., 2018). Moreover, when aphids transmit viral diseases from one plant to another, this can further weaken and stunt the growth of infected plants (Jones, 2022). According to Kinley et al. (2021), aphids cause yield losses directly (35 - 40%) by sucking the plant sap or indirectly (20 - 80%) through viral transmission. Therefore, aphid infestations can can have adverse effects on crop yields and overall plant health (Sarwan Kumar, 2019).

Due to their function as vectors, the presence of aphids on a plant can be highly damaging (Jaouannet et al., 2014). They feed by piercing the plant's tissues and consuming its sap, which can reduce the plant's growth and productivity, ultimately leading to weakness and possible death (Chandel et al., 2022). Additionally, as vectors, aphids can transmit a variety of plant diseases. They are as carriers for various plant viruses, and when they move from infected to healthy plants, these viruses can rapidly spread and cause extensive damage (Guo et al., 2019). In addition, the honeydew that aphids secrete can lead to the growth of sooty mold, a black fungus that can prevent sunlight from reaching the plant's leaves, thereby impairing photosynthesis, the process by which plants produce food (Singh & Singh, 2021). Therefore, it is crucial to control aphid populations in gardens and crops.

Understanding the species diversity of aphids is fundamental to effective aphid control, as it facilitates the development of measures to keep their populations in check. In addition, understanding the diversity of aphid species can provide valuable insights into potential plant diseases, as different aphid species carry distinct viruses. Methods used to control aphids often encompass various techniques, including the use of natural enemies such as predators (like ladybugs, lacewings, and parasitic wasps) (Singh & Singh, 2021; Völkl et al., 2023), parasitoids (Boivin et al., 2012), entomopathogens (Hullé et al., 2020), the use of essential oils as botanical pesticides to control aphids (Ikbal & Pavela, 2019), and crop rotation techniques (Degani et al., 2019). Regular monitoring of aphid populations and diversity can help in detecting when population sizes may be reaching harmful levels, allowing for prompt implementation of the necessary countermeasures.

Many aphid species were found on plants that were not their actual hosts (Peccoud et al., 2010). Aphids have one or more secondary, or "alternative," host plants in addition to their primary host plants, which are the types of plants they feed on most frequently (Clarke et al., 2020). An alternative host can also be a collateral host belonging to the same plant family as the primary host, helping crop pests to survive when the primary hosts are unavailable (Kumar et al., 2021). These secondary hosts may offer less adequate nutrition for insects (Mo & Smilanich, 2023), However, they may provide a means of survival when primary hosts are unavailable, during certain seasons, or under certain environmental conditions (Kumar et al., 2021). According to Liu et al. (2017), since hibiscus serves as an overwintering host for cotton-specialized aphids but not for cucurbit-specialized aphids, it is evident that host-specialized aphids have refuges during times of food shortage. The life cycles of numerous aphid species exhibit such complexity (Jousselin et al., 2010). They maintain a cycle of host alternation, shifting between their primary hosts (typically a woody plant) and secondary hosts (often herbaceous plants) (Yamamoto et al., 2020). Weeds pose a continuous threat in both cropped and non–crop areas, providing food, shelter and reproductive sites for various pest organisms (Kumar et al., 2021). This indicates that weeds can serve as alternative hosts for aphids.

A study of aphid species on horticultural plants has been conducted (Maharani et al., 2018), However, information about aphid species on ornamental and wild plants has not received as much attention and remains largely unexplored. In South Sumatra, particularly in the highland areas like Pagar Alam, there are numerous ornamental and native plants. The research on the diversity of aphid species in ornamental and wild plants has received little attention. Therefore, this study was conducted in Pagar Alam, a highland region of South Sumatra, with the aim of obtaining information on the diversity of aphid species found in ornamental and wild plants. The findings from this study can serve as a valuable resource for aphid management.

## MATERIALS AND METHODS

The field research employed a purposive and direct observation approach to inventory cultivated or wild plants hosting aphids and collecting aphids. The plant selection process included cultivated plants encompassing fruit, vegetable, and ornamental varieties, as well as wild plants or weeds. The collection and identification of host plants, aphids, and their natural enemies involved systematic searches for the selected plants and subsequent examination for the presence of aphids. Observations were made to all existing plant species to find those colonized by aphids. Any plants colonized by aphids were documented as aphid hosts. Aphids, along with their natural enemies within the aphid colonies, were systematically collected. All components of the collected observations were then identified.

Aphid identification was conducted using identification keys (Blackman & Eastop, 2008). Identification of aphid species took place in the Laboratory of Entomology, Faculty of Agriculture, Universitas Sriwijaya. Identification relied on morphological characteristics. The host plants were identified using weed identification hand book (Kallas, 2010;

Meuninck, 2023; Naidu, 2012). The location and size of aphid colonies, morphology of aphids including their shape and color, as well as any symptoms observed in the host plants were recorded, and photographs of the aphid colonies and their host plants were taken.

## RESULT AND DISCUSSION

### Result

The results showed that 15 aphid species were found in Pagaralam, namely *Aphis gossypii*, *Uroleucon* sp., *Toxoptera odinae*, *Macrosiphum rosae*, *Aphis citricola*, *Aphis craccivora*, *Toxoptera aurantii*, *Pentalonia nigronervosa*, *Hystenura* sp., *Aphis glycine*, *Greenidae* sp., *Rhopalosiphum padi*, *Rhopalosiphum maidis*, *Hyperomyzus* sp. *Lipapis erysimi*. Based on the observation, these aphids were found on various ornamental plants (Table 1). The primary colony locations were generally in flowers, and this study documented these colony locations in ornamental plants (Figure 1).

Table 1: Aphid species found in ornamental plants and their colony locations.

| No | Host Plant | Aphid Species | Colony location |
|---|---|---|---|
| 1 | *Aster alpinus* | *Sitobion luteum* | flower |
| 2 | *Brugmansia suaviolens* | *Aulacorthum solani*<br>*Neomyzus circumflexus*<br>*Myzus persicae* | flower |
| 3 | *Caladium* sp. | *Pentalonia* sp | flower |
| 4 | *Cananga odoratum* | *Aphis gossypii* | flower |
| 5 | *Canna indica* | *Pentalonia nigronervosa* | flower |
| 6 | *Catharanthus roseus* | *Aphis citricola* | flower |
| 7 | *Cestrum* sp. | *Aphis gossypii*<br>*Neomyzus circumflexus* | flower |
| 8 | *Clitoria ternatea* | *Aphis craccivora* | flower |
| 9 | *Cosmos caudatus* | *Uroleucon* sp. | flower |
| 10 | *Dahlia Kelvin* | *Aphis gossypii* | flower |
| 11 | *Dendrobium* sp. | *Sinemogoura citricola* | flower |
| 12 | *Duranta* sp. | *Aphis gossypii* | flower |
| 13 | *Helianthus* sp. | *Aphis glycines*<br>*Hyperomyzus* sp. | flower |
| 14 | *Hibiscus rosasinensis* | *Aphis gossypii* | flower |
| 15 | *Ixora paludosa* | *Aphis gossypii,*<br>*Toxoptera aurantii* | flower |
| 16 | *Ixora* sp. | *Aphis citricola*<br>*Aphis gossypii*<br>*Toxoptera aurantii* | flower |
| 17 | *Murraya paniculata* | *Aphis craccivora*<br>*Toxoptera citricidus* | flower |
| 18 | *Mussaenda frondosa* | *Aphis citricola*<br>*Toxoptera odinae* | flower |
| 19 | *Rosa indica* | *Macrosiphum rosae* | flower |
| 20 | *Spondiras dulcssoland* | *Aphis citricola*<br>*Hysteroneura setariae* | flower |


Fig 1. The location of aphid colonization on various plant parts. a) *A. gossypii* in *D. Kelvin* flower b) *A. gossypii* in *H. rosasinensis* flower c) *A. gossypii* in tuberose flower, d) *A. craccivora* in *Clitoria ternatea* flower, e) *A citricola* in *Helianthus* sp., f) *A. aurantii* on the *M. paniculata* flower, g) *T. odinae* in the *S. dulcssoland*, h) *Uroleucon* sp. in chrysanthemums, i) *Macrosiphum rosae* in *R. indica* flower, j) *Pentalonia nigronervosa* in *C. indica* leaves

In addition, this study documented the presence of weeds, which might serve as alternative hosts for aphids (Table 2). The location of aphid colonies also varied, namely on flowers, stalks, plant tops, young leaves and old leaves of wild plants (Figure 2). The presence of specific plants or host plants within a habitat influenced the types of aphids found. Many aphid species are found on a broad range of plants or host plants, while others are highly specialized and are only found on specific plants or host plants. This is closely related to the polyphagous, oligophagous or monophagous nature of aphids (Blackman & Eastop 2000).

Table 2: Species of aphids found in wild plants and their colony locations.

| No | Host Plant | Aphid species | Colony location |
|---|---|---|---|
| 1 | *Ageratum conyzoides* | *Aphis gossypii* | Shoots, young leaves, old leaves, flowers |
| 2 | *Alternanthera philoxeroides* | *Aphis gossypii* | Shoots, buds |
| 3 | *Alternanthera sessilis* | *Aphis gossypii* | Shoots, buds |
| 4 | *Amaranthus gracilis* | *Aphis craccivora* | Flowers, shoots, young leaves, old leaves |
| 5 | *Blumea lacera* | *Lipaphis erysimi* | Flowers, shoots, and buds |
| 6 | *Croton hirtus* | *Aphis gossypii* | Flowers, shoots, young leaves, old leaves, young twigs |
| 7 | *Cynodon dactylon* | *Schizaphis rotundiventris* | Flower, flower stalks |
| 8 | *Cyperus rotundus* | *Schizaphis rotundiventris* | Flower, flower stalks, leaf axils |
| 9 | *Cyperus compressus* | *Schizaphis rotundiventris* | Flower, flower stalks, leaf axils |
| 10 | *Digitaria ciliaris* | *Hystroneura setariae* | Flower, flower stalks |
| 11 | *Echinocloa crussgali* | *Hiperomyzus* sp. | Young leaves, old leaves |
| 12 | *Ecliptica prostrata* | *Aphis gossypii* | Shoots, young leaves |
| 13 | *Eleusin indica* | *Hysteroneura setariae*<br>*Rhopalosiphum maidis* | Flower, flower stalks, leaf axils |
| 14 | *Emilia sonchifolia* | *Aphis gossypii* | Flower, flower stalks, shoots |
| 15 | *Eragrostis tenella* | *Hysteroneura setariae* | Flower, flower stalks, seeds |
| 16 | *Euphorbia hirta* | *Aphis gossypii* | Young leaves, old leaves |
| 17 | *Eupotarium odoratum* | *Aphis gossypii,*<br>*Aphis glycine* | Young leaves, old leaves, young twigs |
| 18 | *Hymenochera acutigluma* | *Hysteroneura setariae* | Flowers, flower stalks, leaf axils |
| 19 | *Lagerstromea* Sp. | *Greenidea* sp. | Young leaves |
| 20 | *Lophatherum gracile* | *Hysteroneura setariae*<br>*Rhopalosiphum maidis* | Young leaves, old leaves, leaf axils |
| 21 | *Melastoma affine* | *Aphis gossypii* | Shoots, young leaves |
| 22 | *Mikania mikranta* | *Aphis gossypii*<br>*Aphis glycine* | Shoots, young leaves, old leaves |
| 23 | *Mimosa invisa* | *Aphis craccivora* | Shoots, pods |
| 24 | *Mimosa pudica* | *Aphis craccivora* | Shoots, pods, flowers |
| 25 | *Mimosa vigra* | *Aphis craccivora* | Shoots, pods |
| 26 | *Oryza rufipogon* | *Rhopalosiphum padi,*<br>*Rhopalosiphum maidis* | Old leaves, young leaves (pupus), leaf axils |
| 27 | *Oxonopus compressus* | *Hysteroneura setariae* | Flower, flower stalk, leaf axils |
| 28 | *Paspalum conjugatum* | *Hysteroneura setariae* | Flower, flower stalk, seeds |
| 29 | *Phylanthus neruri* | *Aphis citricola* | Shoot, young leaves, old leaves, young twigs petioles |
| 30 | *Portulaca oleraceae* | *Aphis craccivora* | Shoots, young leaves, flower |
| 31 | *Physalis angulata* | *Aphis craccivora,*<br>*A. gossypii* | Shoots, young leaves, old leaves |
| 32 | *Rorippa indica* | *Lipapis erysimi* | Flower, fruit, shoots, young leaves |
| 33 | *Sida rhombifolia* | *Aphis gossypii* | Shoots, young leaves, old leaves, fruit/seeds |
| 34 | *Sonchus arventris* | *Lipapis erysimi* | Young leaves, fruit stalks, flower, fruit |

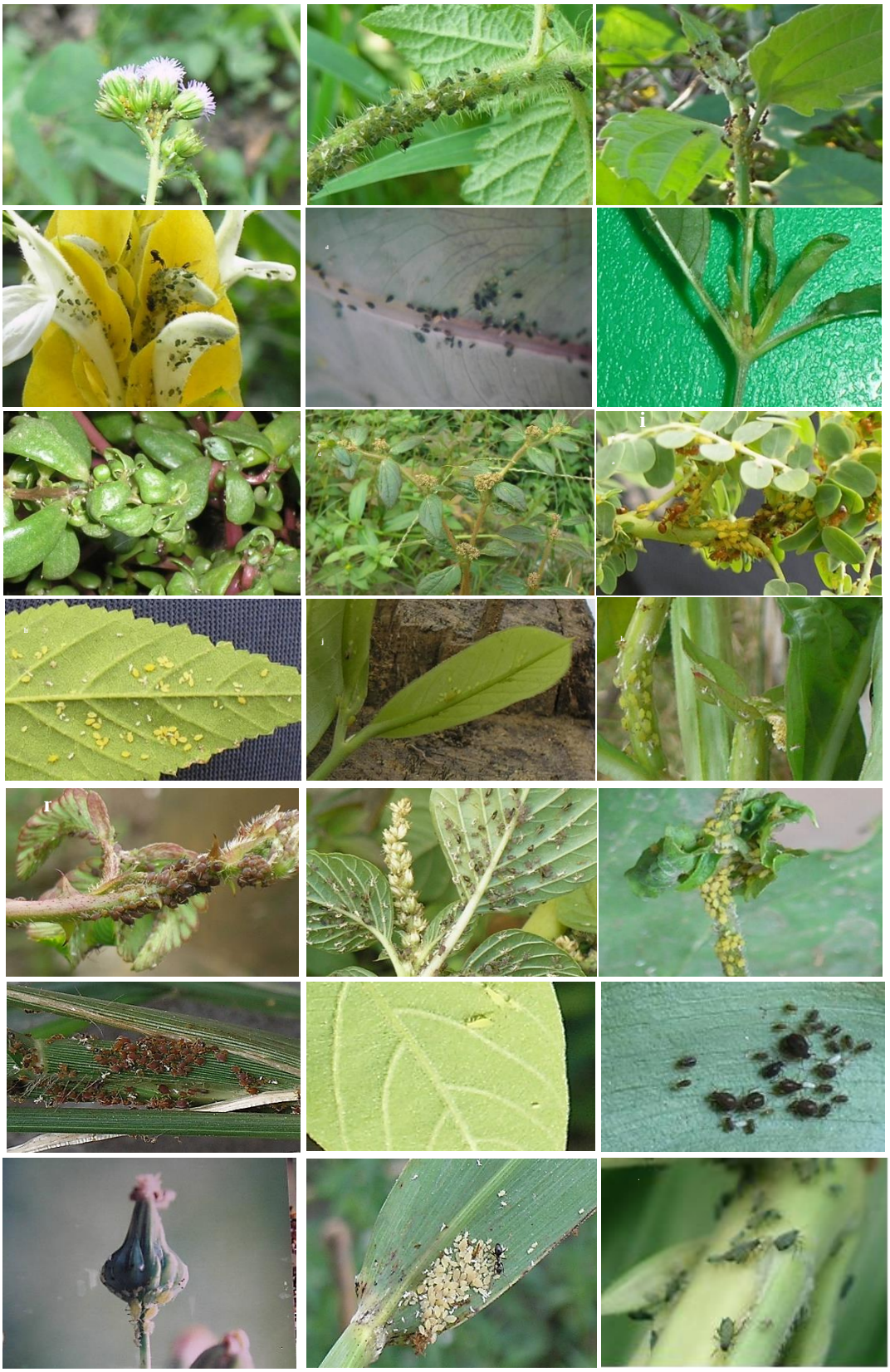

Figure 2. Aphids found on wild plants a) *A. gossypii* on the weed *Ageratum conyzoides, b) A. gossypii* on Croton weed *hirtus c) A. gossypii* on the weed *Eupatorium odoratum, d) A.gossypii* on plants *Pachystochys* sp., *e) A.gossypii* on plants *Caladium* sp., *f) A. gossypii* on the weed *Alternanthera sessilis, g) A.gossypii* in *Portulaca oleraceae weeds, h) A.gossypii* on the weed *Euphorbia hirta, i) A. citricola* on the weed *Phylantus nerruri, j) A. citricola on Sida rhombifolia* weed, k) *A. citricola* on plants *Annona muricata, l) A.citricola* on the weed *Ludwigia peruviana, m) A. craccivora on Mimosa pudica* weed, n) *A.craccivora* on weeds *Amaranthus gracilis, o) A. glycine* in *Mikania micranta weed, p) Hysteneura* sp. in *Eleusin weeds, q) Greenidae* sp. in kenidai trees (shrubs) *indica, r)Hyperomyzus* sp. in *Echinocloa crusgali Weed, s) L. erysimi* on weed *sonchus arventris, t) Rhopalosiphum rice* on the weed *Oryza rufipogon, u)Rhopalosiphum Maidis* on the weed *Oryza rufipogon.*

## Discussion

The plant species or host plant influences the distribution of aphids. There are aphid species that can be found on a wide range of host plants, which is closely related to the polyphagous nature of aphids, allowing them to colonize many different species of host plants. Host plants can also affect the distribution of aphids, as evidenced by the presence of aphid species exclusively found on certain host plants (Peccoud et al., 2010). But there are some species of aphids found only on one particular host and are not found on other host plants (Döring, 2014). *A. gossypii*, and *Aphis aurantii* have been found on many host plants because both aphids are classified as polyphagous aphids (Margaritopoulos et al., 2006; Alotaibi et al., 2023).

Aphids can commonly be found infesting a variety of ornamental plants. They are attracted to these plants due to the rich nutrient content in the plant sap (Wäckers & Van Rijn, 2012). In this present study, some aphid species were found on some ornamental plants in Pagaralam. The location of aphid colonization on the plants varied. On *Adiantum predatum* plants, aphids formed colonies on young leaf stalks and on newly emerging leaves. The aphids displayed brown and black coloration. The aphid colonies found were small, and the colonized plant parts showed no signs of disease. The identification results showed that the aphids were *Neotoxoptera* sp., and notably, they were not associated with ants. On *Aster alpinus*, aphids were found to form colonies on the stems or young leaf shoots, and the colonies were relatively large. The color of the aphids was dark brown to black. The colonized plant parts showed symptoms of stunting. The identification results showed that the aphids were *Uroleucon* sp., and they were associated with ants.

On the *Brugmansia suaviolens* (angel's trumpet), *M. persicae* were found on the undersides of old leaves or leaves that have started to turn yellow. The colonies were relatively small. The aphids found were green and large bodies. The colonized plant parts did not show any signs of disease. On *Caladium* sp. (taro) was found one species of aphids: *A. gossypii*. The aphids formed colonies under the surface of young and older leaves. The occupied leaf areas did not display severe symptoms. The aphids were yellow green to dark green. The wingless adult aphids often had a white, flour-like appearance on their bodies. On the *Cananga odoratum* (ylang-ylang), colonies of *T. aurantii* were found on the undersides of the leaves, the shoots, buds, and unopened flower petals. The *T. aurantii* colonies found were relatively large. Colonized parts, especially shoots, showed signs of stunting. The aphids found were brown to black in color. The colonies of *T. aurantii* were found to be associated with black ants.

Aphids on *C. indica* (Indian shot, African arrowroot) were found to form colonies in the leaf axils and under the leaf surface near the leaf base. The colonies were quite large. The aphids were dark brown to dark red coloring with a medium-sized body. The identification results showed that the aphids were *P. nigronervosa.* The colonies of *P. nigronervosa* were found to be associated with ants. In the *Catharanthus roseus* (periwinkle), *A. citricola* aphids were found. The aphids were yellow-green, sifunculi, and black cauda. The aphids formed colonies on flowers and shoots, and the colonized plant parts did not show any symptoms of disease. On *Cestrum* sp. (Bastard jasmine), aphids formed colonies on the undersides of young leaves, shoots, and within flower parts, especially between petals or flower stalks that had not fully bloomed. The colonies were quite large. The body color of aphids was green to dark green with small to medium-sized bodies. The colonized plant parts, especially leaves, showed stunting symptoms. The identification results showed that the aphids were *A. gossypii.* The aphid colonies found were consistently associated with ants.

Aphids on *Clitoria ternatea* were found to form colonies on flower parts, flower crowns, stems and young leaves. The aphids were brown to black in color. Colonized plant parts, especially shoots and young leaves, showed stunting symptoms. The identification results showed that the aphids were *A. craccivora.* These colonies were consistently associated with ants. On the plant *Cosmos caudatus*, aphids were found on the flower petals. The colonies were not very

large. The body color was green and light green. The identification results showed that the aphids were *A. gossypii*, and they were also associated with ants. The aphids on the *Dahlia kelvin plant* formed colonies on unopened flower buds, with a significant population among the blooming petals. The body color was green to dark green. The identification results showed that the aphids were *A. gossypii*. Aphids on *Datura metel* (amethyst) were found to form colonies on the undersides of old leaves. The aphids were medium sized with a green body color. The colonized plant parts did not show any symptoms of disease. The identification results showed that the aphids were *Myzus ornatus.* The aphid colonies were not associated with ants. Within *Dendrobium* sp., aphid colonies were found on the young leaves. The aphids were yellow, green to dark green. The colonized plants did not show any disease symptoms. The identification results showed that the aphids were *A. gossypii*, and they were associated with ants. On *Duranta* sp. (bonsai), colonies of aphids were located on the undersides of young leaves. The colonized plant parts showed stunting symptoms. The colonies were very large. The aphids were green in color. The identification results showed that the aphids were *A. gossypii.* The aphid colonies were consistently associated with ants.

On the *Helianthus annuus* (sunflower) plants, aphid colonies were found between the flower petals. The colonized flowers, especially the crowns, exhibited a tendency to fall off easily. The aphids were green and yellow in color. The colonies were small. The identification results showed that the aphids were *A. gossypii*. These aphid colonies were associated with ants. Aphid colonies on *Helianthus* sp. were found on the undersides of old leaves. These colonies were small in size. The aphids were green with a medium body size. The colonized plant parts did not show any disease symptoms. The identification results showed that the aphids were *M. ornatus.* The aphid colonies were not associated with ants. Within the colonies, mummified aphids that were parasitized by Aphidiidae were found.

On the *Hibiscus rosa-sinensis*, aphids ranging in color from yellow to dark green were found. The aphids formed colonies on flower buds, unopened flower crowns, and the undersides of aging leaves. The colonies grew to be very large. The identification results showed that the aphids were *A. gossypii.* The aphid colonies were consistently associated with ants. Two types of aphids were found on the flowering plant *Ixora paludosa.* First, the aphids formed colonies on the undersides of young leaves that were still red or light green and sometimes on flower stalks that had not yet bloomed. The occupied plant parts showed symptoms such as stunted leaf growth, leaf shrinkage, necrotic spots on the leaf surface, and slightly downward-curved leaf edges. The upper leaf surface looked wet and sticky, similar to sugar. The aphids had yellow, green, or slightly dark green bodies, with some wingless adults having a powdery white upper surface. The identification results showed that the aphids were *A. gossypii*, and they were almost always associated with ants. The second type of aphids on *Ixora paludosa* formed colonies under the surface of young and older leaves. The colonies could also be found on newly emerging flowers and leaves. The plant parts occupied by these aphids did not show obvious signs of illness. These aphids were dark red to black, with once-branched stigma and venation in their black wings. The identification results showed that the aphids were *T. aurantii*. These aphids were also associated with ants.

In *Ixora* sp. flower plants, two forms of aphids were discovered. These aphids occupied the shoots, young leaves and unopened flowers. The affected plant parts did not show obvious symptoms. The aphids exhibited colors ranging from yellow and green to a slightly darker green. Sometimes the upper surface of the wingless imago's body appeared white, resembling flour. The identification results showed that these aphids were *A. gossypii.* These aphid colonies were almost always associated with ants. Another species of aphids was founded and formed colonies on flower stalks that had not yet bloomed and on newly emerging shoots or leaves. The presence of these aphids on the plant did not induce any symptoms of plant disease. The aphids were yellow or yellow green, with black cauda and siphunculi. Their bodies were very small

to small. The identification results showed that the aphids were *A. citricola*. The colonies of *A. citricola* were also frequently found in association with ants.

Two types of aphids were found on *Mussaenda frondos,* each forming colonies in different locations. The first type formed colonies on young leaves, shoots, and flowers. The plant parts they occupied showed no obvious disease symptoms. The aphids were yellow, green, and some with dark green. The identification results showed that the aphids were *A. gossypii*. The second type of aphids formed colonies on the stems or young twigs, appearing densely clustered as if piled up. The aphid colonies could also be found on young leaves, shoots and within flower parts. The plant parts they infested showed no signs of diseases. The aphids were yellow or yellow green, with black cauda and siphunculi. They had tiny to small bodies. The identification results showed that the aphids were *A. citricola*.

The results showed that 34 species of wild plants, including weeds, were growing in the yard colonized by aphids. This indicated that multiple species of aphids colonized various host plants. The aphid species colonizing these plants were generally consistent within the same taxon. *Ageratum conyzoides* was infested by *Aphis gossypii*. These aphids formed colonies on the flower sections, shoots, lower surfaces of young leaves, or leaves turning yellow. The aphids were green, yellow-green to dark green, often forming large colonies. *Alternanthera philoxeroides* or alligator grass was also colonized by *Aphis gossypii. S*mall colonies were found on shoots or stems. These aphids had small bodies and were green, ranging from yellow-green to dark green. *Alternanthera sessilis* was colonized by *Aphis gossypii,* forming colonies on shoots, flowers, and fruit. The colonies were typically large, and they were often associated with tiny brown ants. *Amaranthus gracilis* was infested by *Aphis craccivora.* These aphids established colonies on shoots, flowers and young and old leaves. They were dark brown to black in color, with shiny black wingless imagoes. Colonies of these aphids were associated with both black and red ants. *Blumea lacera* was colonized by *Lipaphis erysimi aphids.* These aphids were bright green, and of medium size. The colonies formed on flowers, flower stalks and the undersides of the leaves at the top. The aphid colonies were not associated with ants. *Croton hirtus or fire* grass was infested by *Aphis gossypii.* The aphids were yellow-green to dark green. The colonies were found on the stems, leaves, buds and flowers, often forming large colonies. *Cynodon dactylon* or Bermuda grass was colonized by *Schizaphis rotundiventris.* The aphids colonized the flowers, flower stalks and sometimes in the leaf axils of the plant. Small colonies were formed. The aphids were brown to red-brown. They were associated with ants. *Cyperus rotundus* or nut grass was infested by *Schizaphis rotundiventris* aphids. The colonies were found on flower stalks, flowers, and leaf axils. The colonies were quite large and associated with both black and red ants. The aphids were dark brown in color. *Cyperus compressus* or grass puzzle was colonized by *Schizaphis rotundiventris* aphids, forming colonies in the flowers, flower stalks and sometimes in the axils and leaves of the shoots or buds. Small colonies were observed. *Digitaria ciliaris* was infested by *Hysteroneura setariae* aphids, with small colonies scattered on the flowers and flower stalks. These aphids were light brown to brown in color. *Echinocloa crussgali* or water hyacinth plants were colonized by *Hiperomyzus* sp. aphids. These aphids were dark brown to black and formed large colonies on the undersides of both young and old leaves. The aphid colonies were never found in association with ants. *Ecliptica prostrata* or urang aring was colonized by *Aphis gossypii,* forming small colonies on the shoots and flowers. The aphids were bright green to blackish green. The aphid colonies were also consistently associated with ants.

*Eleusin indica* was colonized by two species of aphids: *Hysteroneura setariae* and *Rhopalosiphum maidis. H. setariae* formed colonies in flower parts, flower stalks and leaf axils resulting in quite large colonies. *H. setariae* body color ranged from red brown to dark brown. The colonies were consistently associated with ants. The aphids of *R. maidis* formed colonies in the leaf axils and undersides of leaves and on leaf shoots that had not yet opened. The colonies were not densely packed. The leaf aphids of *R. maidis* were green in color, with distinct black siphunculi and cauda. These

aphids had relatively large bodies with a slightly elongated shape. *R. maidis* colonies were always associated with ants. The plant *Emilia sonchifolia,* characterized by its purple flowers, was colonized by *Aphis gossypii.* The aphids were yellow to green in colour. The colonies formed near flowers, flower stalks, and shoot leaves.

*Eragrostis tenella* was infested by *Hysteroneura setariae* aphids. The aphids were brown to red brown. Small colonies formed on flowers near the seeds, with groups of aphids surrounding the plant's seeds. The aphids of *H. setariae* were consistently associated with ants. *Euphorbia hirta* or wart grass was colonized by Aphis *gossypii.* The aphids formed colonies on the undersides of leaves, resulting in stunted growth of the leaves. The aphids were yellow to dark green in color. *A. gossypii* colonies *on E. hirta* plants were consistently associated with ants. *Eupotarium odoratum* was colonied by both *Aphis gossypii* and *Aphis citricola. A. gossypii* formed colonies in the buds, young leaves, old leaves, and young twigs. Young leaves that were colonized by A. *gossypii* became stunted with an irregular shape. *A. gossypii* found in this plant showed yellow-green to dark green in body colour. The colonies of *A. citricola* formed on the young twigs near the shoots, with these aphids displaying yellow-green coloration and having black siphunculi and cauda. Aphid colonies of both A. *gossypii* and A. *citricola* on E. *odoratum* plants were associated with either black or red ants.

*Hymenochera acutigluma* or hair axis was colonized by *Hysteroneura setariae,* which formed colonies on the flower stalks and flowers. The colonized parts of the plants did not display any noticeable symptoms. *Lagerstromea sp*. or *kenidai,* was infested by *Greenidae* sp. These aphids had bright green bodies and distinctive elongated siphunculi with thorns. The aphids formed colonies on the undersides of leaves, especially on young leaves. The colonized leaves did not show any disease symptoms. *Lophatherum gracile or bamboo grass* plants were colonized by two species of aphids: *hysteroneura setariae* and *Rhopalosiphum maidis.* The aphids of *H. setariae* formed colonies on the undersides of leaves, leaf shoots, and leaf axils. The colonized leaves did not show any disease symptoms. *H. setariae* aphids were brown to red-brown. *R. maidis* aphids also formed colonies on the undersides of leaves, but the colonies were small. *R. maidis* aphids were green to bright green in color, with black siphunculi and cauda. It was possible for colonies of the two species of aphids on L. gracile to mix.

*Melastoma affine* was colonized by *Aphis gossypi.* The colonies formed on shoots, particularly near newly emerging shoots and on newly emerging fruits and flowers. The body colour of aphids ranged from yellow to green. The colonized plant parts did not show any disease symptoms. *Mikania miranta* was colonized by *Aphis gossypii* and *Aphis glycine. A. gossypii* formed colonies on the shoots, especially on the undersides of the leaves, resulting in stunted and curled leaves. *A. glycine* formed colonies on the branches. The colonies were densely populated. *A. Glycine* aphids were light green to green in color. The colonized plant parts became distorted. The two species of aphids could mix to form a single colony.

*Mimosa invisa (cater*-grass) was colonized by *Aphis craccivora.* The aphids of *A. craccivora* on *M. invisa plants* formed colonies only on the shoots with small colonies. The aphids appeared dark black with wingless imagoes. *Mimosa pudica* was observed to be colonized by *Aphis craccivora.* The aphids formed colonies on shoots, especially young shoots, and occasionally on flowers and pods. The aphids were black and of medium size, resulting in stunted growth of the colonized plant parts. The colonies were quite large. *Mimosa vigra* was colonized by *Aphis craccivora.* The colonies of aphids occupied the pods and shoots with small colonies. The nymphs of aphids were black, and wingless adults were shiny black. The colonized plant parts did not show any disease symptoms.

*Oryza rufipogon* was colonized by two species of aphids: *Rhopalosiphum rice* and *Rhopalosiphum maidis.* Both aphids colonized the same plant parts, namely the unopened leaves and the leaf axils with large colonies. The two species could be distinguished by their body color. *R. maidis* appeared green with black sifunculi and cauda, while *R. rice*

appeared white. The colonies of *R. maidis* and *R. rice* in *O. rufipogon* plants were associated with the presence of red ants. *Oxonopus compressus* or *pait* grass was colonized by *Hysteroneura setariae* aphids. The colonies occupied flowers, flower stalks, seeds, and sometimes in the leaf axils. The aphids were brown to dark brown in color. Small colonies were formed, and they were also consistently associated with ants.

*Paspalum conjugatum* was colonized by *H. setariae* aphids. The colonies occupied flower parts, especially the seeds and flower stalks. Aphids had brown to dark brown bodies. *Phylanthus niruri* was colonized by *Aphis citricola*. The colonies formed on the shoots and the undersides of leaves and petioles. The colonized parts became distorted, stunted, and wrinkled. The aphids had yellow bodies with black sifunculi and cauda, and the colonies formed were quite large. *Portulaca oleraceae* plants were colonized by *Aphis craccivora*. The aphids of *A. craccivora* in *P. oleraceae plants* formed colonies on the undersides of leaves, especially young leaves, shoots and in flowers. The colonized plant parts became stunted, and leaf edges curled downward. The aphids had dark brown to black bodies, with wingless imagoes that appeared glossy black.

*Physalis angulata* plants were colonized by *Aphis craccivora.* The aphids had dark green to black bodies, with glossy black wingless imagoes. *A. craccivora* formed colonies on the shoots or near the leaf buds. The colonized plant parts did not show any symptoms of disease. *Rorippa indica* or mustard land was colonized by *Lipaphis erysimi*. The colonies formed on the flowers, fruits, flower stalks and the lower surface of leaves. The colonized plant parts showed symptoms such as curling and stunting. *Sida rhombifolia* or cacabean was colonized by *Aphis gossypii.* The aphids had green-yellow to green body colors. The colonies formed on the surface of lower leaves, stalks and flower petals. The colonized plant parts, especially the shoots, showed curling. and the leaf edges curled downward. *Sonchus arventris* plants were colonized by *L. erysimi.* The aphids had green to whitish green body colours, and the colonies formed on flower stalks, under petals, and on young shoots or leaves. The colonized plant parts became stunted over time.

In general, aphids observed on ornamental and wild plants formed colonies. The colonized plant parts typically displayed typical symptoms of damage, but some did not show any symptoms. Generally, the symptoms of the plants caused by aphid colonies were relatively the same, such as stunted growth, abnormal shape, and stunted or curly leaves. These characteristic symptoms serve as indicators of aphid infestations. However, some plants or plant parts did not show symptoms when colonized by aphids. This condition happened because the colonized parts had reached their maximum growth or development. It indicated that the colonized part was not currently undergoing a growth phase. The colonies that did not induce symptoms typically occurred when the colonized leaves had reached their maximum growth or when the leaves and plant parts were old. The old leaves or twigs might not show the typical symptoms associated with aphid infestations.

The part of the plant exhibiting characteristic symptoms when colonized by aphids also often experienced a cessation in growth due to the piercing by the aphids. In contrast, the areas surrounding the puncture site continued to grow, resulting in some parts developing normally while others become stunted (Pettersson et al., 2017). This condition could lead to the bending of shoots or young stems, curling of leaves, downward curling of leaf edges, or stunted leaf growth. In this observation, monocot plants or groups of grasses with narrow leaves generally did not display any distinctive symptoms when colonized by aphids. This might be because the growth or development of their leaves differed from that of dicot plants. Therefore, the presence of aphids in monocot plants or plants was often easier to recognize through the presence of ants. If a plant was found to have a significant number of ants, there was a possibility that aphids had colonized the plant (Tegelaar et al., 2012). Therefore, the presence of ants could serve as an indicator of the presence of aphid colonies.

Throughout their life cycle, aphids exhibited host alternation by switching between two distinct host plants (Peccoud et al., 2010). They overwintered on woody plants, reproduced in the spring, and migrated to herbaceous plants during the summer before returning to their primary host in the autumn (Yamamoto et al., 2020). This allowed aphids to maximize resource utilization, avoid congestion and competition, evade predators and parasites, circumvent plant defenses, and colonize new areas. Aphids could distribute their population efficiently, thereby avoiding overcrowding, predators and parasites, and plant defenses developing over time through host switching (Yamamoto et al., 2020). This behavior was essential for the survival and environmental adaptation of aphids.

Aphids colonized flowers because they may offer an accessible and rich food source, sugary plant sap found in new growth or reproductive parts of plants. Flowers contain nutrient-rich nature (Jakubczyk et al., 2022) and easy access to sap, therefore aphids were attractive to sap the flowers. Some aphid species were drawn to certain colors (Chittka, 2007), while others preferred different types of plants and plant parts (Sorensen, 2009). It's worth noting that different aphid species often had distinct preferences for plant ty(Harrington et al., 2007)pes and parts.

Herbs served as an alternative host for aphids in this present study. Aphids consumed sugar-rich liquid in plants, known as "sap". Aphids considered herbs and other green vegetation as abundant food sources. Aphids utilized needle-like mouthparts to penetrate plant tissues and access this fluid (Brożek et al., 2015). Numerous herbs had structural characteristics, such as folds, crevices, and concealed flowering portions (Harrington et al., 2007), that provided aphids with refuge .

Due to a symbiotic relationship, the prevalence of aphids and ants was frequently correlated. Aphids produced a delicious substance known as honeydew as a waste product, which ants found highly attractive as a food source (Nelson & Mooney, 2022). The honeydew contained an abundance of sugars, extracted by aphids from the plant juice (Detrain et al., 2010). Ants were drawn to this nutrient-rich food source and would often 'farm' aphids for it. In exchange for honeydew, ants provided aphids with protection from other insects and predators, such as ladybugs, lacewing larvae, and parasitic wasps (Karami-jamour et al., 2018). Certain species of ants would transport aphids to new host plants for improved foraging opportunities, ensuring that aphids had a continuous food source (Giannetti et al., 2021). Honeydew not only nourished the ant colony, but its high sugar content also supported the development of their fungus farms (in certain species) and provided energy for the growth of their own progeny (Biedermann & Vega, 2020).

## CONCLUSION

15 species of aphids were found in ornamental and wild plants in Pagaralam, namely *Aphis gossypii, Uroleucon* sp., *Toxoptera odinae, Macrosiphum rosae, Aphis citricola, Aphis craccivora, Toxoptera aurantii, Pentalonia nigronervosa, Hystenura* sp., *Aphis glycine, Greenidae* sp., *Rhopalosiphum padi, Rhopalosiphum maidis, Hyperomyzus* sp. *Lipaphis erysimi.*


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