International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 19-07-2026, Accepted: 18-08-2026, Published: 02-09-2026
Volume 11, Issue 3, 2026, Page No. 405-408

Characteristic features and nest architecture of wasp species *(Sceliphron coromandelicum)* mud dauber

Maheshwari S[1], Dr. P Sathiyabama[2]
[1] Research Scholar, Mother Teresa Women's University, Kodaikanal, Vilpatti, Tamil Nadu, India
[2] Associate Professor & Head, Department of Zoology, MVM College, Dindigul, Kurumbapatti, Tamil Nadu, India
DOI: https://doi.org/10.66856/ijer.2026.11.3.11298

Abstract
Mud daubers wasps, known for their solitary nesting behaviour, construct distinctive nests using mud, showcasing a remarkable example of insect architecture. This study aims to investigate the nest architecture patterns of selected mud dauber wasp species and to analyze their physic-chemical parameters. Detailed field survey was conducted across selected locations to collect nests of various species such as *Sceliphron coromandelicum*, Morphometric ananysis revealed significant variation in next size, cell arrangement, and mud layering techniques between species and across different environmental conditions. The physic-chemical properties of the nest materials were assessed using XRD, EDAX techniques. Which revealed the presence of minerals such as silica, alumina and iron oxides. Parameters like pH, Moisture content and particle size distribution were also analyzed. These findings suggest that mud dauber wasps exhibit species-specific and site-specific nest-building behaviours, influenced by the availability and composition of local soil materials. The study provided insights into ecological adaptations and bio mineralization strategies of these solitary wasps and contributes to a better understating of their role in natural ecosystems.

Keywords: Mud dauber wasps, nest architecture, XRD, EDAX, ecological adaptation

Introduction

Wasps are an ecologically significant group of insects known for their diverse nesting behaviors and architectural patterns. The construction and design of their nests vary greatly among species, reflecting adaptations to environmental conditions, predation risks, and reproductive strategies. Wasps exhibit a wide range of nesting habits, including underground burrows, paper nests, and mud structures, each serving as a protective environment for their developing offspring. Solitary and social wasps differ in their nest-building techniques. The construction of exposed nests is one of the main characteristics of social life for most polistine wasps (Starr, 1991) [16]. In contrast, solitary wasps, such as those from the Sphecidae family, build nests from mud or dig tunnels in the soil to house their larvae. The architectural complexity of a nest is influenced by factors such as species behavior, habitat selection, climate, and resource availability (Caine, P. B., *et al.*, 2026) [4].

One such solitary wasp is *Sceliphron coromandelicum*, a member of the family Sphecidae, commonly known as mud daubers. This species is widespread in the Indian subcontinent and is easily identified by its characteristic slender black body, long legs, and prominent yellow markings. Unlike social wasps that build large communal nests, *S. coromandelicum* exhibits a solitary lifestyle, with females independently constructing and provisioning nests for their offspring. The nests are made from mud, which the female collects from nearby sources, carrying it in her mandibles to the nesting site (Bulgarella, Mariana, *et al.*, 2026) [3].

One notable example of nest-building behavior is observed in *Sceliphron coromandelicum*, a mud-dauber wasp species that constructs mud nests in protected locations like walls, tree trunks, and rock crevices. The Nests of *Sceliphron coromandelicum* maximum length of 24-28mm. while the abdomen is typically black with a yellow, the thorax displays a variety of yellow markings. (Van der et.al., 1968) The legs are yellow with black femurs and eyes and antennae are black. Females are larger than males, measuring 23 to 25 mm in length, while males are approximately 21 mm in length (Evans 2011, Kim *et al.* 2014) [6]. Its is the only species with yellow marked legs in the United States. The color of the wings is tawny, that build nests out of mud. A distinguishing aspect of *S. coromandelicum* is its nest-building behavior using mud. The female wasp collects moist mud from the environment, transports it in small loads using her mandibles, and constructs flask-shaped or cylindrical cells, typically attached to sheltered vertical surfaces such as walls, rocks, or tree trunks (Iwata, 1976; Rao *et al.*, 1998) [8]. Each cell is stocked with paralyzed spiders that serve as a food source for the developing larva, and the cell is sealed once the egg is laid and provisioning is complete.

They use more mud as a means covering and protecting the whole cluster of cells, thereby forming a smooth appearance, and a uniform nest. The entire nest may attain an area equal to or larger than, size of an average human first (Konstantinou, 2025) [11]. These nests typically consist of multiple chambers, each provisioned with paralyzed prey for the larvae. Like other solitary wasps, Sceliphron species are not aggressive unless threatened. They are sometimes regarded as beneficial due to their control of spider populations, though the spiders themselves may be beneficial in controlling pest insects. Such nesting strategies highlight the intricate relationship between wasp behavior, environmental conditions, and survival mechanisms (Muslim, Ashor Al-etby, and Majeed Faraj Ibrahim, 2026) [12].

Materials and Methods

Study Site

The study was carried out by the around the Dindigul and TamilNadu district. It conducted in selected natural and urban habitats where *Sceliphron coromandelicum* populations were observed actively constructing nests. Locations included tree trunks, building walls, rock crevices, and other sheltered areas favorable for nest building. Environmental parameters such as temperature, humidity, and light exposure were recorded to assess their influence on nest site selection.

Data collection

The nest is obtained from Dindigul, MVM Campus, Gandhigram Campus, and around hill station and other near environmental place and house hold places. The total 100 nest were collected randomly during the period of October to April 2023 (Every Week two to three nests were collected and analyzed) and taken to the laboratory and put in to the plastic bags (10x8x5 cm) under sterilized condition. Out of 100 nests 50 live insects were found to associated with use of mud nests. The wasp nest was brought to persevered under 10% of alcohol and given to Entomology Laboratory for further studies.

Nesting Structures

The architecture of the nests is both species-specific and environmentally adaptive. Studies have shown that the number of cells, their alignment (linear or clustered), and the dimensions of the nest can vary based on temperature, humidity, availability of mud, and site selection (Evans & Eberhard, 1970; Hansell, 2005) [7]. The mud used in nest construction is composed of mineral particles bound together by salivary secretions, forming a strong, water-resistant structure (Blackledge & Pickett, 2000) [1]. The physico-chemical composition of this mud, including pH, particle size, and organic content, contributes to nest durability and influences the development and survival of the offspring.

Usually the nest found on tree trunks, rocks, building walls, window frames, and air conditioners, the nests were occasionally discovered in partially covered areas such as abandoned cars, inside pipes, etc. wet mud is used by female wasps to build their nest. A wasp uses its mandible and prothoracic leg to carry a clay ball and mold it into a circular pot. We observed 3 to 5 number of caterpillars present in a cell on one to three moth species. Adult wasp feed on nectars and developing young growing young ones. Total 100 nests were collected the 25 nests we observed 15 cell and the average length of the nest 5.55cm, long 2.5cm wide and 1.5cm deep(n=15).

Sample architecture

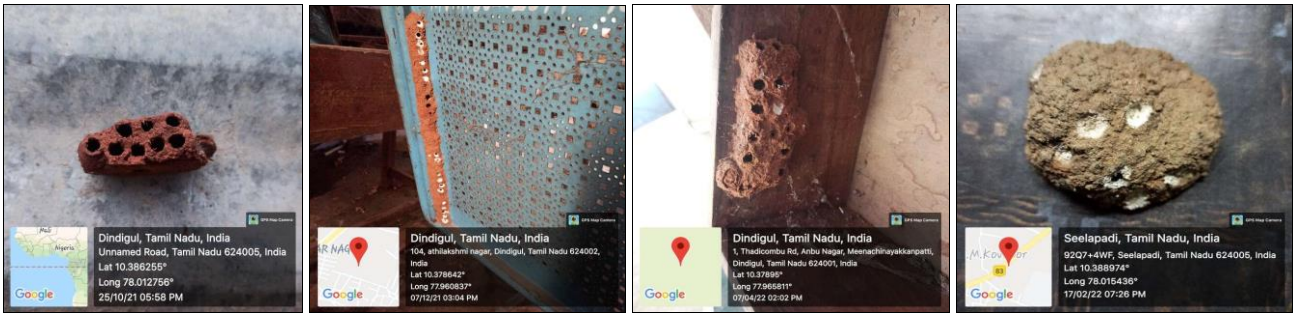


Table 1: Measurements of Nest Parameters

S. No	Parameters	Residential places			Environmental places		
		A	B	C	A	B	C
1	Length (cm)	3.5	4	2.5	2.5	6	2.8
2	Width(cm)	2	2	2	4	3	4
3	Area (LxW)	7	8	5	10	18	11
4	Weight(gm)	10.05	6.05	5.08	10.05	6.05	5.08
5	pH	6.5	6.8	6.7	7.2	7.00	7.5
6	Temperature (^{o}c)	30	30	30	32	32	32
7	Moisture content (%)	1.1	1.4	1.5	1.8	1.7	1.5
8	Dry density(g/cm^{3})	1.15	1.13	1.12	1.17	1.19	1.15
9	Specific gravity	2.71	2.75	2.70	2.80	2.85	2.78
10	Organic content (%)	3.2	2.8	2.8	3.5	3.8	2.9

Element analysis

Different types of nest were collected to respected areas and grained in to pain powder and stored to sterilized vials and labeled. Then the sample are treated with EDAX (Energy Dispersive X-ray Analysis) the technique used for to determine the sample chemical composition the technique used to identify the physical properties of materials. Further, the nest was treated with physic-chemical parameters such as, given table (1 & 2)

Soil texture

Soil texture plays a crucial role in the nesting behavior, distribution, and abundance of wasp species, particularly in relation to nest construction, prey availability, and microhabitat stability.

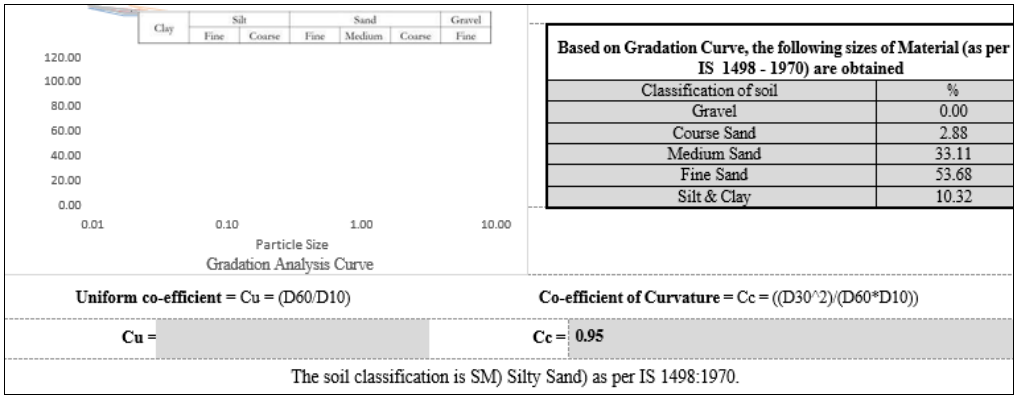


Table 2: Physico- chemical properties of (Sceliphron coromandelicum)

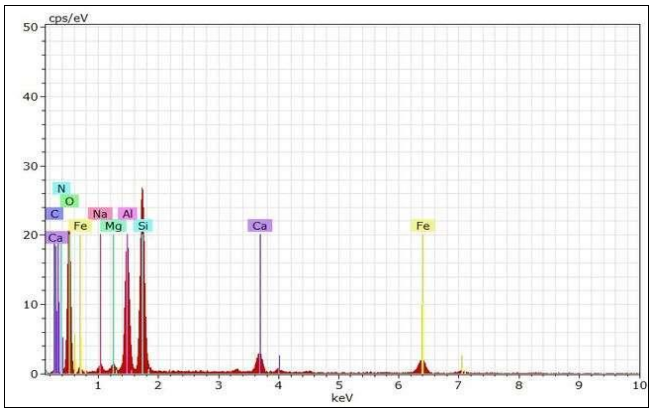
S.no	Name of the test	Result Plain place	Result Hill station	Test method
1	Sodium(ppm)	1132	860	AOAC METHOD
2	Potassium(ppm)	3100	2450	
3	Calcium(ppm)	300	274	
4	Magnesium(ppm)	114	112	
5	Iron(ppm)	6.7	2.8	
6	Zinc(ppm)	0.8	0.6	
7	Phosphorous(ppm)	24.2	21.0	
8	Nitrogen(ppm)	910	875	
9	Manganese(ppm)	1.6	1.5	
10	Boron(ppm)	0.2	0.1	
11	Copper (ppm)	0.6	0.5	

Elemental Analysis

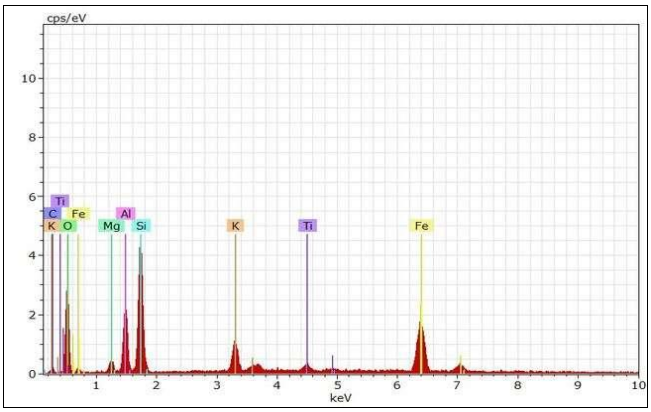
EDAX analyses confirmed the presence of essential minerals in nest construction.

- **Sample A (Hill Station)** had higher concentrations of sodium (1132 ppm), iron (8.2 ppm), and manganese (2.3 ppm), indicating a potential adaptation to mineral-rich soil in hilly terrains. The presence of organic matter might contribute to increased nest durability.

- **Sample B (Plain Place)** showed elevated levels of potassium (3100 ppm) and phosphorus (210 ppm), which could be attributed to agricultural activities in the region. The higher phosphorus content might affect the nest's structural integrity over time.



Graph 1: EDX Analysis Sample A



Graph 2: EDX Analysis Sample B

Result and Discussion

This study was carried out the nest architectural characteristics features and nesting behavior were examined in the wasp species *Sceliphron coromandelicum.* Karsai and Wenzel reported 1998 [10] (1) that V. Velutina observed difference in the nest structure and architectural patterns from other wasp species, with their nest constructions. Turin (1999) and Yuan *et al*., 2022 [17] were reported in S. Caemetarium in Italy with their parasitioids, inquilines and parasitioids of the inquilines. In crimea, a recent study reported that nest of S. destillatorium constitute an important resource for insect species that nest in pre-existing cavities.

Sánchez, X.F.; Charles, R.J. 2017 [15] (2) reported that insect nest construction and architecture highlights a trade-off between thermoregulation and foraging, keeping in mind the need for survival and maintenance of offsprings. Besides the processing of the nest construction importantly the saliva composed the P, Mg, S, Cl, K and Ca. *Sceliphron coromandelicum* mud nests, visibles on superficies, are shielded against water and direct ultraviolet radiation. Some of them were hug, with a solid base, and were challenging to separate. The mud dauber nest showed that mean height from the ground was 53.44±29.86cm and the average length and width were 4.78±1.67 and 2.38±0.44cm respectively. The most of the nest shape was rectangle (96%) and few of them irregular (3%) and nest other substrate was 40% direction followed by north and west direction. The nest substrate nearly 80% of walls and other namely, bamboo poles, strips, cloth, switch box and tables. The maximum nest noted its shows nearly 75% of the nest were inactive, the rest of them being active and were taken further studies such as feed on the chambers.

Soil texture analysis classified the nesting material as silty sand (SM) according to IS 1498:1970, with a dominance of fine and medium sand fractions. This soil type is particularly suitable for mud-dauber nest construction as it provides optimal plasticity when wet and adequate strength

upon drying. The preference for such soil texture highlights an adaptive strategy that ensures nest durability and protection of developing larvae.

Bohart *et al*., 1976 [2] (3) reported the *Sceliphron coromandelicum* is similar to that of Sceliphrom Assimile; all members of the genus Sceliphron build rectangular mud nests made up of the cells. They contain major elements like P, Mg, S, Cl, K and Ca it depends materials collected to the surrounding areas. It has been demonstrated that insects have exceptional behavioral plasticity, as evidenced by their ability to learn and retain a variety of sensory cues that predict rewards. In short term, they also create memories of these experiences that can be retrieved at various points after learning in the short as well as in the long term (Giufa, 2015).

Conclusion

The present study highlights the complex nest architecture and adaptive nesting behavior of the solitary mud-dauber wasp *Sceliphron coromandelicum*. Variations observed in nest dimensions, physico-chemical properties, and elemental composition between plain and hill regions indicate that local environmental conditions, soil texture, and mineral availability strongly influence nest construction. This study contributes valuable baseline information on the nesting ecology and biomineralization strategies of *S. coromandelicum*. Understanding such nesting adaptations is important for appreciating the ecological role of solitary wasps in natural pest regulation and ecosystem functioning.

References

1. Blackledge TA, Pickett KM. Predatory behavior and ecology of Sceliphron wasps. Behavioral Ecology and Sociobiology,2000:48(3):153–163.
2. Bohart RM, Menke AS, *et al*. Sphecid Wasps of the World: A Generic Revision. University of California Press, 1976.
3. Bulgarella M, *et al*. Common wasps, Vespula vulgaris (Hymenoptera, Vespidae), utilise a wide breadth of plants to build nests, as determined via chloroplast metabarcoding. New Zealand Entomologist, 2026, 1–12.
4. Caine PB, *et al*. Architecture of the insect society: comparative analysis of collective construction and social function of nests. Insectes Sociaux,2026:73(1):13–35.
5. Eberhard MJW. The social biology of polistine wasps. Miscellaneous Publications, Museum of Zoology, University of Michigan,1969:140:1–101.
6. Kim *et al*. Nesting behavior and ecological significance of mud dauber wasps (Hymenoptera: Sphecidae) in urban environments of Korea. Journal of Asia-Pacific Entomology,2014:17(3):537–543.
7. Evans HE, Eberhard MJW. The Wasps. University of Michigan Press, 1970.
8. Rao, *et al*. Nesting behavior of the mud-dauber wasp Sceliphron madraspatanum (Fabricius) (Hymenoptera: Sphecidae). Journal of Biosciences,1998:23(5):585–593.
9. Karsai I. Brood Patterns in wasp combs; the influence of brood on egg-laying and building by adults. Ethology Ecology & Evolution,1997:9:27–41.
10. Karsai I, Wenzel JW. Productivity, individual level and colony-level flexibility, and organization of work as consequences of colony size. Proceedings of the National Academy of Sciences USA,1998:95:8665–8669.
11. Konstantinou G, Hadjiconstantis M, Demetriou J. First record of the Asian mud-dauber wasp Sceliphron curvatum (Hymenoptera, Sphecidae) in Cyprus, including an identification key and notes on its possible impacts. Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa",2025:68(1):117–135.
12. Muslim AA, Ibrahim MF. Morphological Characterization and Nesting, Foraging Behavior of Parapolybia escalerae (Meade-Waldo, 1911) (Hymenoptera: Vespidae) in Iraqi Kurdistan. World News of Natural Sciences,2026:65:193–204.
13. Giurfa M, *et al*. Learning and cognition in insects. Wiley Interdisciplinary Reviews: Cognitive Science, 2015, 6(4).
14. Richards OW, Richards MJ. Observations on the social wasps of South America (Hymenoptera, Vespidae). Transactions of the Royal Entomological Society,1951:102:1–170.
15. Sánchez X, Charles RJ. Notes on the Nest Architecture and Colony Composition in Winter of the Yellow-Legged Asian Hornet, Vespa velutina Lepeletier 1836 (Hym.: Vespidae), in Its Introduced Habitat in Galicia (NW Spain). Insects, 2017.
16. Starr CK. The nest as the locus of social life. In: Ross KG, Matthews RW, eds. The social biology of wasps. Cornell University Press, 1991, 520–539.
17. Yuan D, *et al*. Nest ecology and prey preference of the mud dauber wasp Sceliphron formosum (Hymenoptera: Sphecidae). Insects,2022:13(12):1136.