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### Original Article

## Diversity of Insect Pollinators Visiting Rohi Sarson (*Brassica Juncea L.*) in Southern Punjab, Pakistan

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### ABSTRACT

Rapeseed is an important oilseed crop in Pakistan, and its yield can be significantly improved through insect pollination. **Objective:** To explore the diversity of insect pollinators visiting the rapeseed crop (locally known as Rohi Sarson, *Brassica juncea*) in Panjgrain, District Bhakkar, Southern Punjab, Pakistan. **Methods:** This Descriptive ecological survey was conducted in Panjgrain, District Bhakkar, Southern Punjab, Pakistan. The crop was grown in October 2024 and flowered from February to April 2025, which coincided with the period of pollinator activity. During this time, data were collected using a cone-type hand net at regular intervals from 10:00 AM to 4:00 PM, when insect activity was at its peak. Captured specimens were preserved and later identified using standard taxonomic methods and online identification tools. **Results:** A total of 18 insect species were recorded visiting the rapeseed flowers. These species were represented by four major insect classes, namely: Hymenoptera, Diptera, Lepidoptera, and Coleoptera. The best group was Hymenoptera, which comprised different species of honeybee and carpenter bee, mining bee, and paper wasp. It was also found that the dominant pollinators were the honeybees, which defined the production level and quality of the crop. Insects, such as hover flies, butterflies, and beetles, also contributed complementarily to pollination. The pollinators were affected by environmental factors, including temperature, sunlight, and time of day. **Conclusions:** The study concluded the significant role of insect pollinators in rapeseed production and indicated that sustainability in pollinator diversity on the farm enhances crop output with the help of pollinator-friendly farming systems.

### INTRODUCTION

In the plant family Cruciferae, rapeseed is one of the significant plant crops, grown as oilseed in Pakistan. Rapeseed has been produced primarily to use oil, which serves both cooking and industrial needs [1]. The rapeseed also forms Rapeseed oil and Canola oil, where it contains very low quantities of erucic acids (less than 2 per cent) and glucosinolates (less than 30 U mole/g of oil) to be fit to utilize in humans [2]. Rapeseed is grown in all provinces of Pakistan over an area of 26.02 thousand hectares with an annual yield of 812 kg/hectare [3]. Attock, Rawalpindi, Jehlum, Chakwal and Faisalabad are the major rapeseed growing areas in Upper Punjab while in Lower Punjab, the major rapeseed growing areas are Multan, Muzaffargarh, Bahawalpur, Rahim Yar Khan and Bhakkar. In Pakistan, the

primary cultivated rapeseed species are *Brassica napus* (gobhi sarson), *Brassica juncea* (raya), and *Eruca sativa* (taramira). Within these species, various cultivars are grown, including Khanpur Raya, Anmol Raya, Punjab Canola, and others [4]. "Rohi Sarson" refers to Rohi, a new high-yielding rapeseed variety released for irrigated areas in central and south Punjab (lower Punjab), Pakistan. It is also known as a type of mustard seed. The variety is characterized by its high yield, early maturity, and good quality oil. Rapeseed is largely self-fertilized; however, the presence of insect pollinators greatly enhances its yield, seed quality, and oil content. Insect pollination plays a crucial role in crop production, as it impacts both the quality and quantity of yields [5,6,7]. Among pollinators,

honeybees (*Apis mellifera*) [8] are the most effective agents. Studies have shown that fields with active bee visitation can experience up to a 20–30% increase in seed yield compared to non-pollinated or wind-pollinated crops [9]. The mutual benefit between rapeseed crops and pollinators is significant. While bees enhance crop productivity, the rapeseed flowers provide nectar and pollen during early spring when floral resources are limited [10, 11, 12, 13]. The insect pollinators diversity in the region of Southern Punjab is, however, incomplete, in particular, in regions such as Panjgrain, District Bhakkar. The literature has concentrated more on other areas, and the contribution that non-bee pollinators in rapeseed farming is quite insignificant. The research study bridged this gap by recording the available species of pollinators in the area that were critical to enhancing food production and popularizing pollinator-friendly agricultural strategies. This study aimed to explore the diversity of insect pollinators visiting the rapeseed crop in Panjgrain, District Bhakkar, Southern Punjab, Pakistan.

## METHODS

The current research was carried out at a rural area called Panjgrain in Southern Punjab in District Bhakkar, Pakistan, located at the coordinates W6F9+QXW, Shah Alam, Panjgrain. Description: The study was an ecological survey that was conducted during the flowering season of *Brassica juncea* (February–April 2025) in Panjgrain, Bhakkar, to document the insect pollinator diversity and the abundance. The region is agricultural land because of these productive plains and climatic properties of the land, which result in high production of oilseed crops like Canola (*Brassica juncea*), commonly referred to as Rohi Sarson. The flowering season of Rohi Sarson is between February and April, and the weather in the area is usually moderate with a temperature of not more than 25°C and low humidity, and sufficient daylight that is suitable to be pollination by insect pollinators and the flowering of crops. In the present research study, the Rohi Sarson crop was planted in October 2024. Pollination started in early February and lasted up to April 2025, what is coincided with the research time. These months have been chosen cautiously to make pollinator observations because the floral resources are plentiful at this time, and the insects are active in their foraging behavior. The agro-climatic condition of the area, along with Rohi Sarson's flowering stage, offered a suitable environment to study the diversity in insect pollinators of Rohi Sarson (Figure 1).



**Figure 1:** Rohi Sarson fields in Panjgrain, District Bhakkar, Punjab, Pakistan

The insect pollinators observed during the flowering period at the Rohi Sarson (*Brassica juncea*) crop in the month of February to April 2025 had been recorded. The cone-type hand net, which is a common entomology tool used to sample flower visiting insects, was on offer to sample the flower-visiting insects since active pollinators can be captured without causing much havoc to the plants. The insect pollinator was sampled in the form of random transect walks every two hours between 1000 and 1600 hours (10:00 AM to 4:00 PM), the period at which this insect pollinator is active at the highest level given optimal light and temperature conditions. Within each of the periods, systematic sweep netting was done in the sites of the crop field which were flowering. Caught insects were stored precisely into the killing jars with ethyl acetate and subsequently pinned, spread and labeled in an ordinary entomological tradition. Insect collection boxes containing naphthalene were used, after which the specimens were placed. The specimens that had been gathered were put into entomological boxes to be used in the lab to identify the taxon and measure the diversity further. This technique enabled an effective sampling of a vast number of insect pollinators, hence the validity of data that could be utilized in the analysis of their diversity and abundance in the Rohi Sarson crop ecosystem. Identification and classification of insect samples collected were done through available online taxonomic sources and also morphology. Specimens were grouped into large insect orders and families pertinent to pollination, such as, Hymenoptera (bees and wasps), Diptera (flies), Lepidoptera (butterflies and moths), and Coleoptera (beetles). In order to identify correctly, standard keys and field guides on insect identification and entomology were used. Furthermore, a range of online databases and websites of good quality were consulted to help in identifying species at the lowest level. Of these sites, BugGuide.net, iNaturalist and the Integrated Taxonomic Information System (ITIS) offered the most value because of the detailed pictures coupled with a hierarchy of taxonomy and a community of experts who can help. Such an integration of the morphological analysis and the digital tools of identification made it possible to make a dependable classification of the insect pollinators visiting the Rohi Sarson crop, and gave the basis to assess the perceived diversity of the pollinators in the

study region. Data were collected on 12 field trips, and each field trip was taken in regular intervals between 10:00 AM and 4:00 PM in the time of flower maturity. To obtain consistency, three replicates of sweep net sampling were done in each visit. The relative abundance and frequency of each species of insect were noted. The analysis of data was performed with IBM SPSS Statistics, version 27.0. The descriptive statistics were used, and  $p < 0.05$  was assigned.

## RESULTS

The main aim of the data analysis in this research study was to list and describe the various insect species that would visit the flowers of Rohi Sarson (*Brassica juncea*) when it is in a flowering phase between February to April 2025. Identification of the variety of insect species was vital because they visit flowers, but not their frequency or population patterns. Each collected specimen was examined and identified using morphological features and verified through reliable insect identification resources. The analysis involved determining the common name, scientific name, and taxonomic classification (Order, Family, Genus, and Species) of each visitor species. Specifically, the average temperatures, humidity, and high sunlight levels in the period of flowering provided comfortable circumstances of foraging and floral visitation. Identified species were organized systematically and presented in tabular form for clarity (Table 1).

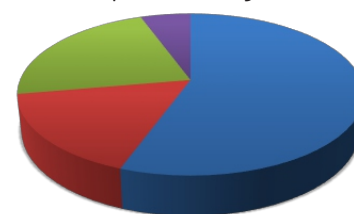
**Table 1:** Insect Pollinators on Rapeseed Crop in Panjgrain

Sr. No.	Common Name	Scientific Name	Order	Family
1	Eastern honeybees	<i>Apis cerana</i>	Hymenoptera	Apidae
2	European honeybees	<i>Apis mellifera</i>	Hymenoptera	Apidae
3	Giant honeybees	<i>Apis dorsata</i>	Hymenoptera	Apidae
4	Dwarf's honeybees	<i>Apis florea</i>	Hymenoptera	Apidae
5	Indian honeybee	<i>Apis indica</i>	Hymenoptera	Apidae
6	Stingless honeybee	<i>Melipona marginata</i>	Hymenoptera	Apidae
7	Carpenter bee	<i>Xylocopa fenestrata</i>	Hymenoptera	Apidae
8	Mining bee	<i>Andrena aegyptiaca</i>	Hymenoptera	Andrenidae
9	Paper wasp	<i>Polistes olivaceus</i>	Hymenoptera	Vespidae
10	European Hover fly	<i>Eristalis tenax</i>	Diptera	Syrphidae
11	Syrphid fly	<i>Eupeodes bacculatus</i>	Diptera	Syrphidae
12	Marmalade hoverfly	<i>Episyrphus balteatus</i>	Diptera	Syrphidae
13	Cabbage butterfly	<i>Pieris brassica</i>	Lepidoptera	Pieridae
14	Blue butterfly	<i>Zizina Otis</i>	Lepidoptera	Lycaenidae

15	Painted lady butterfly	<i>Vanessa cardui</i>	Lepidoptera	Nymphalidae
16	Monarch butterfly	<i>Danaus chrysippus</i>	Lepidoptera	Nymphalidae
17	Lady bird beetle	<i>Coccinella septempunctata</i>	Coleoptera	Coccinellidae

During the flowering period of Rohi Sarson (*Brassica juncea*) from February to April 2025 in Panjgrain, Southern Punjab, a variety of insect species were observed visiting the crop. A total of 18 distinct insect species belonging to four major insect orders—Hymenoptera, Diptera, Lepidoptera, and Coleoptera—were identified as flower visitors.

A total of 18 insect species were documented in 4 insect orders with Hymenoptera (61 %), Diptera (17 %), Lepidoptera (11 %) and Coleoptera (11 %). These included the most predominant honeybees of the genus *Apis* (about 52 percent of all bees counted) and honeybees of the genus *Melophorus* (about 48 percent) (Figure 2).



■ Hymenoptera ■ Diptera ■ Lepidoptera ■ Coleoptera

**Figure 2:** Taxonomic Diversity of Insect Pollinators Rohi Sarson (*Brassica Juncea*)

Among these, the order Hymenoptera was the most represented, with ten species recorded. These included five species of honeybees: *Apis cerana* (Eastern honeybee), *Apis mellifera* (European honeybee), *Apis dorsata* (Giant honeybee), *Apis florea* (Dwarf honeybee), and *Apis indica* (Indian honeybee). Additionally, *Melipona marginata* (Stingless honeybee), *Xylocopa fenestrata* (Carpenter bee), *Andrena aegyptiaca* (Mining bee), and *Polistes olivaceus* (Paper wasp) were also noted, reflecting the strong presence and diversity of pollinators from the Apidae, Andrenidae, and Vespidae families. The order Diptera was represented by three hoverfly species: *Eristalis tenax* (European hover fly), *Eupeodes bacculatus* (Syrphid fly), and *Episyrphus balteatus* (Marmalade hoverfly), all from the family Syrphidae. These flies were commonly seen hovering over and landing on Rohi Sarson flowers during the day. From the order Lepidoptera, four butterfly species were recorded: *Pieris brassica* (Cabbage butterfly), *Zizina otis* (Blue butterfly), *Vanessa cardui* (Painted lady), and *Danaus chrysippus* (Monarch butterfly), belonging to three different families—Pieridae, Lycaenidae, and Nymphalidae. One beetle species from the order Coleoptera, *Coccinella septempunctata* (Lady bird beetle), was also identified, indicating occasional floral visitation by beetles. The



predominance puts them at the focus of pollination of rapeseed (*Brassica juncea*) in the region (Figure 3).



**Figure 3:** Honeybees Gathering Nectar Over Rohi Sarson Flowers

## DISCUSSION

The present study focused on identifying insect pollinators visiting Rohi Sarson (*Brassica juncea*) flowers in the agricultural region of Panjgrain, Southern Punjab, during the flowering season from February to April 2025. The identified pollinators belonged to four major insect orders: Hymenoptera, Diptera, Lepidoptera, and Coleoptera. This diversity indicates the ecological adaptability of Rohi Sarson flowers in attracting a wide range of pollinators [14]. The dominance of bees (Hymenoptera), particularly species from the genus *Apis*, is consistent with findings from earlier studies on mustard and Rohi Sarson crops [14, 15, 16]. Species such as *Apis mellifera*, *A. cerana*, and *A. dorsata* are known to be highly efficient pollinators due to their flower fidelity and morphological adaptations that enhance pollen transfer [17]. Similar results were reported by researchers in various regions of South Asia, confirming the central role of honeybees in mustard-family crop pollination [15, 16]. Hoverflies (Diptera: Syrphidae) and butterflies (Lepidoptera) also contributed notably to floral visitation. Although these groups are generally considered less efficient than bees, their high mobility and regular presence at flowers enhance overall pollination [18, 19]. Studies have shown that flies and butterflies complement bee activity, especially under variable weather conditions when bee foraging may decline [19]. The observed pollinator diversity and activity were influenced by several environmental factors. Weather conditions, particularly temperature, sunshine, and wind, played a key role in determining daily insect activity (20). In addition, floral density and the availability of nectar and pollen likely influenced the attractiveness of Rohi Sarson plants to different insect groups. Pollinators were most active during clear, sunny periods between 10:00 AM and 4:00 PM, corresponding with optimal foraging conditions [17]. From an agricultural perspective, the presence of a wide range of pollinators has important implications. It suggests that Rohi Sarson production in the region benefits not only from managed bee colonies but also from wild insect

populations. Conserving this pollinator diversity is essential for maintaining crop yields, seed quality, and ecosystem health (21). The findings emphasize the need for pollinator-friendly farming practices, such as reduced pesticide use and the preservation of natural habitats around crop fields. This study was based on visual observation and hand-net collection, so some very small or night-active (nocturnal) pollinators might not have been recorded. Also, changes in weather like unusual rain or temperature can affect insect activity. The research was done only in one area and during one flowering season, so the findings may not fully represent all of Southern Punjab.

## CONCLUSIONS

In summary, the study highlights the ecological importance of diverse insect pollinators in Rohi Sarson cultivation and reinforces the need to protect these beneficial organisms for sustainable agricultural development. This study was also narrowed to a single season in a single location, which is a limitation to pollinator diversity in terms of space and time. The study must be extended across seasons and sites of study in the future. The superiority of the *Apis* species raises the importance of the conservation of the native pollinators, via minimizing the use of pesticides and implementing pollinator-friendly agriculture to support sustainable crop production.

## Authors Contribution

Conceptualization: MSK

Methodology: MP

Formal analysis: MSK, MP

Writing review and editing: MSK

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

All the authors declare no conflict of interest.

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