RESEARCH ARTICLE

FORAGING BEHAVIOR OF STINGLESS BEE, *TETRAGONULA IRIDIPENNIS* SMITH 1854 (HYMENOPTERA: APIDAE-MELIPONINI) ON RADISH FLOWERS

G.P. Painkra*

IGKV, All India Co-ordinated Research Project on Honey Bees and Pollinators
Department of Entomology, Raj Mohini Devi College of Agriculture and Research station, Ambikapur-497001(Chhattisgarh) India
Received-25.02.2021, Revised-10.03.2021, Accepted-24.03.2021

Abstract: During first week of February 2020 at 8.00AM (0.40 bees/5min/m2) and reached its peak at 12.00Noon (7.00 bees/5min/m^2) however, its population was decreased at 4.00PM (4.20 bees/5min/m^2) and the overall average population was recorded 3.84 bees/5min/m^2. During the second week of observation minimum population was noticed at 8.00AM(0.20 bees5min/m^2) and reached its peak at 2.00PM(7.20 bees/5min/m^2) and after that its population was decreased at 4.00PM (3.00 bees/5min/m^2. During the third week of observation lower population was recorded at 8.00AM (0.60 bees/5min/m^2) and its peak population was recorded at 12.00Noon (13.00 bees/5min/m^2) followed by at 2.00PM (11.20 bees/5min/m^2) however, low population was noticed at 4.00PM (5.00 bees/5min/m^2) .During the fourth week of observation lowest population was recorded at 8.00AM (2.00 bees/5min/m^2). The maximum population was found at 12.00Noon (14.20 bees/5min/m^2) followed by at 4.00PM (6.20 bees/5min/m^2). During the first week of March low population was recorded at 8.00AM (1.80 bees/5min/m^2). The highest population was recorded at 12.00Noon (15.60 bees/5min/m^2) followed by at 2.00PM (13.20 bees/5min/m^2) and decreased at 4.00PM (6.40 bees/5min/m^2). However, during the second week of observation maximum population was recorded at 12.00Noon (7.80 bees/5min/m^2) followed by at 2.00PM (6.20 bees/5min/m^2) and decreased at 4.00PM (4.60 bees/5min/m^2) however, the lowest population was recorded at 8.00AM (2.00 bees/5min/m^2).

Keywords: Foraging behavior, Radish flower, Stingless bee, *Tetragonula iridipennis*

INTRODUCTION

The radish (*Raphanus sativus*) is an edible root vegetable belongs to the family Brassicaceae. It was domesticated in Asia prior to Roman times.

Radish is grown and consumed throughout the world, being mostly eaten raw as a crunchy salad vegetable with a pungent taste. There are numerous varieties, varying in size, flavor, color, and length of time they take to mature. Radishes owe their sharp flavor to the various chemical compounds produced by the plants, i.e. glucosinolate, myrosinase, and isothiocyanate. They are sometimes grown as companion plants . They germinate quickly and grow rapidly, common smaller varieties being ready for consumption within a month, while larger daikon varieties take several months. Being easy to grow and quick to harvest, radishes are often planted by novice gardeners. Another use of radish is as a cover or catch crop in winter, or as a forage crop. Some radishes are grown for their seeds; others, such as daikon, may be grown for oil production.

Varieties of radish are now broadly distributed around the world, but almost no archeological records are available to help determine their early history and domestication. However, scientists have tentatively located the origin of *Raphanus sativus* in Southeast Asia, as this is the only region where truly wild forms have been discovered. India, central China, and Central Asia appear to have been secondary centers where differing forms were developed. Radishes enter the historical record in third century BC. Greek and Roman agriculturalists of the first century AD gave details of small, large, round, long, mild, and sharp varieties. The radish seems to have been one of the first European crops introduced to the Americas.

Radish is a annual or biennial brassicaceous crop grown for their swollen tap roots which can be globular, tapering, or cylindrical. The root skin colour ranges from white through pink, red, purple, yellow, and green to black, but the flesh is usually white. The roots obtain their color from anthocyanins. Red varieties use the anthocyanin pelargonidin as a pigment, and purple cultivars obtain their color from cyanidin. Smaller types have a few leaves about 13 cm (5 in) long with round roots up to 2.5 cm in diameter or more slender, long roots up to 7 cm long. Both of these are normally eaten raw as a salads. A longer root form, including oriental radishes, daikon or mooli, and winter radishes, grows up to 60 cm long with foliage about 60 cm high with a spread of 45 cm. The flesh of radishes harvested timely is crisp and sweet, but becomes bitter and tough if the vegetable is left in the ground too long. Leaves are arranged in a rosette. They have a lyrate shape, meaning they are divided pinnately with an enlarged terminal lobe and smaller lateral lobes. The white flowers are borne on a racemose inflorescence. The fruits are small pods which can be eaten when young.

Radish vegetables are a fast-growing, annual, cool-season crop. The seed of this vegetable germinates in three to four days in moist conditions with soil temperatures between 18 and 29 °C (65 and 85 °F). Best quality roots are obtained under moderate day lengths with air temperatures in the

*Corresponding Author

range 10 to 18 °C (50 to 65 °F). Under average conditions, the crop matures in 3–4 weeks, but in colder weather, 6–7 weeks may be required.
Radishes grow best in full sun in light, sandy loams, with a soil pH 6.5 to 7.0, but for late-season crops, a clayey-loam is ideal. Soils that bake dry and form a crust in dry weather are unsuitable and can impair germination. Harvesting periods can be extended by making repeat plantings, spaced a week or two apart. In warmer climates, radishes are normally planted in the autumn. The depth at which seeds are planted affects the size of the root, from 1 cm deep recommended for small radishes to 4 cm for large radishes. During the growing period, the crop needs to be thinned and weeds controlled, and irrigation may be required (Wikipedia) . This vegetable crop having the very good flowers due to which attract the various pollinators/visitors for their nectars and pollen or both.

MATERIALS AND METHODS

The observation was undertaken at farmers field about five kilometer away from Raj Mohini Devi College of Agriculture and Research Station, Ambikapur (Chhattisgarh) to study the foraging activity of stingless bee, *Tetragonula iridipennis* on radish flowers during 2020.This area is located at a Latitude of N 23.141578^0 and Longitude of E 83.180567^0 and an altitude 1935ft.The variety of radish was sown of Japani White with the distance of 30x10cm. The plot size was kept m^2 with all the agronomical practices. The population of stingless bee was recorded randomly selected five spots per plot within five minutes per square meter then averaged from 8.00AM, 10.00AM, 12.00Noon, 2.00PM and 4.00PM during six date of observations.

RESULTS AND DISCUSSION

The result depicted in table 1 and fig 1 that the population of stingless bee was observed during first week of February 2020 at 8.00AM (0.40 bees/5min/m2) and reached its peak at 12.00Noon (7.00 bees/5min/m^2) however, its population was decreased at 4.00PM (4.20 bees/5min/m^2) and the overall average population was recorded 3.84 bees/5min/m^2.
During the second week of observation minimum population was noticed at 8.00AM(0.20 bees5min/m^2) and reached its peak at 2.00PM(7.20 bees/5min/m^2) and after that its population was decreased at 4.00PM (3.00 bees/5min/m^2) however, its average population was observed 3.44 bees/5min/m^2.
During the third week of observation lower population was recorded at 8.00AM (0.60 bees/5min/m^2) and its peak population was recorded at 12.00Noon (13.00 bees/5min/m^2) followed by at 2.00PM (11.20 bees/5min/m^2) however, low population was noticed at 4.00PM (5.00 bees/5min/m^2) and the mean average population was recorded 6.56 bees/5min/m^2.
During the fourth week of observation lowest population was recorded at 8.00AM (2.00 bees/5min/m^2). The maximum population was found at 12.00Noon (14.20 bees/5min/m^2) followed by at 4.00PM (6.20 bees/5min/m^2) and the average population was recorded 6.76 bees/5min/m^2).
During the first week of March low population was recorded at 8.00AM (1.80 bees/5min/m^2). The highest population was recorded at 12.00Noon (15.60 bees/5min/m^2) followed by at 2.00PM (13.20 bees/5min/m^2) and decreased at 4.00PM (6.40 bees/5min/m^2) and the average population was recorded 8.24 bees/5min/m^2.
During the second week of observation maximum population was recorded at 12.00Noon (7.80 bees/5min/m^2) followed by at 2.00PM (6.20 bees/5min/m^2) and decreased at 4.00PM (4.60 bees/5min/m^2) however, the lowest population was recorded at 8.00AM (2.00 bees/5min/m^2).The average population was recorded 4.88 bees/5min/m^2.
During the different hours of the day the population of bees/5min/m2 was recorded maximum at 12.00noon (10.46 bees/5min/m^2) followed by at 2.00PM (8.30 bees/5min/m^2) and at 4.00PM (4.90 bees/5min/m^2) however, the lowest population was observed at 8.00AM (1.66 bees/5min/m^2).

Table 1. Population of stingless bee on radish flowers during 2020.

Date of observations	Population of bees/5min/m^2 at different hours of the day)					**Total**	**Mean**
	8.00AM	10.00AM	12.00Noon	2.00PM	4.00PM		
07/02/2020	0.40	1.40	7.00	6.20	4.20	19.20	3.84
14/02/2020	0.20	1.60	5.20	7.20	3.00	17.20	3.44
21/02/2020	0.60	3.00	13.00	11.20	5.00	32.80	6.56
28/02/2020	2.00	5.60	14.20	5.80	6.20	33.80	6.76
07/03/2020	1.80	4.20	15.60	13.20	6.40	**41.20**	**8.24**
14/03/2020	2.00	3.80	7.80	6.20	4.60	24.40	4.88
Total	7.00	19.60	**62.80**	**49.80**	29.40		
Mean	1.66	3.26	**10.46**	**8.30**	4.90		

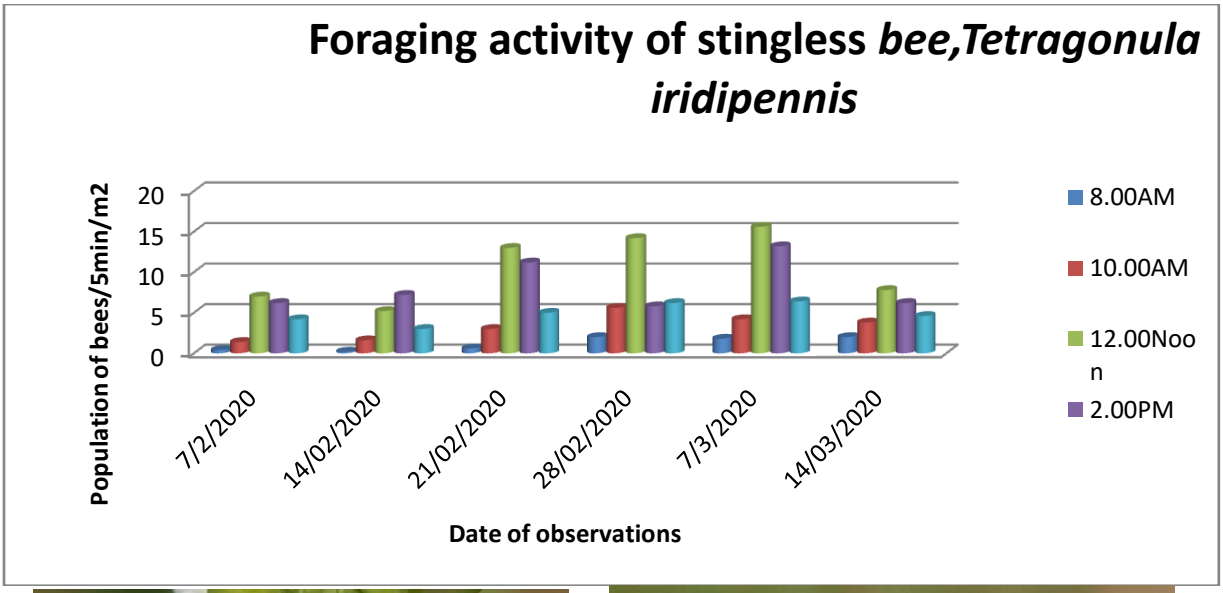

Fig 1. Foraging activity of stingless bee, *Tetragonula iridipennis* in radish flowers.

Stingless bee foraging on radish flowers

The present investigations are more or less conformity with earlier workers Paikara *et al*. (2020) who worked on corianders flowers, Manhare *et al* (2017) on buckwheat flowers, Painkra *et al* (2014a,2014b) on niger crop, Painkra and Shaw (2016) on niger flowers, Painkra (2016) on lajwanti grass, Painkra (2018) on *Ageratum conyzoides*, Painkra (2019) on oriander flowers, Painkra (2019) on broccoli flowers, Painkra and Kumaranag (2019) in sunflower, Painkra (2019) in broccoli flowers, Painkra (2019) in marigold flowers, Painkra *et al* (2021) on maize and Yadav and Painkra (2020) observed on mustard crop.

CONCLUSION

It is concluded that the stingless bee was visited maximum at 12.00Noon and was found decreased during afternoon. During the forenoon the population was recorded minimum during this period if the plant protection is required this period is most suitable and bio-pesticides are recommended to save the honey bee colonies. Integrated pest management tools are very important for save the bee colonies.

ACKNOWLEDGEMENT

The author is highly thankful to Project Coordinating Unit, All India Coordinated Research Project on Honey Bees and Pollinators, Division of Entomology, ICAR-IARI New Delhi for providing the necessary facilities and financial support during the research work.

REFERENCES

Manhare Jogindar, Singh, Painkra, G.P., Bhagat, P.K. and Painkra, K.L. (2017). Studies on the foraging activity of Indian honeybee, *Apis cerana indica* Fabr and other honeybee spp. on buckwheat flowers. Journal of Plant Development Sciences 9(8):823-828.

Paikara, Surya, Prakash, Painkra, G.P., Painkra, K.L. and Bhagat, P.K. (2020). Foraging behavior of different bee species on coriander flowers. Journal of Plant Development Sciences,12(9):517-528.

Painkra, G. P., Shivastava, Shiv, K., Shaw, S. S. and Gupta, Rajeev (2014). Foraging behaviour of honey bees on niger crop(*Guizotia abyssinica* Cass.). An International Research Journal Lab to Land 6(23) :289-293.

Painkra, G. P., Shivastava, Shiv, K., Shaw, S. S. and Gupta, Rajeev (2014). Foraging behaviour of honey bees on niger crop (*Guizotia abyssinica* Cass.).An International Research Journal Lab to Land 6(24) :382 -386.

Painkra, G. P. and Shaw, S. S. (2016). Foraging behaviour of honey bees in niger flowers, *Guizotia abyssinica* Cass.in North zone of Chhattisgarh. International Journal of Plant Protection 9(1): 100-106.

Painkra G. P. (2016). Foraging behaviour of rock bee, *apis dorsata* on lajwanti grass (*mimosa pudica)* in surguja of Chhattisgarh. Journal of Plant Development Sciences. 8 (11) : 543-545.

Painkra, G.P. (2018). Foraging behaviour of giant bee, *Apis dorsata* (Hymenoptera- Apidae) on *Ageratum conyzoides* in northern hill zone of Chhattisgarh. Journal of Plant development Sciences. 9(10): 517-520.

Painkra, G.P. (2019). Foraging behaviour of honey bees on coriander (*Coriandrum sativum* L.) flowers in Ambikapur of Chhattisgarh**.** Journal of Entomology and Zoology Studies. 7(1): 548-550.

Painkra, G.P. (2019). Foraging behaviour of stingless bee, *Tetragonula iridipennis* (Hymenoptera - Apidae) in broccoli flowers in Ambikapur of Chhattisgarh**.** Journal of Plant Development Sciences,11(7):431-433.

Painkra, G.P. and Kumaranag, K.M. (2019). Foraging activity of stingless bee, *Tetragonula iridipennis* Smith (Hymenoptera-Apidae-Meliponinae) in sunflower. Journal of Plant Development Sciences. 11(8):463-466.

Painkra, G.P. (2019). Foraging behavior of Italian honey bee, *Apis mellifera* (Hymenoptera-Apidae) in broccoli flowers. Journal of Plant Development Sciences.11(11):681-683.

Painkra, G.P. (2020). Foraging behavior of European honey bee, *Apis mellifera* (Hymenoptera-Apidae) in marigold flowers in Chhattisgarh, India. Journal of Plant Development Sciences, 12(3):177-180.

Painkra, G.P., Jaiswal, Sachin Kumar and Prajapati, Vinod Kumar (2021). Foraging behavior of various species of Honey bees on Maize among it's correlation with weather parameters. Journal of Entomology and Zoology Studies; 9(1): 613-617.

Yadav, Shubham and Painkra, G.P. (2020). Foraging behavior of rock bee (*Apis dorsata*) on mustard ecosystem in Ambikapur, Chhattisgarh. Journal of Plant Development Sciences,12(10):635-639.