www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2022; 11(12): 4316-4319

www.thepharmajournal.com
Received: 13-09-2022
Accepted: 16-10-2022

**Shaikh AK**
M.Sc. Scholar, Department of Agricultural Entomology, College of Agriculture, Dapoli, Maharashtra, India

**Wankhede SM**
Scientist (Entomology), Regional Coconut Research Station, Bhatye, Ratnagiri, Maharashtra, India

**Sanap PB**
Vegetable Specialist, Vegetable Improvement Scheme, CES, Wakawali, Dapoli, Ratnagiri, Maharashtra, India

**Kale SN**
Assistant Professor, Department of Agricultural Entomology, DBSKKV, Dapoli, Ratnagiri, Maharashtra, India

**Waman AG**
M.Sc. Scholar, Department of Agricultural Entomology, College of Agriculture, Dapoli, Maharashtra, India

**Patil SR**
M.Sc. Scholar, Department of Agricultural Entomology, College of Agriculture, Dapoli, Maharashtra, India

**Corresponding Author:**
**Shaikh AK**
M.Sc. Scholar, Department of Agricultural Entomology, College of Agriculture, Dapoli, Maharashtra, India

# Impact of different bee attractants for the orientation of stingless bee for pollination in radish, *Raphanus sativus* (L.)

**Shaikh AK, Wankhede SM, Sanap PB, Kale SN, Waman AG and Patil SR**

**Abstract**
An experiment was carried out at Central Experimental Station, Wakawali, Dr. BSKKV, Dapoli during Rabi, 2021-22 with eight treatments and three replications in RBD. Results revealed that the treatment T1- jaggery solution @ 10 percent was the best treatment which was recorded the maximum (11.4 bees/5 min) and was found significantly superior over the treatments T7- molasses @ 10 percent (8.1 bees/5 min), T5- Apis honey @ 10 percent (8.0 bees/5 min), T6- stingless bee honey @ 10 percent (7.5 bees/5 min), T3- coconut water 10 percent (7.5 bees/5 min) and T8- untreated control (3.8 bees/5 min). It was at par with treatments T4- sugarcane juice @ 10 percent which recorded (10.8 bees/5 min) and T2- sugar solution @ 10 percent (10.1 bees/5 min). The highest seed yield was recorded in T1-Jaggery solution @ 10 percent (2.64 q/ha). Stingless bee pollination can enhance the high percent of pod setting and seed yield of radish.

**Keywords:** Attractants, pollination, radish, seed yield, stingless bee

## 1. Introduction
Apiculture is the practice of raising honey bees for honey production and as pollinators for various crops. An essential aspect of the environment, pollination helps to improve lives and promote food security. The most important activity of stingless bees in terms of benefits to people and environment is pollination, which they carry out in both natural vegetation and crops, particularly those from the compositae, cruciferae and leguminosae families. There is a need for new pollinator species to be used in agriculture in order to preserve food production persistence and improve output due to the growing environmental strain and the subsequent loss of honey bees. It is now essential to find a realistic alternative to controlled pollination in agriculture. This search appears to have focused on stingless bees, which are found in tropical and subtropical ecosystems. Any method that attracts bees to visit a specific crop would be very beneficial in terms of utilizing the advantages of cross-pollination. The use of attractants has recently gathered a lot of attention and there are currently a lot of commercially available patented pollinator attractants (Chandrashekhar and Sattigi, 2009) [2]. Bee attractants that encourage honey bees to visit certain crops, would be extremely useful in maximizing the advantages of cross pollination. In India, local bee attractants such as sugar solution, jaggery solution, sugarcane juice, and honey solution are utilized to increase crop production (More *et al*. 2020) [4]. Radish, *Raphanus sativus* (L.) a vegetable and cross-pollinated crop grows fast and lasts a short period. It is pollinated by wild honey bees, wild-flower flies, bumble bees, Hymenopterans, Dipterans, Coleopterans, Lepidopterans and other insects (Chandrashekhar and Sattigi, 2009) [2]. In Konkan region, stingless bees found in electric and plumbing pipe, live and dead tree trunk, crevices in window, door and walls (Wankhede *et al*. 2022) [8] and playing major role in radish for pollination. Considering importance of bees for pollination in radish and attractants for orientation of bees, the present research work was conducted with objective to study the impact of different bee attractants for the orientation of stingless bee for pollination in radish.

## 2. Material and Methods
An experiment was conducted at the Central Experimental Station, Wakawali during Rabi 2021-22. The experiment was laid out in a randomised block design with eight treatments *viz*., T1- jaggery solution @ 10 percent, T2-sugar solution @ 10 percent, T3- coconut water @ 10

percent, T4-sugarcane juice @ 10 percent, T5- Apis honey @ 10 percent, T6- stingless bee honey @ 10 percent and T7- molasses @ 10 percent and T8- untreated control and three replications. In each treatment plot, total 5 plants in a 4x3 m2 area were tagged randomly for recording the visits of bees. At 50% flowering, three stingless bee colonies were installed with equal distance in a radish plot. Two sprays were undertaken at 50 percent flowering and second spray was taken after the 12 days of first spray. Pre-count observations were undertaken at one day prior to spraying and post treatments observations were recorded @ 1st, 3rd and 5th days after application of treatments about visiting bees per five minutes during its peak period (11.00 hr-1.00 hr) on radish flowers. The crop was protected from various pests and diseases, but no insecticides were used during the flowering period. Recommended agronomical package of practices were followed for raising good seed production plot. Radish, *Raphanus sativus* (L.) yield parameters *viz*., number of pods set and seed yield were recorded separately for each treatment. Each plot was harvested and weigh separately and yield per plot was later convert into yield per hectare. The generated data was subjected in statistical analysis.

## 3. Results and Discussion

### 3.1 Mean of number of bees attracting towards the different treatments for pollination in radish, *Raphanus sativus* (L.)

The pooled mean of first and second sprays of stingless bee visitation towards attractant treatments presented in table 1 and depicted in fig 1. The data on mean of first spray revealed that the maximum stingless bee population recorded in treatment T1- jaggery solution @ 10 percent (11.2 bees/5 min) which was significantly superior over the treatments T3- coconut water @ 10 percent recorded (7.7 bees/5 min), T6- stingless bee honey @ 10 percent (7.1 bees/5 min) and T5- Apis honey @ 10 percent (7.0 bees/5 min). It was at par with the treatments T4- sugarcane juice @ 10 percent which recorded (10.7 bees/5 min), T2- sugar solution @ 10 percent (9.5 bees/5 min) and T7- molasses @ 10 percent (7.9 bees/5 min). Minimum bees were recorded in the T8- untreated control (2.9 bees/5 min). The observations recorded after second spraying of attractant treatments indicated that the maximum visitation of stingless bee was found in the treatment T1- jaggery solution @ 10 percent (11.6 bees/5 min) was significantly superior over the treatments T5- Apis honey @ 10 percent (8.8 bees/5 min), T7- molasses @ 10 percent (8.4 bees/5 min), T6- stingless bee honey @ 10 percent (8.0 bees/5 min) and T3- coconut water @ 10 percent (7.3 bees/5 min) and T8- untreated control (4.6 bees/5 min). It was at par with the treatments T4- sugarcane juice @ 10 percent which recorded (11.0 bees/5 min) and T2- sugar solution @ 10 percent (10.8 bees/5 min). The data on mean of two sprays revealed that the treatment T1- jaggery solution @ 10 percent was the best treatment which recorded the maximum (11.4 bees/5 min) and was found significantly superior over the treatments T7- molasses @ 10 percent recorded (8.1 bees/5 min), T5- Apis honey @ 10 percent (8.0 bees/5 min), T6- stingless bee honey @ 10 percent (7.5 bees/5 min), T3- coconut water 10 percent (7.5 bees/5 min) and T8- untreated control (3.8 bees/5 min). It was at par with treatments T4- sugarcane juice @ 10 percent (10.8 bees/5 min) and T2- sugar solution @ 10 percent (10.1 bees/5 min). The T8-untreated control treatment was recorded lowest bee population. The present study is in conformity with Manchare *et al*. (2019) [3] who observed the impact of bee attractants before and after spraying. A day following the initial spray, a jaggery solution 10 percent attracted more bees (4.44 bees/m2/min) and was considerably superior to other treatments and this treatment was at par to honey solution 10 percent (3.55 bees/m2/min), sugarcane juice 10 percent (3.33 bees/m2/min) and molasses 10% (3.1 bees/m2/min). Similarly, Wankhede *et al*. (2019) [7] concluded that, a day following the initial spray, a 10 percent jaggery solution attracted 3.78 bees/m2/min. The results were in accordance with More *et al*. (2020) [4] who reported that, the jaggery solution (10%) treatment was found to be more effective than the other treatments.

### Impact of different attractants for orientation of stingless bees on pod setting and seed yield of radish, *Raphanus sativus* (L.)

After spraying of different bee attractants at flowering stage of radish, *Raphanus sativus* (L.), the yield parameters *viz*., number of pods set and seed yield/ha was recorded for each treatment. The observations on the pod sets per plant and seed yield/ha were recorded which are presented in table 1 and graphically depicted in fig. 2 and 3.

### Pods set/plant

The treatment T1- Jaggery solution (10%) produced the maximum pod sets (67.6 pods/plant) because it attracted the most stingless bees and was at par with T4- sugarcane juice (64.9 pods/plant). It was significantly superior over rest of the treatments *viz*., T2- sugar solution (10%) which recorded (52.5 pods/plant). It was followed by T7- molasses @ 10 percent (45.6 pods/plant), T5- Apis honey @ 10 percent (36.3 pods/plant), T6- stingless bee honey @ 10 percent (31.1 pods/plant) and T3- coconut water @ 10 percent (27.8 pods/plant). The treatment T8- untreated control which recorded lowest number of pods set (25.2 pods/plant).

### Seed yield/ha

The yield in various treatments had been greatly impacted by stingless bee visitation. The data indicated that the maximum seed yield was recorded in the treatment of T1- Jaggery solution @ 10 percent which recorded (2.64 q/ha). The next best treatment was T4- sugarcane juice @ 10 percent (2.56 q/ha). The rest of the treatments had lesser seed yield as compared to these treatments and followed the descending manner T2- sugar solution @ 10 percent (2.39 q/ha), T7- molasses @ 10 percent (2.13 q/ha), T5- Apis honey @ 10 percent (1.96 q/ha), T6- stingless bee honey @ 10 percent (1.87 q/ha) and T3- coconut water @ 10 percent (1.74 q/ha) with respect to seed yield. The lowest seed yield was found in the T8- untreated control (1.65 q/ha). The treatment T1- Jaggery solution (10%) treatment increased radish seed yield during the Rabi season by attracting the maximum number of bees. Jaggery solution has an adhesive character, a higher capacity for retention and a solid sugar content. It is adsorptive in nature and has a higher viscosity. In comparison, jaggery solution has a strong scent and atmosphere-diffusing ability that attracts honey bees. It was observed that the stingless bee was a frequent pollinator in radish. The present study is in conformity with Munj *et al*. (2017) [5] who studied the major mango pollinators in Konkan and concluded that the intensity of stingless bee Tetragonula

spp. was high (11.50/panicle/hour) followed by honey bee, Apis indica Fab. (6.40/panicle/hour). The current findings are in agreement with those of Azmi *et al*. (2016) [1] who reported on the stingless bee pollination of a chilli crop in a green house and came to the conclusion that chilli from hand-cross pollination and H. itama pollination were significantly heavier, longer and contained more seeds per fruit than self-pollination. The results corroborate with those of Tej *et al*. (2017) [6] who also reported that stingless bees are essential to the pollination of greenhouse cucumber crop. Besides that, it was noted that the improvement in the qualitative and quantitative yield parameters of the cucumber crop had increased the yield and selling value of the crop.

**Table 1:** Impact of different bee attractants for orientation of stingless bee and yield of radish, *Raphanus sativus*(L.)

| Tr. No. | Treatment details | Stingless bee visits/plot/5 min | | | No. of pod set/plant | Seed yield/q/ha |
|---|---|---|---|---|---|---|
| | | 1st spray | 2nd spray | Pooled mean | | |
| T1 | Jaggery solution @ 10% | 11.2 (3.49) * | 11.6 (3.54) | 11.4 (3.51) | 67.6 (8.28) | 2.64 |
| T2 | Sugar solution @ 10% | 9.5 (3.21) | 10.8 (3.41) | 10.1 (3.31) | 52.5 (7.31) | 2.39 |
| T3 | Coconut water @ 10% | 7.7 (2.88) | 7.3 (2.87) | 7.5 (2.87) | 27.8 (5.36) | 1.74 |
| T4 | Sugarcane juice @ 10% | 10.7 (3.44) | 11.0 (3.44) | 10.8 (3.44) | 64.9 (8.11) | 2.56 |
| T5 | Apis honey @ 10% | 7.1 (2.70) | 8.8 (3.06) | 8.0 (2.92) | 36.3 (6.10) | 1.96 |
| T6 | Stingless bee honey @ 10% | 7.1 (2.77) | 8.0 (2.96) | 7.5 (2.87) | 31.1 (5.66) | 1.87 |
| T7 | Molasses @ 10% | 7.9 (2.96) | 8.4 (3.02) | 8.1 (2.99) | 45.6 (6.82) | 2.13 |
| T8 | Untreated control | 2.9 (1.97) | 4.6 (2.33) | 3.8 (2.15) | 25.2 (5.12) | 1.65 |
| S.E (m±) | | 0.17 | 0.12 | 0.14 | 0.07 | |
| C.D. @ 5% | | 0.53 | 0.38 | 0.45 | 0.23 | |

(*Figures in parenthesis are square root transformed (√x+1) values).

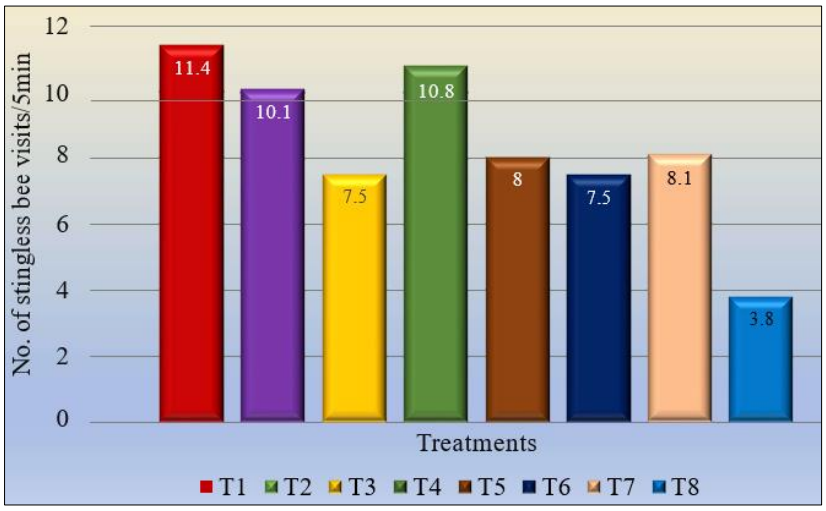


**Fig 1:** Number of stingless bee visits on radish flower

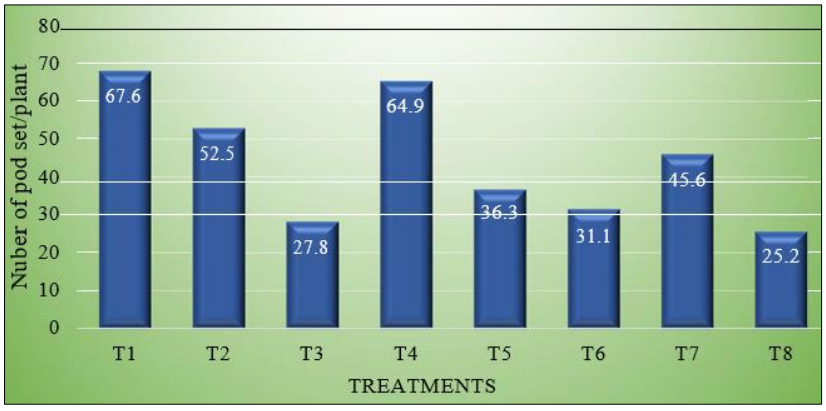


**Fig 2:** Impact of different attractants for orientation of stingless bee on pod setting of radish, Raphanus sativus (L.)

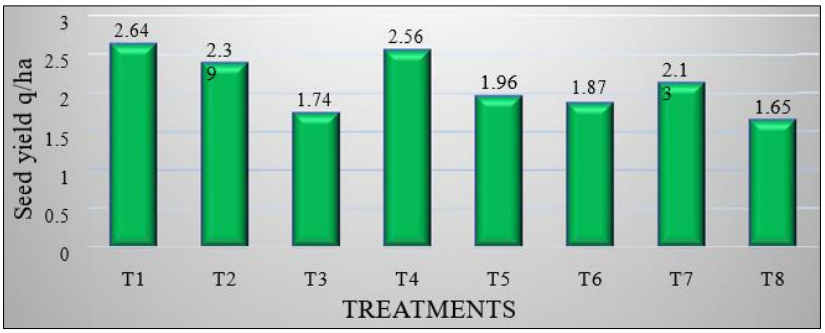


**Fig 3:** Impact of different bee attractants for orientation of stingless bee on seed yield of radish, Raphanus sativus (L.)

**Plate 1:** General view of experimental plot

**Plate 2:** Attractants

**Plate 3:** Stingless bee visits on radish flower

## 4. Conclusion

In the present investigation it is observed that the maximum number of stingless bees were visited towards T1- jaggery solution @ 10 percent for pollination and ultimately increase the high percent of pod setting and seed yield. Stingless bee can be used as an alternative pollinator for the benefit of pollinating crops and enhance the yield.

## 5. Acknowledgement

Authors are thankful to Department of Agricultural Entomology, College of Agriculture, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli-415712, Dist-Ratnagiri, Maharashtra (India) for providing necessary facilities and valuable suggestion during investigation.

## 6. References

1. Azmi WA, Seng CT, Solihin NS. Pollination efficiency of the stingless bee, *Heterotrigona itama* (Hymenoptera: Apidae) on chilli (*Capsicum annuum*) in greenhouse. J Trop. Plant Physiol. 2016;8:1-11.
2. Chandrashekhar, Sattigi. Influence of attractants on bee visitation to radish. J Agric. Sci. 2009;22(4):909-911.
3. Manchare RR, Kulkarni SR, Chormale TS. Effect of bee attractants on foraging activities of Indian bees Apis cerena indica in bitter gourd (*Momordica charantia* L.). J Entomol. Zool. Stud. 2019;7(5):468-472.
4. More MR, More SA, Tamboli ND, Kulkarni SR. Effect of sprays of bee attractants on qualitative and quantitative yield parameters on seed onion crop (*Allium cepa* L.) J Entomol. Zool. Stud. 2020;8(6):1513-1516.
5. Munj AY, Zote VK, Raut RA, Salvi BR. Survey and surveillance of pollinators of mango in South Konkan coastal region of Maharashtra. J Entomol. Zool. Stud. 2017;5(3):190-192.
6. Tej KM, Srinivasan MR, Rajashree V, Thakur RK. Stingless bee *Tetragonula iridipennis* Smith for pollination of greenhouse cucumber. J Entomol. Zool. Stud. 2017;5(4):1729-1733.
7. Wankhede HK, Kulkarni SR, Pawar SA. Effect of bee attractants on foraging activity of honey bees Apis mellifera and Apis cerana for enhancing seed production of cucumber (*Cucumis sativus* L.). J Entomol. Zool. Stud. 2019;7(2):566-569.
8. Wankhede SM, Shinde VV, Narangalkar AL, Haldankar PM. Feasibility of different traps for trapping of stingless bee colony from its natural habitat. Pharm. Innov. J. 2022;SP11(10):2073-2077.