

Study on the effects of bee attractants on the Attraction of Giant Honey Bee, *Apis dorsata* and their effect on niger (*Guizotia abyssinica* (L.f.) Cass) seed yield

Abstract

The study was conducted at the experimental farm of the PC Unit Sesame and Niger, CoA, Jawaharlal Nehru Krishi Vishwa Vidyalyaya, located in Jabalpur, Madhya Pradesh, during the *Kharif* season of 2022. 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 behaviour 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, *A. pis dorsata* visit was numerically the highest with flower extract of *Madhuca longifolia* 10% with 15.67 and 10.33 *A. pis dorsata*/m²/5min, respectively. This was followed by fruit extract of *F. dactylifera* spray with 14.92 and 9.75 *Apis dorsata*/m²/5min, respectively. The population of *A. pis dorsata* was received from the controlled condition 2.67 and 3.25 *A. pis dorsata*/m²/5min at 10% and 50% flowering stage, respectively. This was followed by water spray 5.08 and 5.16 *A. pis dorsata*/m²/5min at 10% and 50% flowering stage, respectively. The foliar spray of flower extract of *Madhuca M. longifolia* and fruit extract of *F. dactylifera* 10% were found significantly superior over others in respect to record higher seed yield and recorded 6.96 q and 6.90 q/ha seed yield, respectively.

Keywords: 10% and 50% flowering stage, fruit extract of *F. dactylifera*, flower extract of *Madhuca longifolia*, *Apis dorsata*, /m²/5min and bee attractants, Niger.

Introduction

Niger, scientifically known as *Guizotia abyssinica*, is a crop primarily cultivated for its seeds, which are rich in oil and protein. It's commonly referred to as niger seed, ramtil, or black seed. Niger is native to Ethiopia and has been cultivated for centuries in various parts of Africa and South Asia. It is known with different names in different part of the country viz., *ramtil*, *jagni* or *jatangi* (Hindi); *ramtal* or *kharsani* (Gujarati); *karale* or *khurasani* (Marathi); *uhechellu* (Kannada); *payellu* (Tamil); *verrinuvvulu* (Telugu); *alashi* (Oriya); *sarguza* (Bengali); *ramtil (Punjabi)* and *sorguja* (Assamese) (Dwarka et al., [3]). In Madhya

Comment [SK1]: Reframe this part with clarity. This might be confusing to the reader.

Comment [SK2]: Provide common name of the crop before mentioning the scientific name.

Comment [SK3]: Check the spelling (Phoenix dactylifera). Also add the common names before the scientific name.

Pradesh it is mainly cultivated by resource-poor farmers, notably in the tribal regions of Kymore Plateau Zone of districts of Chhindwara, Dindori, Mandla, Seoni, Jabalpur and Shahdol. It is an annual (3-4 months crop) herbaceous plant with branches and height up to 1.8 metres. Niger seed contains 32 to 40% of quality oil with 18 to 24% protein. Niger seed oil is free from antinutrients and rich in (70% linoleic acid) essential fatty acids (Dwarka *et al.*, [3]). The statistics you provided further underscore the significance of niger seed in the agricultural landscape. With an average yield of 357.2 kg per hectare and a total production of 40.3 thousand tonnes, niger seed is cultivated across 112.8 thousand hectares in India. Notably, Madhya Pradesh plays a substantial role in niger cultivation, dedicating approximately 16.0 thousand hectares to this crop. This highlights the regional importance in the overall production and supply of niger seeds in the country. (Anonymous, [1]). Niger oil, extracted from niger seeds, is characterized by its pale yellow color, nutty flavor, and pleasant aroma. It boasts a protein content ranging from 18 to 24% and a high-quality oil content of 32-40%, making it highly valued. Notably, the oil has a taste reminiscent of desi ghee, and the seeds are free from harmful toxins. This multifaceted utility underscores the importance of niger cultivation in India agricultural and economic landscape, particularly for tribal communities that rely on it for sustenance and livelihood (Dwarka *et al.*, [4]). 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 Dwarka *et al.*, [4]. This type of research is significant as it helps in understanding 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, especially those that produce seeds. By studying the effects of different attractants on bee behaviour and their impact on seed yield, researchers can potentially identify methods to enhance pollination and improve crop productivity.

Comment [SK4]: Correct this sentence.

Comment [SK5]: Mention other bees aswell if you intend to address bee community here.

Comment [SK6]: Mention about different extracts used in similar manner

Material and methods

The ~~provided excerpt outlines a~~ research ~~was study~~ conducted during the *Kharif* season of 2022 at the experimental farm of the PC Unit (ICAR) Sesame and Niger, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalyaya, located in Jabalpur, Madhya

Pradesh. The study focused on investigating the impact of bee attractants on the foraging behaviour 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 minimize bias and ensures 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 behaviour of rock honey bees and potentially their influence on niger crop productivity.~~

Jabalpur, a city in Madhya Pradesh, is situated on the bank of Narmada river geographically located between 22° 49" and 24° 8" North latitude and 78° 21" East longitude and at an altitude of 411.78 m. above the mean sea level. The Jabalpur comes under semi-humid and sub-tropical climate. It is in the agro-climatic zone of Kymore Plateau and Satpura Hills. The mean annual rainfall is nearly 1423 mm, which is received by South west monsoon. The mean maximum temperature recorded in months of May-June varies from 45.5 °C to 48.4 °C, while the average minimum temperature varied between 6.2° C to 8.7°C during December-January that are the coldest months of the year.

Attractants list

1. T₁: Flower extract of *Madhuca longifolia* 10%.
2. T₂: Juice of *Sachharum officinarum* 10%.
3. T₃: Jaggery solution 10%.
4. T₄: Honey solution 10%.
5. T₅: Fruit extract of *Phoenix dactylifera* 10%.
6. T₆: Sugar solution 10%.
7. T₇: Rose water (marketed) 10%.
8. T₈: Water spray.
9. T₉: Control.

The attractants were sprayed twice, first at the 10 percent flowering stage and then at the 50 percent flowering stage. The recommended agronomical practices were followed to ensure a good seed production plot, and spraying of insecticides was avoided during the flowering stage of the crop. In each plot, a one-meter square area was randomly selected, and the number of pollinators visiting the flowers was recorded. Observations were made a day before the first spraying, and then on the 1st, 3rd, 5th and 7th days after both the first and second sprayings.

Results and discussion

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The current study findings show that the capacity of *A. dorsata* ~~rock honey bees~~ to forage in the niger crop was significantly impacted by each bee attractant sprayed. The attractants exhibited superior performance compared to the control group in all recorded criteria. This indicates that the bee attractants evaluated were effective in attracting rock honey bees to the niger crop, potentially leading to increased pollination activity and higher crop output. The results underscore the importance of using bee attractants as a strategy to enhance agricultural output and pollination efficiency, particularly when cultivating crops in regions like the Niger Delta. Further, research into the specific effects of each attractant and their long-term impact on crop productivity may provide valuable insights into optimizing pollination management in agricultural settings. The study findings show that every treatment used significantly influenced the number of *A. pis dorsata* ~~(giant honey bees)~~ that were attracted. This implies that the various treatments had variable degrees of effect on the bees attraction, demonstrating the potency of the different techniques or materials employed as attractants. These discoveries are critical to our understanding of how various attractants can affect bee behaviour and their presence in agricultural environments. In particular, for niger crops, where bee pollination is critical, researchers can develop methods to improve crop productivity by determining which treatments are most successful in attracting *A. pis dorsata*. Extensive examination of the distinct attributes and outcomes of each intervention can yield significant understanding for enhancing bee attractant techniques in support of sustainable farming approaches.

At 10% flowering stage giant honey bee visit was numerically the highest with treatment, flower extract of *M. adhuca longifolia* 10% (15.67/m²/5min) followed by (10.33/m²/5min) later to the fruit extract of *PF. dactylifera* 10% (14.92/m²/5min) while it was the lowest at control (2.67/m²/5min) followed by water spray (5.08/m²/5min) and 10% sugar solution (9.67/m²/5min). At 50% flowering stage the highest population of *A. pis dorsata* was attracted with flower extract of *Madhuca longifolia* 10% (10.33/m²/5min) followed by (9.75/m²/5min) fruit extract of *PhFoenix dactylifera* while it was least on controlled condition (2.75/m²/5min) followed by water spray (5.00/m²/5min) and 10% sugar solution spray (8.33/m²/5min). Present findings are also supported by the findings of Nidagundi [7], who reported that spraying *cacambe* at (10 per cent), Bee-Q at (1.25 per cent) and *jaggery* solution at (10 per cent) enhanced bee visitation to the flowers of bitter gourd. These findings are in close conformity with the earlier reports of Dwarka *et al.*, ([3]), who reported that the 10% and 50% flowering stages of the niger crop, the highest number of visits by giant honey bee were observed with the treatment of mahua flower extract at 10%. Specifically, during

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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 giant honey bee was received from controlled condition 15 and 17.21 giant honey bees/m²/5 min at 10% and 50% flowering stage, respectively. This was followed by water spray 18.67 and 19.76 giant honey bees/m²/5min at 10% and 50% flowering stage, respectively on niger. Present findings are corroborated with the findings of Kalmath and Sattigi [6], who reported that spraying of cacambe (10 per cent) and jaggery (10 per cent) attracted maximum number of *A.pis dorsata* up to 15 days after first and second spray. Present findings are corroborated with the findings of Dwarka *et al.*,[5],who reported that at 10% and 50% flowering stage *A.pis dorsata* visit was numerically the highest with flower extract of *M.adhuca longifolia* 10% with 20.42 and 19.25 *A.pis dorsata*/m²/5min, respectively.

Seed yield (q/ha)

It seems like you were discussing the results of an experiment or study on seed yield. The findings suggest that there were significant differences among all the treatments in terms of seed yield, indicating that each treatment led to higher seed production compared to others. This underscores the importance of considering the specific treatments when analyzing seed yield data. The highest seed yield (6.96 q/ha) was recorded with the treatment involving a foliar spray of 10% flower extract of *M.adhuca longifolia*. This was followed by a yield of 6.90 q/ha from a 10% fruit extract of *F. dactylifera* spray and 6.42 q/ha from a 10% sugar solution spray. In contrast, the lowest seed yield (3.25 q/ha) was observed under controlled conditions, with a slightly higher yield of 5.16 q/ha recorded from a 10% water spray. The findings of your study align with those of Chandrashekhar and Sattigi [2], who observed similar results regarding the efficacy of bee attractants in enhancing both quantitative and qualitative parameters of radish seed. Chandrashekhar and Sattigi [2], found that the spraying of bee attractants such as cacambe (10%) and jaggery solution (10%) significantly improved various aspects of radish seed production. Present findings are closely corroborated with the findings of Dwarka *et al.*,[5], who reported that the foliar spray of 10% flower extract of *M.adhuca longifolia* and rose water 10% were found significantly superior over others in

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respect to record higher seed yield and recorded 6.90 q/ha and 6.70 q/ha seed yield, respectively.

[Include conclusion part to the manuscript.](#)

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Table 1: Effect of different attractants on the attraction of giant honey bee, *Apis dorsata* and their impact of seed yield in niger crop 2022

Treatment	Population of <i>Apis dorsata</i> /m ² /5minutes												Yield (q/ha)
	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 <i>M. longifolia</i> 10%	7.00 (2.73)	13.00 (3.49)	19.33 (4.43)	17.33 (4.19)	13.00 (3.65)	15.67 (4.02)	3.67 (2.02)	8.33 (2.97)	8.00 (2.91)	13.67 (3.74)	11.33 (3.41)	10.33 (3.28)	6.96 (2.73)
T ₂ -Juice of <i>S. officinarum</i> 10%	8.67 (2.99)	13.67 (3.72)	15.67 (4.02)	13.67 (3.72)	9.00 (3.03)	13.00 (3.66)	6.00 (2.51)	8.00 (2.89)	11.33 (3.44)	7.33 (2.75)	7.00 (2.73)	8.42 (2.98)	6.00 (2.55)
T ₃ -Jaggery solution 10%	6.33 (2.58)	17.33 (4.12)	14.33 (3.83)	12.00 (3.50)	11.00 (3.35)	13.67 (3.74)	6.00 (2.54)	6.67 (2.66)	10.67 (3.29)	9.67 (3.19)	9.00 (3.08)	9.00 (3.07)	4.50 (2.24)
T ₄ -Honey solution 10%	6.00 (2.53)	16.67 (4.11)	14.00 (3.77)	12.67 (3.60)	8.67 (3.00)	13.00 (3.65)	6.33 (2.56)	7.67 (2.85)	11.33 (3.44)	8.00 (2.83)	7.33 (2.77)	8.58 (3.01)	5.55 (2.46)
T ₅ - Fruit extract of <i>F. dactylifera</i> 10%	7.67 (2.84)	15.33 (3.98)	16.00 (4.02)	14.67 (3.89)	13.67 (3.71)	14.92 (3.92)	5.67 (2.40)	8.67 (3.02)	10.00 (3.05)	10.33 (3.29)	10.00 (3.15)	9.75 (3.18)	6.90 (2.72)
T ₆ -Sugar solution 10%	5.33 (2.39)	6.67 (2.64)	8.67 (2.76)	16.33 (4.07)	7.00 (2.60)	9.67 (3.15)	7.00 (2.71)	7.33 (2.80)	10.33 (3.28)	8.00 (2.87)	7.67 (2.86)	8.33 (2.97)	6.42 (2.63)
T ₇ -Rose water 10%	8.00 (2.90)	16.33 (4.10)	15.67 (4.00)	12.00 (3.47)	11.67 (3.41)	13.92 (3.78)	6.67 (2.62)	6.00 (2.54)	9.00 (2.98)	10.33 (3.24)	9.33 (3.13)	8.67 (3.03)	6.08 (2.56)
T ₈ -Water spray	5.33 (2.40)	4.67 (2.26)	7.33 (2.80)	4.67 (2.26)	3.67 (2.00)	5.08 (2.36)	3.67 (2.04)	4.33 (2.18)	5.33 (2.41)	5.00 (2.34)	5.33 (2.40)	5.00 (2.34)	5.16 (2.38)
T ₉ -Control	2.33 (1.66)	3.67 (2.03)	1.67 (1.44)	3.33 (1.79)	2.00 (1.56)	2.67 (1.77)	2.00 (1.56)	3.00 (1.86)	3.33 (1.95)	2.67 (1.77)	2.00 (1.47)	2.75 (1.80)	3.25 (1.92)
SEm±	0.24	0.44	0.40	0.38	0.37	0.22	0.29	0.18	0.38	0.31	0.27	0.12	0.03
CD at 5%	0.72	1.32	1.21	1.14	1.11	0.67	0.88	0.53	1.13	0.91	0.80	0.37	0.10

*Figures in parenthesis are square root of $\sqrt{x+0.5}$

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