Effect of bee attractants on the attraction of *Apis dorsata* and their impact on seed yield of niger*Guizotiaabyssinica* (L.f.)Cass crop

Abstract

The study was conducted at the experimental farm of the PC Unit Sesame and Niger, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), located in Jabalpur, Madhya Pradesh, during the *Kharif* season of 2021. The primary objective of the experiment was to assess the influence of bee attractants on the attraction of *Apis dorsata* (giant honey bees) and their subsequent impact on the seed yield of niger crop. The experiment was designed using a Randomized Block Design (RBD) with nine treatments and three replications. This experimental setup allows for systematic testing of the effects of different bee attractants on both bee behavior and crop yield while controlling for potential sources of variation. By utilizing this design, researchers can obtain reliable data on the efficacy of various bee attractants in enhancing pollination and improving seed yield in niger crops.The results showed that the both at 10% and 50% flowering stage *Apis dorsata*visit was numerically the highest with flower extract of *Madhuca longifolia* 10% with 20.42 and 19.25*Apis dorsata*/m^2/5min, respectively.This was followed by rose water spray with 19.25 and 15.33*Apis dorsata*/m^2/5min, respectively. The population of *Apis dorsata*was received from the controlled condition 4.08 and 6.08*Apis dorsata*/m^2/5min at 10% and 50% flowering stage, respectively. This was followed by water spray 5.75 and 8.58*Apis dorsata*/m^2/5min at 10% and 50% flowering stage, respectively. The foliar spray of mahua flower extract and rose water 10% were found significantly superior over others in respect to record higher seed yield and recorded 6.90 q and 6.70 q/ha seed yield, respectively.

Keywords: Flower extract, *Madhuca longifolia*,dates extract, bee, *Apisdorsata.*

1. Introduction

Niger [*Guizotiaabyssinica* (L. f.) Cass.] is a native of Tropical Africa and belong to the family Asteraceae (Compositae), it is known as lifeline of tribal agriculture and economy in India. Niger cultivation in India, particularly by tribal communities, is indeed notable for its ability to thrive on marginal and sub-marginal lands with minimal inputs and under rainfed conditions, as highlighted by Ranganatha *et al.,* (2009). The statistics you provided further underscore its significance in the agricultural landscape: With an average yield of 357.2 kg per hectare and a total production of 40.3 thousand tonnes, niger is cultivated across 112.8

thousand hectares in India. Madhya Pradesh contributes significantly to niger cultivation, with roughly 16.0 thousand hectares of land dedicated to it. The state yields approximately 4.9 thousand tonnes annually, with a seed productivity of 308.8 kg per hectare (Anonymous, 2021-22). In terms of its role as an oilseed crop, niger plays a crucial part in fulfilling India's edible oil requirements: It contributes about 3% of the country's total edible oil needs (Getinet and Sharma, 1996).Niger oil, extracted from its seeds, is characterized by its pale yellow color, nutty flavor, and pleasant aroma. With a protein content ranging from 18 to 24% and a quality oil content of 32-40%, niger oil is highly valued. Notably, the oil has a taste reminiscent of desi ghee, and the seeds are free from any harmful toxins. This multifaceted utility underscores the importance of niger cultivation in India's agricultural and economic landscape, particularly for tribal communities relying on it for sustenance and livelihood.Niger, being a self-incompatible plant, relies entirely on cross-pollination for successful seed production. Insect pollination, particularly by bees, is crucial for ensuring optimal seed yields and enhancing the quality of the crop. This reliance on insect pollinators underscores the importance of maintaining healthy populations of pollinating insects for sustainable niger cultivation and agricultural productivity overall.Indeed, insect pollination, especially by bees, can contribute to consistent crop maturity and an early harvest for niger crops. When flowers are effectively pollinated, they develop into fruits and seeds more uniformly, leading to a more synchronized maturation process across the crop. This synchronization can result in a more predictable harvest timeline, allowing farmers to plan and manage their harvesting operations more efficiently. Additionally, early and effective pollination can stimulate the development of fruits and seeds, leading to earlier maturity and consequently an earlier harvest, which is beneficial for farmers in terms of reducing exposure to potential risks such as adverse weather conditions or pest damage later in the growing season. Therefore, ensuring adequate pollination through insect pollinators like bees can contribute to a more reliable and timely harvest of niger crops.Provision of bee colonies during the flowering period of crop is a simple but essential input Dwarka *et al.,* (2022). A planned bee pollination programme on national scale significantly contributes in solving the problem of edible oil shortage in the country even at the existing level of land use of oil crops (Mohana Rao *et al.*, 1981). The research findings you mentioned highlight the critical role of honey bee pollinators and other natural pollinators in niger crop production. When these pollinators are absent, there can be a significant negative impact on production, ranging from 11% to as high as 78%. This underscores the dependence of niger crops on effective pollination for successful seed set and ultimately yield. Ensuring the presence of honey bees and other pollinators during the flowering period is therefore essential to maximize production and achieve optimal yields in niger cultivation. It also emphasizes the importance of pollinator conservation efforts to safeguard these vital contributors to agricultural productivity.An additional income of Rs. 252 to Rs. 2125 including Rs. 1015/ha from honey was estimated through beekeeping with niger over open pollinated crops (Anonymous, 2005). Actually, honey bees are often considered one of the most effective pollinators due to their ability to visit numerous flowers during a single foraging trip, their proficiency in transferring pollen between flowers, and their tendency to exhibit flower constancy, meaning they preferentially visit the same type of flower during a foraging trip. Their effectiveness in pollinating a crop depends not on their performance compared to other nearby plants, but rather on their efficiency in transferring pollen between flowers of the same crop species. Honey bees are particularly effective pollinators for many crops because they can carry large amounts of pollen on their bodies and transport it between flowers, facilitating successful fertilization and fruit set. However, the presence of other nearby plants can still influence honey bee behavior and foraging patterns. A diverse floral environment can provide honey bees with a balanced diet and support their overall health and vitality, which can indirectly contribute to their effectiveness as pollinators for specific crops. Therefore, maintaining floral diversity in agricultural landscapes can be beneficial for supporting honey bee populations and enhancing their pollination services.Commercial and local bee attractants *viz.*, bee line, bee here, bee scent, bee scent plus, fruit boost, Bee-Q, sugar solution, sugarcane juice, jaggery solution, Molasses, etc. are being used to boost the foraging activities in niger in the India mainly Jabalpur, Madhya Pradesh region Dwarka *et al.*, (2022). Nevertheless, there are not many research on the topic of bee attractants used in India.Insect pollinator conservation and management are becoming more and more important every day.This type of research is significant as it can help understand the role of bee attractants in pollination and its subsequent effects on crop yield. Bees, including *Apis dorsata*, play a crucial role in pollination, which is essential for the reproduction of many plants, including those that produce seeds. By studying the effects of different attractants on bee behavior and their impact on seed yield, researchers can potentially identify methods to enhance pollination and improve crop productivity.

2. Material and methods

The provided excerpt outlines a research study conducted during the *Kharif* season of 2021 at the experimental farm of the PC Unit (ICAR) Sesame and Niger, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, located in Jabalpur, Madhya

Pradesh. The study focused on investigating the impact of bee attractants on the foraging behavior of rock honey bees in niger crops. The research was structured using a randomized block design, a common experimental design in agricultural research, with three replications. This design helps to minimize bias and ensure that any observed effects are likely due to the treatments being studied rather than other variables. By using this design, researchers can draw more reliable conclusions about the effects of bee attractants on the behavior of rock honey bees and potentially their influence on niger crop productivity.

Table. 1: List of attractants

Sl.No.	Treatments/attractants
1.	T_1- Flower extract of *Madhuca longifolia* 10%
2.	T_2-Juice of *Sachharum officinarum* 10%
3.	T_3 -Jaggery solution 10%
4.	T_4 -Honey solution 10%
5.	T_5 -Fruit extract of *Foenix dactylifera* 10%
6.	T_6-Sugar solution 10%
7.	T_7 -Rose water(Marketed) 10%
8.	T_8 -Water spray.
9.	T_9-Control

Two times, at 10% and 50% of the blooming phases, the aforementioned attractants were sprayed.The suggested set of agronomic procedures was adhered to in order to produce a productive and healthy crop. A one-meter square section was randomly chosen from each plot, and the number of gigantic honey bees and *Apis dorsata* that visited the flowers was counted. The observations were recorded a day before and 1st, 3rd, 5th and 7th day after first and second spraying and seed yield obtained from different treatments were recorded separately.

3. Results and discussion

The results of the current study indicate that each bee attractant sprayed had a significant effect on the ability of rock honey bees to forage in the niger crop. These attractants demonstrated superiority over the control group across various recorded parameters. This suggests that the bee attractants tested were successful in enticing rock honey bees to forage within the niger crop, potentially leading to increased pollination activity and, consequently, enhanced crop yield. The findings underscore the importance of using bee attractants as a strategy to improve pollination efficiency and agricultural productivity, particularly in niger crop cultivation. Further analysis of the specific impacts of each attractant and their long-term effects on crop yield could provide valuable insights for optimizing pollination management practices in agricultural settings.

The results of the study indicate that all the treatments applied had a significant impact on attracting the population of *Apis dorsata* (giant honey bees). This suggests that each treatment influenced the bees attraction to varying degrees, highlighting the effectiveness of the different methods or substances used as bee attractants. Such findings are important in understanding how different attractants can influence bee behavior and their presence in agricultural settings. By identifying which treatments are most effective in attracting *Apis dorsata*, researchers can develop strategies to enhance pollination and ultimately improve crop yield, particularly in niger crops where bee pollination plays a crucial role.Further analysis of the specific characteristics and effects of each treatment can provide valuable insights into optimizing bee attractant methods for sustainable agriculture practices.At 10% flowering stage *Apis dorsata* visit was numerically the highest with treatment, flower extract of *Madhuca longifolia* 10% (20.42/m^2/5min) followed by (19.25/m^2/5min) lated to the rose water spray and juice of *S. officinarum* 10% (16.42/m^2/5min) while it was the lowest at control (4.08/m^2/5min) followed by water spray (5.75/m^2/5min) and 10% sugar solution (11.50/m^2/5min). At 50% flowering stage the highest population of *Apis dorsata* was attracted with flower extract of *Madhuca longifolia* 10% (19.25/m^2/5min) followed by (16.33/m^2/5min) fruit extract of *Foenix dactylifera* while it was least on controlled condition (6.08/m^2/5min) followed by water spray (8.58/m^2/5min) and 10% sugar solution spray (10.92/m^2/5min). Present findings are also supported by the findings of Nidagundi (2004) who reported that spraying cacambe at (10 percent), Bee-Q at (1.25 percent) and jiggery solution at (10 percent) enhanced bee visitation to the flowers of bitter gourd.These findings are in close conformity with the earlier reports of Dwarka *et al.*, (2022) who reported that the 10% and 50% flowering stages of the niger crop, the highest number of visits by *Apis dorsata* (giant honey bees) were observed with the treatment of mahua flower extract at 10%. Specifically, during the 10% flowering stage, there were 50.71 giant honey bees per square meter per 5 minutes, while during the 50% flowering stage, this number increased to 52.46 giant honey bees per square meter per 5 minutes. Following closely behind the mahua flower extract treatment, the next highest number of visits were recorded with the treatment of rose water spray. During the 10% flowering stage, there were 43.58 giant honey bees per square meter per 5 minutes, and during the 50% flowering stage, this number slightly increased to 44.96 giant honey bees per square meter per 5 minutes. The population of *Apis dorsata* was received from controlled condition 15 and 17.21 giant honey bees/m^2/5 min at 10% and 50% flowering stage, respectively. This was followed by water spray 18.67 and 19.76 giant honey bees/m^2/5min at 10% and 50% flowering stage, respectively on niger. Present findings are corroborated with the findings of Kalmath and Sattigi (2002) who reported that spraying of cacambe (10 percent) and jaggery (10 percent) attracted maximum number of *Apisdorsata* up to 15 days after first and second spray.

3.3. Seed yield (q/ha)

According to the statistics on seed yield, there were substantial differences between all of the treatments in terms of recording greater seed yields. The highest seed yield (6.90 q/ha) was recorded with the treatment in which foliar spray of flower extract of *Madhuca longifolia* 10% was applied followed by (6.70 q/ha) rose water 10 % and (6.30 q/ha) fruit extract of *F. dactylifera* spray while the lowest seed yield (3.15 q/ha) was recorded from the controlled condition followed by (4.40 q/ha) 10% jiggery solution and water spray (4.80 q/ha). The findings of your study align with those of Chandrashekhar and Sattigi (2009), who observed similar results regarding the efficacy of bee attractants in enhancing both quantitative and qualitative parameters of radish seed. Chandrashekhar and Sattigi (2009),found that the spraying of bee attractants such as cacambe (10%) and jaggery solution (10%) significantly improved various aspects of radish seed production. These enhancements likely included increased pollination activity and subsequent improvements in seed yield and quality. This convergence in findings between your study and Chandrashekhar and Sattigi's work provides additional support for the effectiveness of bee attractants in agricultural settings. It reinforces the notion that using bee attractants can be a viable strategy for improving pollination and crop productivity across different crops and environments.

Similarly Jayaramappa*et al.*, (2011) observed that spraying of comparison to control where there were 10.66 fruits per plant, fruit boost@0.5ml/litre increased yield characteristics such as number of fruits/plants to 19:00 and 17:00.

4. Conclusion

The study findings suggest that *M. longifolia* (mahua) flower extract at a concentration of 10%, applied during both the 10% and 50% flowering stages, was the most effective in attracting *A. dorsata* (giant honey bees). Following closely behind, rose water at a concentration of 10% also demonstrated high effectiveness in attracting *A. dorsata* and resulted in a higher seed yield compared to other treatments. These results indicate the strong potential of *M. longifolia* flower extract and rose water as effective bee attractants for enhancing pollination activity, particularly by *A. dorsata*, in agricultural settings. The higher seed yield associated with these treatments further highlights their importance in improving crop productivity, underscoring the practical significance of using bee attractants in crop management strategies. The findings provide valuable insights into optimizing bee attractant methods for sustainable agriculture practices, with implications for improving pollination efficiency and overall crop yield.

Table 2: Effect of different attractants on the attraction of *Apis dorsata*, Fab. and their impact of seed yield in niger crop

Treatment	Population of *Apis dorsata*/m^2/5minutes											
	1[st] spray at 10% flowering						2[nd] spray at 50% flowering					
	1DBS	Days after spray				Mean	1DBS	Days after spray				Mean
		1DAS	3DAS	5DAS	7DAS			1DAS	3DAS	5DAS	7DAS	
T_1-Flower extract of *M. longifolia* 10%	15.67 (4.02)	25.00 (5.03)	22.33 (4.75)	17.00 (4.17)	17.33 (4.18)	20.42 (4.55)	9.00 (3.08)	18.33 (4.31)	19.33 (4.43)	21.33 (4.66)	19.67 (4.27)	19.25 (4.43)
T_2-Juice of *S. officinarum* 10%	10.67 (3.34)	17.67 (4.24)	19.33 (4.45)	21.67 (4.69)	7.00 (2.67)	16.42 (4.10)	9.67 (3.15)	15.33 (3.97)	14.67 (3.89)	16.67 (4.13)	15.56 (3.39)	14.50 (3.86)
T_3-Jaggery solution 10%	9.00 (3.02)	16.00 (3.93)	18.67 (4.36)	20.00 (4.52)	8.33 (2.91)	15.75 (4.02)	9.00 (3.08)	17.67 (4.11)	14.67 (3.87)	15.67 (3.99)	16.00 (3.55)	15.08 (3.94)
T_4-Honey solution 10%	8.33 (2.96)	19.33 (4.44)	17.67 (4.24)	19.00 (4.38)	9.33 (3.12)	16.33 (4.08)	7.33 (2.78)	11.67 (3.46)	18.33 (4.33)	15.00 (3.89)	15.00 (3.06)	13.50 (3.73)
T_5- Fruit extract of *F. dactylifera* 10%	8.33 (2.97)	15.33 (3.86)	15.67 (3.95)	14.00 (3.77)	12.00 (3.50)	14.25 (3.83)	6.67 (2.64)	18.00 (4.19)	17.00 (4.16)	17.67 (4.26)	17.56 (3.60)	16.33 (4.08)
T_6-Sugar solution 10%	8.00 (2.89)	10.33 (3.29)	15.00 (3.80)	13.33 (3.70)	7.33 (2.66)	11.50 (3.41)	4.33 (2.18)	8.33 (2.94)	15.67 (3.90)	9.00 (3.01)	11.00 (3.27)	10.92 (3.34)
T_7-Rose water 10%	8.33 (2.96)	21.00 (4.63)	25.33 (5.07)	20.00 (4.52)	10.67 (3.24)	19.25 (4.43)	8.33 (2.96)	17.67 (4.25)	16.67 (4.08)	17.33 (4.20)	17.22 (3.07)	15.33 (3.96)
T_8-Water spray	9.33 (3.12)	5.33 (2.39)	5.67 (2.45)	9.00 (3.07)	3.00 (1.81)	5.75 (2.48)	6.33 (2.60)	7.33 (2.73)	7.00 (2.73)	13.67 (3.76)	9.33 (2.59)	8.58 (3.01)
T_9-Control	5.33 2.40)	4.67 (2.22)	5.00 (2.34)	4.67 (2.24)	2.00 (1.52)	4.08 (2.14)	4.67 (2.26)	4.67 (2.27)	6.00 (2.54)	9.00 (3.03)	6.56 (2.27)	6.08 (2.56)
SEm±	0.22	0.41	0.39	0.29	0.39	0.25	0.22	0.45	0.36	0.31	0.35	0.24
CD at 5%	0.66	1.24	1.17	0.88	1.18	0.74	0.66	1.36	1.07	0.92	1.05	0.71

*Figures in parenthesis are square root of √ x+0.5

5. References

Abrol DP. 2010. Foraging behavior of *Apis florea* F. an important pollinator of *Allium cepa* L. Journal Apicultural Research, 49 (4) : 318-325.

Anonymous, 2005, observations made during “national seminar on strategies for enhancing production and export of sesame and niger” and “annual workshop of AICRP on sesame and niger research workers, 2005”.

Anonymous. 2020-21. 4th Advance Estimate, Agriculture Statistics Division, Directorate of Economics and statistics, New Delhi. Indian Journal of Natural Products and Resources, 2:221-226.

Chandrasekhar GS and Sattigi HN. 2009. Influence of bee attractants on bee pollination on seed setting and yield in raddish. Karnataka Journal Agric. Science, 22 (4):777-780.

Dwarka, Panday AK and Saxena AK. 2022. To study the effect of bee attractants on the attraction of giant honey bees (*Apis dorsata*) and their impact on seed yield of Niger (*Guizotiaabyssinica*) crop. The Pharma Innovation Journal, 11(12): 866-868.

Getinet A and Sharma SM. 1996. Niger, *Guizotiaabyssinica (L.f.)* Cass. Promoting the conservation and use of underutilized and neglected crops. Institute of Plant Genetics and Crop Plant Research. International Plant Genetic Resources Institute, Rome.

JayaramappaKract V, Pattibhiramaiah M and Bhargava HR. 2011. Influence of beeattractants on yield parameters of Ridge gourd (*Luffa acutangulus*L.)(Cucurbitaceae).World Applied Science Journal,15(4):547-462.

Kalmath BS and Sattigi HN. 2002. Effect of different attractants on attracting the bees to onion (*Alium cepa*) crop. Indian Bee Journal, 64(6): 68-71.

Mohana Rao, GM, Lazar M and Suryanarayana MC. 1981. Foraging behaviour of honeybees in sesame (*Sesamum indicum* L.). *Indian Bee J.*, 43:97-100.

Nidagundi B. 2004, Pollination potentiability of honeybees on yield of bitter gourd (*Momordica charantia*L.). *M.Sc. (Agri.) Thesis*, University Agricultural Science, Bangalore (India).

Ranganatha ARG, Tripathi A, Jyotishi A, Paroha S, Deshmukh MR and Shrivastava N. 2009. Strategies to enhance the productivity of sesame, linseed and niger.In: Proceedings of Platinum Jubilee Celebrations, UAS,Raichur.

Venkataramegowda S, Koragandahalli VJ, Menon A and Ruben MC. 2013. Use of Bee-attractants in Increasing Crop Productivity inNiger (*Guizotiaabyssinica*. L). Brazilian Archives Biology and Technology 56(3):365-370.