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Arthropod Assemblage Associated with *Clerodendrum infortunatum* L. (Family: Lamiaceae)

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Abstract: *Clerodendrum infortunatum* L. (Family: Lamiaceae) is a naturally growing shrub of medicinal value. The plant has woody stem, elliptical leaves and sweet-smelling flowers borne on pyramid-shaped peduncle panicle. The leaves and calyces are provided with EFNs which produce extra floral nectar while floral nectaries produce nectar rich in sucrose and amino acids. These food resources attract several floral and extra floral arthropod visitors like butterflies, bees, ants, bugs, grasshoppers, spiders etc. which can be grouped as EFN visitors, potential pollinators, herbivores and predators. The arthropod assemblage, recorded during the period of study, consisted of 22 species belonging to five orders (Hymenoptera, Hemiptera, Lepidoptera, Orthoptera and Coleoptera) and 10 families (Apidae, Aphididae, Formicidae, Nymphalidae, Pieridae, Pyrgomorphidae, Pyrochoridae, Pentatomidae, Coccinellidae and Papilionidae) of class Insecta and two arachnid families, Salticidae and Oxyopidae. The species of these groups may affect the distribution and resource exploitation ability of each other which would in turn affect the plant fitness.

Keywords: Arthropods, *Clerodendrum infortunatum*, Hymenoptera, Hemiptera, Lepidoptera, Orthoptera, Coleoptera

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Introduction

Clerodendrum infortunatum L. (Family: Lamiaceae), commonly known as hill glory bower in English and Bhand or Bhatwas in Hindi, is a terrestrial shrub, native to the tropical region of Asia. It grows wild in most parts of India round the year. In Uttar Pradesh, it is found along the roadside and any uncultivated land between January to May. The shrub is of 2-4 feet in height. It is a medicinal plant which has an active bitter

substance called clerodin (Bhattacharjee *et al.*, 2011). The root and leaf extract of this species is used in various ailments like scorpion sting and snake bite, tumors and certain skin diseases (Sannigrahi *et al.*, 2009) and in treatment of malaria (Goswami *et al.*, 1998). Ethanolic extract of the leaves of *C. infortunatum* has antioxidant activity (Modi *et al.*, 2010). Besides its use in therapeutics, the leaves have been positively

tested for their pesticidal properties against *Oryctes rhinoceros* (L.) (Sreelatha and Geetha, 2011), *Helicoverpa armigera* (Hubner) larvae (Abbaszadeh *et al.*, 2014) and *Orthaga exvinacea* (Hampson) larvae (Ranjini and Nambiar, 2015).

The leaves of *C. infortunatum* are simple, opposite, broadly elliptic, ovate, dentate, (Kumar *et al.*, 2017) and both surfaces provided with extrafloral nectaries (EFNs) (self. obs.) and attract diverse types of extrafloral visitor especially ants by secreting carbohydrate rich nectars. In *C. infortunatum* flowering starts in the month of February and reaches its peak in March. The flowers of *C. infortunatum* are sweet-smelling and produce nectar which has a high concentration of sucrose and amino acids (Meerabai, 2014) and visited by most of arthropods which are viewed as potential pollinators or nectar robbers and include ants, bees, wasps, butterflies, plant lice, spiders, bugs and flies. Each branch terminates with pyramid-shaped peduncle panicle having about 12 to 132 flowers which are large, sweet-scented, zygomorphic and bisexual (Reddy and Reddi, 1995). The pollination in *C. infortunatum* is carried out mostly by butterflies and bees (Rueda, 1993; Meerabai, 2014).

By perusal of literature we found that most of the studies are focused on flowers and not on flower visitors and there is hardly any study conducted on arthropod abundance and diversity associated with *C. infortunatum*. Therefore, the present study was performed to examine the species richness and diversity of arthropods associated with the plants of *C. infortunatum* and their ecological contributions with respect to insect-plant interactions. This study provides some preliminary observations regarding arthropod assemblage on *C. infortunatum* plants, which would obviously affect the biotic interactions among different trophic levels and have a marked effect on plant fitness.

Materials and Methods

The study pertaining to the arthropod visitors of *C. infortunatum*, was carried out at St. Andrew's College campus, Gorakhpur (latitude: 26° 46' N,

longitude: 83° 2'E), India. The plants of *C. infortunatum* grow wildly in the college campus. They flourish in the month of January in the study area. Therefore, the study was conducted from January to April, in 2 consecutive years i.e., 2018 and 2019.

Thirty plants were randomly selected to record the assemblage of different species of arthropods visiting the *C. infortunatum* plants. The composition of arthropod orders was determined at two levels i.e., at extra-floral and floral levels and separate observation strategies were adopted for both the levels. For extra-floral visitors the observations were recorded weekly between 8:00 to 10:00 h from the month of January and April. Each plant was thoroughly examined for the presence of arthropods and their spatial distribution on the plant was carefully recorded.

To determine the diversity of floral visitors, observations were recorded on thirty randomly selected plants. The observations were taken weekly for 30 min between 8:00 to 10:00 h throughout the flowering season i.e. February to April. All the plant visited insect species were collected, preserved and identified in the laboratory at the Department of Zoology, St. Andrew's College, Gorakhpur. On the basis of their functional role insects were divided in one of four guilds: herbivores, potential pollinators, predators, and EFN visitors.

Results and Discussion

The arthropod assemblage associated with *C. infortunatum* recorded during the period of study consisted of 22 species belonging to five Orders (Hymenoptera, Hemiptera, Lepidoptera, Orthoptera and Coleoptera) and 10 families (Apidae, Aphididae, Formicidae, Nymphalidae, Pieridae, Pyrgomorphidae, Pyrrochoridae, Pentatomodae, Coccinellidae and Papilionidae) of Class Insecta and a single Order Araneae of Family Salticidae and Oxyopidae of Class Arachnida (Table 1).

As plants of *C. infortunatum* started growing the ants were the first arthropods to register their

Table 1: Arthropod assemblage associated with *Clerodendrum infortunatum*

Class/Order/Family	Species	Foraging on
A. Insecta		
a. Hymenoptera		
1. Apidae	<i>Apis dorsata</i> Fabr.	Floral nectar
	<i>Apis cerana</i> Fabr.	Floral nectar
	<i>Tetragonula iridipennies</i> Smith	Floral nectar
2. Formicidae	<i>Camponotus compressus</i> (Fabr.)	Extra floral nectar
	<i>Camponotus parius</i> Emery	Extra floral nectar
	<i>Crematogaster subnuda</i> Mayr	Extra floral nectar
b. Lepidoptera		
1. Nymphalidae	<i>Danaus plexippus</i> (Linn.)	Floral nectar
	<i>Danaus chrysippus</i> (Linn.)	Floral nectar
2. Pieridae	<i>Delias eucharis</i> (Drury)	Floral nectar
	<i>Catopsilia pyranthe</i> (Linn.)	Floral nectar
	<i>Eurema hecabe</i> (Linn.)	Floral nectar
3. Papilionidae	<i>Papilio demoleus</i> Linn.	Floral nectar
	<i>Graphium doson</i> C. and R. Felder	Floral nectar
	<i>Pelopida</i> sp.	Floral nectar
c. Hemiptera		
1. Aphididae	<i>Aphis fabae</i> Scop.	Herbivore
2. Pyrrhocoridae	<i>Dysdercus koenigii</i> (Fabr.)	Herbivore
3. Pentatomodae	<i>Nezara viridula</i> (Linn.)	Herbivore
d. Orthoptera		
1. Pyrgomorphidae	<i>Atractomorpha crenulata</i> (Fabr.)	Herbivore
e. Coleoptera		
1. Coccinellidae	<i>Coccinella transversalis</i> Fabr.	Predator
B. Arachnida		
a. Araneae		
1. Oxyopidae	<i>Oxyopes javanus</i> Thorell	Predator
2. Salticidae	<i>Myrmarachne prava</i> (Karsch)	Predator
	<i>Myrmarachne melanocephala</i> MacLeay	Predator

attendance on them. Three ant species namely *Camponotus compressus*, *Camponotus parius* and *Crematogaster subnuda* were found to visit *C. infortunatum* (Fig. 1A, B). All the ant species were observed on extra-floral parts of plant foraging on extra-floral nectaries on foliage and if at all they approached the flowers they were restricted only up to the calyx. Thus, in the

present study no ant species was observed foraging on floral nectar.

During the pre-flowering period, the ants confined foraging activity only on the foliage and with the onset of the flowering stage, they moved towards flowers but never crossed the outermost whorl of the flowers. It was also interesting to note that spatial distribution of ants on

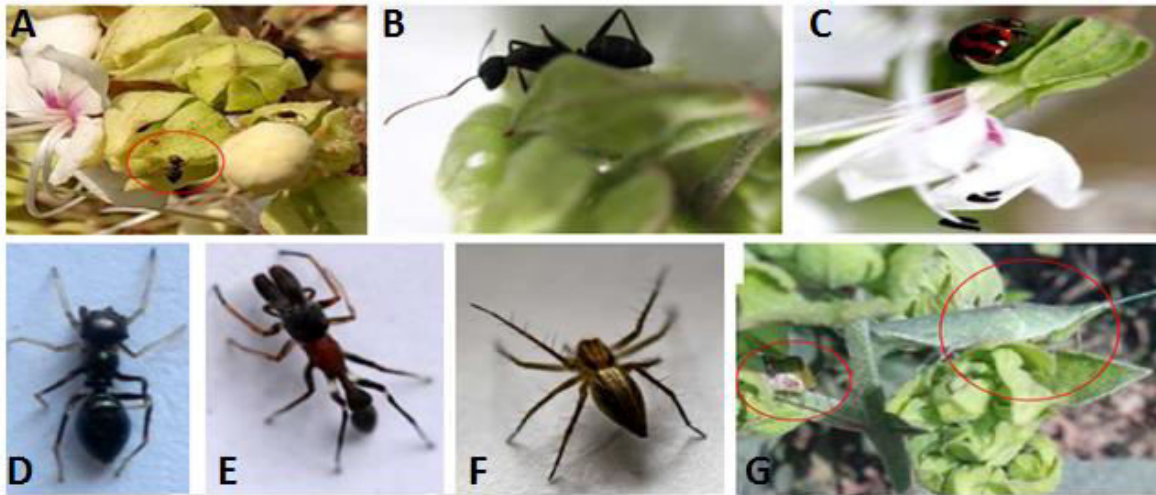


Fig. 1: Arthropod visitors on *Clerodendrum infortunatum* plant: ant species: (A) *Crematogaster subnuda*, (B) *Camponotus compressus* on extrafloral nectaries located on flower calyces; predators: (C) *Coccinella transversalis*, (D) *Oxyopes javanus*, (E) *Myrmarachne melanocephala*, (F) *Myrmarachne prava*; insect herbivores: (G) *Nezara viridula* and *Atractomorpha crenulata*.

C. infortunatum plants was greatly influenced by the leaf age as ants were mostly observed foraging on the EFNs of young leaves.

The flowers of *C. infortunatum* produce nectar which is rich in sucrose and amino acids and it is a potential food source (Haber *et al.* 1981) for ants. However, even though flowers possess suitable resources that ants may be expected to exploit (nectar, insect prey), in this study ants were absent from flowers. This seems to be the reason that many plants have evolved mechanisms to keep ants away from their flowers (Junker and Blüthgen, 2008). The calyces of *C. infortunatum* flowers are richly provided by EFNs which possibly act as distraction that draws ants away from flowers (Wagner and Kay, 2002).

During flowering stage, the blooming flowers of *C. infortunatum* attracted a host of floral visitors comprising of bees and butterflies. Bees *Apis dorsata*, *Apis cerana*, *Tetragonula iridipennies* and butterflies *Danaus plexippus*, *Danaus chrysippus* (Nymphalidae), *Delias eucharis*, *Catopsilia pyranthe*, *Eurema hecabe* (Pieridae), *Papilio demoleus*, *Graphium doson*,

Pelopida sp. (Papilionidae) were found to be actively engaged in foraging activity on flowers. All the floral visitors visit flowers to obtain their food from the floral food resources and can be considered as potential pollinators. These floral guests started their foraging activity right in the morning as the flowers of *C. infortunatum* bloom in the morning hours (Reddy and Reddi, 1995) and in this study also a good assemblage of potential pollinators was recorded foraging on flowers. Reproductive biology of *C. infortunatum* has been studied by Kumar *et al.* (2017) and they concluded that the flowers are visited by different diurnal insects of which only papilionid and pierid butterflies are pollinators.

Indeed, major stakeholders of arthropod assemblage of *C. infortunatum* belong to Hymenoptera and Lepidoptera but other insect orders like Hemiptera, Orthoptera and Coleoptera and order Araneae of class Arachnida were also present. The arthropod representatives of these taxa form two functional groups/guilds of herbivore and predators; aphid *Aphis fabae* (Hemiptera: Aphididae), bugs *Dysdercus koenigii* (Hemiptera: Pyrrhocoridae), *Nezara*

viridula (Hemiptera: Pentatomidae) and grasshopper *Atractomorpha crenulata* (Orthoptera: Pyrgomorphidae) are herbivore species and ladybird beetle *Coccinella transversalis* (Coleoptera: Coccinellidae), and spiders *Myrmarachne prava*, *M. melanocephala* (Araneae: Salticidae), *Oxyopes javanus* (Araneae: Oxyopidae) are insect predators associated to *C. infortunatum* (Fig. 1).

This study pertaining to arthropod assemblage of *C. infortunatum* plant furnishes the basic findings regarding species richness and diversity of the arthropods on this medicinally important, naturally growing plant. The species constituting distinct ecological functional groups and occupying various trophic strata may affect the distribution, resource exploitation ability and fitness of each other which would definitely have a net result on the plants' vegetative and reproductive wellbeing.

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