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# Pollinators' community of *Capparis aphylla* at Dera Ghazi Khan, Punjab, Pakistan

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**Abstract**
Pollination is an important ecosystem service responsible for better plant yield and production. In the current study, pollinator community of *Capparis aphylla* was investigated at Dera Ghazi Khan, Punjab, Pakistan. The results revealed four bee, three wasp and two butterfly species visiting the flowers of *C. aphylla*. Bees were the most abundant floral visitors (1035 individuals) followed by wasp (354 individuals) and butterflies (151 individuals). Among all pollinator species *Amegilla* sp. had the highest visitation rate (20 ±1.22 number of flowers/min) while *Danaus chrysippus* butterfly had the lowest visitation rate (2.75±2.68 number of flowers/min). *Amegilla* sp. showed the highest visitation frequency (3.38±0.12 individuals/flower/5 min) and the *Ropaldia marginata* wasp represented the lowest visitation frequency (0.17±0.16 individuals/flower/5 min). Maximum numbers of pollen grains were recovered from the body of *Amegilla* bee (20432.5 ± 1025) and minimum from *Eumenes punctatus* (4140 ± 250). The results indicated *Amegilla* sp. (bee) as effective pollinator of *C. aphylla* plant.

**Keywords:** insect preferences, flower attraction, pollination, visitation frequency, visitation rate, pollen load

## Introduction
Pollination is one of the most essential and important regulating and supporting factor of ecosystem service [1]. Loss of pollination services may result in improper functioning of ecosystem [2-4]. Insect pollinators play an essential role in the pollination of plants and both partners (plant and insects) get benefit from each other due to mutualistic relationship. Plant-pollinators co-evolution started about 225 million years ago [5]. Almost 80% of wild plant species and 75% of the cultivated plant species rely on insect pollinators for better fruits set and seeds production [6, 7]. According to Ollerton *et al*. [8], about 78-94% of angiosperm species depend on the cross-pollination activities provided by a variety of about 300,000 pollinator species.
Capparidaceae family consists of about 40–45 genera with 700–900 species. Its members represent wide diverse fruit and floral features [9, 10]. *Capparis aphylla* is a small shrub consisting of many branches without leaves (or very small leaves) in family Capparidaceae. This plant is distributed in desert areas of Pakistan and India. Its fruits are orange red in colour. The whole plant especially its fruit has medicinal value for cough, asthma**,** cardiac and many other problems [11-13]. In the current study, we aimed to investigate the pollinator community of this important medicinal plant.

## Materials and methods
### Study site
The study area was located at Dera Ghazi Khan (longitude 70° 29' 7" E and latitude 29° 57' 38" N), Punjab, Pakistan. The experiments were conducted during the flowering season of *C. aphylla* (May-July 2014). The experimental area was situated near undisturbed natural habitat with a plant community dominated by xerophytes i.e., *Acacia* sp., *Zizyphus jujuba, Alhagi marurum*, *Prosopis cineraria*, *Rhazya stricta*, *Prosopis glandulosa*, *Calotropis procera* etc. Dea Ghazi Khan is subtropical region having extreme environmental conditions with hot summer and cold winter. The maximum and minimum temperature of the year varies from 28-49 ºC during summer and 2-12 °C in winter and mean monthly summer rainfall is 18mm.

**Visitation survey of pollinators**

Pollinators' abundance (total numbers of individuals of a taxon in an area) was calculated from the data recorded during the flowering season by following the methodology of Tidke and Thorat [14]. The frequency of pollinators visiting flowers was measured by observing a set of five branches for five minutes. We observed a total of 200 branches from 40 plants during the flowering period. For visitation rate, the time period spent by a visitor on a single flower was recorded. Each visitor was observed for forty times during the flowering season. To avoid disturbance during data recorded, a specific distance was maintained and observer remained motionless. Observations were recorded during favourable environmental conditions.

**Taxonomic identification**

Pollinators were captured with the help of hand net and killed in ethyl acetate fumes and preserved for identification. The preserved insect pollinators were identified to lowest taxonomic level by using standard identification keys developed by Department of Biology, Valdost State University.

**Pollen load analysis**

Different insect pollinators visiting flowers of *C. aphylla* were captured with the help of hand net and were killed in a glass vial using fumes of ethyl acetate. This was done very carefully to avoid dislodging of pollens from the body of insects. After this, pollinators were transferred to vial containing 70% alcohol and small amount of detergent to facilitate removal of pollens present on the body of pollinators. Then volume of suspension in the vial was raised to 10 ml by adding distilled water. After that, 7 µL suspension was taken with the help of micropipette and transferred to haemocytometer for pollen count. The total numbers of pollen grains present on the body of insect were determined using haemocytometric method [15].

**Results and Discussion**

**Pollinator fauna**

The pollinator's fauna visiting the flowers of *C. aphylla* included four bee species, three wasp species and two butterfly species (Table 1).

**Pollinator's abundance**

Among four bee species, *Amegilla* sp. exhibited the maximum abundance (760 numbers) followed by *Andrena* sp. (176 numbers) while *Megachile* sp. had the lowest abundance (39 numbers). *Eumenes punctatus* (282 numbers) wasp was abundantly recorded as compared to other three wasp species. However, among butterflies, *Zizeeria krasanda* had maximum abundance (110 numbers) followed by *Danaus chrysippus* (41 numbers) (Table 1).

**Pollinator's visitation rate**

In bees, visitation rate of bee, *Amegilla* sp. had the highest visitation rate (20 number of flowers visited per min) as compared to other bee species. In butterflies, *Z. karsandra* expressed maximum visitation rate (10.35 number of flowers visited per min) and *D. chrysippus* expressed the lowest visitation rate (2.75 number of flowers visited per min) (Table 1).

**Pollinator's visitation frequency**

In bees, the maximum visitation frequency was observed in *Amegilla* sp. (3.38 individuals/ branch/ 5 min) followed by *Andrena* sp. (1.10 individuals/ branch/5 min), while other species remained less frequent. The wasp *Eumenes punctatus* (1.32 individuals/ branch/5 min) was frequently recorded compared to the other wasp species. Among butterflies, *Z. krasanda* showed maximum visitation frequency (0.61 individuals/branch/5 min) followed by *D. chrysippus* (0.26 individuals/branch/5 min) (Table 1).

**Pollen load**

Total number of pollen grains on pollinators' body varied from species to species. Among bees, maximum pollen grains were recorded from *Amegilla* bee (20432.5) followed by *Andrena* sp. (18077.5). *Vespa orientalis* wasp had the highest numbers of pollen grains (17932.5) and *Eumenes punctatus* (4140) had the lowest numbers of pollen grains among all wasp species. The numbers of pollen grains recovered from butterflies revealed maximum numbers from *Z. karsandra* (6445.8) followed by *D. chrysippus* (5892.5) (Table 1).

Pollination is an important ecosystem service responsible for better yield in plants. Different plant species have different requirements for effective pollination and some plants solely depend on insects for pollination [16]. Many insect species visit flowers of plants but only a few insect species are effective pollinators. The visitation rate and frequency of pollinators may be influenced by a number of flower and pollinator characters including floral structure, type and quantity of floral rewards, instinctive forging behavior, length of proboscis, hours of the day and environmental conditions [17-22]. In the current study bees were observed as the most important and frequent pollinator of *C. aphylla* while wasp and butterflies were less frequent visitors. The bee *Amegilla* sp. had the maximum abundance followed by maximum visitation rate, frequency and pollen load. So, *Amegilla* sp. is regarded as the effective pollinator of *C. aphylla.* In other studies, bees have been reported as effective pollinators of a majority of the flowering plants [23, 24]. This is due their hairy body to carry large numbers of pollens, high searching ability. *Amegilla* sp. has been reported to respond well to both minimum and maximum temperature while relative humidity (minimum and maximum) and rainfall had negative impact on the foraging behavior of *Amegilla* sp. [25]. In the current study, *Amegilla* sp. was found as effective pollinator of *C. aphylla* which may be due to its high ability to withstand high temperature (28-49 ºC) during the flowering seasons as compared to other pollinator species at Dera Ghazi Khan, Punjab, Pakistan.

**Table 1:** Abundance, visitation rate, visitation frequency and pollen load of different insect species visiting the flowers of *C. aphylla* at Dera Ghazi Khan, Punjab, Pakistan

| Order | Taxonomic group | Family | Genus/Species | Total abun-dance | Visitation rate (No. of flowers visited/min) (N=40) | Visitation frequency (Individuals/flower/5 min) (N=200) | Pollen load |
|---|---|---|---|---|---|---|---|
| Hymenoptera | Bees | Apidae | *Amegilla* sp. | 760 | 20±1.22 | 3.38±0.12 | 20432.5±1025 |
| | | Megachilidae | *Megachile bicolor* | 60 | 6.1±0.42 | 0.62±0.18 | 6865±345 |
| | | | *Megachile* sp. | 39 | 3.47±0.47 | 0.62± 0.19 | 6922.5±135.3 |
| | | Andrenidae | *Andrena* sp. | 176 | 4.4±0.3393 | 1.1±0.12 | 18077.5±965.4 |
| | Wasp | Vespidae | *Eumenes punctatus* | 282 | 6.425±0.18 | 1.32±0.14 | 4140±250 |
| | | | *Ropaldia marginata* | 34 | 11.3±0.788 | 0.17±0.16 | 16517.5±834.4 |
| | | | *Vespa orientalis* | 38 | 2.95±0.24 | 0.19±0.72 | 17932.5±1256 |
| Lepidoptera | Butterflies | Danaidae | *Danaus chrysippus* | 41 | 2.75±2.68 | 0.26± 0.92 | 5892.5±225.1 |
| | | Lycaenidae | *Zizeeria karsandra* | 110 | 10.35±0.39 | 0.61±0.84 | 6445.8±280.3 |

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