Impact of a single *Amegilla calens* (Hymenoptera: Apidae) flower visit on *Solanum melongena* (Solanaceae), Black Beauty variety at Dourga-Maroua (Far North, Cameroon)

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1 ABSTRACT

To assess the impact of the wild bee, *Amegilla calens*, on *Solanum melongena* yields, its foraging and pollinating activities were examined in Dourga-Maroua for two years, July-December 2022 and June-November 2023. Observations were made on 300 flowers every year divided in two treatments: the first with flowers protected (100), uncovered then rebagged without any visit and the second, flowers protected (200), uncovered when flowers were opened, to permit a single *A. calens* visit in 2022. Then, the process is renewed in 2023. The wild bee's seasonal rhythm of activity, its foraging behaviour on flowers and its pollination efficiency on yields were evaluated. Results showed that, *A. calens* foraged flowers on *S. melongena* from 8 am to 3 pm, with peak activity between 8-9 am. On *S. melongena* flowers, wild bee *A. calens* intensely and exclusively foraged pollen. The mean abundance forager per flower was 1 (n = 136; s = 0), the foraging speed was 14.24 flowers/min (n = 102; s =13.91) and the duration of visits was 4.91 s (n = 91; s =2.8) to collect pollen. *Amegilla calens* is an effective pollinator, it shakes flowers, and this movement could facilitate the liberation of pollen by anthers, for the optimal occupation of the stigma and of course their visits increase yield. Through its pollination efficiency on *S. melongena*, *A. calens* has increased the fruiting rate by 17.95 %, number of seeds/fruits by 10.65% and the percentage of normal seeds by 4.59%. Conservation of *A. calens* nests close to *S. melongena* fields could be recommended to boost fruit and seed production in the area.

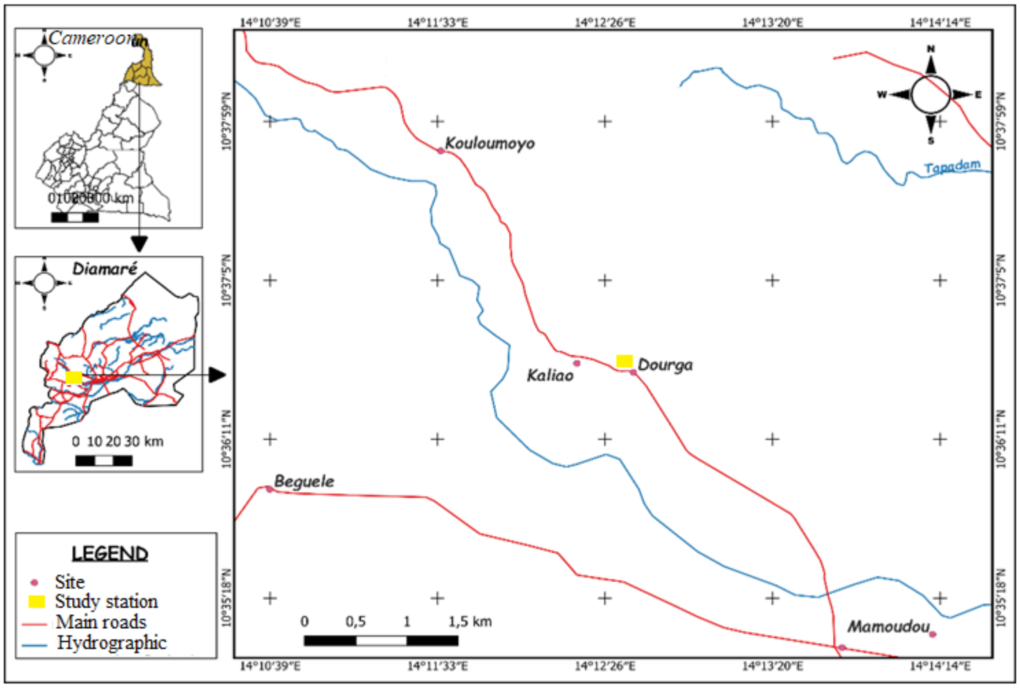
2 INTRODUCTION

There are several important relationships sustaining terrestrial ecosystems (Kevan, 2018). All embrace biophysical interactions in the soil and atmosphere; some comprise more specific co-evolved relationships (Kevan, 2018). Pollinators are a key component of global biodiversity, providing vital ecosystem services to crops and wild plants (Potts *et al*., 2010; Willmer *et al*., 2017) and their role in many plants is well known throughout the world (Jacob-Remacle, 1989). Many insects visit flowers from which they obtain carbohydrate and protein food (Pesson and Louveaux, 1984). Similarly, pollination is a pivotal process in almost all productive terrestrial ecosystems (Kevan, 2018). Nevertheless, pollination has been generally overlooked until very recently (Buchmann and Nabhan, 1996), a surprising omission given that the biodiversity of the world's dominant flora, flowering plants, and dominant fauna, insects are so intimately and co-evolutionarily enmeshed through insect and flower relationships (Willemstein, 1987). Through pollination, bees contribute to the preservation and maintenance of the genetic diversity of flowering plants (Bradbear, 2010). Eggplant *Solanum melongena* (Solanaceae) is an annual herbaceous plant native to India that is cultivated for his leaves and fruits that are consumed by humans (Simpson and Ogorzaly, 1995). Very low in calories, this vegetable is an important source of vitamins, minerals, trace elements, antioxidant compounds and fibre (Eric *et al.,* 2020). Its cultivation is linked to constraints of high temperatures, sunshine and permanent water availability (Eric *et al.,* 2020). In developing countries including Cameroon, where the economy is essentially based on agriculture (DSCE, 2009), the role of pollinating insects to increase agricultural yields is not well study (Pando *et al.,* 2011; Tchuenguem *et al.,* 2014). Most farmers in these countries believe that high yields are essentially due to various techniques, the use of fertilizers and pest control (Kumar, 1991). From worldwide, data concerning the relationships between *S. melongena* and floricultural insects exist but are insufficient. The floricultural entomofauna of *S. melongena*, has been studied in Kenya by Barbara and Ochieng (2008), in Asia by Bodlah and Waqar (2013), in Brazil by Nunes-Silva *et al.* (2013), in Nepal by Mainali *et al.* (2015) and in Sri Lanka by Shanika *et al.* (2017). In Maroua (Far North, Cameroon), there has been no previous research report on the relationship of *S. melongena* and its anthophilous insects. It is therefore important to investigate in this region to complete the information on the pollination of *S. melongena*. The main objective of this study, therefore, was to assess the effects of foraging behaviour of *Amegilla calens* on yield of *S. melongena*. Specifically, our research's aim was to study foraging activity and to evaluate the impact of a single visit of *A. calens* on *S. melongena* pollination, fruit size and seed yield.

3 MATERIAL AND METHODS

3.1 Material

3.1.1 Study station and biological materials: Fieldwork was carried out from June to December 2022 and from May to November 2023 at Dourga-Maroua in Diamaré division, Far North Region of Cameroon. The climate is Sudano-Sahelian, characterized by a long dry season (November to June) and a short rainy season (July to October: Sakatai *et al.,* 2022). The weather or month of August is the wettest of the year, with annual rainfall ranging is 1209 mm (INS, 2017). The mean annual temperature is 39°C (Moutsavara *et al.,* 2021). The study station is a rectangular area measuring 325m², centred on a point with the following geographical coordinates: Latitude 10°35.375'N, Longitude 14°12.214'E and Altitude 942m above the sea level (Figure 1). These geographical coordinates were recorded with a "Global Positioning System" brand Garmin GPS II+.



Source: WGS 84/ UTM Zone 32/N

Figure 1: Location map of the investigation site (Dourga-Maroua) in Diamaré, Far North (Cameroon).

The choice of this observation site is justified by the existence of other peasant crops and the guarantee of safety of the experimental plot and the observer. The plant material consisted of: (a) seeds of *S. melongena* L. 1753 var. Black beauty purchased at the Abattoir Market in Maroua in an approved shop selling agricultural seeds; (b) various plant species (*Corchorus olitorius, Cucumis melo, Hisbicus cannabinus, Peristrophe bicalyculata*, *Zea mays*) located near the experimental plot and which were in bloom at the same time as *S. melongena*. *Amegilla calens* naturally present in the experimental field was represented the animal material.

3.2 Methods

3.2.1 Preparation, sowing and maintenance of the *Solanum melongena* experimental plot: From the 21th of June 2022 and from the 08th of June 2023, the experimental plots underwent the following successive operations: clearing, plowing and formation of the eight sub-plots of $5m^2$ of side and 10cm of height each. They were separated from each other by 1m aisles. The distance from the field boundary was 1m. The nursery was prepared on the15th of July 2022 and the 04th June 2023. The soil was disturbed and the seeds of *S. melongena* were seeded by dispersion. Then, the soil was lightly stirred again, watered and then covered with straw, all covered by a mosquito net to prevent attacks of pests in order to maintain moisture to facilitate the emergence of seeds.

The set up was watered every two days, until transplanting. Thus, the plants took 40 days in the nursery before being transplanted to the fields. On the 24th of August 2022 and on the 29th of July 2023, vigorous seedlings were transplanted, with ten (10) lines per sub-parcel and one foot per pot. The spacing was 50cm on the lines and 80cm between the lines. A week after transplantation, the dead plants were replaced. From nursery planting (on the 15th of July 2022, and 14th of June 2023) to the onset of the first flowers (on the 10th of October 2022, and the 20th of September 2023), hoeing was done regularly every two weeks. From flowering to fruit ripening, weeding was done regularly by hand.

3.2.2 Study of the activity of *Amegilla calens* on the *Solanum melongena* flowers

3.2.2.1 Floral products harvested: The floral products (nectar or pollen) collected by *Amegilla calens* during each floral visit were documented in view of its foraging behaviour. The pollen gatherers scratch anthers with the mandibles or legs. The appreciation of this activity revealed whether *A. calens* is strictly pollinivore or nectarivore. This may give an idea of its participation in the cross-pollination of *S. melongena*.

3.2.2.2 Duration of visits: The duration of visits according to Tchuenguem *et al.* (2014), was timed during the registration of visits (using a stopwatch) at least five periods: 7-8 am, 9-10 am, 11-12 am, 1-2 pm and 3-4 pm.

3.2.2.3 Foraging speed: During the same days concerning the recurrence of visits, the span of individual flower visits was recorded (utilizing a stopwatch) as indicated by five times frames: 7-am, 9-10 am, 11-12 am, 1-2 pm and 3-4 pm. The foraging speed, according to Jacob-Remacle (1989), is the number of flowers visited by a bee per min. Also, according to Tchuenguem *et al.* (2014), the foraging speed can be calculated as follows: $Vb = (Fi / di) \times 60$ where *di* is the time (s) given by a stopwatch and *Fi* is the number of flowers visited during *di*.

3.2.2.4 Abundances per flower and per 1000 flowers: The abundance per flower was recorded following direct observation. To evaluate the abundance per 1000 flowers, *A. calens* were counted on a known number of blooms. The following formula was used A_{1000}: $A_{1000} = [(Ax/ Fx) * 1000]$, where *F*x and *A*x are the number of open flowers, and the number of foragers effectively counted on these flowers at time x according to Tchuenguem *et al.* (2014).

3.2.2.5 Foraging ecology: The disruption of the activity of foragers by competitors or predators and the attractiveness of other plant species to *A. calens* were assessed. During each daily period of investigation, a mobile thermo-hygrometer was used to record the temperature and relative humidity at the station.

3.2.3 Assessment of the pollination efficiency of *Amegilla calens* on *Solanum melongena* flowers: From 22 October 2022, 300 flowers (at the flower bud stage) belonging to 300 plants spread over six subplots were tagged and two treatments formed. Treatment 1: six subplots (consisting of 100 flowers spread over 100 plants) were isolated using gauze bags and treatment 2 consisting of 200 plants also (bearing 200 flowers labelled and spread over six subplots) isolated as those of treatment 1. Between 8 and 9 am (the peak of period activity of *A. calens*), the gauze bag is gently removed from each of the plants under treatment 2 bearing the labelled and newly bloomed flowers and the latter observed for 10min, in order to note a possible visit of *A. calens*, after this handling, the plant is again protected (Figure 2). The experiment was renewed in 2023.

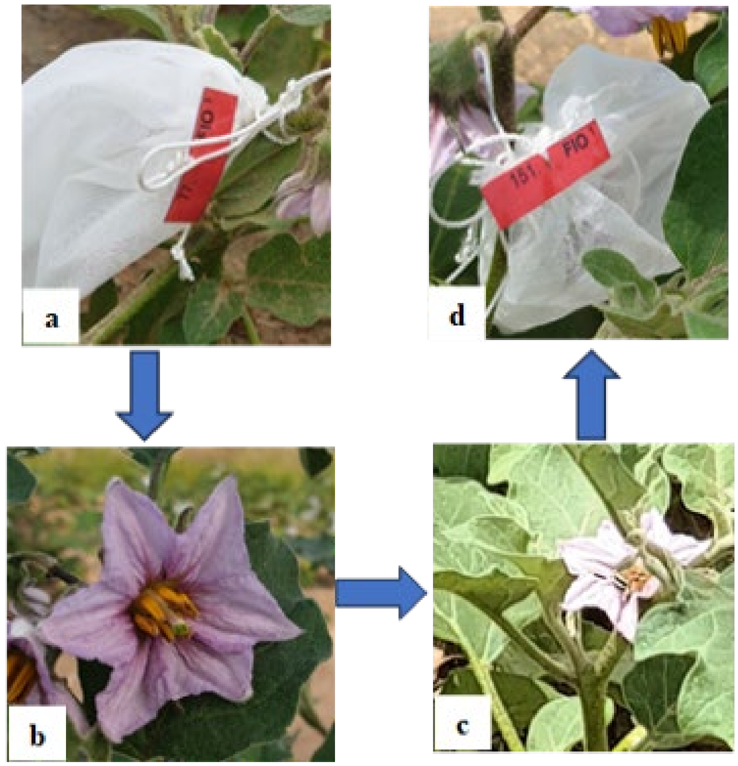


Figure 2: Different stages of assessment pollination efficiency of *Amegilla calens* on *Solanum melongena* flowers

At fruit maturity, for each year of study, the numerical contribution (*Pf*) of *A. calens* in the fruiting rate was calculated using the following formula: $Pf = \{[(f_2 - f_1) / f_2] \times 100\}$ where f_2 and f_1 are the fruiting rates in treatment 2 (protected flowers and visited exclusively by *A. calens*) and 1 (protected flowers) (Tchuenguem *et al.,* 2014). The direct numerical contribution (*Pg*) of *A. calens*, the number of seeds per fruit was calculated using the following formula: $Pg = \{[(g_2 - g_1) / g_2] \times 100\}$ where g_1 and g_2 are the mean numbers of seeds per fruit in treatments 1 and 2 (Tchuenguem *et al.,* 2014). The numerical contribution (*Pgn*) of *A. calens* at normal seed formation was calculated using the following formula: $Pgn = \{[(gn_2 - gn_1) / gn_2] \times 100\}$ where gn_1 and gn_2 are the percentages of normal seed in treatments 1 and 2 (Tchuenguem *et al.,* 2014).

3.2.4 Statistical analysis: Data were analysed using descriptive statistics, Student's t-test for the comparison of means of two samples, Chi-square (χ^2) for comparison of percentages using SPSS statistical software and Pearson's correlation coefficient (*r*) for evaluate two linear variables.

4 RESULTS AND DISCUSSION

4.1 Results

4.1.1 Floral products harvested: From field observations, it was found that *A. calens* foragers collected intensively and exclusively pollen from *S. melongena* flowers (Figure 3). The collecting nectar wasn't observed during our investigations.

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Figure 3: *Amegilla calens* to collect pollen on *Solanum melongena* flower

4.1.2 Daily frequency of visits: *Amegilla calens* foraged *S. melongena* flowers throughout the blooming period from 8 am to 1pm and 8 am to 3 pm in 2022 and 2023 respectively, with a peak of activity being observed between 8-9 am daily (48.10%). Climatic conditions influenced the activity of *A. calens*. The correlation between the number of *A. calens* visits to *S. melongena* flowers and temperature was negative and non-significant in 2022 (r = -0.78; [df = 2; $P > 0.05$]); positive and non-significant in 2023 (r = 0.85; [df = 3; $P > 0.05$]) for the years of observation. The correlation between the number of visits and relative humidity was negative and non-significant in 2022 (r = -0.20; [df = 2; $P > 0.05$]); positive and highly significant in 2023 for this year of study (r = 0.97; [df = 3; $P < 0.01$]) as seen in figure 4.

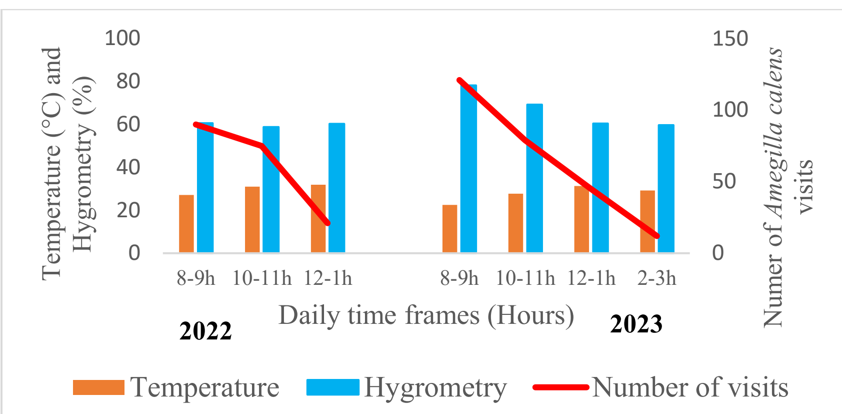

Figure 4: Variation of the temperature, the humidity and the number of *Amegilla calens* visits on *Solanum melongena* flowers according to the daily time frames in 2022 and in 2023 at Dourga-Maroua

4.1.3 Frequency of visits according to the flowering stages: The number of visits made was highest when the number of open flowers was highest. Furthermore, a positive and highly significant correlation was found between the number of *S. melongena* opened flowers and the number of *A. calens* visits in 2022 (r = 0.78; [df = 8; $P < 0.01$] and in 2023 (r = 0.85; [df = 9; $P < 0.01$]). During each flowering period of *S. melongena, A. calens* collected pollen exclusively and regularly. Collection of nectar wasn't observed because this plant species doesn't produce this substance.

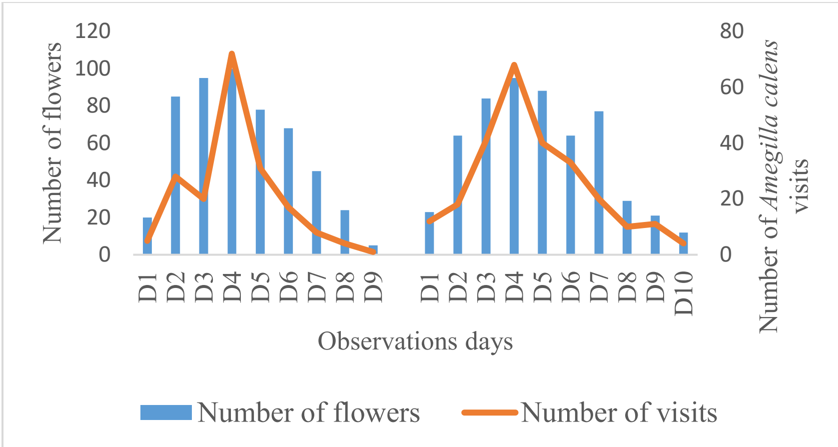

Figure 5: Seasonal variations of the number *Solanum melongena* opened flowers and the number of *Amegilla calens* visits on these organs in 2022 and in 2023 at Dourga-Maroua

4.1.4 Duration of visits per flower: The mean duration of a visit to *A. calens* by flower of *S. melongena* in 2022 was 5.69 sec (n = 87; s = 2.83), the corresponding result was 4.12 sec (n = 95; s = 2.77) in 2023. The difference between the visit times of a flower in 2022 and 2023 was very highly significant (t = 3,76; [df = 180; P < 0,001]).

4.1.5 Foraging speed of *Amegilla calens*: On the experimental plot of *S. melongena*, *A. calens* visited between 1 and 25 flowers/min and the mean foraging speed was 9.88 flowers/min (n = 94; s = 5.98) and 18.6 flowers/min (n = 110; s = 21.84) in 2022 and 2023 respectively. The difference between these two means was highly significant (t = -4.00; [df = 202; P < 0,001]).

4.1.6 Abundance of *Amegilla calens*: In 2022, the highest number of individuals (*A. calens*) simultaneously active was 1 per flower (n = 71; s = 0) and 19.36 per 1000 flowers (n = 71; s = 16.54). In 2023, the corresponding results were 1 per flower (n = 65; s = 0) and 22.91 per 1000 flowers (n = 62; s = 13.28). The difference between the mean number of foragers per 1000 flowers in 2022 and 2023 was negative and not significant (t = -1.36; [df = 131; P < 0.01]).

4.1.7 Influence of fauna: The foraging of *A. calens* activity was interrupted by individuals of the same or different species who were either competitors for the harvest of pollen or predators. Of the 186 visits studied in 2022, 55 (29.57%) were interrupted by some agents as such as: *Xylocopa* sp. (11.29%), *Xylocopa olivacea* (10.22%) and *A. calens* (8.06%). In 2023, the corresponding figure was 68 (26.46%) by *Nomiapis bispinosa* (7.78%), *Lasioglossum costulatum* (6.61%), *Seladonia* sp. (4.28%, *Megachile* sp. (3.89%) and *A. calens* (3,89).

4.1.8 Influence of neighbouring flora: During the observation period, several other flowering plant species along the edge of the experimental plot of *S. melongena* were visited by *A. calens* for their nectar (Ne) and/or pollen (Po). These plants included *Corchorus olitorius* and *Hisbiscus cannabinus* (Malvaceae, Ne, Po)*, Cucumis melo* (Cucurbitaceae, Ne, Po)*, Peristrophe bicalyculata* (Acanthaceae, Ne, Po) and *Zea mays* (Poaceae, Po). During one foraging visit, this bee foraging *S. melongena* were not seen to be visiting the neighbouring plant and vice versa.

4.1.9 Impact of pollination efficiency of *Amegilla calens* yields of *Solanum melongena*: During pollen collection of *S. melongena*, *A. calens* workers always agitates flowers and regularly induce contact with the anthers and stigma, boosting the possibility of cross-pollination of *S. melongena*. The percentage of the total number of visits during which forager bees came into contact with the stigma of the visited flowers was 100% to harvest pollen. Thus, *A. calens* greatly boosted the pollination possibilities of *S. melongena* flowers. Table 1 shows the fruiting rate, the number of seeds per fruit, and the percentage of normal seeds obtained in the different treatments. It arises from this table that each flower turned into a fruit, nevertheless of the treatment it received:

- the flowers bagged and visited exclusively by *A. calens* produced more fruit than those isolated. Fruiting rates were 61%, 75.5%, 65% and 78.5% in treatments 1, 2, 3 and 4 respectively. The comparison of the fruiting rate shows a highly significant difference between treatments 1 and 2 (χ^2_{2022} = 6.76 [*df* = 1; *P* < 0.05]) and significant difference between treatments 3 and 4 (χ^2_{2023} = 6.31 [*df* = 1; *P* < 0.05]). Consequently, the fruiting rate of single flowers and visited exclusively by *A. calens* (treatment 2 or 4) is higher than that of protected, uncovered and recovered without received any visit flowers during their flowering period (treatment 1 or 3). The percentage of the fruiting rate due to the pollination efficiency of *A. calens* was 14.07% and 21.84% in 2022 and 2023 respectively. For the two years of experimentation, the mean percentage was 17.95%.

Table 1: Fruiting rate, mean number of seeds per fruit and percentage of normal seeds according to the different treatments of *Solanum melongena.*

					Seeds/fruit				
Years	**Treatments**	**NF**	**NFF**	**FR%**	*m*	*Sd*	**TNS**	**NS**	**%NS**
2022	**T1 (Fps)**	100	61	61	892	497.46	26767	22346	83.48
	T2 (Fvl)	200	151	75.50	1010	412.14	30301	27423	90.50
2023	**T3 (Fps)**	100	65	65	902	203.34	27047	23899	88.36
	T4 (Fvl)	200	157	78.50	1008	327.79	30232	27101	89.64

Fps: flowers bagged then uncovered and rebagged without a visit by insects or any other organism; Fvl: flowers visited exclusively by *Amegilla calens*; NFF: number of fruits formed; FR: fruiting rate; *m*: mean; *sd*: standard deviation; TNS: total number of seeds; NS: number of normal seeds; %NS: percentage of normal seeds.

- the average number of seeds per fruit was 892 (*n* = 30, *s* = 497.46), 1010 (*n* = 30, *s* = 412.14), 902 (*n* = 30, *s* = 203.34) and 1008 (*n* = 30, *s* = 327.79) in treatments 1, 2, 3 and 4 respectively. The difference between treatments 1 and 2 was not significant (t_{2022} = -0.98 [*df* = 58; *P* > 0.05]) and then between treatments 3 and 4 (t_{2023} = -1.48 [*df* = 58; *P* > 0.05]). Therefore, in 2022 and 2023, the number of seeds/fruits of single flowers visited exclusively by *A. calens* (treatment 2 or 4) is higher than that of protected flowers (treatment 1 or 3). The percentage of the mean number of seeds/fruits owed to the pollination efficiency of *A. calens* was 11.66% and 9.64% in 2022 and 2023 respectively. For both studied seasons, this contribution is 10.65%.
- the percentages of normal seeds were 83.48%, 90.50%, 88.36% and 89.64% in treatments 1, 2, 3 and 4 respectively. Comparison of the percentage of normal seeds shows a highly significant difference between treatments 1 and 2 (χ^2_{2022} = 627.66 [*df* = 1; *P* < 0.01]) and between treatments 3 and 4 (χ^2_{2023} = 24.04 [*df* = 1; *P* < 0.01]). Therefore, in 2022 and 2023, normal seeds from single flowers visited exclusively by *A. calens* (treatment 2 or 4) is higher than that of protected flowers (treatment 1 or 3) thus indicating the importance of this bee. This can explicate the high pollination deficit on the crop, indicating need for *A. calens* management to increase developed seeds. The percentage of normal seeds owed to the pollination efficiency of *A. calens* was 7.75% and 1.43% in 2022 and 2023 respectively. For the two years of experimentation, this percentage was 4.59%.

5 DISCUSSION

This study indicates that *A. calens* is visited eggplant flowers to collect exclusively and intensively pollen. Mamoudou *et al.* (2024) reported that the individual of *A. calens* collected nectar and pollen on *S. lycopercicum* flowers at Meskine. The present research proves that *A.*

calens is an important and efficient pollinator of eggplant in Cameroon. Previous work carried out in Kenya by Barbara and Ochieng (2008) revealed that *A. calens* ranks third among the floral insects visiting this plant. In other parts of the world, other species have been reported as such as *Melipona fasciculata* in Brazil by Nunes-Silva *et al.* (2013), *Bombus* sp. in Népal by Mainali *et al.* (2015) and *Hoplonomia westwoodi* in Sri Lanka by Shanika *et al.* (2017) are the main floral visitors of this crop. Individuals of *A. calens* has been shown to be the most abundant floral visitor on another plant species as such as on the *Gossipium hirsutum* flowers by Kodji *et al.* (2021) and *Solanum lycopersicum* flowers by Mamoudou *et al.* (2024) at Meskine-Maroua.

The peak of *A. calens* activity on *S. melongena* situated in the morning between 8 am and 9 am was correlated with the availability of pollen in this species plant flowers. During this period of the day, the mean hygrometry (< 70%) along with the mean temperature (< 28°C) are high and could therefore be favourable to the high availability of pollen that attracts this bee or this period which the stigma of *S. melongenum* flowers has optimal receptivity for pollen or the weather conditions. These conditions might partially justify the highest frequency of *A. calens* visits during that time frame. The reduction of *A. calens* visits observed on flowers after 1 pm could be linked to the low quantity and/or quality of their respective floral products and to the increase of the temperature in the experimental area. Although foragers preferred warm or sunny days for the good floral activity, the negative influence of the up temperature is higher on the plant as pollen producer than on the foragers. Thus, the temperature allows floral anthesis and accelerates flower wilting or closing when raising (Pesson and Louveaux, 1984). Bramel *et al.* (2004) in the same order were documented that an environmental factor could disrupt the floral bee activity. According to Kasper *et al.* (2008), when the floral products are not easily reached or when its quantity and/or quality decrease, foragers reduce their activity on flowers.

The significant difference observed between the duration of pollen visits to both years of study could be explained by the disruption observed during our investigations. In fact, 26,46% and 29.57% visits of *A. calens* were interrupted by bees in 2022 and 2023 respectively. These results of a reduction in the duration of the scorer's visits, forcing individuals of *A. calens* to increase the number of flowers to visit in order to obtain its maximum pollen load. That could explain the significant difference observed between the foraging speeds. Also, the difference could be explained by the accessibility, availability of pollen or the distance separating the flowers visited during the various foraging trips. This result agrees that reported Mainali *et al.* (2015) in Nepal and Shanika *et al.* (2017) in Sri Lanka on the same plant. The low abundance of *A. calens* per 1000 flowers of *S. melongena* could be partially explained that it is solidary wild bee. We know that, by the availability of this substance, its accessibility and the needs of *A. calens* during the flowering period of the Solanaceae.

The passage of *A. calens* from *S. melongena* flowers to the flowers of another plant species and vice versa could be explained by the lack of nectar products because this plant species produces only pollen. *Amegilla calens* visit other flowers of different plant species for nectar (example: *Corchorus olitorius, Hisbiscus cannabinus, Cucumis melo* and*, Peristrophe bicalyculata*). Similarly, our results agreed with those obtained by Anderson and Symon (1988) in Australia and by Free (1993) in England for the absence of nectar on *S. melongena* flowers. The present work reveals that during one foraging trip, an individual bee foraging a given plant species hardly visits another plant species. This finding indicates that *A. calens* exhibited flower constancy (Basualdo *et al.,* 2000) for the flowers of each of the plant species studied.

During the collection of pollen on each flower, *A. calens* regularly comes in contact with the stigma. It could enhance autopollination, which has been reported in the past by Barbara and Ochieng (2008) in Kenya on the same plant. So, this bee shown an important floral visit pollinator for this plant species. Individuals of

A. calens would facilitate allogamous pollination by carrying pollen with their hairs, abdomen, legs and mouth accessories from the anther of a flower to the stigma of another flower. The size of *A. calens* plays a positive role: when collecting pollen, *A. calens* shake flowers and this movement could facilitate the liberation of pollen by anthers for the optimal occupation of the stigma according by Pando *et al.* (2011). *Amegilla calens* has previously been reported to be a regular visitor and so is an effective pollinator. A similar result has been documented in Kenya by Barbara and Ochieng (2008) this bee can be one of the most important visitors and an efficient pollinator for this species plant. The most important yield (fruits, seeds, percentage of normal seeds in fruits) recorded in unlimited and visited flowers exclusively by *A. calens* can be attributed to the important role the pollinating insect. The numeric contribution of *A. calens* to the yields of *S. melongena* through its pollination efficiency was significantly higher than that of unprotected, uncovered and recovered without any visits on flowers. This would mean that the vibration of eggplant flowers by *A. calens* during foraging increases the possibility of fertilizing a greater number of ovules by causing the release of more pollen; this high pollen release results in the formation of good quality fruit and a greater number of normal seeds. Barbara and Ochieng (2008) in Kenya, Bodlah and Waqar (2013) in Pakistan and Shanika *et al.* (2017) in Sri Lanka have shown that bee pollination was necessary to increase the fruit and seed yields on the same plant species. This shows on one hand that *A. calens* was one of the principal insect pollinators of this plant. In general, our results showed that the impact of *A. calens* activity on eggplant fruit and seed production was positive, because foragers brought supplementary pollen grains onto the stigma on top of the previously deposited through passive self-pollination.

6 CONCLUSION

In Maroua, *A. calens* visited the flowers of *S. melongena* from 8 am to 3 pm, with peak activity between 8-9 am. This wild bee intensively and exclusively harvested pollen, and the duration of the visit was 4.91 sec and foraging speed was 14.24 flowers/min. The flowers that are received exclusively (treatments 1 and 3) visited of *A. calens* provided more fruits, a greater number of seeds per fruit and more normal seed with those protected flowers, opened and recovered without visits (treatments 2 and 4). This research thus proves that investment in the management of *A. calens* in terms of nest placement close to *S. melongena* fields is worthwhile for growers. The conservation and/or the placement of *A. calens* nests near *S. melongena* plots is recommended for farmers to boost fruit and seed yields.

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