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# Food preferences and foraging activity of the weaver ant, *Oecophylla smaragdina (*Fabricius) (Hymenoptera*:* Formicidae)

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**Abstract**
Weaver ant (*Oecophylla smaragdina*) is an important tree canopy insect population; however, their foraging behaviour is rarely studied. A field experiment was undertaken for three consecutive days in order to evaluate the food preferences and foraging activity of weaver ants. Seven varieties of food (jaggery, sugar, sugar free, honey, dry fish, chicken intestine, biscuit) were investigated to determine the feeding preferences of the weaver ants. Chicken intestine was highly preferred by *O. Smaragdina* (71.23±28.43) compared to the dry fish (22.18±14.80) and sugar (8.26±7.60). At 28$^{0}$C temperature and 100 per cent relative humidity highest foraging activity were observed.

**Keywords:** *Oecophylla smaragdina*, food preference, foraging activity, temperature, relative humidity

## Introduction

Weaver ants, *Oecophylla smaragdina*, are famed for their intricate nests (Sabina *et al.*, 2017) [23].These ants weave the leaves of trees into a closed-circuit construction with many different compartments. On arboreal ants, a number of critical elements impact the process of nest construction (Sanders *et al.*, 2007) [28]. They are, in terms of food and tree or branch kinds, the habitat, but little is known about their foraging habits (Peng *et al.*, 2012) [20] and food preferences (Nene *et al.*, 2016) [15]. There have been some studies on their colony structures (Offenberg *et al.*, 2012; Marcela *et al.*, 2012) [18, 14], ecology (Offenberg *et al.*, 2004) [17], predation behaviour and (Pierre and Idris, 2013; Gathalkar and Barsagade, 2016) [21, 7] benefit as a biological control agent (Offenberg *et al.*, 2013; Rodrguez-Gironés *et al.*, 2013) [16].

The foraging actions of ants are split into two categories: daily foraging and seasonal foraging. The daily foraging pattern is an ant's 24-hour routine, such as foragers finding food outside their nests and bringing it back to their colonies, whereas the seasonal foraging pattern is an ant's response to seasonal change, such as winter and summer (Ashikin and Hashim, 2015) [1].

Many ant species' daily and seasonal behaviors are influenced by biotic variables such as natural enemies, inter-specific competition, and resource availability (Raimundo *et al.*, 2009; Zhou *et al.*, 2014) [23, 31]. In the case of successful crop protection, where weaver ants are widely used as a biological control agent, knowing weaver ants' food preferences is critical for identifying supplementary food for sustaining stable colonies during periods of natural food scarcity, as well as for increasing population size (Nene *et al.*, 2016) [15].

Understanding ant foraging behaviour and food preferences is important in pest management since it aids in locating nest locations, providing clues for optimal bait manufacture, and determining the best time to manage ants (Loke and Lee, 2005; Chong and Lee, 2009) [13, 5]. Furthermore, for *O. smaragdina* to be successful as a biocontrol agent, farmers and officers in charge of weaver ant farming must know the ideal time of day to detect and transplant ant colonies (Peng *et al.*, 2012) [20]. Present study focuses on evaluating their food preferences using different types of foods as well the effects of environmental parameters, such as temperature and relative humidity on its daily foraging activities of *O. smaragdina*.

## Materials and Methods

The study was conducted at the garden of Faculty of Agriculture, Department of Entomology, Annamalai University, Tamil Nadu, India (11°24’N, 74°44’E) in *Ixora coccinea* L. A preliminary observation was conducted to identify stable colonies of *O. Smaragdina (*colonies that did not move to another nest site within two weeks of observation) before conducting the experiments of foraging activities and food preferences**.** The workers of 5mm and 8mm in length were considered as minor and major workers respectively.

Three main trails on the study site were identified and selected as sampling site to evaluate the food preferences and foraging activity pattern**.** The experiments of food preferences and foraging activity of *O. smaragdina* were replicated three times. Seven types of foods *viz.*, jaggery (4gm), sugar (4gm), sugar syrup (4ml), honey (4ml), dry fish (4gm), chicken intestine (4gm) and biscuit (4gm) were selected for this experiment**.**

Four grams of each food type were weighed and placed on plastic containers on three select trails of the *O. smaragdina.* Each trail was provided with the seven types of foods described previously**.** The foods were replaced every eight hours to sustain freshness**.** The food preferences and foraging pattern were observed for three consecutive days starting from 8 a.m. to 6 a.m. and observations were recorded. Number of *O. smaragdina* foraging on each food were counted for one minute at one-hour interval for three times at three trials (Modified after Pimid *et al*, 2019) [22]

The meteorological parameters were obtained from the Department of Agronomy, Annamalai University. Statistical analysis was performed using SPSS version 16.

**Results and Discussion**

Results showed a significant difference between the jaggery, sugar, sugar syrup, honey, dry fish, chicken intestine, biscuit. Chicken intestine was highly preferred by *O. smaragdina* (71.23±28.43) compared to the dry fish (22.18±14.80) and sugar (8.26±7.60), jaggery (1.07±2.84), sugar syrup (1.86±3.16), honey (1.78±1.50) were less preferred and the biscuit (0.03 ±0.16) was least preferred by *O. smaragdina*.(Table 1).

The current study revealed *O. smaragdina* highly preferred chicken intestine followed by dry fish and sugar. In addition, they did not switch their food preferences and consistently preferred chicken intestine over other foods for three days. Group of ants were gathered over the chicken intestine surface until the freshness and moisture got lost. In dry fish the rough skin were scratched by using their strong mandibles, the major workers bite the dry fish scales, the minute pieces were collected by the minor workers and stored in the nest, similarly the sugar crystalline were taken as a single unit in their mandibles by both the major and minor workers but there was very low foraging in crushed biscuit powder. According to Pimid *et al.* (2019) [22], *O. smaragdina* prefers tuna fish over chicken skin and milk powder. Food freshness, olfactory sense, size of the meal product, and the external weather conditions, all were affected *O. smaragdina's* food choices.

In the present study *O. Smaragdina* favored chicken intestine and dried fish, which included a high nutrition mix of protein and carbs. However, because the study did not explicitly assess its influence on colony needs such as queen, worker, and larvae, the dietary choices of weaver ants based on nutritional content must be taken with caution. Based on preliminary observation, the foods (*i.e.*, chicken intestine, dry fish, Sugar) which became dry after eight hours were less preferred by *O. smaragdina* compared to their fresh form. Therefore, in the present study foods were replaced every eight hours to sustain freshness. Sugar syrup and honey were visited by low number of *O. smaragdina*. They consumed both the liquids.

In the present study, an olfactory impact may impact weaver ants' food preferences, with the scent of chicken intestine and dry fish being greater than sugar, sugar syrup, honey, jaggery, and biscuit. According to Lim (2007) [12], *O. smaragdina* formed foraging pathways to food resources right away and continued foraging throughout the day and night until the resource was exhausted or no longer appealing. According to Brown (2000) [3], *O. smaragdina* belongs to the Myrmicinae functional group, which recruits and defends clumped food supplies quickly.

Previous research has shown that *Lasius niger* ants utilise olfactory cues to find meals while *Cataglyphis fortis* ants utilise olfactory cues to locate meals in the Sahara Desert (Beckers *et al.*, 1994; Buehlmann *et al.*, 2014) [2, 14]. According to Pimid *et al*. (2019) [22], more research into adding olfactory signals in food selections might help us better comprehend weaver ant decision-making during foraging

Similar to the present findings, Lim (2007) [12] also found that *O. smaragdina* favoured fresh feeds and were less sensitive to dried meals, which is similar to our results. Using their mandibles, weaver ants have trouble collecting and removing milk powder (Pimid *et al*. 2019) [22]. Due to their huge mandibles, *O. longinoda* had trouble gathering minute particles back to their nest, according to Nene *et al.* (2016) [15].

The new study adds to our knowledge of weaver ants' food preferences and foraging behavior, which may be used in pest control and crop protection. In order to maximize the number of ants within the nest for crop protection, weaver ant colonies should be transplanted when the ants are least active (between 2 p.m. and 4 p.m., according to a recent research). (Van Mele *et al.* 2009; Peng *et al.* 2012) [30, 20]. Similar results were got in the present study also.

On first day ants foraging on seven types of foods were more during morning hours at 8 a.m. and gradually showed increasing pattern during 10 a.m. and afterwards showed decreasing pattern from 12 p.m. to 4 p.m. During 6 p.m. got increased again and showed decreasing pattern up to 2 a.m. afterwards slowly increased up to second day morning 8 a.m. The similar pattern was observed for next two days also. Highest population was recorded at 28 $^0$C as 33 and at 27 $^0$C and 26 $^0$C as 28. Lowest population was found at 27 $^0$C as 6, 29 $^0$C and 27 $^0$C as 7 (Fig. 1).

Highest population (33) was recorded at 100 per cent relative humidity. Also, more population (28) was recorded at 98 and 99% RH during 2$^{nd}$ day also at 108% RH during the end of the third day of the study (Fig.2). Thus *O. smaragdina* foraging behavior did not affect by temperature and relative humidity but only by circadian rythm.

The lowest foraging activity was seen between the hours of 12 p.m. to 4 p.m., presumably owing to the hot weather. Similar results were previously reported on the tuna food by Pimid *et al.* (2019) [22]. Also, they added that, when the temperature was between 25°C and 27°C, and the ambient humidity was above 80%, the ants foraged heavily. Between 2 p.m. and 4 p.m., there was the least amount of foraging activity due to hot weather, which reached around 32°C. This is similar to the present study observations.

Ants' daily activity can also be governed by an endogenous rhythm influenced by environmental cues such as the light/dark cycle. Environmental circumstances and/or colony demands can, however, coincide with the circadian cycle in many ant species (Hölldobler and Wilson, 1990; Heinrich, 1993) [10, 9]. Despite the fact that *C. rufipes'* foraging activity was primarily nocturnal, temperature and humidity had no significant impact on the daily cycle of foraging in this species, suggesting that its activity rhythm is more endogenous than affected by external variables (Ronque *et al*, 2018) [26]. While environmental variables may not be as significant in determining nest structure as they are in determining nest arrangement, they do appear to be major drivers of nest structure. The factors to consider while constructing nests might be essential in determining the evolutionary motivations for colonial life in social animals (Devarajan, 2016) [6].

Temperature and humidity had no effect on anting displays, although overcast days had substantially less anting events (Revis, 2002) [24]. According to Lee (2002) [11], *Paratrechina longicornis* (Lattreille), *Monomorium pharaonis* (Linnaeus), and *Solenopsis geminata* Fabricius had activity cycles that were inversely associated with ambient temperature. Varied ant species have different foraging habits; according to their circadian rhythm of foraging activity, they can be classified as nocturnal, diurnal, or crepuscular (Sudd, 1967; Chong and Lee, 2009) [29]. During the wet and dry seasons in Australia, Peng *et al*. (2012) [20] indicated that peak foraging activity of *O. smaragdina* occurred between 4 p.m. and 9 p.m. Meanwhile, a research in the Solomon Islands discovered that *O. smaragdina* is a diurnal species, with foraging activity ceasing abruptly after 6 p.m. and resuming after 6 a.m. (Greenslade, 1972) [8]. This is slightly in contrary with the present study results.

**Table 1***:* Food Preferences of *O. smaragdina* on different food products

| Treatments | | Mean no. ants/day ± Standard deviation * # ∞ | S.E.M |
|---|---|---|---|
| $T_1$ | Jaggery | 1.07±2.84 | 0.46 |
| $T_2$ | Sugar | 8.26±7.60 | 1.23 |
| $T_3$ | Sugar Syrup | 1.86±3.16 | 0.51 |
| $T_4$ | Honey | 1.78±1.50 | 0.24 |
| $T_5$ | Dry Fish | 22.18±14.80 | 2.40 |
| $T_6$ | Chicken intestine | 71.23±28.43 | 4.61 |
| $T_7$ | Biscuit | 0.03±0.16 | 0.03 |

*Mean of forager ants for three days
# Mean of three trials
∞ Mean of three observations

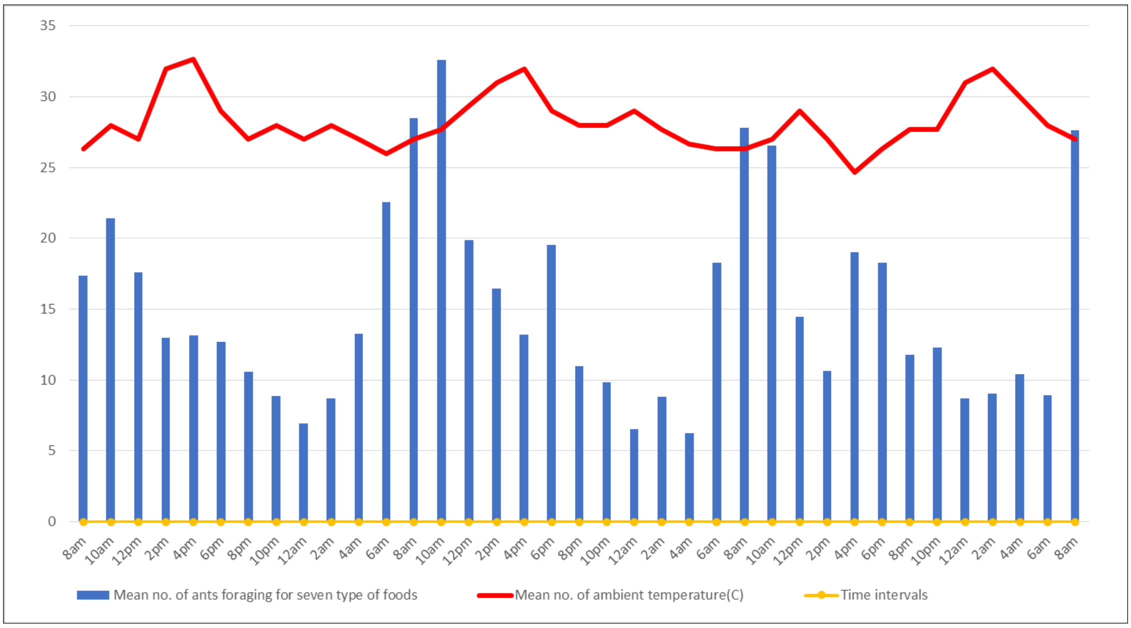


**Fig 1:** Foraging activity Vs temperature relationship of *O. smaragdina*

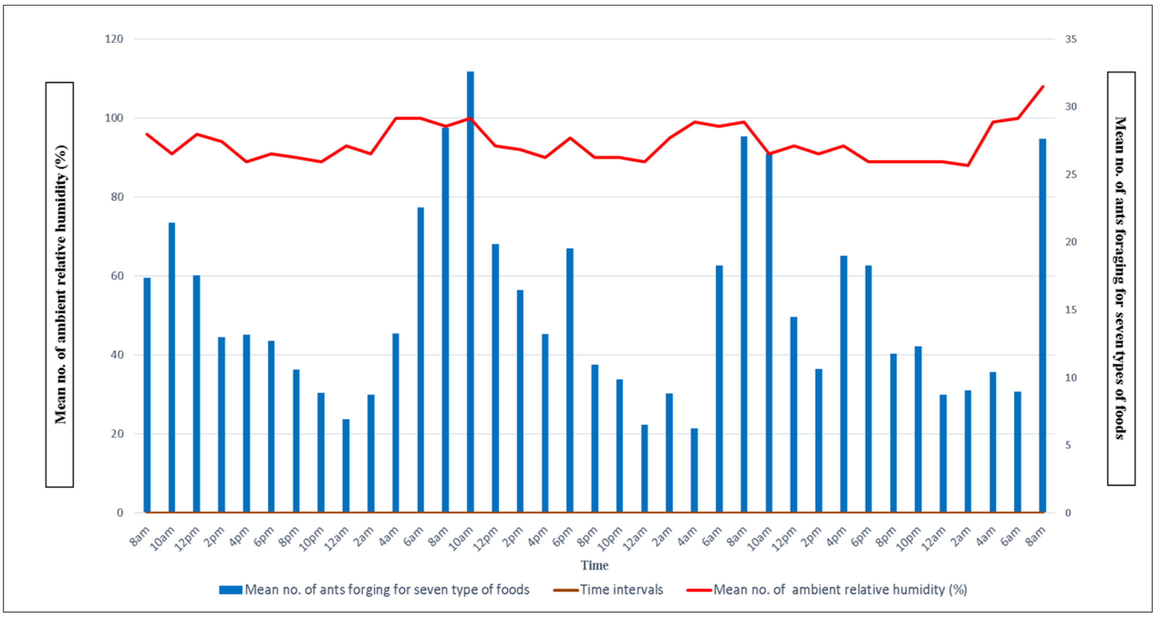


**Fig 2:** Foraging activity Vs relative humidity relationship of *O. smaragdina*

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