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Attractant mediated effect of pollination on yield and quality attributes of *B. campestris* L.

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Abstract

Brassica campestris L. (brown sarson) is a predominantly insect-pollinated oilseed crop in which effective pollination significantly influences yield and quality. The present study was conducted to evaluate the effect of different insect attractants on pollination, yield attributes, and biochemical parameters under field conditions. The experiment comprised treatments of jaggery solution (10% and 5%), molasses (10% and 5%), sugarcane syrup (10%), sugar syrup (5%), water spray, control, and caged conditions. Results revealed that attractant application significantly enhanced all yield attributes over control and caged plants. Among treatments, jaggery solution (10%) proved most effective, recording the highest number of pods per plant (108), pod length (5.76 cm), seed yield per plant (4.80 g), pod setting (95.5%), test weight (4.01 g), plant height (117.4 cm), and seeds per pod (16.6), along with the lowest percentage of wrinkled seeds (1.01%). In contrast, caged plants recorded the lowest values for most parameters, including pods per plant (83.3), seed yield (2.98 g), and seeds per pod (6.35), and the highest wrinkled seeds (16.3%). Biochemical analysis showed that vitamin C content increased significantly with attractant treatments, with maximum values recorded under jaggery solution (10%) at different flowering stages (1.35, 1.44, and 1.55 mg at 20%, 50%, and 100% flowering, respectively). Conversely, chlorophyll content (SPAD values) decreased under effective pollination, with the lowest values observed in jaggery-treated plants (34.4-36.2), while caged plants recorded the highest SPAD values (43.11-47.07). The study concludes that the application of low-cost attractants, particularly jaggery solution (10%), significantly improves pollination efficiency, yield, and quality of brown sarson. This approach offers a sustainable and economically viable strategy to enhance oilseed productivity.

Keywords: Vitamin C, chlorophyll, attractants, Jaggery, caging, brown Sarson

Introduction

Brown sarson (*Brassica campestris* L.) is an important rabi oilseed crop cultivated extensively in temperate regions such as the Kashmir valley, where it serves as a key component of the edible oil economy and cropping systems (Shekhawat *et al.*, 2015) [6]. Despite its economic and nutritional importance, the productivity and quality of this crop remain below optimal levels, largely due to inadequate pollination. Pollination plays a crucial role in determining both yield and quality parameters in *Brassica campestris*. The crop is predominantly insect-pollinated, with more than 80-85% of fertilization occurring through insect-mediated cross-pollination (Free, 1970; Prasad *et al.*, 1989) [1, 4]. Effective pollination directly influences key yield attributes such as number of pods per plant, seeds per pod, seed weight, and overall seed yield. In addition, pollination significantly affects quality parameters, including seed development, reduction in wrinkled seeds, and improvement in biochemical constituents such as vitamin C and chlorophyll content.

However, inadequate pollinator activity has become a major constraint affecting both yield and quality. Reduced pollination leads to poor pod setting, lower seed filling, higher proportion of shrivelled seeds, and inferior nutritional quality. Studies have shown that insufficient pollination not only reduces yield but also negatively affects biochemical composition, as plants tend to allocate more resources towards vegetative growth rather than reproductive development (Sabbahi *et al.*, 2006) [5]. In recent years, the decline in pollinator populations has further aggravated the problem, making natural pollination unreliable. While managed pollination using honeybee colonies can enhance crop productivity, it is often not

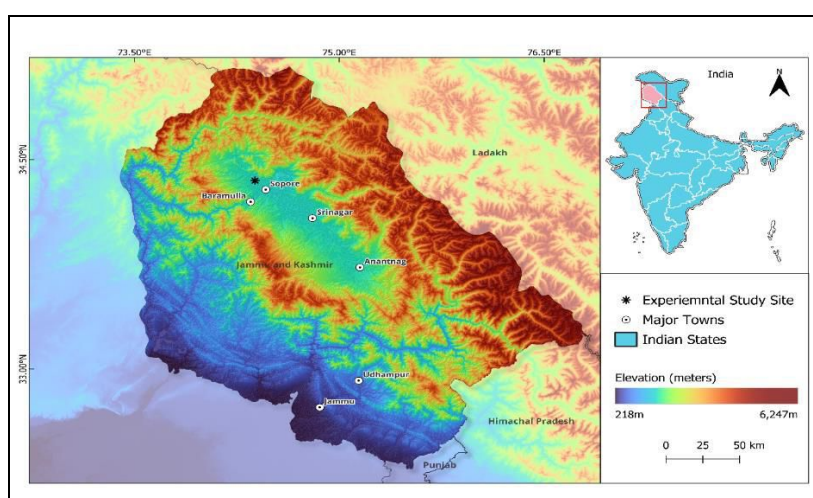
feasible for small and marginal farmers due to economic and logistical constraints. Therefore, there is a need for simple, cost-effective approaches to enhance pollinator activity directly in the field. The use of insect attractants has emerged as a promising strategy to improve pollination efficiency. Substances such as jaggery, molasses, and sugar-based solutions are rich in sugars and volatile compounds that enhance insect foraging behaviour and increase visitation to crop flowers (Mahadik, 2019) [3]. Increased visitation frequency leads to better pollen transfer, thereby improving fertilization and ultimately enhancing both yield and quality parameters. Although the positive impact of insect attractants on pollination has been reported in various crops, limited information is available regarding their integrated effect on both yield attributes and quality parameters of brown sarson under temperate conditions. In particular, the relationship between enhanced pollination and biochemical traits such as vitamin C and chlorophyll content remains inadequately explored. Therefore, the present study entitled “Effect of Insect Attractants on

Pollination, Yield and Quality Parameters of Brown Sarson (*Brassica campestris* L.)” was undertaken to evaluate the influence of different insect attractants on pollination efficiency, yield attributes, and quality parameters under the agro-climatic conditions of Jammu and Kashmir.

Materials and Methods

The experiment was conducted during the rabi season of 2022-2023 at the Experimental Farm of the Division of Entomology, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Wadura, Sopore. The experimental site is situated at an altitude of 1610 m above mean sea level (34°20' N latitude and 74°24' E longitude) and falls under temperate climatic conditions of the Kashmir valley.

Brown sarson (*Brassica campestris* L.) variety ‘Shalimar Sarson-1’ was grown following recommended agronomic practices. The crop was sown in the third week of September with a spacing of 30 × 10 cm.



Experimental design and treatments

experiment was laid out in a randomized block design (RBD) with nine treatments replicated three times. The treatments were designed to evaluate the effect of insect attractants on pollination, yield, and quality parameters:

- T₀: Open pollination (control)
- T₁: Pollinator exclusion (caged condition)
- T₂: Jaggery (5%)
- T₃: Sugar solution (5%)
- T₄: Molasses (5%)
- T₅: Jaggery (10%)
- T₆: Sugar solution (10%)
- T₇: Molasses (10%)
- T₈: Water spray

Application of insect attractants

The attractant solutions were prepared freshly and applied as foliar sprays using a hand sprayer. Two sprays were given during the flowering period at 20% and 50% flowering stages to enhance insect visitation and pollination activity.

Recording of observations

Yield attributes

To assess the effect of pollination on yield, observations were recorded from ten randomly selected plants in each plot:

- Number of pods per plant
- Pod length (cm)
- Seed yield per plant (g)
- Percent pod setting (%)
- Test weight (1000-seed weight, g)
- Plant height (cm)
- Percentage of wrinkled seeds (%)
- Number of seeds per pod

Quality parameters

To evaluate the effect of pollination on crop quality, biochemical parameters were recorded from leaf samples collected at different flowering stages (20%, 50%, and 100% flowering):

Vitamin C (ascorbic acid): Estimated using standard titration method (AOAC, 1984).

Chlorophyll content (SPAD values): Measured using a SPAD meter as an indicator of leaf chlorophyll status.

Pollination assessment approach

Pollination effects were assessed indirectly by comparing open pollination (T₀), pollinator exclusion (T₁), and attractant-treated plots. Differences in yield and quality

parameters among treatments were used as indicators of pollination efficiency.

Statistical analysis

The data obtained from various observations were subjected to appropriate statistical analysis using standard analytical methods (R software and OP STAT). Treatment means were compared to determine the significance of differences among treatments.

Results

Effect of pollination on yield attributes of *Brassica campestris*

Application of different attractants significantly influenced the yield attributes of *Brassica campestris* (Table 1) and figure 1. Among all treatments, jaggery solution (10%) consistently recorded superior performance across all parameters. The maximum number of pods per plant (108 ± 1.1), pod length (5.76 ± 0.04 cm), seed yield per plant (4.80 ± 0.01 g), pod setting ($95.5 \pm 1.2\%$), test weight (4.01 ± 0.01 g), plant height (117.4 ± 1.1 cm), and number of seeds per pod (16.6 ± 0.05) were observed under this treatment. It also resulted in the lowest percentage of wrinkled seeds ($1.01 \pm 0.02\%$).

This was followed by molasses (10%) and sugarcane syrup (10%), which also showed significantly higher values for all yield parameters compared to lower concentrations (5%) and water spray. In contrast, caged plants exhibited the poorest performance, recording the lowest number of pods (83.3 ± 0.31), shortest pod length (2.80 ± 0.21 cm), lowest

seed yield (2.98 ± 0.02 g), minimum pod setting ($68.6 \pm 1.2\%$), lowest test weight (2.01 ± 0.01 g), reduced plant height (92.24 ± 0.50 cm), lowest number of seeds per pod (6.35 ± 0.05), and highest proportion of wrinkled seeds ($16.3 \pm 0.2\%$).

All attractant treatments were found to be significantly superior to the control across all yield attributes, indicating the positive role of pollinator attraction in enhancing crop productivity.

Vitamin C and chlorophyll content

The application of attractants significantly influenced the biochemical parameters of *Brassica campestris* (Table 2). And figure 2 and 3. Jaggery solution (10%) recorded the highest vitamin C content at all flowering stages, with values of 1.35 ± 0.01 mg at 20% flowering, 1.44 ± 0.04 mg at 50% flowering, and 1.55 ± 0.05 mg at 100% flowering. This was followed by molasses (10%) and sugarcane syrup (10%). In contrast, caged plants consistently recorded the lowest vitamin C content across all stages. All treatments were significantly superior to the control.

In terms of chlorophyll content (SPAD values), an inverse trend was observed. The lowest SPAD readings were recorded in plants treated with jaggery solution (10%) at all flowering stages (34.4 ± 1.2 , 36.2 ± 1.03 , and 34.62 ± 1.05 at 20%, 50%, and 100% flowering, respectively), whereas the highest values were observed in caged plants. Control plants recorded comparatively higher SPAD values than treated plants but lower than caged conditions.

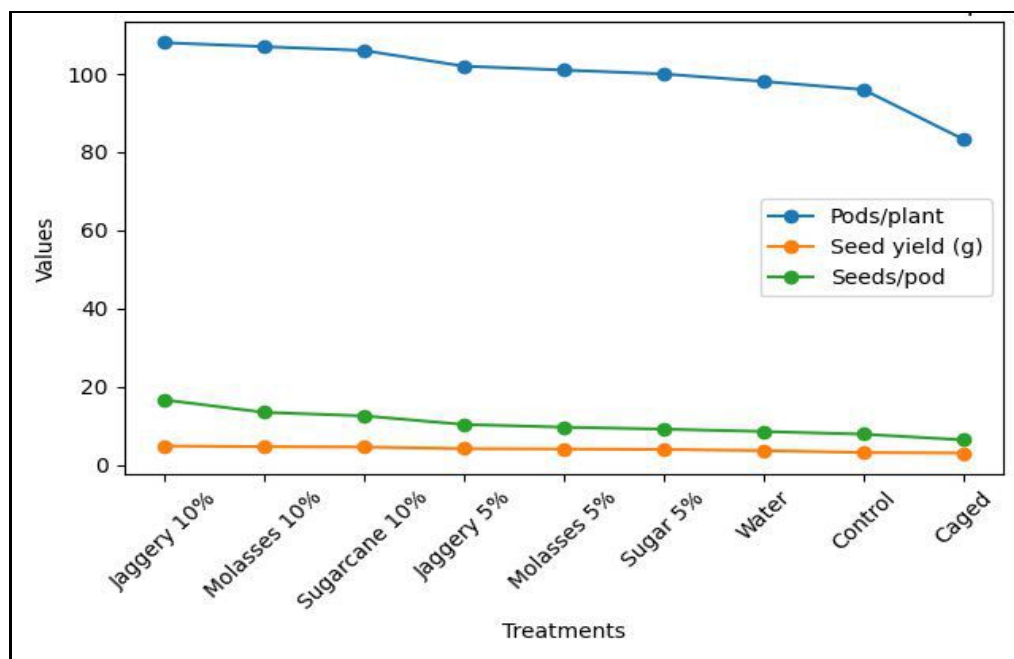


Fig 1: Combined effect of pollination on yield parameters

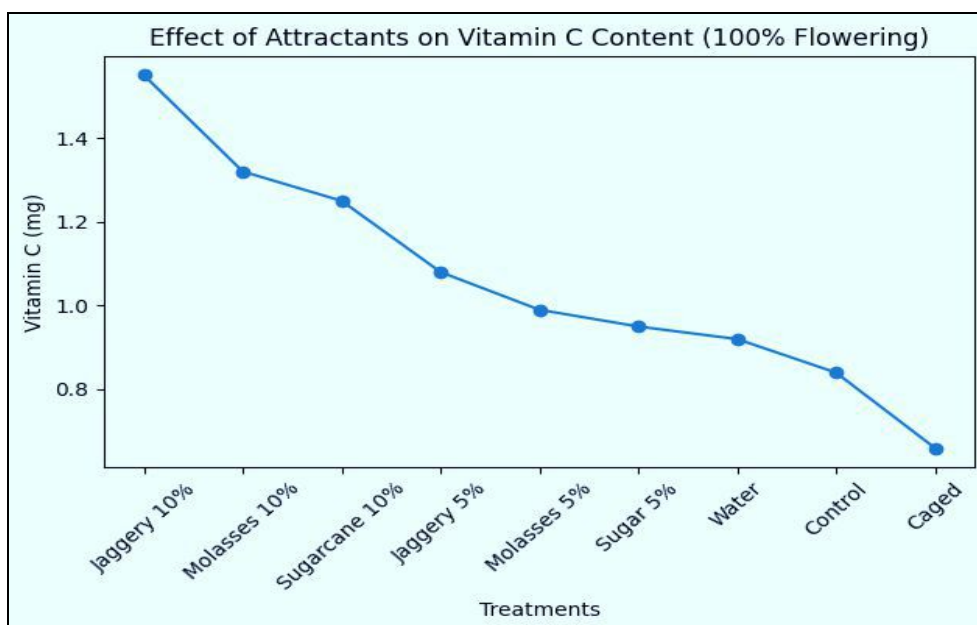


Fig 2: Effect of attractants on Vitamin content

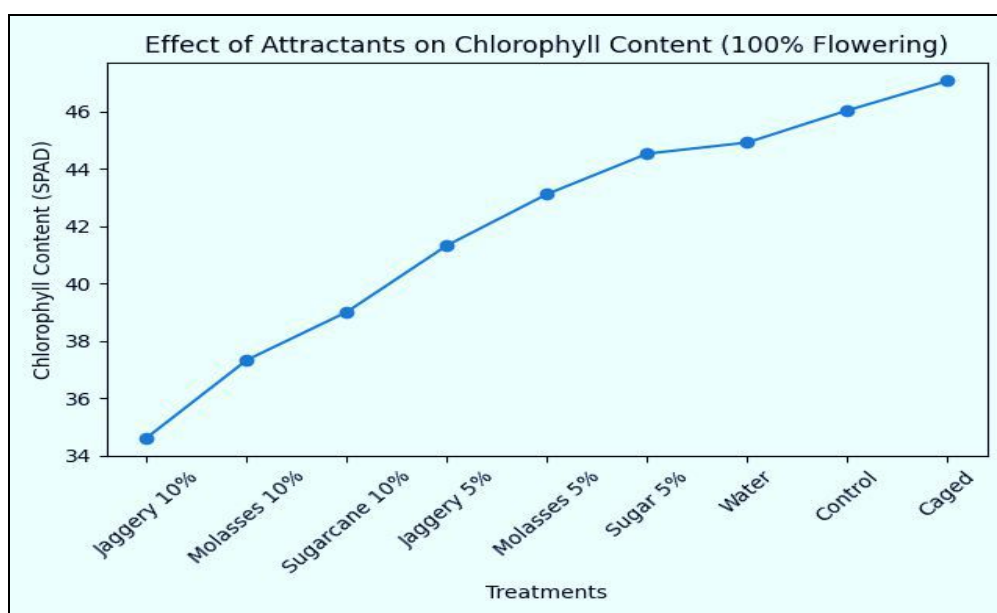


Fig 3: Effect of attractants on chlorophyll content

Table 1: Effect of attractants on yield attributes of *Brassica campestris* L.

Treatments	*Number of pods per plant	*Seed yield per plant (g)	*Test weight (g)	*Percent wrinkled seed	*Pod length (cm)	*Percent pod setting	*Number of seeds per pod	*Plant height (cm)
Control	96±0.12 ^b	3.11±0.01 ^a	2.31±0.04 ^a	9.11±0.05 ^d	3.12±0.13 ^a	71.1±0.5 ^b	7.81±0.02 ^a	97.70±0.45 ^b
Caging	83.3±0.31 ^a	2.98±0.02 ^a	2.01±0.01 ^a	16.3±0.2 ^e	2.80±0.21 ^a	68.6±1.2 ^a	6.35±0.05 ^a	92.24±0.50 ^a
Jaggery @ 5%	102±0.82 ^c	4.10±0.06 ^b	3.22±0.03 ^a	5.30±0.05 ^c	4.13±0.02 ^b	88.0±1.1 ^c	10.3±0.82 ^b	110.0±0.33 ^d
Sugar syrup @ 5%	100±0.15 ^b	3.90±0.01 ^a	2.97±0.06 ^a	6.81±0.04 ^d	3.99±0.02 ^b	79.8±0.56 ^d	9.10±0.01 ^b	103.5±0.36 ^c
Molasses @ 5%	101±0.35 ^c	4.01±0.05 ^a	3.03±0.01 ^a	6.22±0.01 ^c	4.04±0.01 ^b	83.4±0.15 ^d	9.60±0.05 ^b	108.5±0.25 ^d
Jaggery @ 10%	108±1.1 ^d	4.80±0.01 ^b	4.01±0.01 ^b	1.01±0.02 ^a	5.76±0.04 ^c	95.5±1.2 ^e	16.6±0.05 ^d	117.4±1.1 ^e
Sugar syrup @ 10%	106±1.01 ^d	4.52±0.03 ^b	3.63±0.05 ^b	2.33±0.02 ^b	4.43±0.01 ^b	91.1±0.55 ^f	12.5±0.05 ^c	114.3±0.15 ^d
Molasses @ 10%	107±0.12 ^d	4.61±0.02 ^b	3.9±0.02 ^b	1.22±0.05 ^a	4.75±0.03 ^b	93.5±0.15 ^f	13.4±0.15 ^c	116.5±0.22 ^d
Water	98±0.12 ^b	3.60±0.03 ^a	2.56±0.02 ^a	7.04±0.02 ^d	3.78±0.03 ^a	75.3±0.42 ^c	8.50±0.02 ^b	102.3±0.50 ^c
CD (≤0.05)	2.7	0.94	0.86	0.99	1.15	2.10	1.57	1.76

*Mean of three replications

Table 2: Effect of attractants on Vitamin C and chlorophyll of *B. campestris*

Treatments	*Vitamin-C at 20 percent flowering	*Vitamin-C at 50 percent flowering	*Vitamin-C at 100 percent flowering	*Chlorophyll at 20 percent flowering	*Chlorophyll at 50 percent flowering	*Chlorophyll at 100 percent flowering
Control	0.65±0.01 ^a	0.79±0.01 ^a	0.84±0.06 ^a	42.34±0.52 ^f	45.07±1.4 ^d	46.04±0.25 ^d
Caging	0.47±0.04 ^a	0.56±0.03 ^a	0.66±0.66 ^a	43.11±1.4 ^g	46.63±1.53 ^e	47.07±0.16 ^d
Jaggery @ 5%	0.86±0.01 ^a	0.98±0.02 ^b	1.08±0.03 ^a	39.54±1.01 ^d	39.22±0.25 ^b	41.33±0.5 ^c
Sugar syrup @ 5%	0.78±0.01 ^a	0.86±0.01 ^a	0.95±0.02 ^a	41.20±0.5 ^e	43.33±0.25 ^d	44.53±0.15 ^d
Molasses @ 5%	0.82±0.02 ^a	0.95±0.01 ^b	0.99±0.02 ^a	38.33±0.84 ^c	41.44±0.5 ^c	43.12±0.48 ^c
Jaggery @ 10%	1.35±0.01 ^b	1.44±0.04 ^c	1.55±0.05 ^b	34.40±1.2 ^a	36.20±1.03 ^a	34.62±1.05 ^a
Sugar syrup @ 10%	0.90±0.02 ^a	1.12±0.02 ^b	1.25±0.01 ^b	37.51±1.02 ^c	38.21±0.25 ^b	39.01±0.53 ^b
Molasses @ 10%	0.99±0.01 ^a	1.20±0.02 ^b	1.32±0.04 ^b	35.58±1.09 ^b	36.33±0.42 ^a	37.33±0.12 ^b
Water	0.70±0.02 ^a	0.82±0.01 ^a	0.92±0.03 ^a	41.70±1.03 ^e	44.10±1.3 ^d	44.96±0.36 ^d
CD (≤0.05)	0.55	0.34	0.45	1.01	1.74	2.67

*Mean of three replications

Discussion

The present study clearly demonstrated that application of different attractants significantly enhanced pollination efficiency, which in turn improved yield and quality parameters of *Brassica campestris*. Among all treatments, jaggery solution (10%) proved to be the most effective, consistently recording superior values for all yield attributes including number of pods per plant, pod length, seed yield, pod setting, test weight, plant height, and number of seeds per pod, along with minimum percentage of wrinkled seeds. The enhanced performance under jaggery (10%) may be attributed to its strong ability to attract pollinators, particularly bees, due to its rich sugar composition and volatile compounds. Increased pollinator visitation likely improved pollen transfer efficiency, resulting in better fertilization, higher pod set, and improved seed development. Similar findings have been reported by Wankhede *et al.* (2019) [8], who observed that jaggery-based attractants significantly enhanced fruit set, seed number, and yield in cucumber. The present findings are also in agreement with Srikanth (2012) [7], who reported improved fruit set using attractant-based pollination strategies, thereby emphasizing the crucial role of pollinators in enhancing crop productivity.

Molasses (10%) and sugarcane syrup (10%) were found to be the next best treatments, indicating that higher concentrations of sugar-based attractants are more effective in attracting pollinators compared to lower concentrations (5%). This trend suggests a dose-dependent response, where increased sugar availability enhances pollinator activity, ultimately improving reproductive success. In contrast, control and water-treated plants recorded comparatively lower values, while caged plants exhibited the poorest performance across all yield parameters, confirming the essential role of insect-mediated pollination in *B. campestris*.

The significantly higher percentage of wrinkled seeds in caged plants further supports the importance of adequate pollination. Poor pollen transfer under restricted conditions likely led to incomplete fertilization, resulting in malformed or underdeveloped seeds. These findings highlight that successful pollination is not only critical for yield quantity but also for seed quality.

In terms of biochemical parameters, vitamin C content was significantly enhanced in attractant-treated plants, with the highest values recorded under jaggery solution (10%) across all flowering stages. This increase may be attributed to improved pollination and fertilization, which enhances metabolic activity and nutrient accumulation in developing

seeds. The results are in agreement with Klein *et al.* (2013) [2], who reported that pollinator-dependent crops exhibit higher nutritional quality, including increased vitamin C content.

Interestingly, chlorophyll content exhibited an inverse trend, with lower SPAD values in attractant-treated plants and higher values in caged plants. This phenomenon may be explained by the allocation of plant resources. Under conditions of effective pollination, plants tend to divert assimilates towards reproductive structures (seed and pod development), thereby reducing investment in vegetative components such as chlorophyll. Conversely, in caged plants where pollination is limited, resources may be redirected towards vegetative growth and maintenance, resulting in relatively higher chlorophyll content.

Overall, the study highlights the critical role of attractant-mediated pollination in enhancing both yield and quality of *Brassica campestris*. The findings suggest that application of jaggery solution (10%) can serve as an effective, low-cost, and eco-friendly strategy to improve pollination efficiency and crop productivity under field conditions.

Conclusion

The present study clearly indicates that attractant-mediated pollination significantly enhances yield and quality parameters of brown sarson (*Brassica campestris*). Among the treatments, jaggery solution (10%) proved to be the most effective, recording maximum values for yield attributes such as number of pods per plant, pod length, seed yield, pod setting, test weight, plant height, and number of seeds per pod, along with minimum percentage of wrinkled seeds. All attractant treatments performed significantly better than the control, whereas caged plants recorded the lowest values for all yield parameters, confirming the importance of effective pollination in improving crop productivity.

In terms of quality parameters, vitamin C content was significantly higher under jaggery solution (10%), while chlorophyll content showed a decreasing trend with increasing pollination efficiency. Overall, the results suggest that application of jaggery solution (10%) is an effective and economical strategy to enhance both yield and quality of brown sarson.

References

1. Free JB. Insect pollination of crops. London: Academic Press; 1970.
2. Klein AM, Vaissière BE, Cane JH, Steffan-Dewenter I, Cunningham SA, Kremen C, *et al.* Importance of

- pollinators in changing landscapes for world crops. Proc R Soc B Biol Sci. 2007;274(1608):303-313.
3. Mahadik SG. Effect of bee attractants on pollination and yield of crops. J Entomol Zool Stud. 2019;7(3):123-127.
 4. Prasad VG, Pratap U, Singh RP. Impact of bee pollination on mustard yield and yield components. Indian J Agric Sci. 1989;59:684-687.
 5. Sabbahi R, de Oliveira D, Marceau J. Influence of honey bee (Hymenoptera: Apidae) pollination on seed yield and quality of canola. J Econ Entomol. 2006;99(3):828-833.
 6. Shekhawat K, Rathore SS, Premi OP, Kandpal BK, Chauhan JS. Advances in agronomic management of Indian mustard (*Brassica juncea*). Indian J Agron. 2015;60(1):1-10.
 7. Srikanth K. Effect of bee attractants on pollination and yield parameters in cucumber. Indian J Entomol. 2012;74(3):245-249.
 8. Wankhede SM, Kale VS, Patil RP. Influence of bee attractants on yield and quality of cucumber (*Cucumis sativus* L.). J Entomol Zool Stud. 2019;7(3):1234-1238.