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Abundance of insect pollinators in cowpea

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Abstract
During the 2023 kharif season, the Central Research Farm, Naini Agricultural Institute, SHUATS, Prayagraj, undertook research on the Abundance of insect pollinators in cowpea in Trans-Yamuna region. five insect pollinators visits were identified in cowpea. *Apis dorsata*, *Apis cerena indica*, *Apis mellifera*, *Danus chrysippus*, and *Polyommatus icarus*. *Apis mellifera* was the most common, with 36.48% of visits. *Apis cerena indica* and *Apis dorsata* followed with 31.73% and 23.16%. *Danus chrysippus* and *Polyommatus icarus* had fewer visits. This highlights the importance of honeybees for cowpea pollination. The study also looked at how weather affects these pollinators. Data on temperature, humidity, rainfall, and sunshine were collected on the same dates. There was non-significant correlation found between the number of insect visitation in cowpea and the following factors: temperature, sunshine, relative humidity, and rainfall. The only significant finding was that humidity strongly influenced *Polyommatus icarus* (r = 0.836, p<0.05). Other weather factors did not significantly affect pollinator numbers. These results suggest that humidity is important for some pollinators, which can help improve crop management and pollination.

Keywords: Abundance, composition, environmental factor, humidity, insect, pollination, season, species, sunshine, temperature, visitors

Introduction
A pollinator is a biotic agent that facilitates fertilization, or "syngamy," by moving pollen grains from a flower's male anther to its female stigma (Faegri and Pijil, 1979) [4]. Insect pollinators, particularly honey bees, are essential to pollination and are among the least expensive and environmentally benign inputs for increasing the yields of cross-pollinated crops (Mane, 2003) [8]. Pollination, the transfer of pollen crucial for plant reproduction, is facilitated by diverse pollinators such as bees, butterflies, flies, birds, and bats. According to scientific studies, these pollinators play a critical role in global agriculture, enhancing crop yields and maintaining biodiversity (Klein *et al*., 2007) [7]. Honey bees, in particular, contribute significantly, accounting for 63% of global pollination efforts (Patidar *et al*., 2017) [9]. Conservation of pollinator diversity is essential for sustainable food production and ecosystem resilience, supported by research advocating for reduced pesticide use and habitat preservation (Joshi, 2018; Kumar and Jaiswal, 2012) [5, 7]. Understanding these relationships is vital for securing food supplies and environmental health in the face of agricultural challenges (Calderone, 2012) [3].

Objectives
1. To establish the species structure, composition, and abundance of insect pollinators of cowpea.
2. Effect of weather parameters on population of insect pollinators in cowpea

Materials and Methods
A survey was conducted at the Central Research Farm (CRF) of Sam Higginbottom University of Agriculture, Technology and Sciences" Prayagraj, Uttar Pradesh during the kharif season 2023 for the insect pollinators visiting the crops mentioned above. The pollinators visiting on flower head were collected with the help of sweep nets, properly processed, pinned, dried and were identified with the help of available taxonomic literature and keys in the Department of Entomology Naini Agricultural Institute.

Observations all flower visiting insect pollinators were collected at different hours of the day i.e., 6:00-7:00, 7:00-8:00, 8:00-9:00, 9:00-10:00, 10:00-11:00, 11:00-12:00, 12:00-13:00, 13:00-14:00, 14:00-15:00, 15:00-16:00, 16:00-17:00, 17:00-18:00 and 18:00- 19:00 hours from selected kharif crops which mentioned above already. Observations were taken from each square meter area from five random spots for five minutes in every time period. Sweep net sampling method of collection were adopted for the observations.

Weekly data on mean atmospheric temperature (ºC), mean relative humidity (%), rainfall (mm) and sunshine (hrs.) were recorded for the experimental period during kharif season of 2023. In order to study the influence of key abiotic factors on the population abundance and species richness of major insect pollinators, simple correlations were worked out between the population of insect pollinators and abiotic factors by the following method given by Karl Pearson (1973). Statically analysis and calculation done through by (OPSTAT) software.

Results and Discussion

In the cowpea fields, the most abundant order observed among the pollinator species was Hymenoptera, represented by families Apidae and Vespidae. Among these, the family Apidae was the most abundant, with species such as *Apis cerana indica*, *Apis mellifera*, and *Apis dorsata*. Apidae contributed significantly to the total abundance, with *Apis cerana indica* being the most abundant species, with an abundance of 232.9 individuals and a relative abundance of 31.73%. European honey bee (*Apis mellifera*) also showed significant abundance, with 267.75 individuals (36.48% relative abundance). *Apis dorsata*, another significant pollinator, had an abundance of 170 individuals and a relative abundance of 23.16%. Conversely, the order Lepidoptera was represented by the families Nymphalidae and Lycaenidae with species such as *Danus chrysippus* and *Polyommatus icarus*. *Danus chrysippus* was the least abundant species, with an abundance of 22.8 individuals and a relative abundance of 3.11%. *Polyommatus icarus* had an abundance of 40.6 individuals and a relative abundance of 5.53%.

The population dynamics of insect visitors on cowpea inflorescences were observed overa six-week period. Mean temperature ranged from 27.6°C to 33°C, with the highest mean temperature recorded at 33°C. Mean relative humidity ranged from 67.5% to 82.5%, with the highest humidity recorded at 82.5%. Rainfall was observed only once, with a total of 6.8 mm. Sunshine hours varied from 4 to 9 hours, with the lowest recorded at 4 hours and the highest at 9 hours. Among the insect visitors, *Apis dorsata* showed the highest population throughout the observation period, with a peak population of 33.8. The population of other insect species variedduring the observation period: *Apis cerena indica* (peak population of 47.2), *Apis mellifera* (peakpopulation of 51.6), *Danus chrysippus* (peak population of 4.4), and *Polyommatus icarus* (peak population of 8.8). Correlation analysis revealed significant relationships between insect population and environmental variables. There was a positive and significant correlation betweeninsect population and mean relative humidity for all species except *Polyommatus icarus* (r = 0.836, *), with coefficients ranging from r = 0.496 to r = 0.650, all significant at $p<0.05$. Similarly, there was a significant positive correlation between insect population and rainfall for*Apis cerena indica* (r = 0.775, $p<0.05$) and *Polyommatus icarus* (r = 0.749, $p<0.05$), while for other species, the correlation was not significant. Sunshine hours showed a positive but not significant correlation with insect population for all species.

Further, literature review revealed similar studies conducted on different crops and in various regions. Tesfaye *et al*. (2020) [18] observed seven insect species on coriander (*Coriandrum sativum*) flowers, with Apis mellifera being the dominant species. Kavadana *et al*. (2022) studied the foraging behavior and pollination efficiency of bees visiting sesame (*Sesamum indicum*) crops, where Apis dorsata and Apis mellifera were the most abundant species. Mohanty *et al.* (2023) examined the influence of weather parameters on the foraging activity of Apis cerana indica and found significant differences in foraging activity between coastal and interior regions in Odisha, India. Sinaga *et al*. (2024) [13] investigated the diversity and foraging activity of coffee insect pollinators in North Sumatra, Indonesia, and found that proximity to forests influenced pollinator diversity and abundance.

Table 1: Relative abundance of pollinators during different hours in Cowpea

Species	Number of pollinators visited in different date						Total	Relative abundance (%)
	27.08.2023	03.08.2023	10.09.2023	17.09.2023	24.09.2023	01.10.2023		
Apis dorsata	29±2.34	28.4±2.54	33.8±2.52	30.8±2.18	30±2.31	18±1.63	170	23.16
Apis cerena indica	37±2.80	38.8±2.57	47.2±3.14	41±2.99	37.9±3.11	31±2.68	232.9	31.73
Apis mellifera	34.2±2.07	43±2.71	51.6±2.93	52.6±3.21	41±2.53	45.35±2.11	267.75	36.48
Danus chrysippus	3±0.49	3.8±0.63	4.4±0.69	4.4±0.69	3.2±0.56	4±0.79	22.8	3.11
Polyommatus icarus	6±0.77	6±0.87	8.8±1.06	7.8±1.09	6.8±1.23	5.2±0.81	40.6	5.53
Total							734.05	

*Total numbers of pollinators visited in a day which was observed at an hourly interval
#±Standard deviation of mean

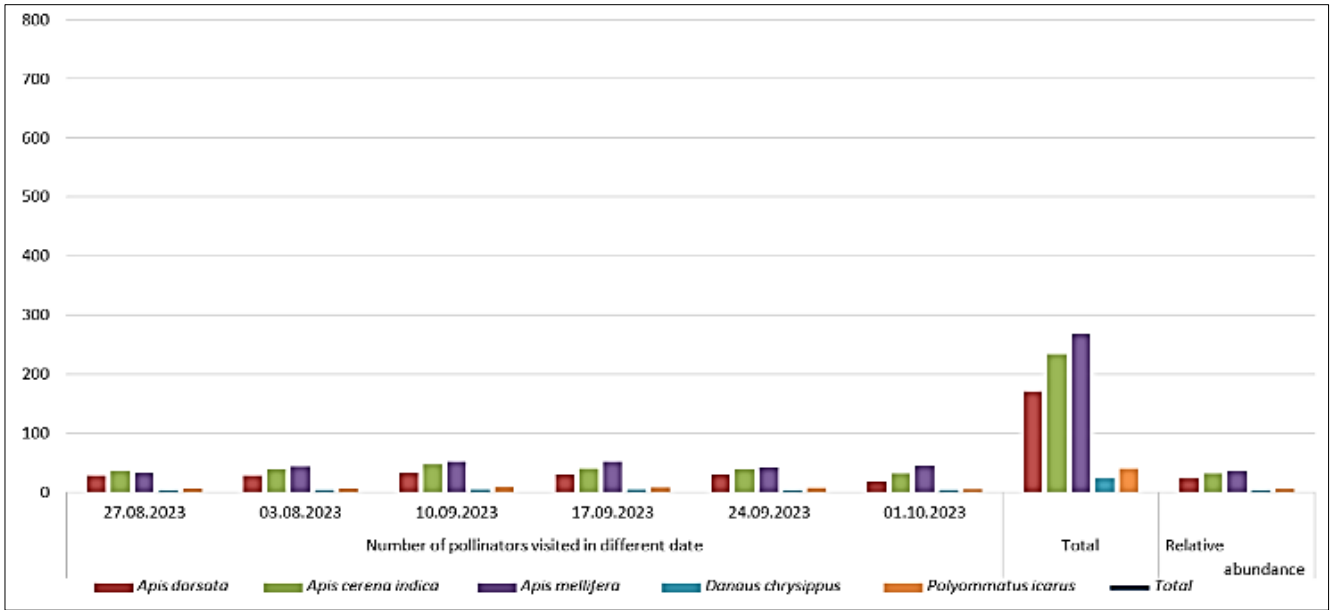

Fig 1: Richness of pollinators during different time period in cowpea

Table 2: Effect of weather parameters on population of insect pollinators in cowpea

Date of Observation	Mean Temp (◦C)	Mean RH (%)	Rainfall (mm)	Sunshine (Hrs.)	*Apis dorsata*	*Apis cerena indica*	*Apis mellifera*	*Danus chrysippus*	*Polyommatus icarus*
27.8.2023	31	75.5	0	4	29 (5.43)	37 (6.12)	34.2 (5.89)	3 (1.87)	6 (2.55)
03.09.2023	33	67.5	0	9	28.4 (5.38)	38.8 (6.27)	43 (6.60)	3.8 (2.07)	6 (2.55)
10.09.2023	30.1	82.5	6.8	5.6	33.8 (5.86)	47.2 (6.91)	51.6 (7.22)	4.4 (2.21)	8.8 (3.05)
17.09.2023	29.4	79.5	0	7.8	30.8 (5.59)	41 (6.44)	52.6 (7.29)	4.4 (2.21)	7.8 (2.88)
24.09.2023	28.8	76	0	6	30 (5.52)	37.9 (6.20)	41 (6.44)	3.2 (1.92)	6.8 (2.70)
01.10.2023	27.6	72.5	0	4.6	18 (4.30)	31 (5.61)	45.35 (6.77)	4 (2.12)	5.2 (2.39)
Coefficient of correlation (r) between population and mean temperature					0.449NS	0.353NS	-0.260NS	-0.155NS	0.019NS
Coefficient of correlation (r) between population and mean relative humidity					0.559NS	0.650NS	0.496NS	0.365NS	0.836*
Coefficient of correlation (r) between population and rainfall					0.496NS	0.775NS	0.496NS	0.495NS	0.749NS
Coefficient of correlation (r) between population and Sunshine					0.302NS	0.299NS	0.404NS	0.382NS	0.195NS

#Data in parenthesis are squire root transformed values $\sqrt{x}+0.5$ NS: Non-significant
*: Significant at 0.05% **: Significant at 0.01%

Conclusion

According to the result we conclude that cowpea there were five insect species were visited on flowers and observed that *Apis mellifera* (36.48%) was most abundant. In cowpea the abundance of *A. dorsata A. indica*, *A. mellifera*, *Danus chrysippus* and *Polyommatus icarus* was found to exhibit a non-significant association with temperature, sunshine, relative humidity, and rainfall. But the Polyommatus icarus were significant to relative humidity.

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