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# Influence of indigenous bee attractants in enhancing pollination and yield of onion seeds

**Barad CS, Rabari PH, Patel PS and Gothi HR**

**Abstract**
Ten distinct treatments and three replications were used in the experiment, which measured 3.60 m × 3.00 m in size and had plant spacing of 60.0 cm × 30.0 cm. The goal was to determine the impact of native bee attractants on improving pollination and yield of onion seeds (*Allium cepa* L.). The most productive method for attracting bees to onions was determined to be the 15% table sugar solution and 15% jaggery solution when applied at 1500 ml/10 lit of water. This resulted in the highest number of bees/m2/2 minutes among the various bee attractants at the Horticultural Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Gujarat.

**Keywords:** *Allium cepa* L., pollination, bee attractants, jaggery solution

## Introduction
In India, onions (*Allium cepa* L.) are one of the most significant vegetable crops. Central Asia is the primary origin region, with the Mediterranean region serving as a secondary center. With 10.64 lakh hectares, or roughly 26.79% of the world's onion acreage, India is the largest country in terms of area. Rabi season is when it is primarily grown. In the Nasik division of Maharashtra, three crops are harvested: Kharif, late Kharif, and Rabi. In contrast, Gujarat, Andhra Pradesh, Rajasthan, Punjab, Haryana, Madhya Pradesh, Karnataka, and Tamil Nadu harvest two crops: Kharif and Rabi. The introduction of the Kharif onion is relatively new in Northern, Eastern, and Central India. The fundamental building block of crop production is the seed. For some plants, whose seeds serve as the primary means of propagation, the basic and essential phenomena of seed set and subsequent seed development are essential to any program aimed at producing seeds. A crop grown every two years for seed production is the onion. Bulbs are grown from seeds in the first season and are transplanted in the second season to yield seeds. The onion flower undergoes inadequate pollination, which produces smaller, malformed seeds with poor germination potential (McGregor, 1976) [6]. The pollination and fertilization of onions' blooms is one of the main issues with onion seed production. Being entomophilous, onion blossoms are mostly pollinated by insects, such as honeybees. A lot of people use planned honeybee pollination to guarantee a high-quality crop output. To maximize the benefits of cross-pollination and improve seed quality and quantity, any item that increases honey bee visits to a particular crop would be highly valuable (Padamshali and Mandal 2018) [7]. On the other hand, relatively little research has been done in India about the potential use of bee attractants to increase the yield of vegetable crop seeds.

## Materials and Methods
At the Horticultural Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, the study was conducted in Rabi, 2020–21, and 2021–22. Ten treatments and three replications were used on an onion crop (Agrifound Light Red), with each plot measuring 3.60 m × 3.00 m in size and plant spacing of 60.0 cm × 30.0 cm.
The crop was grown by following accepted standards for agronomy. Using a backpack sprayer with a hollow cone nozzle, two foliar sprays of each treatment were administered. Every treatment was applied after a thorough cleaning of the sprayer. A one square meter area was chosen for each plot, and at its peak period, the number of honey bee visits to the flowers every two minutes was recorded. A day prior to and on the first, third, fifth, and seventh days following the first and second sprays, ten randomly chosen tagged plants per plot will be monitored for the number of honey bees. Ten percent of the flowers were covered with the first spray, and fifty percent of the flowers with the second spray. At harvest, the seed yield (kg/ha) was noted.

Treatment details

| Tr. No. | Treatment | Concentration (%) | Dose (g or ml)/ 10 litre waters |
|---|---|---|---|
| $T_1$ | Table sugar solution | 10 (w/v) | 1000 |
| $T_2$ | Table sugar solution | 15 (w/v) | 1500 |
| $T_3$ | Sugarcane juice | 10 (v/v) | 1000 |
| $T_4$ | Sugarcane juice | 15 (v/v) | 1500 |
| $T_5$ | Jaggery solution | 10 (w/v) | 1000 |
| $T_6$ | Jaggery solution | 15 (w/v) | 1500 |
| $T_7$ | Honey solution | 1 | 100 |
| $T_8$ | Honey solution | 1.5 | 150 |
| $T_9$ | Pollination without pollinators (Net covered) | - | - |
| $T_{10}$ | Untreated control | - | - |

**Preparation of different indigenous bee attractants**

Before using the mixture as a spray, the appropriate amount of table sugar was added to the water and thoroughly stirred with a glass rod until the sugar was entirely dissolved in the water.

In order to extract sugarcane juice, raw sugarcane was bought from a nearby market, cleaned with a knife, and then the juice was extracted using a sugarcane crusher equipment. The juice that was gathered was used to make the spray.

The jaggery solution was made by adding tiny chunks of jiggery to water, bringing it to a boil in a medium-sized pan, and letting it cool to room temperature. After being sieved, the solution was used for the spray.

**Results and Discussion**

The findings displayed in the table demonstrated that the total number of bees in each treatment prior to spraying was homogenous, with treatment differences not being statistically significant. This suggests that the bee population on the onion crop was evenly dispersed over the whole experimental plot.

**Efficacy of indigenous bee attractants on activity of bees on onion flowers**

In 2020–21, all treatments considerably outperformed the untreated control in terms of the number of bees/m2/2 min. across the course of the first and second spray periods. However, the combined results for 2020–21 (Table 1) showed that the treatment with 15% jaggery solution @ 1500 ml/10 lit of water had the highest number of bees (6.95 bees/m2/2 min.) and that it continued to be significantly better than the other treatments for the duration of the first and second spray. The 15% table sugar solution in 1500 ml/10 lit (6.28 bees/m2/2 min) of water was the next successful treatment. In the untreated control plot, the lowest reported number of bees/m2/2 min. was 2.16 bees/m2/2 min.

In terms of bees/m2/2 min for the whole first and second spray period in 2021–2022, all treatments performed much better than the untreated control. However, the combined results for 2021–22 (Table 2) showed that the treatment with 15% jaggery solution @ 1500 ml/10 lit of water had the highest number of bees (7.17 bees/m2/2 min.) and that this number remained significantly higher than the rest of the treatment for the duration of the first and second spray. Table sugar solution (15 percent @ 1500 ml/10 lit./6.22 bees/m2/2 min.) of water was the next successful treatment. In the untreated control plot, the lowest reported number of bees/m2/2 min. was 2.36 bees/m2/2 min.

The treatment with 15% jaggery solution at 1500 ml/10 lit of water was found to be the most effective in terms of number of bees/m2/2 min., recording the maximum number of bees/m2/2 min. Additionally, it remained significantly superior to the other treatments. These results are based on pooled data from two consecutive years (Table 3). All of the native bee attractants, however, were also noticeably better than the untreated control. In the untreated plot, however, the lowest number of bees/m2/2 min. was recorded (2.30 bees/m2/2 min.). The most successful treatment for attracting bees to onions was determined to be 15% jaggery solution at 1500 ml/10 lit of water, according to two years' worth of data on the number of bees/m2/2 min.

These findings are in agreement with Pateel and Sattagi (2007) [4] who ascertained that jaggery solution 10 per cent and sugar solution 10 per cent were efficient in attracting more bees up to third day after first, second and third spray. Kulkarni *et al*. (2017) [1] reported that spraying of jaggery solution 10% and sugar solution 10% attracted maximum number of *Apis dorsata* up to 3 days after first spray (at 10% flowering). Wankhede *et al*. (2019) [5] reported jaggery solution 10 and sugar solution 10 per cent sugar solution, sugarcane juice 10 per cent were found superior in attracting maximum number of bees like *A. mellifera* and *A. cerana indica* in cucumber crop which is also close association with the present finding. The study by scientists Manchare *et al*. (2020) [2] and Manchare *et al*. (2020) [3] revealed that *A. dorsata* and *A. mellifera* were attracted maximum to jaggery solution 10 per cent up to 5$^{th}$ day after first spray and 7$^{th}$ day after second spray.

**Impact on yield**

According to Table 4's onion yield data, the plot treated with 15% jaggery solution @ 1500 ml/10 lit of water produced the highest yield in both the first (1147.67 kg/ha) and second (1153.00 kg/ha) years. This was comparable to the treatment with 15% table sugar solution @ 1500 ml/10 lit of water, which produced yields of 1102.67 kg/ha and 1107.67 kg/ha, respectively, during both years. Drawing from combined data spanning two years, it can be shown that the highest production (1150.33 kg/ha) was achieved in the 15% jaggery solution treatment at 1500 ml/10 lit of water, while the lowest yield (412.83 kg/ha) was found in the pollination plot lacking pollinators (Net covered).

**Table 1:** Evaluation of indigenous bee attractants on activity of bees on onion flowers during 2020-21

| Tr. No. | Treatments | Conc. (%) | Number of bees/m²/ 2 min. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DBS | 1st spray (10% flowering stage) | | | | Pooled | DBS | 2nd spray (50% flowering stage) | | | | Pooled | Pooled over spray |
| | | | | 1 DAS | 3 DAS | 5 DAS | 7 DAS | | | 1 DAS | 3 DAS | 5 DAS | 7 DAS | | |
| $T_1$ | Table sugar solution | 10 | 1.64$^{a}$ (2.18) | 2.16$^{d}$ (4.16) | 2.11$^{cd}$ (3.96) | 2.07$^{c}$ (3.80) | 1.97$^{c}$ (3.39) | 2.07$^{e}$ (3.80) | 1.81$^{a}$ (2.79) | 2.34$^{de}$ (4.97) | 2.19$^{cd}$ (4.30) | 2.12$^{cd}$ (3.99) | 2.07$^{c}$ (3.80) | 2.17$^{d}$ (4.21) | 2.12$^{e}$ (3.99) |
| $T_2$ | Table sugar solution | 15 | 1.73$^{a}$ (2.49) | 2.68$^{ab}$ (6.68) | 2.62$^{ab}$ (6.37) | 2.43$^{ab}$ (5.39) | 2.30$^{ab}$ (4.80) | 2.50$^{b}$ (5.76) | 1.76$^{a}$ (2.58) | 2.94$^{ab}$ (8.17) | 2.81$^{a}$ (7.40) | 2.55$^{ab}$ (6.00) | 2.47$^{ab}$ (5.60) | 2.69$^{b}$ (6.74) | 2.60$^{b}$ (6.28) |
| $T_3$ | Sugarcane juice | 20 | 1.75$^{a}$ (2.56) | 2.14$^{d}$ (4.10) | 2.07$^{cd}$ (3.80) | 2.02$^{c}$ (3.59) | 1.88$^{c}$ (3.05) | 2.03$^{e}$ (3.62) | 1.83$^{a}$ (2.86) | 2.24$^{e}$ (4.50) | 2.14$^{cd}$ (4.10) | 2.10$^{cd}$ (3.93) | 2.02$^{c}$ (3.59) | 2.12$^{e}$ (3.99) | 2.07$^{ef}$ (3.80) |
| $T_4$ | Sugarcane juice | 30 | 1.70$^{a}$ (2.40) | 2.50$^{bc}$ (5.76) | 2.34$^{bc}$ (4.97) | 2.19$^{bc}$ (4.30) | 2.04$^{bc}$ (3.67) | 2.26$^{c}$ (4.61) | 1.87$^{a}$ (3.00) | 2.69$^{bc}$ (6.74) | 2.49$^{b}$ (5.69) | 2.35$^{bc}$ (5.01) | 2.15$^{c}$ (4.13) | 2.41$^{c}$ (5.31) | 2.34$^{c}$ (4.97) |
| $T_5$ | Jaggery solution | 10 | 1.58$^{a}$ (1.98) | 2.25$^{cd}$ (4.56) | 2.16$^{cd}$ (4.16) | 2.12$^{c}$ (3.99) | 2.00$^{c}$ (3.49) | 2.13$^{d}$ (4.04) | 1.80$^{a}$ (2.74) | 2.59$^{cd}$ (6.22) | 2.42$^{bc}$ (5.34) | 2.34$^{bc}$ (4.97) | 2.16$^{bc}$ (4.16) | 2.37$^{c}$ (5.12) | 2.25$^{d}$ (4.56) |
| $T_6$ | Jaggery solution | 15 | 1.57$^{a}$ (1.95) | 2.93$^{a}$ (8.10) | 2.71$^{a}$ (6.86) | 2.60$^{a}$ (6.28) | 2.38$^{a}$ (5.19) | 2.65$^{a}$ (6.52) | 1.82$^{a}$ (2.81) | 3.08$^{a}$ (8.99) | 2.91$^{a}$ (7.99) | 2.70$^{a}$ (6.79) | 2.51$^{a}$ (5.80) | 2.80$^{a}$ (7.34) | 2.73$^{a}$ (6.95) |
| $T_7$ | Honey solution | 1.0 | 1.62$^{a}$ (2.12) | 2.00$^{d}$ (3.49) | 1.91$^{d}$ (3.17) | 1.92$^{c}$ (3.19) | 1.91$^{c}$ (3.17) | 1.93$^{f}$ (3.22) | 1.78$^{a}$ (2.66) | 2.10$^{e}$ (3.93) | 2.04$^{d}$ (3.67) | 2.00$^{d}$ (3.49) | 2.00$^{c}$ (3.49) | 2.03$^{f}$ (3.62) | 1.98$^{g}$ (3.42) |
| $T_8$ | Honey solution | 1.5 | 1.56$^{a}$ (1.93) | 2.04$^{d}$ (3.67) | 1.97$^{d}$ (3.39) | 1.91$^{c}$ (3.17) | 1.92$^{c}$ (3.19) | 1.95$^{f}$ (3.30) | 1.86$^{a}$ (2.96) | 2.16$^{e}$ (4.16) | 2.08$^{d}$ (3.85) | 2.04$^{cd}$ (3.67) | 2.00$^{c}$ (3.49) | 2.07$^{f}$ (3.80) | 2.01$^{fg}$ (3.54) |
| $T_9$ | Pollination without pollinators (Net covered) | -- | 0.71$^{b}$ (0.00) | 0.71$^{f}$ (0.00) | 0.71$^{f}$ (0.00) | 0.71$^{e}$ (0.00) | 0.71$^{e}$ (0.00) | 0.71$^{h}$ (0.00) | 0.71$^{b}$ (0.00) | 0.71$^{g}$ (0.00) | 0.71$^{f}$ (0.00) | 0.71$^{f}$ (0.00) | 0.71$^{e}$ (0.00) | 0.71$^{h}$ (0.00) | 0.71$^{i}$ (0.00) |
| $T_{10}$ | Untreated control | -- | 1.56$^{a}$ (1.93) | 1.64$^{e}$ (2.18) | 1.55$^{e}$ (1.90) | 1.54$^{d}$ (1.87) | 1.57$^{d}$ (1.95) | 1.57$^{g}$ (1.95) | 1.79$^{a}$ (2.69) | 1.71$^{f}$ (2.42) | 1.73$^{e}$ (2.49) | 1.67$^{e}$ (2.30) | 1.67$^{d}$ (2.30) | 1.69$^{g}$ (2.36) | 1.63$^{h}$ (2.16) |
| S.Em. ± | T | | 0.12 | 0.12 | 0.11 | 0.10 | 0.09 | 0.049 | 0.11 | 0.11 | 0.10 | 0.10 | 0.11 | 0.051 | 0.036 |
| | P | | - | - | - | - | - | 0.033 | - | - | - | - | - | 0.034 | 0.023 |
| | S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.016 |
| | T×P | | - | - | - | - | - | 0.104 | - | - | - | - | - | 0.106 | 0.073 |
| | T×S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.052 |
| | P×S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.033 |
| | T×P×S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.103 |
| C. D. at 5% | T | | 0.37 | 0.35 | 0.31 | 0.30 | 0.27 | 0.14 | 0.33 | 0.34 | 0.30 | 0.31 | 0.31 | 0.14 | 0.102 |
| C. V. (%) | | | 13.93 | 9.74 | 9.03 | 8.86 | 8.53 | 9.10 | 11.17 | 8.69 | 8.09 | 8.72 | 9.24 | 8.71 | 8.72 |

**Note:** DBS: Days before Spray, DAS: Days after Spray, Figures in parentheses are retransformed values of $\sqrt{X+0.5}$ transformation Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance.

**Table 2:** Evaluation of indigenous bee attractants on activity of bees on onion flowers during 2021-22

| Tr. No. | Treatments | Conc. (%) | Number of bees/m²/ 2 min. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | DBS | 1st spray (10% flowering stage) | | | | Pooled | DBS | 2nd spray (50% flowering stage) | | | | Pooled | Pooled over spray |
| | | | | 1 DAS | 3 DAS | 5 DAS | 7 DAS | | | 1 DAS | 3 DAS | 5 DAS | 7 DAS | | |
| $T_1$ | Table sugar solution | 10 | 1.58$^{bc}$ (1.98) | 2.20$^{de}$ (4.35) | 2.10$^{e}$ (3.93) | 1.99$^{d}$ (3.46) | 1.91$^{cd}$ (3.17) | 2.04$^{e}$ (3.67) | 1.70$^{b}$ (2.40) | 2.38$^{d}$ (5.17) | 2.11$^{e}$ (3.96) | 2.03$^{e}$ (3.62) | 1.87$^{e}$ (3.00) | 2.09$^{e}$ (3.87) | 2.07$^{e}$ (3.80) |
| $T_2$ | Table sugar solution | 15 | 1.64$^{abc}$ (2.18) | 2.74$^{b}$ (6.99) | 2.66$^{b}$ (6.59) | 2.50$^{b}$ (5.76) | 2.34$^{a}$ (4.97) | 2.56$^{b}$ (6.05) | 1.72$^{ab}$ (2.45) | 3.00$^{b}$ (8.52) | 2.70$^{b}$ (6.79) | 2.42$^{b}$ (5.34) | 2.34$^{b}$ (4.97) | 2.61$^{b}$ (6.31) | 2.59$^{b}$ (6.22) |
| $T_3$ | Sugarcane juice | 20 | 1.67$^{a}$ (2.30) | 2.17$^{ef}$ (4.21) | 2.05$^{ef}$ (3.70) | 1.93$^{de}$ (3.22) | 1.86$^{de}$ (2.96) | 2.00$^{e}$ (3.49) | 1.74$^{ab}$ (2.54) | 2.30$^{d}$ (4.80) | 2.05$^{ef}$ (3.70) | 1.92$^{f}$ (3.19) | 1.82$^{ef}$ (2.81) | 2.02$^{f}$ (3.59) | 2.01$^{f}$ (3.54) |
| $T_4$ | Sugarcane juice | 30 | 1.57$^{c}$ (1.95) | 2.54$^{c}$ (5.96) | 2.42$^{c}$ (5.34) | 2.25$^{c}$ (4.56) | 2.02$^{b}$ (3.59) | 2.30$^{c}$ (4.80) | 1.81$^{a}$ (2.79) | 2.68$^{c}$ (6.68) | 2.43$^{c}$ (5.39) | 2.25$^{c}$ (4.56) | 2.16$^{c}$ (4.16) | 2.37$^{c}$ (5.12) | 2.34$^{c}$ (4.97) |
| $T_5$ | Jaggery solution | 10 | 1.66$^{ab}$ (2.22) | 2.30$^{d}$ (4.80) | 2.21$^{d}$ (4.38) | 2.19$^{c}$ (4.30) | 1.95$^{bc}$ (3.30) | 2.16$^{d}$ (4.16) | 1.82$^{a}$ (2.81) | 2.64$^{c}$ (6.44) | 2.34$^{d}$ (4.97) | 2.14$^{d}$ (4.10) | 1.97$^{d}$ (3.39) | 2.27$^{d}$ (4.65) | 2.21$^{d}$ (4.38) |
| $T_6$ | Jaggery solution | 15 | 1.64$^{abc}$ (2.18) | 2.98$^{a}$ (8.35) | 2.88$^{a}$ (7.79) | 2.65$^{a}$ (6.52) | 2.40$^{a}$ (5.26) | 2.72$^{a}$ (6.89) | 1.79$^{ab}$ (2.69) | 3.16$^{a}$ (9.50) | 2.95$^{a}$ (8.20) | 2.65$^{a}$ (6.52) | 2.52$^{a}$ (5.83) | 2.81$^{a}$ (7.40) | 2.77$^{a}$ (7.17) |
| $T_7$ | Honey solution | 1.0 | 1.57$^{c}$ (1.95) | 2.01$^{g}$ (3.54) | 1.97$^{g}$ (3.39) | 1.89$^{e}$ (3.08) | 1.78$^{ef}$ (2.66) | 1.91$^{f}$ (3.17) | 1.80$^{ab}$ (2.73) | 2.14$^{e}$ (4.10) | 2.01$^{f}$ (3.54) | 1.84$^{gh}$ (2.88) | 1.78$^{f}$ (2.66) | 1.94$^{g}$ (3.26) | 1.92$^{h}$ (3.19) |
| $T_8$ | Honey solution | 1.5 | 1.63$^{abc}$ (2.16) | 2.07$^{fg}$ (3.80) | 2.02$^{fg}$ (3.59) | 1.90$^{e}$ (3.11) | 1.83$^{de}$ (2.86) | 1.95$^{f}$ (3.30) | 1.76$^{ab}$ (2.58) | 2.19$^{e}$ (4.30) | 2.02$^{f}$ (3.59) | 1.87$^{fg}$ (3.00) | 1.79$^{f}$ (2.69) | 1.96$^{g}$ (3.34) | 1.96$^{g}$ (3.34) |
| $T_9$ | Pollination without pollinators (Net covered) | -- | 0.71$^{d}$ (0.00) | 0.71$^{i}$ (0.00) | 0.71$^{i}$ (0.00) | 0.71$^{g}$ (0.00) | 0.71$^{g}$ (0.00) | 0.71$^{h}$ (0.00) | 0.71$^{c}$ (0.00) | 0.71$^{g}$ (0.00) | 0.71$^{h}$ (0.00) | 0.71$^{i}$ (0.00) | 0.71$^{g}$ (0.00) | 0.71$^{i}$ (0.00) | 0.71$^{j}$ (0.00) |
| $T_{10}$ | Untreated control | -- | 1.57$^{c}$ (1.95) | 1.60$^{h}$ (2.08) | 1.64$^{h}$ (2.18) | 1.65$^{f}$ (2.22) | 1.68$^{f}$ (2.33) | 1.64$^{g}$ (2.18) | 1.73$^{ab}$ (2.49) | 1.74$^{f}$ (2.54) | 1.75$^{g}$ (2.56) | 1.76$^{h}$ (2.58) | 1.77$^{f}$ (2.63) | 1.75$^{h}$ (2.56) | 1.69$^{i}$ (2.36) |
| S.Em. ± | T | | 0.09 | 0.11 | 0.10 | 0.08 | 0.11 | 0.051 | 0.11 | 0.11 | 0.09 | 0.09 | 0.08 | 0.051 | 0.035 |
| | P | | - | - | - | - | - | 0.032 | - | - | - | - | - | 0.030 | 0.022 |
| | S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.015 |
| | T×P | | - | - | - | - | - | 0.102 | - | - | - | - | - | 0.095 | 0.069 |
| | T×S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.049 |
| | P×S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.022 |
| | T×P×S | | - | - | - | - | - | - | - | - | - | - | - | - | 0.098 |
| C. D. at 5% | T | | 0.26 | 0.34 | 0.29 | 0.25 | 0.33 | 0.14 | 0.31 | 0.33 | 0.28 | 0.26 | 0.25 | 0.14 | 0.097 |
| C. V. (%) | | | 9.77 | 9.27 | 8.22 | 7.35 | 10.29 | 8.82 | 10.98 | 8.52 | 7.64 | 7.67 | 7.85 | 8.00 | 8.35 |

**Note:** DBS: Days before Spray, DAS: Days after Spray, Figures in parentheses are retransformed values of $\sqrt{X+0.5}$ transformation Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance.

**Table 3:** Evaluation of indigenous bee attractants on activity of bees on onion flowers during 2020-21 and 2021-22 (pooled)

| Tr. No. | Treatments | Conc. (%) | Day Before Spray | Number of bees/m$^2$/ 2 min. | | |
|---|---|---|---|---|---|---|
| | | | | 2020-21 | 2021-22 | Pooled over year |
| $T_1$ | Table sugar solution | 10 | 1.68$^{a}$ (2.32) | 2.12$^{e}$ (3.99) | 2.07$^{e}$ (3.80) | 2.10$^{e}$ (3.93) |
| Z | Table sugar solution | 15 | 1.71$^{a}$ (2.42) | 2.60$^{b}$ (6.28) | 2.59$^{b}$ (6.22) | 2.59$^{b}$ (6.22) |
| $T_3$ | Sugarcane juice | 20 | 1.75$^{a}$ (2.56) | 2.07$^{ef}$ (3.80) | 2.01$^{f}$ (3.54) | 2.04$^{ef}$ (3.67) |
| $T_4$ | Sugarcane juice | 30 | 1.74$^{a}$ (2.54) | 2.34$^{c}$ (4.97) | 2.34$^{c}$ (4.97) | 2.34$^{c}$ (4.97) |
| $T_5$ | Jaggery solution | 10 | 1.71$^{a}$ (2.42) | 2.25$^{d}$ (4.56) | 2.21$^{d}$ (4.38) | 2.23$^{d}$ (4.48) |
| $T_6$ | Jaggery solution | 15 | 1.70$^{a}$ (2.40) | 2.73$^{a}$ (6.95) | 2.77$^{a}$ (7.17) | 2.76$^{a}$ (7.11) |
| $T_7$ | Honey solution | 1.0 | 1.69$^{a}$ (2.36) | 1.98$^{g}$ (3.42) | 1.92$^{h}$ (3.19) | 1.96$^{g}$ (3.34) |
| $T_8$ | Honey solution | 1.5 | 1.70$^{a}$ (2.40) | 2.01$^{fg}$ (3.54) | 1.96$^{g}$ (3.34) | 1.99$^{fg}$ (3.46) |
| $T_9$ | Pollination without pollinators (Net covered) | -- | 0.71$^{b}$ (0.00) | 0.71$^{i}$ (0.00) | 0.71$^{j}$ (0.00) | 0.71$^{i}$ (0.00) |
| $T_{10}$ | Untreated control | -- | 1.66$^{a}$ (2.22) | 1.63$^{h}$ (2.16) | 1.69$^{i}$ (2.36) | 1.67$^{h}$ (2.30) |
| S.Em. ± | | T | 0.048 | 0.036 | 0.035 | 0.025 |
| | | P | - | 0.023 | 0.022 | 0.016 |
| | | S | - | 0.016 | 0.015 | 0.064 |
| | | Y | 0.034 | - | - | 0.011 |
| | | T×P | - | 0.073 | 0.069 | 0.050 |
| | | T×S | - | 0.052 | 0.049 | 0.036 |
| | | P×S | - | 0.033 | 0.031 | 0.022 |
| | | Y×T | 0.107 | - | - | 0.036 |
| | | Y×P | - | - | - | 0.022 |
| | | Y×S | - | - | - | 0.016 |
| | | T×P×S | - | 0.103 | 0.098 | 0.071 |
| | | Y×S×T | - | - | - | 0.050 |
| | | Y×S×P | - | - | - | 0.032 |
| | | Y×P×T | - | - | - | 0.071 |
| | | Y×S×P×T | - | - | - | 0.100 |
| C. D. at 5% | | T | NS | 0.102 | 0.097 | 0.070 |
| | | Y×T | - | - | - | NS |
| C. V. (%) | | | 11.54 | 8.72 | 8.35 | 8.53 |

**Note:** Figures in parentheses are retransformed values, those outside are $\sqrt{X+0.5}$ transformed values, DAS: Days after spraying; Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance

**Table 4:** Effect of indigenous bee attractants on onion seed yield kg per ha during 2020-21 and 2021-22 (Pooled)

| Tr. No. | Treatments | Concentration (%) | Onion Seed yield (kg/ha) (2020-21) | Onion Seed yield (kg/ha) (2021-22) | Pooled over year |
|---|---|---|---|---|---|
| $T_1$ | Table sugar solution | 10 | 849.33$^{c}$ | 852.33$^{d}$ | 850.83$^{d}$ |
| $T_2$ | Table sugar solution | 15 | 1102.67$^{a}$ | 1107.67$^{ab}$ | 1105.16$^{ab}$ |
| $T_3$ | Sugarcane juice | 20 | 850.00$^{c}$ | 855.00$^{d}$ | 852.50$^{d}$ |
| $T_4$ | Sugarcane juice | 30 | 1026.33$^{ab}$ | 1006.00$^{bc}$ | 1016.16$^{bc}$ |
| $T_5$ | Jaggery solution | 10 | 903.33$^{bc}$ | 908.67$^{cd}$ | 906.00$^{cd}$ |
| $T_6$ | Jaggery solution | 15 | 1147.67$^{a}$ | 1153.00$^{a}$ | 1150.33$^{a}$ |
| $T_7$ | Honey solution | 1.0 | 858.33$^{c}$ | 852.67$^{d}$ | 855.50$^{d}$ |
| $T_8$ | Honey solution | 1.5 | 830.67$^{c}$ | 828.33$^{de}$ | 829.50$^{d}$ |
| $T_9$ | Pollination without pollinators (Net covered) | -- | 416.67$^{e}$ | 409.00$^{f}$ | 412.83$^{f}$ |
| $T_{10}$ | Untreated control | -- | 672.67$^{d}$ | 673.33$^{e}$ | 673.00$^{e}$ |
| S. Em. ± | | T | 45.11 | 46.40 | 29.00 |
| | | Y | - | - | 14.47 |
| | | Y×T | - | - | 45.76 |
| C. D. at 5% | | T | 134.04 | 137.86 | 82.60 |
| | | Y×T | - | - | NS |
| C. V. (%) | | | 9.03 | 9.30 | 9.16 |

## Conclusion

The largest number of bees/m$^2$/2 minutes was observed using a 15% jaggery solution and a 15% table sugar solution administered at 1500 ml/10 lit of water. The treatment with the highest yield was found to be the most successful at attracting bees to onions.

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