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PREDATORY BEHAVIOUR OF CRAB SPIDER *THOMISUS* SP

Ajit Pandey[1], Rakesh Pandey[1]*, Shailendra Kumar Mishra[1], Ankit Kumar Mishra[1], and Brajrajsharan Tiwari[1]

[1]Department of Entomology, Banda University of Agriculture and Technology, Banda 210001, Uttar Pradesh, India
*Email: pandeyent@gmail.com (corresponding author): ORCID ID 0009-0004-5409-5516

ABSTRACT

The study delves into the predatory behaviour of the crab spider, *Thomisus* sp. (Araneae: Thomisidae) bringing out its remarkable ability to mimic the *Cajanus cajan* flower. This mimicry proves to be a strategic advantage in capturing larger prey, such as the honey bee (*Apis dorsata* and *A. florea*) and hover fly. By blending seamlessly with the yellow corolla of the flower, it achieves effective colour camouflage, positioning itself beneath the standard petal. This deceptive tactic allows the spider to conceal and ambush its unsuspecting prey, highlighting the intricate interplay between spider behaviour and plant style in the predation process.

Key words: Araneae, thomisid spiders, camouflage, kleptoparasitism, mimicry, pollinators, predatory tactics, yellow, corolla, petal, deception

Spiders are diverse groups of invertebrate's which play an important predatory role in agroecosystem (Saranya et al., 2019). Spiders exhibit a tendency to visit flowers, showcasing specific adaptations in sensory mechanisms and these play a crucial role in their ability to recognize and engage with host flowers (Knauer et al., 2018). The Thomisidae family members typically exhibit a distinctive crab-like appearance, characterized by a short and broad carapace and abdomen. Their eyes are small, arranged in two rows, with the posterior ones often encircled by black rings. The first two pairs of legs are long and stout, resembling the sideways movement of crabs. Unlike other spiders, Thomisidae don't spin webs; instead, some species swiftly pursue prey, while others, with a slower pace, wait in ambush, often blending with their surroundings (Biswas and Raychaudhuri, 2023). Among the predatory strategies, mimicry and camouflage emerge as highly effective mechanisms, with a specific focus on a form of predation where the predator functions unnoticed by the prey, ensuring a successful set-up process.

The strategic use of camouflage or mimicry not only aids in evading predators but also deceives prey, making them go unnoticed and easily trapped. This adaptive strategy underscores the predators' expertise in utilizing flowers as platforms for feeding activities, ensuring successful prey acquisition through the application of camouflage and mimicry (Shweta et al., 2023). *Thomisus* sp. cleverly utilizes the visual attributes and structure of flowers as a strategic base for its predatory actions. Notably, during times of scarce pollinators, these spiders adapt by also consuming the flower's pollen and nectar, ensuring their prolonged survival (Vogelei and Greissl, 1989). Furthermore, when female crab spiders mimic various flower species, they achieve a dual camouflage, remaining inconspicuous in the color-vision systems of both avian predators and hymenopteran prey. The members of the genus *Thomisus* are new to Bundelkhand area. The interaction between the predator and prey is quite interesting in case of *Thomisus* sp., investigation. Hence, this study of the predation patterns observed in *Thomisus* sp., with a focus on its use of *Cajanus cajan* flowers as a strategic hunting ground.

MATERIALS AND METHODS

Observations were carried out in the field of *C. cajan* at Entomological Research Blocks of Banda University of Agriculture and Technology Banda (24º 53′ and 25º 55′ N 80º 07′ and 81º 34′ E) during January to February 2023 (flowering stage of *C. cajan*) in the day hours when the pollinators visited the flowers. The predatory behaviour of the crab spider *Thomisus* sp. was observed against pollinator bee species and hover fly and these were documented with photographs. Crab spiders were observed in the experimental plots from pre-anthesis to the flowering stage. The places where these typically reside in plants i.e., within corollas of flowers were first identified. At different time intervals, such identified spots were observed to notice the predatory behaviour. Field photographs were taken to illustrate the mimicry and predatory activity. Visual observations were conducted to capture the *Thomisus* sp., which were then collected in specimen tubes for identification. Specimens obtained through visual observation were euthanized with chloroform-soaked cotton strips, individually preserved in a 70% ethyl alcohol, and stored in designated bottles within dark-coloured cardboard boxes. Preservatives were changed occurred every two weeks to prevent the dilution of spider body fluids, ensuring specimen preservation and preventing contamination. The identification of Araneae order was undertaken by Dr. Souvik Sen, Lot No-98/2022 Id & Adv. No 3632 by the Zoological Survey of India, Kolkata.

RESULTS AND DISCUSSION

It was observed that *Thomisus* sp. effectively utilized the *C. cajan* flower as a predation site. A typical papilionaceous flower consists of a vexillum (standard) petal that envelops the alae (wings) and the carina (keel) petals, as depicted in Fig. 1A. This structural arrangement is characteristic of leguminous plants, showcasing a specialized and intricate floral morphology. The flowers of *C. cajan* offer a dual advantage to crab spiders in their predatory strategies against pollinators. The efficiency of this approach stems from the congruence between the spider's coloration and the floral hues, as well as the spider's adept concealment within the inner cavity of the standard petal. This positioning not only aids in evading potential predators but also serves to blend seamlessly with the floral environment, creating conspecificity with both predators and prey. Furthermore, the spider exhibits remarkable dexterity in utilizing the cavae present on the keel petal, facilitating a secure grip on the flower. The strategic manipulation of the standard petal, orchestrated by the spider to create an accommodating orifice for visiting bees, underscores the sophistication of its predatory tactics.

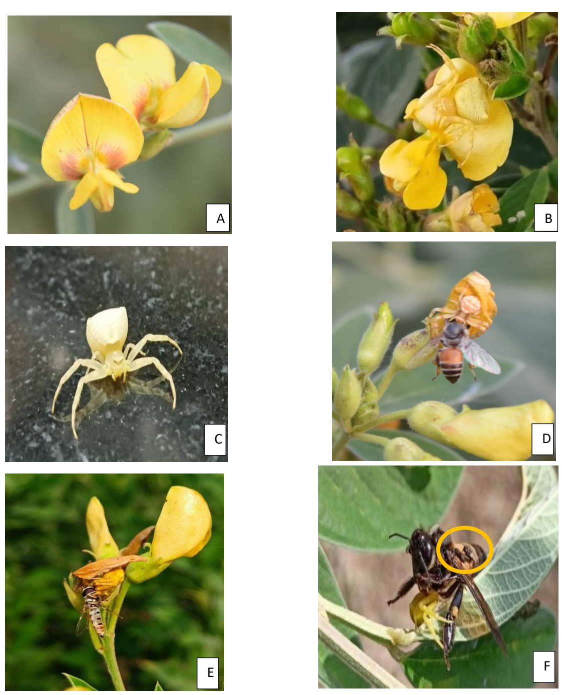

Fig. 1A. Pigeon pea flower with attracting corolla petals B. *Thomisus* sp. mimicking the flower of pigeon pea C. Crab spider, *Thomisus* sp. D. *Thomisus* sp. using its raptorial forelegs to ambush the bee *Apis* sp. E. *Thomisus* sp. ambushing the hover fly with its raptorial forelegs F. Kleptoparasitism interaction between spider, *Apis dorsata* and dipteran fly

These spiders primarily inhabit plants and foliage, seeking refuge under stones and bark during the winters. Some species employ camouflage in flowers, strategically ambushing insects seeking nectar. Their bright colors mimic the flowers they inhabit, ensuring unsuspecting insects become prey before noticing the spider. The spider demonstrated a notable utilization of the wing petal cavae on *C. cajan* to secure a stable grip, as depicted in Fig. 1B. In order to accommodate visiting pollinators, particularly the honey bees (*Apis dorsata* and *Apis florea*) and hoverflies, the spider employs a tactic of pushing the standard petal to create a suitable orifice (Fig. 1B, D). The honey bee, while innocently foraging for nectar, appears unaware of the potential consequences upon entering the flower. The spider adopts a sit-and-wait strategy, capitalizing on the inevitable visits of pollinators collecting nectar as part of their pollination activities.

A solitary visit by a pollinator proves sufficient for the spider to ensnare its prey. Upon the bee's ingress through the created orifice, the spider swiftly executes an ambush, utilizing its raptorial forelegs to impede any escape, ultimately leading to the demise of the prey (Fig. 1E). Kleptoparasitism had also been observed in the present investigation, wherein *Thomisus* sp. and *A. dorsata* engaged in an interaction with a dipteran fly (Fig. 1F). This interaction exhibits a behaviour, where the dipteran fly steals or scavenges resources from the spider. In this context, the fly likely exploits the efforts of the spider or captures its prey, taking advantage of the spider's hard work in hunting or obtaining food. This interaction showcases a dynamic where the fly benefits at the expense of the spider, illustrating a form of parasitism where the fly capitalizes on the spider's efforts to acquire sustenance.

A similar predatory observation was also reported by Shweta et al. (2023), thereby validating the present research findings. Similar deceptive strategies employed by crab spiders, specifically those within the genus *Phrynarachne,* have been documented, as outlined in the findings by Yu et al. (2021). Conversely, observations of *Epicadus heterogaster* indicate a distinct evolutionary pathway, where the spider exhibits the ability to attract pollinators irrespective of specific floral associations, as elucidated by Vieira et al. (2017). In the absence of a papilionaceous corolla in certain flowers, the likelihood of crab spiders being detected increases significantly. Consequently, pollinators exercise caution and tend to avoid visiting such flowers, as highlighted by Antiqueira and Romero (2016). This cautious behaviour on the part of pollinators has been correlated with a noticeable reduction in bee visits, as evidenced by the observations reported by Knauer et al. (2018). These collective findings underscore the varied adaptive strategies employed by crab spiders in the context of floral interactions, shaping their dynamics with both prey and pollinators. The cumulative observations suggest that the colour mimicry employed by crab spiders proves highly effective in both the visual systems of predators and prey. This intricate interplay between colour adaptation, concealment, and behavioural tactics underscores the nuanced strategies employed by crab spiders in optimizing their predation within the context of papilionaceous flowers.

In summary, the exploration of *Thomisus* sp. predatory behaviour, particularly its adept mimicry of the *C. cajan* flower, provides crucial insights into the evolutionary arms race between predators and prey. This study enhances our comprehension of the nuanced ecological relationships at play, emphasizing the co-evolutionary adaptations that shape the interactions between spiders and their larger prey, including bees and hoverflies. Beyond its immediate implications for biodiversity, the findings have broader applications in agriculture, offering potential insights into pest control strategies. Additionally, the research contributes to novel insights in the fields of animal behaviour and ethology, deepening our understanding of the intricate mechanisms behind effective camouflage and ambush tactics in the natural world.

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AUTHOR CONTRIBUTION STATEMENT

All authors contributed equally to the conception and design of the study. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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