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## Study of the insect pollinators visiting on Niger (*Guizotia abyssinica* Cass.)

**Ganesh Kumar Tiwari, GP Painkra, PK Bhagat, KL Painkra and Gajala Ameen**

### Abstract

Studies on the different species of insect pollinators visiting on niger crop was undertaken during the kharif 2019-20. The result revealed that the sum of 12 species of pollinators were recorded on niger flowers. Among these Indian honey bees - *Apis cerana indica* (19.55), Rock honey bee - *Apis dorsata* (13.67), Italian honey bee - *Apis mellifera* (7.24) and Little bee - *Apis florea* (1.81) were observed as most dominant pollinators. Other than bee species there were some other pollinators like Monarch butterfly - *Danaus chrysippis* (4.22), Rice skipper - *Pelopidas mathias* (4.88), Wasp - *Vespa cincta* (1.95), House fly - *Musca domestica* (3.28), Syrphid fly - *Eristalis sp.* (5.50), Blow fly- *Chrysomya beziana* (1.82), Red cotton bug- *Dysdercus cingulatus* (1.97), and Tiger moth - *Amata passalis* (2.44) were also found that visiting on niger flower at throughout the flowering period during kharif season.

**Keywords:** Niger crop, Different species of insects pollinators

### Introduction

The niger (*Guizotia abyssinica* L.) is a species in the family asteraceae and an important oilseed crop which is highly ubiquitous in distribution, mostly in India and Ethiopia. More than 50 per cent of area and production of niger in the world is covered by India. The area of niger in Chhattisgarh is 0.65 lakh hectare, with 250 kg ha<sup>-1</sup> productivity (Anonymous, 2017) [1]. Vernacular names of niger are jatgi (Surguja), sorguja (Bengali), sarguza (Oriya), alashi (Telugu), ramtal (Hindi) and ramtil (Punjabi) in various localities in India. The niger plants completes its life cycle within 3-4 months. The nature of this crop is annual, branched and herbaceous which grows up to a 1.8 meter height. In a cluster of 2 to 5 the yellow flower heads of 2-3 cm are formed in the leaf axil.

Due to its valuable exploitation in diverse sectors of agriculture & applied industries it has good demand in domestic and in foreign markets too. Entirely reliant on external agents for its reproductive development by means of pollination through external agencies, predominantly taking the help of insect honeybee, which often visit flowers and gathers pollens besides nectar for sustaining their life (Bhambure, 1958) [3].

Pollinators are the crucial insects which plays an essential role in the action of niger pollination. The crop imparts both nectar and pollen to honeybees and huge quantities of nectar are gathered from this crop wherever extensive cultivation is followed. Honeybees accomplish pollen transportation from one flower to another. Utilization of bees in pollination increases the yield of different crops and in addition improves their quality. It helps in early harvest of the crop and uniform maturity (Kachhela and Pastagia, 2018) [10].

The aim of the present study was to identify the pollinator visiting on niger flower.

### Materials and Methods

The field studies was conducted at the experimental area of Research Cum Instructional Farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The Niger crop was sown and the variety was JNC-9 with spacing 30\*10cm within plot size 2.50\*2.30m<sup>2</sup>. It was upland, the pollinators were observed from randomly selected 3 spots from 4 plots in each 1 sq. m area at 5 day intervals within 5 min and was counted from 0700-0900hrs, 1100-1300hrs & 1500-1700hrs at 2 hrs interval during the blooming period. Statistical analysis was done in ms excel.

## Results and Discussion

During the course of the study, 12 species of insect pollinators were recorded on niger flowers. Among them Indian honey bee (*Apis cerana indica*) was first pollinator observed to pollinate on niger crop which visited the crop throughout the flowering period, other bee pollinators like *Apis dorsata*, *Apis mellifera* and *Apis florea* were also recorded. Besides, these

some pollinators viz., *Danaus chrysippis*, *Pelopidas mathias*, *Vespa cincta*, *Musca domestica*, *Eristalis sp.*, *Chrysomya beziana*, *Dysdercus cingulatus*, and *Amata passelis* were also recorded throughout the blooming period on niger crop (Table 1-2). The different species of pollinators were reported as under:

**Table 1:** The different species of insect pollinators visiting on niger flower during kharif season 2019-20

| S. No | Pollinators / visitors | Scientific Name             | Order       | Family        | (Visits/5 min/m <sup>2</sup> ) Hours of the day |              |              |        | Mean  |
|-------|------------------------|-----------------------------|-------------|---------------|---|--------------|--------------|--------|-------|
|       |                        |                             |             |               | 900-1100hrs                                     | 1100-1300hrs | 1500-1700hrs | Total  |       |
| 1     | Indian honey bee       | <i>Apis cerana indica</i>   | Hymenoptera | Apidae        | 14.40   | 25.58        | 18.69        | 58.67  | 19.55 |
| 2     | Rock bee               | <i>Apis dorsata</i>         | Hymenoptera | Apidae        | 11.68   | 18.38        | 10.95        | 41.01  | 13.67 |
| 3     | Italian bee            | <i>Apis mellifera</i>       | Hymenoptera | Apidae        | 7.25  | 9.11         | 5.36         | 21.72  | 7.24  |
| 4     | Little bee             | <i>Apis florea</i>          | Hymenoptera | Apidae        | 1.80  | 2.26         | 1.38         | 5.44   | 1.81  |
| 5     | Monarch butterfly      | <i>Danaus chrysippis</i>    | Lepidoptera | Nymphalidae   | 4.25  | 4.91         | 3.51         | 12.67  | 4.22  |
| 6     | Rice skipper           | <i>Pelopidas mathias</i>    | Lepidoptera | Hesperidae    | 4.01  | 4.86         | 5.77         | 14.64  | 4.88  |
| 7     | Wasp                   | <i>Vespa cincta</i>         | Hymenoptera | Vespidae      | 2.50  | 2.02         | 1.33         | 5.85   | 1.95  |
| 8     | House fly              | <i>Musca domestica</i>      | Diptera     | Muscidae      | 3.97  | 3.83         | 2.05         | 9.85   | 3.28  |
| 9     | Syrphid fly            | <i>Eristalis sp.</i>        | Diptera     | Syrphidae     | 6.16  | 6.47         | 3.88         | 16.51  | 5.50  |
| 10    | Blow fly               | <i>Chrysomya beziana</i>    | Diptera     | Calliphoridae | 2.05  | 1.86         | 1.55         | 5.46   | 1.82  |
| 11    | Red cotton bug         | <i>Dysdercus cingulatus</i> | Hemiptera   | Pyrrhocoridae | 2.16  | 2.02         | 1.75         | 5.93   | 1.97  |
| 12    | Tiger moth             | <i>Amata passelis</i>       | Lepidoptera | Amatidae      | 2.52  | 2.16         | 2.66         | 7.34   | 2.44  |
|       | Total                  |                             |             |               | 62.75   | 83.46        | 58.88        | 205.09 | 68.36 |
|       | Mean                   |                             |             |               | 5.22  | 6.95         | 4.90         | 17.07  | 5.69  |

\*hrs = Hours of the day

**Table 2:** The mean population of different species of insect pollinators visiting on niger flower during kharif season 2019-20

| Date of observation | Average population of pollinators/5min/m <sup>2</sup> |          |             |            |                   |              |       |           |             |          |                |            |
|---------------------|---|----------|-------------|------------|-------------------|--------------|-------|-----------|-------------|----------|----------------|------------|
|                     | Indian honey bee                                      | Rock bee | Italian bee | Little bee | Monarch butterfly | Rice skipper | Wasp  | House fly | Syrphid fly | Blow fly | Red cotton bug | Tiger moth |
| 22.10.2019          | 6.98  | 2.12     | 3.83        | 0.42       | 2.17              | 1.26         | 0.67  | 2.23      | 1.10        | 2.50     | 1.50           | 1.75       |
| 27.10.2019          | 9.56  | 5.32     | 6.85        | 1.50       | 3.58              | 4.52         | 1.75  | 4.53      | 4.15        | 4.75     | 4.50           | 2.17       |
| 01.11.2019          | 15.35   | 8.76     | 10.17       | 2.42       | 5.08              | 7.26         | 2.17  | 6.52      | 6.25        | 6.75     | 6.50           | 3.58       |
| 06.11.2019          | 19.85   | 13.53    | 12.26       | 2.97       | 7.03              | 10.41        | 2.25  | 8.56      | 8.06        | 8.00     | 7.75           | 3.42       |
| 11.11.2019          | 25.67   | 21.67    | 16.58       | 3.83       | 9.48              | 16.43        | 3.58  | 12.62     | 9.26        | 10.00    | 11.50          | 4.50       |
| 16.11.2019          | 22.47   | 17.78    | 11.00       | 2.33       | 5.25              | 12.84        | 2.67  | 13.51     | 8.65        | 6.25     | 8.50           | 2.17       |
| 21.11.2019          | 18.23   | 13.62    | 4.08        | 1.83       | 3.33              | 9.73         | 1.83  | 10.35     | 6.51        | 5.25     | 6.25           | 1.83       |
| 26.11.2019          | 13.89   | 9.67     | 2.75        | 0.42       | 2.17              | 5.49         | 1.25  | 6.46      | 4.56        | 4.25     | 5.50           | 1.67       |
| 01.12.2019          | 7.57  | 1.90     | 1.25        | 0.58       | 1.17              | 2.67         | 0.50  | 2.02      | 2.05        | 1.50     | 1.50           | 1.17       |
| Total               | 139.56  | 94.38    | 68.78       | 16.30      | 39.27             | 70.62        | 16.67 | 66.81     | 50.59       | 49.25    | 53.50          | 22.25      |
| Mean                | 15.51   | 10.49    | 7.64        | 1.81       | 4.36              | 7.85         | 1.85  | 7.42      | 5.62        | 5.47     | 5.94           | 2.47       |

### Picture of different species of pollinators visiting on niger flowers



*Apis cerana indica* on niger flowers



*Apis dorsata* on niger flowers



*Apis mellifera* on niger flowers



*Apis florea* on niger flowers



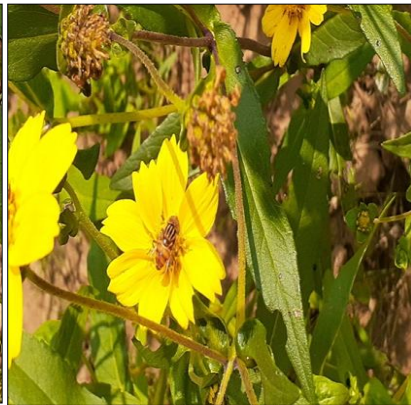
Monarch butterfly on niger flowers



Rice skipper on niger flowers



House fly on niger flowers



Syrphid fly on niger flowers



Blow fly on niger flowers



Red cotton bug on niger flowers

**Indian honey bee (*Apis cerana indica*)**

The visit of Indian honey bee (*Apis cerana indica*) was observed from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (06.98 bees/5min/m<sup>2</sup>), 27 October 2019 (09.56 bees/5min/m<sup>2</sup>), 01 November 2019 (15.35 bees/5min/m<sup>2</sup>), and 06 November 2019 (19.85 bees/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 November 2019 (25.67 bees/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November 2019 (22.47 bees/5min/m<sup>2</sup>), 21 November 2019 (18.23 bees/5min/m<sup>2</sup>) and 26 November of 2019 (13.89 bees/5min/m<sup>2</sup>) and the last observation was recorded during 01 December of 2019 where population declined (7.57 bees/5min/m<sup>2</sup>). The mean population was 15.51 bees/5min/m<sup>2</sup>.

These findings corroborated the results of Singh *et al.* (2006)<sup>[15]</sup> who reported the foragers on litchi with higher population during the early flowering stage than during the mature flower stage of the crop. Among the foragers *A. mellifera* was predominant species (35.08%) of insect visitors followed by *A. cerana indica* (18.64%) and Painkra *et al.* (2015)<sup>[12]</sup> who reported the *Apis cerana indica* (20.66 bees/5min/m<sup>2</sup>).

**Rock bee (*Apis dorsata*)**

The Rock bee (*Apis dorsata*) was observed during from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 week of October 2019 (02.12 bees/5min/m<sup>2</sup>), 27 October 2019 (05.32 bees/5min/m<sup>2</sup>), 01 November 2019 (08.76 bees/5min/m<sup>2</sup>), and 06 November 2019 (13.53 bees/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 November 2019 (21.67 bees/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November of 2019 (17.62 bees/5min/m<sup>2</sup>), 21 November 2019 (13.62 bees/5min/m<sup>2</sup>) and 26 November of 2019 (09.67 bees/5min/m<sup>2</sup>) and the last observation was observed during 01 December of 2019 where population declined (1.90 bees/5min/m<sup>2</sup>). The mean population was 10.49 bees/5min/m<sup>2</sup>.

These findings are in conformity with the earlier workers on different crops, Chaudhary (2001)<sup>[4]</sup> reported little bee, *A. florea* in most abundant form (42.8%) on rapeseed followed by rock bee *A. dorsata* (16.6%) and Painkra *et al.* (2015)<sup>[12]</sup> who reported the *Apis dorsata* (04.43 bees/5min/m<sup>2</sup>).

**Italian honey bee (*Apis mellifera*)**

The activity period to Italian honey bee was recorded from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (03.83 bees/5min/m<sup>2</sup>), 27 October 2019 (06.85 bees/5min/m<sup>2</sup>), 01 November (10.17 bees/5min/m<sup>2</sup>) and 06 November (12.26 bees/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 of November 2019 (16.58 bees/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November of 2019 (11.00 bees/5min/m<sup>2</sup>), 21 November 2019 (04.08 bees/5min/m<sup>2</sup>) and 26 November of 2019 (02.75 bees/5min/m<sup>2</sup>) and the last observation was recorded during 01 December 2019 where population declined (1.25 bees/5min/m<sup>2</sup>). The mean population was 07.64 bees/5min/m<sup>2</sup>.

Guruprasad (2001)<sup>[8]</sup> reported the pollinators on niger in which *A. dorsata* (27.35%) was the most prominent pollinators followed by *A. mellifera* (10.81%), *A. florea* (4.88%) and *A. cerana* (4.17%).

**Little bee (*Apis florea*)**

The activity of little bee was noticed from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (0.42 bees/5min/m<sup>2</sup>), 27 October 2019 (01.50 bees/5min/m<sup>2</sup>), 01 November 2019 (2.42 bees/5min/m<sup>2</sup>), and 06 November 2019 (02.97 bees/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 November 2019 (03.83 bees/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November 2019 (02.33 bees/5min/m<sup>2</sup>), 21 November 2019 (01.83 bees/5min/m<sup>2</sup>) and 26 November of 2019 (0.42 bees/5min/m<sup>2</sup>) and the last observation was observed during 01 December of 2019 where population declined (0.58 bees/5min/m<sup>2</sup>). The mean population was 1.81 bees/5min/m<sup>2</sup>.

These results corroborated the early findings of several workers on different crops Nidagundi and Sattagi (2005)<sup>[11]</sup> recorded *Apis florea* was the most predominant sp. in bitter gourd constituting 43.00 per cent followed by *Apis cerana* (26.00%) and *A. dorsata* (13.00%) and Painkra *et al.* (2015)<sup>[12]</sup> who reported the *Apis florea* (02.24 bees/5min/m<sup>2</sup>).

**Monarch butterfly (*Danaus chrysippus*)**

The activity period of monarch butterfly, *Danaus chrysippus* was recorded during 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (02.17 monarch butterfly/5min/m<sup>2</sup>), 27 October 2019 (03.58 monarch butterfly/5min/m<sup>2</sup>), 01 November 2019 (05.08 monarch butterfly/5min/m<sup>2</sup>) and 06 November 2019 (07.03 monarch butterfly/5min/m<sup>2</sup>), respectively. It reached its peak population during 11 November 2019 (09.48 monarch butterfly/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November 2019 (05.25 monarch butterfly/5min/m<sup>2</sup>), 21 November 2019 (03.33 monarch butterfly/5min/m<sup>2</sup>) and 26 November of 2019 (02.17 monarch butterfly/5min/m<sup>2</sup>) and the last observation was recorded during 01 December of 2019 where population declined (01.17 monarch butterfly/5min/m<sup>2</sup>). The mean population was 04.36 monarch butterfly/5min/m<sup>2</sup>.

The present results are in line with the findings of Dhakal and Pandev (2003)<sup>[6]</sup> who observed that the butterflies visited the niger flowers through the flowering span and Painkra *et al.* (2015)<sup>[12]</sup> who reported *Danaus chrysippus* (00.45 monarch butterfly/5min/m<sup>2</sup>).

**Rice skipper (*Pelopidas mathias*)**

The first appearance of Rice skipper, *Pelopidas mathias* was recorded in 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (01.26 rice skipper/5min/m<sup>2</sup>), 27 October 2019 (04.52 rice skipper/5min/m<sup>2</sup>), 01 November 2019 (07.26 rice skipper/5min/m<sup>2</sup>) and 06 November 2019 (10.41 rice skipper/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 November 2019 (16.43 rice skipper/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November of 2019 (12.84 rice skipper/5min/m<sup>2</sup>), 21 November 2019 (09.73 rice skipper/5min/m<sup>2</sup>) and 26 November of 2019 (05.49 rice skipper/5min/m<sup>2</sup>) and the last observation was recorded during 01 December of 2019 where population declined (02.67 rice skipper/5min/m<sup>2</sup>). The mean population was 07.85 rice skipper/5min/m<sup>2</sup>.

These findings are in more or less conformity with the earlier results of Chaudhary (2002)<sup>[5]</sup> who observed that the moths and butterflies visited on ber accounted for 12.38 per cent,

whereas, the other insects contribution was 26.58 per cent of the total flower visitors and Painkra *et al.* (2015) [12] who reported the *Pelopidas mathias* (00.35 rice skippers/5min/m<sup>2</sup>).

#### Wasp (*Vespa cincta*)

The population of *Vespa cincta* was observed from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (00.67 wasps /5min/m<sup>2</sup>), 27 October 2019 (01.75 wasps /5min/m<sup>2</sup>), 01 November 2019 (02.17 wasps /5min/m<sup>2</sup>) and 06 November 2019 (02.25 wasps /5min/m<sup>2</sup>), respectively. It reached its peak population during 11 November 2019 (03.58 wasps /5min/m<sup>2</sup>), thereafter, its population decreased during 16 November 2019 (02.67 wasps /5min/m<sup>2</sup>), 21 November 2019 (01.83 wasps /5min/m<sup>2</sup>), and 26 November 2019 (01.25 wasps /5min/m<sup>2</sup>) and the last observation was recorded during 01 December 2019 where population declined (00.50 wasps /5min/m<sup>2</sup>). The mean population was 01.85 wasps /5min/m<sup>2</sup>.

The present findings are more or less conformity with the earlier reports of Dhurve (2008) [7] who observed the wasp on niger flowers. Jadhav *et al.* (2010) [9] recorded the *Vespa tropica* and *Polistine sp.* were visiting on hybrid sunflower and Painkra *et al.* (2015) [12] who reported the *Vespa cincta* (00.24 wasps/5min/m<sup>2</sup>).

#### House fly (*Musca domestica*)

The major activity period of *Musca domestica* was recorded from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (02.23 house flies/5min/m<sup>2</sup>), 27 October 2019 (04.53 house flies/5min/m<sup>2</sup>), 01 November (06.62 house flies/5min/m<sup>2</sup>) and 06 November (08.56 house flies/5min/m<sup>2</sup>) respectively. During 11 November 2019 (12.62 house flies/5min/m<sup>2</sup>), thereafter, it reached its peak population during 16 November 2019 (13.51 house flies/5min/m<sup>2</sup>), its population decreased 21 November of 2019 (10.35 house flies/5min/m<sup>2</sup>) and 26 November of 2019 (06.46 house flies/5min/m<sup>2</sup>) and the last observation was recorded during 01 December of 2019 where population declined (02.02 house flies/5min/m<sup>2</sup>). The mean population was 07.42 house flies/5min/m<sup>2</sup>.

These results are in close conformity with the findings of Saeed *et al.* (2008) [14] who recorded the pollinators on onion with effective bee species *Apis dorsata* and *A. florea* which were greater than true flies, *Episyrphus balteatus*, *Eupeodes sp.*, *Musca domestica* and *Eristalinus aeneus*.

#### Syrphid fly (*Eristalis sp.*)

The activity of Syrphid fly observed from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (01.10 syrphid flies/5min/m<sup>2</sup>), 27 October 2019 (04.15 syrphid flies/5min/m<sup>2</sup>), 01 November 2019 (06.25 syrphid flies/5min/m<sup>2</sup>) and 06 November 2019 (08.06 syrphid flies/5min/m<sup>2</sup>). It reached its peak population during 11 November 2019 (09.26 syrphid flies/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November of 2019 (08.65 syrphid flies/5min/m<sup>2</sup>), 21 November of 2019 (06.51 syrphid flies/5min/m<sup>2</sup>) and 26 November of 2019 (04.56 syrphid flies/5min/m<sup>2</sup>) and the last observation was observed during 01 December of 2019 where population declined (02.05 syrphid flies/5min/m<sup>2</sup>). The mean population was 05.62 syrphid flies/5min/m<sup>2</sup>.

These findings are in close conformity with the earlier reports of Atmowidi *et al.* (2007) [2] who recorded the syrphid fly

(2.07%) on mustard. *Apis cerana* (43.11%), *Ceratina sp.* (36.98%) and *A. dorsata* (8.36%) were found in high abundance and Painkra *et al.* (2015) [12] who reported the *Eristalis sp.* (01.89 syrphid flies/5min/m<sup>2</sup>).

#### Blow fly (*Chrysomya megacephala*)

The population of *Chrysomya megacephala* was noticed in the 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (00.83 blow fly /5min/m<sup>2</sup>), 27 October 2019 (01.58 blow fly /5min/m<sup>2</sup>), 01 November 2019 (02.25 blow fly /5min/m<sup>2</sup>) and 06 November 2019 (02.67 blow fly /5min/m<sup>2</sup>) respectively. It reached its peak population during 11 of November 2019 (03.33 blow fly /5min/m<sup>2</sup>) thereafter, its population decreased during 16 November 2019 (02.08 blow fly /5min/m<sup>2</sup>), 21 November of 2019 (01.75 blow fly /5min/m<sup>2</sup>), 26 November of 2019 (01.42 blow fly /5min/m<sup>2</sup>) and the last observation was recorded during 01 December of 2019 where population declined (00.50 blow fly /5min/m<sup>2</sup>). The mean population was 01.82 blow fly /5min/m<sup>2</sup>.

The present results on blow fly is in conformity with Priti *et al.* (2001) [13] who reported the pollinators like *Apis florea*, *A. mellifera*, *A. dorsata*, *Halictus sp.*, *Chrysomya bezziana*, *Gasterophilus sp.* and *Sarcophaga sp.* on radish flower. Saeed *et al.* (2008) [14] who also reported various pollinators on onion blooms, among them the dipterans species composed 72 per cent of syrphid flies and 28 per cent non-syrphid flies i.e. *Musca domestica*, *Calliphoridae sp.* and *Sarcophaga sp.*

#### Red cotton bug (*Dysdercus cingulatus*)

The activity period of Red cotton bug, *dysdercus cingulatus* was observed 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (00.50 red cotton bugs/5min/m<sup>2</sup>), 27 October 2019 (01.50 red cotton bugs/5min/m<sup>2</sup>), 01 November 2019 (02.07 red cotton bugs/5min/m<sup>2</sup>) and 06 November 2019 (02.58 red cotton bugs/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 November 2019 (03.83 red cotton bugs/5min/m<sup>2</sup>). Thereafter, its population decreased during 16 November of 2019 (02.83 red cotton bugs/5min/m<sup>2</sup>), 21 November 2019 (02.08 red cotton bugs/5min/m<sup>2</sup>) and 26 November 2019 (01.83 red cotton bugs/5min/m<sup>2</sup>) and the last observation was observed during 01 December 2019 where population declined (00.50 red cotton bugs/5min/m<sup>2</sup>). The mean population was 01.98 red cotton bugs/5min/m<sup>2</sup>.

Earlier reports support the observation by Thapa (2006) [16] who reported the red cotton bug as a flower visitor on radish blooms and Painkra *et al.* (2015) [12] who reported the *Dysdercus cingulatus* (00.08 red cotton bug/5min/m<sup>2</sup>).

#### Tiger moth (*Amatapassalis*)

The population of tiger moth, *Amata passalis* was recorded from 22 October 2019 to 01 December 2019. Their occurrence was gradually increased from 22 October 2019 (01.75 tiger moths/5min/m<sup>2</sup>), 27 October 2019 (02.17 tiger moths/5min/m<sup>2</sup>), 01 November 2019 (03.58 tiger moths/5min/m<sup>2</sup>) and 06 November 2019 (03.42 tiger moths/5min/m<sup>2</sup>) respectively. It reached its peak population during 11 November 2019 (04.50 tiger moths/5min/m<sup>2</sup>), thereafter, its population decreased during 16 November of 2019 (02.17 tiger moths/5min/m<sup>2</sup>), 21 November 2019 (01.83 tiger moths/5min/m<sup>2</sup>) and 26 November of 2019 (01.67 tiger moths/5min/m<sup>2</sup>) and the last observation was recorded during 01 December of 2019 where population declined (01.17 tiger

moths/5min/m<sup>2</sup>). The mean population was 02.47 tiger moths/5min/m<sup>2</sup>.

The present results are in the line with the findings of Painkra *et al.* (2015)<sup>[12]</sup> who recorded the *Amata passelis* (00.14 tiger moth/5min/m<sup>2</sup>) were found in high abundance.

### Conclusion

Over all on the basis of above results it can be concluded that the honey bees (*Apis cerana indica* and *Apis dorsata*) were the most dominant among all the pollinators. Other than honey bees, there were some other pollinators like *Danaus chrysippis*, *Pelopidas mathias*, *Vespa cincta*, *Musca domestica*, *Eristalis sp.*, *Chrysomya beziana*, *Dysdercus cingulatus*, and *Amata passelis* were also found visiting on niger flowers.

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