Indian Journal of Entomology 85(Special Issue) May 2023: 7-10 eRef. No. NWRABNRG02 DoI. No.: 10.55446/IJE.2023.1151

COMPARATIVE PERFORMANCE OF HIVE BEE ON YIELD OF CUCUMBER (*CUCUMIS SATIVUS* L.)

Divya H Patel* and J J Pastagia[1]

Department of Entomology, N M College of Agriculture,
Navsari Agricultural University, Navsari 396 450, Gujarat, India
[1]College of Agriculture, Navsari Agricultural University, Waghai 374 730, Gujarat, India
*Email: divyapatel96320@gmail.com (corresponding author): https://orcid.org/0000-0001-6592-8932

ABSTRACT

The studies on comparative performance of hive bee on yield of cucumber (*Cucumis sativus* L.) were carried out with five treatments like pollination with *Apis cerana*, *A. mellifera*, *Tetragonula laeviceps*, pollination without bees and open pollination at college farm, Navsari Agricultural University, Navsari during summer 2018. In the present study, it was found that pollination by different bee species in cage condition as well as different pollinators in open pollination have the positive influence on different yield parameters of cucumber viz., number of fruits in each plant, fruit set (%), fruit length, fruit diameter and fruit weight. The present findings clearly indicates the role of honey bees i.e. *A. cerana* and *A. mellifera* which can be further exploited in planned bee pollination to achieve desired production potentials of cucumber crop.

Key words: *Apis cerana*, *Apis mellifera*, *Apis dorsata*, *Tetragonula laeviceps*, pollinator, cucumber, honey bee, pollination, *Cucumis sativus*, pollination efficiency

Insect pollinators are flower visiting insects that forage on flowering plants to obtain plant provided food. Flower visiting insects have the potential to transfer male gametes to the female gametes while foraging, resulting in pollination. Utilization of pollinators, especially honey bees is considered as one of the cheapest and eco-friendly approaches in maximizing the yield of cross pollinated crops (Free, 1970). As cucumber has monoecious flowers and further, due to excessive use of pesticide especially at flowering stage and intensive cultivation has reduced the population of pollinators especially of honey bees to a great extent and due to that the full production potential of cucumber cannot be harnessed. In this situation, the hive bees, viz., *A. cerana*, *A. mellifera* and *T. laeviceps* can be utilized for planned bee pollination. To utilize the specific bee species, it is necessary to study the pollination efficiency of individual species.

MATERIALS AND METHODS

The experiment was undertaken at the college farm of Navsari Agricultural University, Navsari during Summer, 2018. The cucumber crop, variety Gujarat cucumber-1 was grown in five different plots measuring 6×6 m for five different treatments. In treatment one to four i.e. pollination with *A. cerana* (4.52 bees/ 5 min/ m^2), pollination with *A. mellifera* (4.03 bees/ 5 min/ m^2), pollination with *T. laeviceps* (0.78 bees/ 5 min/ m^2) and pollination without bees, the plots were covered with 20 mesh net (6×6×6 m) before flowering. Colonies of honey bees having four frames/ hive were placed separately inside the cage. In case of T_1 bee hive with *A. cerana*, in T_2 bee hive with *A. mellifera* and in T_3 a single colony of *T. laeviceps* in bee hive was placed inside the cage at 20% flowering. In T_4 no pollinators were allowed. In T_5 free access to all the pollinators were there. The crop was kept unsprayed throughout the crop season.

To study the effect of different pollinators on the yield of cucumber, various observations like number of flowers per plant, number of fruits per plant, healthy and malformed fruits per plant were recorded from randomly selected three plants per replication of each treatment. Length, diameter and weight of fruits were also recorded. The fruit set in all the treatments were estimated by counting the number of fruit set (%) out of the female flowers.

The fruits harvested from each replication were weighed and recorded during each picking and total weight of all pickings was summed up to work out total yield/ plot which was then converted to one hectare area for each treatment.

RESULTS AND DISCUSSION

In treatments, (T_1) pollination with *A. cerana*, (T_2)

pollination with *A. mellifera*, (T_3) pollination with *T. laeviceps*, (T_4) pollination without bees and (T_5) open pollination, the mean number of male and female flowers per plant was observed to be 245.80, 248.67, 238.07, 236.80, 226.47 and 20.47, 20.27, 19.27, 19.32, 20.67 respectively (Table 1). The analysis of data revealed that there were no significant differences among different treatments with respect to male and female flowers. These results clearly indicated that the number of male and female flowers per plant is genetically controlled but not influenced by external factors. The ratio of male: female flowers of cucumber observed in various treatments was 12.00:1, 12.27:1, 12.35:1, 12.25:1 and 10.95:1 in (T_1) pollination with *A. cerana*, (T_2) pollination with *A. mellifera*, (T_3) pollination with *T. laeviceps*, (T_4) pollination without bees and (T_5) open pollination, respectively. These results endorse the earlier reports of Pateel (2007) and Santos et al. (2008) on cucumber. They reported that there were non-significant differences in terms of male and female flowers for both conditions (open and cage condition). Kohli and Vikram (2005) observed that the ratio of male to female flowers is 10:1 in monoecious cultivars.

The observations recorded on number of fruits as affected by different pollination treatments revealed that the significantly higher number of fruits per plant was recorded in treatment of open pollination (11.73) which was statistically at par with the treatment of *A. cerana* pollination (11.00) and treatment of *A. mellifera* pollination (10.80) followed by treatment of *T. laeviceps* pollination (8.93 fruits/ plant). Significantly the least number of fruits per plant (2.80) were harvested from treatment of pollination without bees. The present finding is in line with the reports of Mitta et al. (2017) and Bui et al. (2017) who observed that the number of cucumber fruits per plant was higher in the pollinated plants as compared to control. Gaire and Yubak (2015) recorded that the maximum number of cucumber fruit was harvested from *A. cerana* pollinated plant and *A. mellifera* pollinated plant in cage condition followed by open pollinated plant.

As regards to the fruit set (%) as affected by different pollination treatments, the significantly higher fruit set was observed in open pollination (T_5) treatment (53.79%) which was at par with treatment (T_1) of pollination with *A. cerana* (53.77%), treatment (T_2) of pollination with *A. mellifera* (52.53%) and treatment (T_3) of pollination with *T. laeviceps* (49.70%). Significantly the least fruit set was observed in treatment (T_4) pollination without bees (17.23%). The present findings are in conformity with the observation of Bui et al. (2017) who recorded that the fruit set of cucumber was the highest in plot caged with bees (51.5%) and the least in plots without bees (18.7%).

The numbers of healthy and malformed fruits were recorded separately for each treatment and the healthy fruits were worked out and presented in Table 2. The analysis of data on healthy fruits revealed that significantly maximum were recorded in (T_1) pollination with *A. cerana* (77.42%) which was at par with (T_2) pollination with *A. mellifera* (74.18%) and (T_3) pollination with *T. laeviceps* (73.30%) and (T_5) open pollination (69.33%). Significantly minimum healthy fruits were recorded in (T_4) pollination without bees (20.02%). The present finding is in line with the reports of Meena and Rana (2008) who observed that the honey bee pollination resulted in significantly high and healthy fruits (92.22%) as compared to hand (85.85%) and open pollination (79.64%).

The length of fruit was measured by taking ten fruits from each replication and average length was calculated. The data revealed that significantly maximum average

Table 1. Mean number of male and female flowers per plant in different treatments

Treatments	Male flower	Female flower	Male: Female ratio
T_1: Pollination with *A. cerana*	245.80	20.47	12.00:1
T_2: Pollination with *A. mellifera*	248.67	20.27	12.27:1
T_3: Pollination with *T. laeviceps*	238.07	19.27	12.35:1
T_4: Pollination without bees	236.80	19.32	12.25:1
T_5: Open pollination	226.47	20.67	10.95:1
S.Em ±	9.89	1.21	-
CD at 5 %	NS	NS	-
CV %	9.24	13.57	-

Table 2. Yield parameters of cucumber as affected by different pollination treatments

Treatments	No. of fruits/ plant	Fruit set (%)	Healthy fruit (%)	Average fruit length (cm)	Average fruit diameter (cm)	Average fruit weight (g)	Average yield (kg/ plant)	Yield (kg/ ha)
T_1: Pollination with *A. cerana*	11.00[a]	54.63 (47.68)[a]	77.42 (61.74)[a]	20.29[a]	03.72[a]	148.00[a]	01.67[a]	22,722[a]
T_2: Pollination with *A. mellifera*	10.80[ab]	53.63 (47.09)[a]	74.18 (59.44)[a]	20.09[a]	03.62[ab]	146.66[a]	01.61[a]	22,388[a]
T_3: Pollination with *T. laeviceps*	08.93[b]	46.92 (43.22)[b]	73.30 (58.93)[a]	19.40[ab]	03.48[bc]	122.53[ab]	01.10[b]	15,250[b]
T_4: Pollination without bees	02.80[c]	14.92 (22.46)[b]	20.02 (26.20)[b]	18.07[b]	03.35[c]	105.33[b]	00.29[c]	4,055[c]
T_5: Open pollination	11.73[a]	57.18 (49.21)[a]	69.33 (56.42)[a]	20.23[a]	03.54[abc]	142.00[a]	01.61[a]	22,361[a]
S.Em±	00.65	02.35	01.90	00.46	00.08	08.60	00.06	936.53
CD at 5%	01.96	07.05	05.70	01.38	00.24	25.78	00.20	2807.85
CV%	16.17	12.55	08.09	05.26	05.05	14.47	12.07	12.07

*Mean values followed by the same alphabet in the columns do not differ significantly by DMRT at 5% level
Figures in parentheses are arcsine transformed values

fruit length was recorded in the treatment pollination by *A. cerana* (20.29 cm) which was at par with open pollination (20.23 cm), pollination with *A. mellifera* (20.09 cm) and pollination with stingless bee (19.40 cm). The significantly lower mean fruit length was recorded in pollination without bees (18.07 cm) which was at par with treatment of pollination with *T. laeviceps*. The present findings are in close agreement with Gaire and Yubak (2015) and Bui et al. (2017) who reported that the length of the cucumber fruits was more in plots caged with bees than plots caged without bees.

The diameter of fruits was measured by taking ten fruits from each replication and average diameter was calculated. The data revealed that significantly higher average fruit diameter was recorded in the treatment (T_1) pollination with *A. cerana* (3.72 cm) which was at par with (T_2) pollination with *A. mellifera* (3.62 cm) and (T_5) open pollination (3.54 cm) followed by (T_3) pollination with *T. laeviceps* (3.48 cm) and minimum fruit diameter was observed in treatment (T_4) pollination without bees (3.35 cm). The present findings are in close agreement with Bui et al. (2017) who recorded that the width of the cucumber fruits was more in plots caged with bees than plots caged without bees.

The average fruit weight was calculated by summing up the weight of all the fruits divided by the number of fruits in each treatment. The data revealed that maximum average fruit weight was recorded in the treatment of pollination with *A. cerana* (148.00 g) which was statistically at par with the treatment of pollination with *A. mellifera* (146.66 g), treatment of open pollination (142.00 g) and treatment of pollination with *T. laeviceps* (122.53 g). Statistically significant minimum fruit weight was recorded in treatment of pollination without bees (105.33 g) which was at par with treatment of pollination with *T. laeviceps* (122.53 g). The present results are in accordance with the findings of Gaire and Yubak (2015).

The data on average fruit yield of cucumber revealed that significantly highest average fruit yield per plant was recorded in the treatment of bee pollination with *A. cerana* (1.64 kg/ plant) which was statistically at par with treatment of bee pollination with *A. mellifera* (1.61 kg/ plant) and treatment of open pollination (1.61 kg/ plant) followed by treatment of bee pollination with *T. laeviceps* (1.10 kg/ plant). The significantly minimum fruit yield was recorded in the treatment of pollination without bees (0.29 kg/ plant).

The converted yield per hectare was based on average yield/ plant in each replication. The data revealed that the significantly higher yield per hectare was recorded in treatment of bee pollination with *A. cerana* (22,722 kg/ ha) which was at par with treatment of bee pollination with *A. mellifera* (22,388 kg/ ha) and

treatment of open pollination (22,361 kg/ ha). The next in order was the treatment of bee pollination with *T. laeviceps* (15,250 kg/ ha). The significantly minimum fruit yield was recorded in the treatment of pollination without bees (4,055 kg/ ha). The present findings are more or less in conformity with the earlier workers like Sarwar et al. (2008) who recorded that both the open pollinated plants with bees and caged plants with bees significantly increased yield per plant of cucumber crop as compared to the control.

Due to the monoecious nature of cucumber flowers, both male and female flowers are incomplete and imperfect as well as born separately on the same plant. Cucumber crop requires insect pollination as an input for producing fruits. However, due to injudicious use of pesticide especially, at flowering stage of crops and intensive cultivation has reduced the population of pollinators especially of honey bees to a great extent and as a reason the full production potentials of cucumber cannot be harnessed. In the present study it was found that pollination by different bee species in cage condition as well as different pollinators in open pollination have the positive influence on yield components of cucumber viz*.,* number of fruits per plant, fruit set (%), fruit length, fruit diameter and fruit weight. The present findings clearly indicates the role of hive honey bees i.e. *A. cerana* and *A. mellifera* which can be further exploited in planned bee pollination to achieve desired production potentials of cucumber crop.

REFERENCES

Bui M, Singh H K, Waluniba, Alemla A M. 2017. Qualitative enhancement of cucumber with bee (*Apis cerana*) pollination at Nagaland. Indian Journal of Entomology 79(2): 160-162.

Free J B. 1990. Insect pollination of crops. London Academic Press, London, UK 544 pp.

Gaire S K, Yubak D G C. 2015. Effect of Pollination on Cucumber (*Cucumis sativus* L.) production in Chitwan, Nepal. Agriculture Development Journal 11: 1-8.

Kohli U K, Vikram A. 2005. Hybrid cucumber. Journal of New Seeds 6: 375-380.

Meena T, Rana R S. 2008. Studies on the role of insect pollination on cucumber yield. Pest Technology 2(2): 130-133.

Mitta K T, Srinivasan M R, Rajashree V, Thakur R K. 2017. Stingless bee *Tetragonula iridipennis* Smith for pollination of greenhouse cucumber. Journal of Entomology and Zoology Studies 5(4): 1729-1733.

Pateel M C. 2007. Impact of honey bee pollination on qualitative and quantitative parameters of cucumber (*Cucumis sativus* L.). M Sc Thesis submitted to the University of Agricultural Sciences, Dharwad.

Santos S A B, Roselino A C, Bego L R. 2008. Pollination of cucumber, *Cucumis sativus* L. (Cucurbitales: Cucurbitaceae), by the stingless bees *Scaptotrigona* aff. *depilis* Moure and *Nannotrigona testaceicornis* Lepeletier (Hymenoptera: Meliponini) in greenhouses. Neotropical Entomology 37(5): 506-512.

Sarwar G, Aslam M, Munawar M S, Raja S, Mahmood R. 2008. Effect of honey bee (*Apis mellifera* L.) pollination on fruit setting and yield of cucumber (*Cucumis sativus* L.). Pakistan Entomologist 30(2): 185-191.

(Paper presented: February, 2021;
Peer reviewed, revised and accepted: April, 2022; Online Published: May, 2023)
Online published (Preview) in www.entosocindia.org and indianentomology.org (eRef. No. NWRABNRG02)