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# IMPACT OF BEE POLLINATION IN BRINJAL

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## ABSTRACT

**Impact of bee pollination on brinjal (*Solanum melongena* L.) under protected condition was assessed with five pollination treatments viz., *Apis mellifera* L., *Apis cerana* F., *Tetragonula iridipennis* S., open pollination and control (pollinator exclusion). Comparative foraging activity and pollination efficiency index of the pollinators was recorded along with fruit production and quality parameters (fruit yield, length, diameter and weight, seed number and weight). Data revealed maximum pollination efficiency index (21) for *A. cerana.* The weight of fruit (96.30 g), diameter (56.54 cm), healthy fruits (53.89 %) observed with *A. cerana* was maximum. However, fruit length (15.10 cm), fruit yield (48.33 %) and seed weight (5.79 g) were found at par in all the pollination treatments. Significantly least crooked fruits (13.73%) were obtained when *A. cerana* was used, along with many folds increase in fruit set (26.69 %) and quality.**

**Key words:** Pollination, *Apis mellifera*, *Apis cerana*, *Tetragonula iridipennis*, *Solanum melongena*, pollination index, protected condition, yield and quality, fruit weight, length and shape

Honey bees are the primary and only dependable pollinators of many crops (Free, 1993). *Apis mellifera* L , *A. cerana* L, *A. dorsata* F., and *A. florea* F., are the main pollinators abundantly found. Of which the domesticated ones viz., *A. mellifera* and *A. cerana* posess special value while others not studied widely (Meena, 2016). Stingless bees are now emerging as pollinators for crops grown under protected conditions (Chauhan et al., 2019). Horticultural crops such as pomegranate, ber, aonla, phalsa, citrus, brinjal, tomato, bale, field beans, cucurbits, jamun and fig etc. need insect pollinators for pollination and for maximizing yield (Haldhar, 2018). Brinjal is self-pollinated, but cross pollination resulted in maximum fruit yield and quality (Chaudhary, 1970). The limitation of cross pollination in brinjal is up to 48% and hence it is also identified as cross-pollinated crop; anthers are cone like in formation which favours self-pollination but since the stigma ultimately projects beyond the anthers, there is an ample chance for cross pollination. Crossing usually takes place with the help of insects (Gallaiet, 2009); and hymenopterans are the superior flower visitors (90.75%) over lepidopterans in brinjal (9.25%) (Mainali, 2015); insect's activity (above 60%) was observed to be maximum at morning hours with less numbers (12.54%) visiting during noon (Waqar, 2013). Pollination requirements of brinjal were observed by Herren (2008) which revealed that *Xylocopa caffra* L., and *Macronomia rufipes* S., as important pollinators. Patricio (2012) investigated how dependent brinjal is on bees for fruit production. In brinjal, production of fruit and seed was enhanced by pollinator's visitation and pollen complementation; and the highest yield in was insects were used as pollinators (Miyamoto, 2006). Keeping in view the importance of insects in pollination of brinjal, effectiveness of different modes of pollination on its production and productivity were evaluated in this study at Nagaland.

## MATERIALS AND METHODS

The experiment was carried out at the Experimental farm, Department of Entomology, School of Agricultural Science and Rural Development (23°45'43"N, 93°52'04" E). Colonies of *A. mellifera* ($T_1$), *A. cerana* ($T_2$) and *Tetragonula iridipennis* ($T_3$) were introduced at 10% blooming stage in separate cages and $T_5$-control (no pollinator was introduced). Similarly, crop was grown under open condition ($T_4$) for treatment with four replications and plot size of cages being 40 $m^2$. All agronomical practices were done as per good agricultural practices, with the crop sown in the first week of April, 2019. The crop came to bloom in the second week of May. After that the colonies were shifted and data were recorded. Foraging activity of bees and other pollinators was recorded as per the method adopted by Chauhan (2015) under open field conditions from early morning (0600 hr) till late evening (1600 hr) at two hours interval for seven days continuously.

Pollination efficiency was derived for each species as suggested by Bohart and Nye (1960). Impact of bee pollination on brinjal was evaluated with % fruit set, for which ten plants were tagged randomly, and fruit set observed along with yield calculated on fruit set basis. Healthy (%) and crooked fruits (%) were also calculated. Fruit length, diameter and weight were observed (10 fruits/ treatment) using the scale, digital vernier callipers and digital weighing balance, respectively. Similarly, seed weight and number were also calculated. The increase (%) over control in fruit set, healthy fruits, length, diameter, weight, number of seeds, weight of 1000 seeds was also calculated.

## RESULTS AND DISCUSSION

The results revealed that *A. mellifera* and *A. cerana* were the most significant flower visitors in brinjal followed by *T. iridipennis*, *A. dorsata* and *Lophotrigona canifrons* as frequent visitors; while *Lasius niger* and *Aulacophora nigripennis* were observed to be less frequent. The activity of honey bees was maximum during 0600-0800 hr and *A. cerana* (6.07/ 5min/ $m^2$) significantly outnumbered the *A. mellifera*, *T. iridipennis*, *L. canifrons*, *L. niger* and *A. nigripennis* (Table 1). Waqar (2013) described *A. cerana* and *A. mellifera* as major visitors, and Amano (2000) observed 24 insects, of which hymenopterans were predominant. Girlish (1981) concluded that *A. cerana* was more active, followed by *A. mellifera* and *T. iridipennis*; most efficient and important pollinators were observed to be *A. cerana* and *A. mellifera*. Similarly, Grewal et al. (1971) concluded that *A. cerana* is the major one in solanaceous crops; *A. cerana* significantly visited more flowers (8.07/ 5min/ $m^2$) as compared to *A. mellifera*, *T. iridipennis*, *L. canifrons*, *L. niger* and *A. nigripennis*. Mainali (2015) reported that honey bees were the most abundant flower visitors over Lepidoptera and Coleoptera; *A.cerana* most frequently visited flowers followed by *A. mellifera* and *T. iridipennis;* and maximum foraging speed/ time spent was observed with *A. cerana* (5.20 sec/ flower) as compared to *A. mellifera* and others; and *A. cerana* showed maximum pollination efficiency (21.00) and is better in terms of pollination potential (Table 1).

Longer fruits were obtained from plants pollinated by *A. cerana* over *A. mellifera*, *T. iridipennis*, open pollinated and control; and these treatments being significantly at par to each other. Similarly, significantly at par fruit set (48.33 %) was recorded with *A. cerana* compared to that of *A. mellifera*, *T. iridipennis*, open pollinated and control were recorded at par to each other; likewise fruits having more weight and diameter were recorded with *A. cerana*. Bee pollinated flowers yielded fruits having significantly more seeds, and less crooked fruits were obtained when *A. cerana* was used; and significantly more healthy fruits (53.89 %) were produced from *A. cerana* pollinated plots (Table 2). Santos and Bego (2007) reported that *A. cerana* effectively pollinated brinjal under closed environment, and maximum increase in fruit weight and number of seeds/ fruit was observed with pollinated treatments. Rajasri et al. (2012) studied effect of bee pollination on seed yield of sunflower and observed improvement (633 g) with pollination by *T. iridipennis* while it was only 352 g in self pollinated crops. Viana et al. (2014) found that stingless bee (*Melipona quadrifasciata* L.) play an important role as pollinator of apple flowers-with increase in fruit set, healthy fruits, diameter, length, weight, weight of 1000 seeds and number of seeds with *A. cerana* pollination. Chauhan et al. (2019) also

Table 1. Foraging activity and pollination efficiency index of pollinators on brinjal

| Time | *Apis cerana* | | | | *Apis mellifera* | | | | *Tetragonula iridipennis* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (h) | *RA | FR | FS | LPG | RA | FR | FS | LPG | RA | FR | FS | LPG |
| 0600 | 5.97 | 9.54 | 6.14 | | 5.67 | 6.91 | 5.94 | | 4.17 | 6.14 | 7.28 | |
| 0800 | 8.93 | 9.82 | 6.52 | | 4.93 | 7.92 | 5.42 | | 4.33 | 7.22 | 4 | |
| 1000 | 6.82 | 8.84 | 5.82 | 1970 | 4.82 | 6.84 | 4.92 | 1648 | 6.02 | 5.24 | 5.72 | 1564 |
| 1200 | 5.98 | 7.85 | 4.95 | ± 24 | 5.38 | 6.55 | 4.85 | ± 31 | 5.88 | 5.15 | 5.55 | ± 27 |
| 1400 | 4.82 | 6.97 | 3.93 | | 4.32 | 5.87 | 3.63 | | 4.56 | 4.97 | 4.82 | |
| 1600 | 3.91 | 5.42 | 3.85 | | 3.31 | 4.94 | 2.85 | | 3.91 | 3.42 | 4.66 | |
| Mean | 6.07 | 8.07 | 5.20 | | 4.73 | 6.50 | 4.60 | | 4.81 | 5.35 | 5.82 | |
| $CD_{0.05}$ | 0.54 | 0.47 | 0.58 | | 0.54 | 0.47 | 0.58 | | 0.68 | 0.47 | 0.60 | |
| Pollination Efficiency Index | | | 21 | | | 12 | | | | 5 | | |

*Relative abundance = number of foragers/ 5 min/ $m^2$; Foraging rate = Number of flowers visited / 5 min; Foraging speed = time spent / flower (in seconds); Loose pollen grains = the total number of loose pollen grains in the whole rinsate was calculated

Table 2. Impact of modes of pollination on fruit quality and production in brinjal

| Treatment | Fruit length (cm) | Fruit diameter (cm) | Fruit weight (kg) | Fruit set (%) | Healthy fruit (%) | Crooked fruits (%) | Number of seeds/ fruit | Weight of 1000 seeds (g) |
|---|---|---|---|---|---|---|---|---|
| *A. cerana* pollination | 15.10 | 56.54 | 96.30 | 48.33 | 53.89 | 13.73 | 307 | 5.79 |
| *A. mellifera* pollination | 14.42 | 55.78 | 90.44 | 47.45 | 51.58 | 15.86 | 223 | 5.32 |
| *T. iridipennis* pollination | 14.19 | 53.67 | 88.31 | 45.76 | 49.68 | 20.62 | 183 | 4.16 |
| Open pollination | 13.64 | 52.33 | 82.20 | 39.34 | 40.91 | 25.37 | 165 | 3.10 |
| Pollinator exclusion (control) | 13.03 | 49.03 | 68.81 | 33.84 | 32.63 | 28.90 | 138 | 3.01 |
| CD (p= 0.05) | 1.6 | 0.45 | 0.19 | 0.90 | 0.82 | 0.51 | 0.61 | 0.98 |
| Increase (%) over control | 90.25 | 68.53 | 442.56 | 26.69 | 29.84 | 139.12* | 628 | 111.58 |

*Reduction

observed similar results with stingless bee pollinated crop.

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