Article

Arthropod diversity and abundance in rose flowers at Shadullapur, Savar, Dhaka, Bangladesh

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Abstract
Arthropod species pose a significant threat to ornamental plants through feeding, ovipositional injury, and the spread of pathogenic microbes.This study investigated arthropod species infesting rose plants grown at Shadullapur, Savar, Dhaka, Bangladesh, from October 2019 to February 2020. A total of 1,454 individuals from seven insect orders and two arachnid groups were recorded. Individuals from the order Thysanoptera were the most abundant, followed by Hemiptera and Lepidoptera. Among arachnids, spider mites and predatory mites were dominant. A total of 25 species were identified, including 22 insect species and three arachnids. Lepidoptera exhibited the highest species diversity, followed by Hemiptera and Coleoptera. The Shannon Diversity Index of 0.9596 indicates a moderate level of species diversity, suggesting that while a few orders dominate in abundance, a variety of species contribute to the ecosystem.This study highlights the importance of understanding arthropod diversity in developing effective pest management strategies for rose cultivation. Additionally, it emphasizes the need for further research on the interactions between pest species and their host plants, which can further refine pest control practices and minimize crop loss.

Keywords arthropods; rose pests;golap gram; abundance; rose cultivation; diversity.

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1 Introduction

The floral industry has emerged as one of the fastest-growing sectors worldwide, and the same holds for Bangladesh, where it is rapidly expanding. Bangladesh is known for its favorable agricultural conditions, including an ideal climate and fertile soil, which are essential for plant growth (Hoque, 2001). Over the past few decades, flower cultivation has transformed into a significant economic contributor, playing a vital role in both domestic and international markets. While previously not widely recognized as a viable business, flower cultivation is now an important part of Bangladesh's economic development (Aditya, 1992; Dadlani, 2003).

Flowers are cultivated across 10,000 hectares of land in 26 districts, including Jessore, Jhenidah, Magura, Rangpur, Bogra, Dhaka, Manikganj, and Gazipur (Ahmed et al., 2021; Kaysar et al., 2023; Khan, 2024; Reza, 2013; Karmaker, 2022). Popular flowers such as roses, tuberose, gladiolus, marigolds, lotuses, gerberas, hyacinths, chrysanthemums, and lilies are now grown commercially(Khan et al., 2021). Bangladesh's floral industry’s market value has seen remarkable growth, with an estimated annual value of Tk 1,200 crore and a consistent growth rate of 10% per year (Dhaka Tribune, 2018; Mim, 2020). In addition to meeting local demand, Bangladesh has become an exporter of floral products, including cut flowers, leaves, plants, bulbs, and roots. According to the Export Promotion Bureau (EPB), floral exports reached $86,000 in the 2016-17 fiscal year, marking a 10.26% increase compared to the previous year (Dhaka Tribune, 2018). This flourishing industry contributes to the country’s foreign currency reserves and provides employment to over 25,000 families, indirectly benefiting more than 200,000 people (Dhaka Tribune, 2018).

Despite its growth, the floral industry faces challenges in maintaining the quality and productivity of flowers. One major issue is the infestation of harmful arthropods. Pests like thrips, aphids, worms, beetles, leaf miners, whiteflies, moths, and scale insects cause significant damage (Dorn, 2023) by reducing photosynthesis, stunting plant growth, and deforming flowers and leaves (Gibb, 2018), leading to lower yields and reduced market value (Ali et al. 2016). Some pests also spread viral, bacterial, and fungal diseases, compounding the difficulty of pest control (Pandit et al., 2022). Arthropod infestations are a global concern in ornamental crop production. For instance, in Himachal Pradesh, India, 65 insect species have been documented to damage ornamental plants (Pal and Sarkar 2009). Ganai and Khaliq reported one mite and one insect attacking marigolds in Jammu, India (Ganai and Khaliq, 2017).

In Bangladesh, studies on floral pest infestations are relatively limited. Ali et al. (2016) identified 16 insect pests and one mite species affecting flowers, with aphids, thrips, and two-spotted spider mites causing the most significant damage. Another study by Islam et al. (2019) recorded 51 insect species and four mite species infesting ornamental plants in areas such as Jessore, Narsingdi, Chokoria, Satkhira, and Gazipur. International research, such as in Indonesia, highlights scale insects and thrips as major pests, with damage intensities of 50.50% and 20%, respectively (Handayati and Sihombingn, 2017). In Bangladesh, a study by Master’s students at Sher-e Bangla Agricultural University found that aphids infested 94.82% of ornamental flowers in their study fields. Among the identified pests, aphids and red mites were the major contributors to significant damage with high infestation levels (Rayhan, 2016).

However, despite the availability of studies, detailed research on the arthropod species affecting flowers in Shadullahpur village, also known as Golap Gram, is lacking. This area is renowned for its extensive rose cultivation, with numerous growers actively engaged in floriculture. To address this research gap, the present study focuses on exploring the population diversity and abundance of arthropod species infesting rose plants in Golap Gram, Savar, Dhaka. This investigation aims to provide valuable insights into the pest challenges faced by local floricultural growers and contribute to the development of effective pest management strategies.

2 Materials and Methods

For our research, a systematic methodology was implemented to investigate the arthropod populations associated with rose plants in Shadullapur, The approach encompassed defining the study area, selecting suitable plants, collecting and processing samples, identifying arthropod specimens, and analyzing the data. Each step was carefully designed to ensure accuracy and reliability in capturing the diversity and abundance of arthropods infesting rose plants.

2.1 Study area and sampling period

The research was conducted at Shadullapur, located in Birulia, Savar, Dhaka, Bangladesh (23.83865°N, 90.30736°E) (Fig. 1), also known as Golap Gram. The study area is renowned for its extensive rose cultivation and provides an ideal setting for floricultural research due to its tropical climate. The region experiences wet and dry, two distinct seasons. The sampling was performed during the dry season, from October 2019 to February 2020, when temperatures ranged between 26°C and 33°C. These conditions were conducive to studying the arthropod populations as pest activity tends to peak during stable weather patterns. The geographical coordinates and the proximity of the study area to Jahangirnagar University facilitated logistical ease for sample collection and subsequent laboratory analysis.

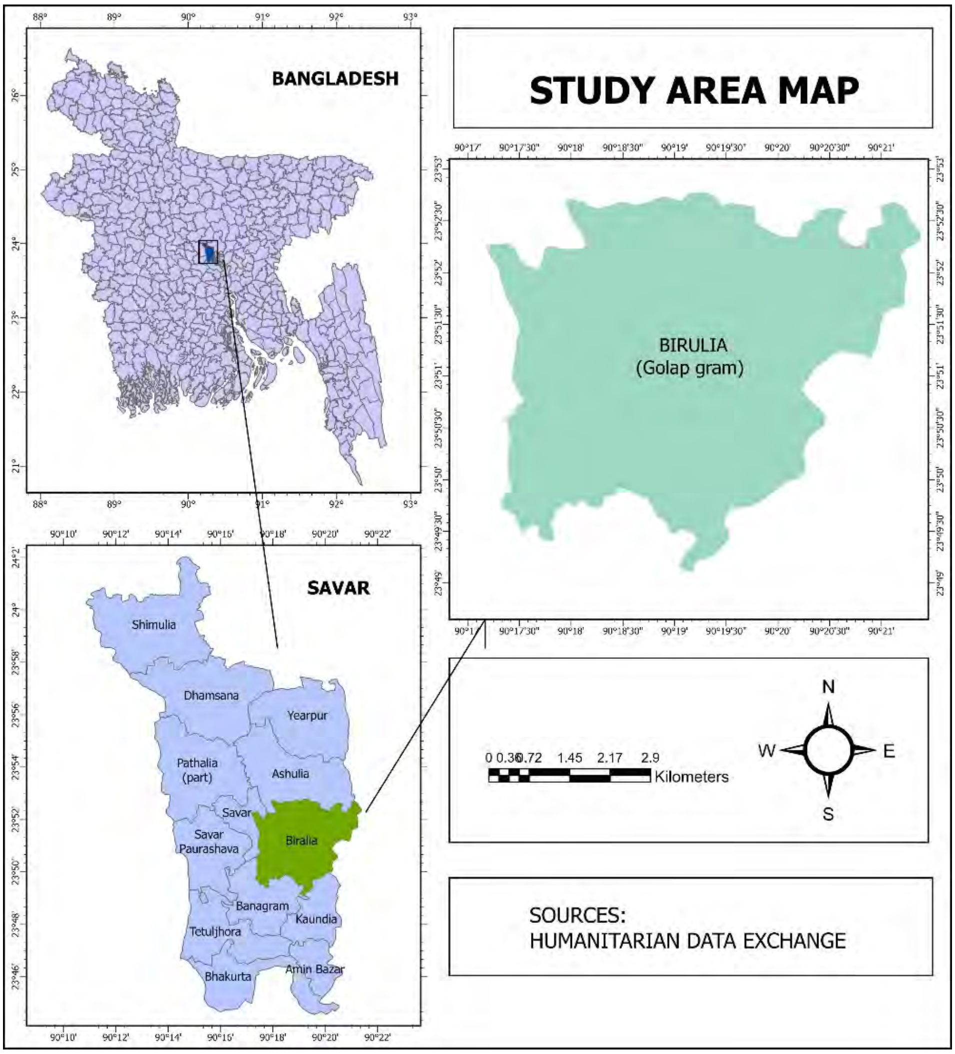

Fig. 1 Geographic location of the study area inShadullapur, Birulia, Savar.

2.2 Sample collection

Samples were collected mid of each month to minimize temporal bias and ensure consistency across observations. Each sampling field was divided into four subplots with visual estimation. A total of fivecolors ofroses, bearing red, white, pink, yellow and pink-white flowers were randomly selected from different fields in the study area. To provide a holistic assessment of pest populations, plant parts most prone to arthropod activity—such as flowers, buds, and the upper third of the leaves - were targeted.

2.3 Specimen collection and storage

Arthropod specimens were collected using two distinct techniques:

Sweep Netting: A sweep net was employed to capture flying and crawling arthropods that actively moved around the rose plants. This method effectively traps insects hovering near or climbing on the plants.

Manual Collection: Plant materials such as leaves, buds, and flowers were manually removed for closer inspection of concealed arthropods.

The collected samples were placed in 500 mL airtight plastic containers to prevent escape or contamination during transportation. Each container was labeled with the field number, collection date and flower color for accurate traceability. Care was taken to maintain optimal conditions during transport to the Entomology Laboratory at Jahangirnagar University, ensuring the integrity of the specimens.

2.4 Arthropod extraction

In the laboratory, plant materials were processed to extract arthropods effectively. The samples were soaked in 70% ethanol for 30 minutes to dislodge arthropods from the plant surfaces, targeting both adult and immature stages. The ethanol solution was then filtered through a fine mesh sieve to separate the arthropods from plant debris.Extracted specimens were transferred to Petri dishes containing additional ethanol for detailed examination. This method ensured the recovery of a wide range of arthropods, including those tightly adhering to plant surfaces.

2.5 Preservation and identification

To preserve specimens for long-term storage and facilitate identification, small arthropods, such as larvae, were stored in 80% ethanol. Larger specimens were mounted on identification points and air-dried for further examination. Identification was conducted using standard taxonomic keys and reference materials available at the Entomology Laboratory. For species posing identification challenges, comparisons were made with existing laboratory specimens and high-resolution images. Arthropods were categorized into seven insect orders and one arachnid groups, including spider mites and predatory mites, reflecting the diversity of pest species associated with rose plants.

2.6 Statistical analysis

Descriptive statistics were used to analyze the data. Species richness, representing the total number of arthropod species identified, was documented. Relative abundance was calculated as the proportion of each species within the overall arthropod population, highlighting dominant pests. Species diversity across different insect orders was evaluated to understand community composition. Comparative analyses were conducted to identify variations in arthropod abundance and diversity among plant parts (flowers, buds, and leaves). These evaluations provided critical insights into pest dynamics and their potential impact on rose cultivation.

This systematic methodology enabled a thorough investigation of arthropod populations infesting rose plants in GolapGram, providing a foundation for understanding pest behavior and developing targeted management strategies. The subsequent results will shed light on the trends and implications of the data collected.

3 Results

From the study, a total of 1,454 individuals were counted from 7 insect orders and 2 orders of Arachnida. Based on the individuals found from each order, the largest number of insects were from the order Thysanoptera (66%), followed by Hemiptera (14.16%), Lepidoptera (1.3%), Orthoptera (0.82%), Hymenoptera (0.68%), Coleoptera (0.55%), and Collembola (0.55%) (Table 1). Arachnida accounted for 10% of the infestation, with predatory mites being the most dominant, followed by spiders.

A total of 25 species were documented, of which 22 were insects and 3 were mites and spiders. Among the

22 insect species, the maximum number was found from the order Lepidoptera (45%), followed by Hemiptera (17%), Coleoptera (14%), Thysanoptera (9%), Hymenoptera (5%), Orthoptera (5%), and Collembola (5%). Ali et al. (2016) reported 16 insect species and 2 mite species infesting floricultural crops, which is similar to the findings of this study. This result also shows a resemblance to the previous study on arthropod fauna of roses by Narayan et al. (2020).

To analyze the species diversity more scientifically, we will use the equation of the Shannon diversity index, also known as the Shannon-Weiner diversity index. The equation is as follows (Rita Rain, 2024),

$$H = -\sum\{(p_i) * \text{In}(p_i)\}$$

Here, p_i shows the proportion of species *i*relative to the total number of species. It takes into account both the evenness and abundance of the species present. The minimum value for this index is 0, which indicates the absence of diversity, having only one species in a community.

The calculations for the Shannon diversity index based on our data are presented in Table 1, which provides detailed information on species composition, abundance, and diversity within the arthropod orders found in the rose plants.

Table 1 Species composition, abundance, and diversity of arthropod orders in rose plants.

SL. No	Order	No. of pests found (n)	Proportion and % of individual orders, Proportion, p_i= (n/N)	ln(p_i)	p_i* ln(p_i)	Number of species found	Infestation rate based on species number
01	Thysanoptera	966	0.66 (66%)	-0.415	-0.2739	2	8%
02	Hemiptera	206	0.1416 (14.16%)	-1.955	-0.2768	4	16%
03	Lepidoptera	19	0.013 (1.3%)	-4.342	-0.0564	10	40%
04	Orthoptera	12	0.008 (0.82%)	-4.828	-0.0386	1	4%
05	Hymenoptera	10	0.006 (0.68%)	-5.115	-0.0307	1	4%
06	Coleoptera	8	0.005 (0.55%)	-5.298	-0.0265	3	12%
07	Collembola	8	0.005 (0.55%)	-5.298	-0.0265	1	4%
08	Arachnida	148	0.1 (10%)	-2.302	-0.2302	3	12%
		Total(N) = 1454	Total = 1 (100%)	∑ ln(p_i)= -29.553	$\sum\{pi * \ln(pi)\}$ = -0.9596		

So, the value for Shannon index diversity will be,

$$H = -\sum(p_i) * \text{In}(p_i) = -(-0.9596) = 0.9596$$

The Shannon Diversity Index value of 0.9596 indicates that the arthropod community in the rose ecosystem has low to moderate diversity. This means insects from one order (Thysanoptera) are dominant, while others are present in much smaller numbers. The community is unevenly distributed, with a few species making up the majority of the population. This suggests a need to manage the dominant species carefully to maintain ecological balance.

Table 2 Taxonomic profile and status of pests found in rose foliage and flowers.

SL. No	Pest's name	Scientific name	Order	Family	Pest status
01	Thrips	*Frankliniellaoccidentalis*	Thysanoptera	Thripidae	Major
02	Thrips	*Frankliniella*sp.	Thysanoptera	Thripidae	Major
03	Aphid	*Macrosiphumrosae*	Hemiptera	Aphididae	Major
04	Aphid	*Aphis gosypii*	Hemiptera	Aphididae	Major
05	Dusky cotton bug	*Oxycarenuslaetus*	Hemiptera	Iygaeidae	Minor
06	Hollyhock-tinged bug	*Urentius euonymus*	Hemiptera	Tingidae	Major
07	Japanese beetle	Popilla japonica	Coleoptera	Scarabaeidae	Minor
08	Spotted cucumber beetle	*Dibroticaundecimpunctata*	Coleoptera	Chrysomelidae	Minor
09	Chafer beetle	*Oxycetoniaversicolor*	Coleoptera	Scarabaeidae	Major
10	Grasshopper	*Atracttomorphacrenulata*	Orthoptera	Tettigoniidae	Minor
11	Orange tortrix	*Argyrotaeniafranciscana*	Lepidoptera	Tortricidae	Minor
12	Leafroller moth	*Archipsargyrospila*	Lepidoptera	Aceraceae	Minor
13	Tent caterpillar	*Malacosomaamericanum*	Lepidoptera	Lasiocampidae	Minor
14	Tussock moth	*Lymantriinae sp.*	Lepidoptera	Erebidae	Minor
15	Hairy caterpillar	*Orgyiaposticus*	Lepidoptera	Lymantriidae	Minor
16	Castor semilooper	*Achaea janata*	Lepidoptera	Erebidae	Minor
17	Hairy caterpillar	*Spilosomaobliqua*	Lepidoptera	Erebidae	Minor
18	Rose budworm	*Helicoverpavirescens*	Lepidoptera	Noctuidae	Major
19	Lemon butterfly	*Papiliodemolius*	Lepidoptera	Papilionidae	Minor
20	Common emigrant	*Catopsiliapomona*	Lepidoptera	Pieridae	Minor
21	Little black ant	*Formica* sp.	Hymenoptera	Formicidae	Minor
22	Unknown Collembola	Species unknown	Collembola	unknown	Minor
23	Red spider mite	*Tetranychusurticae*	Acariformes	Tetranychidae	Major
24	Predatory mite	Species unknown	Acariformes	Phytoseiidae	Beneficial
25	Spider	Species unknown	Araneae	unknown	Beneficial

From the results, it is evident that among the 25 species, the majority belonged to the order Lepidoptera, followed by Hemiptera, Thysanoptera, Coleoptera, Acariformes, Hymenoptera, and Orthoptera. The number of species recorded would likely have been higher if the study had been conducted over a longer period, as seasonal variations might have influenced arthropod diversity and abundance. Unfortunately, the research duration was limited due to the COVID-19 lockdown. Additionally, only two sampling techniques were used, which may have restricted the diversity of species captured. Despite these limitations, the study provides valuable insights into the arthropod community associated with roses and lays the foundation for future research in the study area.

Fig. 2 represents the scenario of infestation based on the species number identified and the comparison between infestation patterns among orders: species count and percentage contribution.

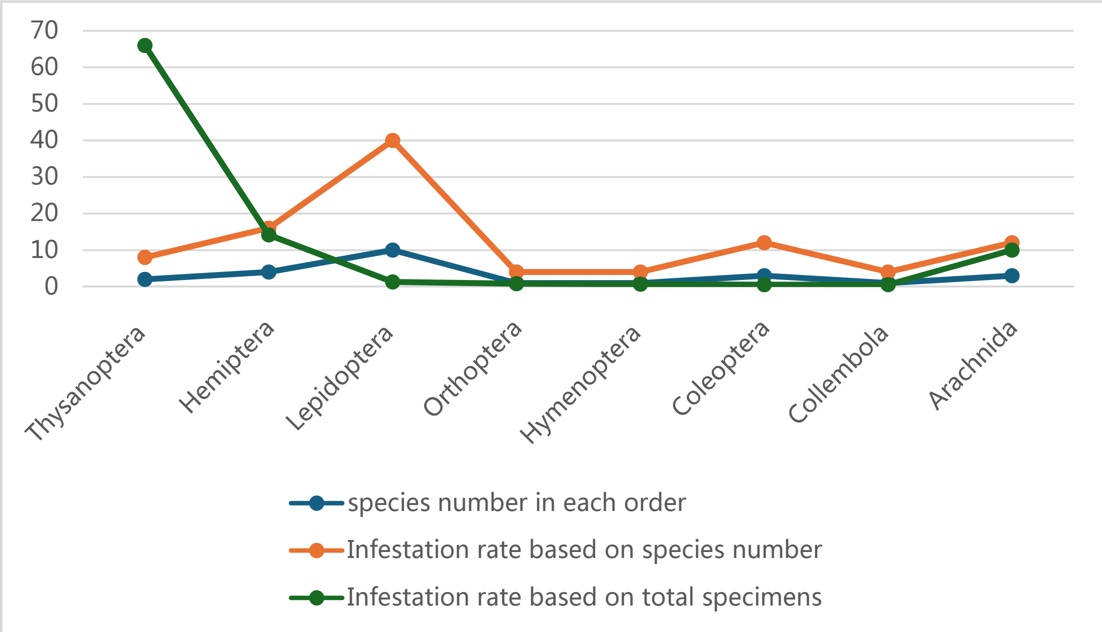

Fig. 2 Comparison of infestation patterns across orders: species count, infestation rates by species, and total specimens.

The graph shows that Thysanoptera dominates infestation based on numbers, while Lepidoptera exhibits the highest diversity of species infesting. The difference between the number of species found within an order and the total number of specimens is likely influenced by the ecological roles and reproductive strategies of the arthropods. For example, **Thysanoptera** showed a low number of species but a high number of specimens, which suggests a few dominant species capable of rapid reproduction and forming large populations. In contrast, **Lepidoptera** exhibited high species diversity but low total specimen numbers, likely because many species are transient visitors rather than permanent residents, and roses may serve as a secondary resource like nectar. Similarly, **Hemiptera** displayed a balance, with multiple species and moderate total specimens, reflecting their role as specialized plant feeders with moderate population sizes. These differences highlight how ecological roles, resource dependency, and life cycles shape the variations in species richness and abundance across arthropod orders.

4 Discussion

This study revealed that insects from the order Thysanoptera were the most abundant, which is consistent with the findings of Dash and Naik (1998). However, Islam et al. (2019) reported Hemiptera as the most abundant pest in roses, though Thysanoptera (thrips) species were identified as the most damaging pest. These pests can do significant damage by feeding sap and rasping tissues (Griep, 2022). The disagreement with Islam et al. (2019) might be due to differences in study areas and the large number of host crops examined, as various studies have shown that the abundance, distribution, and infestation of arthropod species are influenced by the availability of host species and ambient climatic conditions. Weather parameters can also influence insect population dynamics (Amin et al., 2018; Amin et al., 2019).

The economic significance of rose cultivation in Bangladesh further highlights the importance of managing arthropod pests effectively. Roses are a highly profitable crop with a yield of 540,107 flowers per hectare and a net return of Tk. 261,509 per hectare (Haque et al., 2013).The results of this study emphasize the need for continued research on arthropod pests in roses and other floricultural crops in both the same area and across different regions of Bangladesh. Understanding the pest complex in a specific agro ecosystem is crucial for the development of pest management strategies that are both economically viable and ecologically sustainable.

The findings of this study offer a foundational understanding of the insect and mite pests affecting rose plants, providing growers with essential data to make informed pest management decisions. By comprehending the diversity and population dynamics of pests, more effective management strategies can be developed to reduce economic losses while preserving ecological balance. To further enhance these insights, future studies should aim to extend the duration, employ diverse sampling methods, and explore a broader range of geographic areas.

Through an in-depth investigation of the arthropod fauna in rose flowers at Golap Gram, Savar, this study uncovers the diversity and population distribution of various arthropod species. The results reveal how environmental factors, such as temperature and humidity, strongly influence the abundance and distribution of these pests. This highlights the complex ecological relationships between the arthropods and their host plants, offering a deeper perspective on the dynamics of rose cultivation.

By addressing a significant gap in knowledge about arthropod pests in Bangladesh's rose cultivation, this research provides critical data for the development of effective pest management strategies. The study’s in-depth analysis of pest species diversity and their behavior is pivotal in shaping better pest control approaches. With this knowledge, growers can identify specific pest threats with greater precision and implement more targeted measures to mitigate their impact. Ultimately, these insights not only enhance pest management practices but also contribute to improved crop yield and quality, fostering more sustainable and profitable rose cultivation practices in Bangladesh.

Beyond its local significance, this study contributes to the global field of rose cultivation and pest management. The findings underscore the importance of tailoring pest control methods to specific environmental and ecological contexts. Furthermore, the research opens avenues for exploring integrated pest management (IPM) practices that combine biological, cultural, and mechanical methods to reduce reliance on chemical pesticides (Zhang, 2025). Such approaches not only enhance sustainability but also promote ecological balance by preserving beneficial arthropod species.

The implications of this study extend to future research, as future researchers can use this data to compare differences among species found in different regions or conditions and analyze the factors influencing these variations. This helps in understanding species interactions, environmental changes, and improving pest management strategies.

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