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RESEARCH NOTE

Influence of pollination by honey bee (*Apis cerana indica* F.) on the yield parameters of bottle gourd

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ABSTRACT: The effect of different modes of pollination on quantitative parameters of bottle gourd was studied during *kharif* 2019 at Navsari Agricultural University, Navsari. The different quantitative parameters like the number of fruits/plant, per cent fruit set, per cent malformed fruit, fruit diameter, fruit weight, yield, and yield/ha were maximum in open pollination (5.38, 59.67%, 25.09%, 6.84cm, 961.24g, 5.17 kg/plant and 25,836 kg/ha, respectively) compared to pollination with *Apis cerana indica* (5.14, 54.03%, 20.43%, 6.76cm, 878.57g, 4.52 kg/plant and 22,607 kg/ha, respectively). The number of fruit drops was maximum in pollination with *A. cerana indica* (4.57), followed by open pollination (3.69). In the treatment of pollination without insects, no fruit formation was observed. The cost-benefit ratio was highest in open pollination (22.49:1) compared to pollination with *A. cerana indica* (4.69: 1).

Keywords: Bottle gourd, *Apis cerana indica*, pollination, quantitative parameters

Bottle gourd, *Lagenaria siceraria* (Molina) Standl. (F: Cucurbitacea) is an important multi-purpose vegetable grown for its leaf, fruit, and seed. In Ayurveda, bottle gourd is advocated for treatment of diabetes mellitus, hypertension, liver diseases, weight loss and other associated benefits (Prajapati *et al*., 2010). Being a monoecious crop, bottle gourd is mostly cross pollinated. There are several studied undertaken to seen the impact of *Apis cerana* on crop yield and productivity which showed that pollination by *A. cerana* increased fruit and seed set, increased the quality of fruit and seeds, and reduced premature fruit drop (Koetz, 2013; Kumar *et al*., 2021). Different types of pollinator fauna are available for the pollination of the bottle gourd. Among available pollinator insects, honey bees are the major pollinator (Ipsita Panigrahi, *et al.,* 2018) and they also contribute in the increasing of yield and quantitative parameters of bottle gourd. But, the detailed information on pollinator complex and role of pollinators on quantitative improvement of the bottle gourd is very scanty. There for present study is directed to access the role of honey bee, *A. cerana indica* F. on quantitative parameters of bottle gourd.

The study was carried out during *kharif* (July-December 2019) at college farm, Navsari Agricultural University, Navsari, Gujarat. Bottle gourd crop (MGH 4- WARAD) was sown in three plot measuring 12m × 12m size comprising three treatments. Planting was done with a spacing of 2×1 m between plants. The cultural operations were done as and when required. In the treatments, treatment number one (T_1) comprises of open pollination means free excess to insect pollinators were made available to pollinate the flowers. In the treatment number second (T_2), plants were covered with mosquito net 10m × 6m × 3m to prevent the entry of insect pollinators. In the third treatment (T_3), plants were covered with mosquito net and bee pollination was done by placing one healthy colony of *Apis cerana indica* F. containing four frames at the 10% flowering. The plots were kept unsprayed throughout the crop season. To study the effect of bee pollination on the yield parameters of bottle gourd in all treatments, in each replication three plants were tagged and observations were recorded on number of flowers per plant, number of fruits, number of fruits drop, per cent fruit set, healthy and malformed fruits per plant, diameter of fruit, weight of fruit, yield per plant, yield per hectare and economics. The collected data were analyzed statistically.

Among the different treatments, (T1) open pollination, (T2) pollination without insect and (T3) pollination with *A. cerana*, the mean number of male and female flowers per plant was observed that 46.76, 46.71, 47.61 and 9.04, 9.47, 9.71 respectively. The analysis of data revealed that there were non-significant differences among different treatments with respect to male and female flowers. The number of fruits per plant as affected by different pollination treatment revealed that maximum number of fruits per plant was recorded in treatment of open pollination (5.38) which was followed by the treatment of pollination with *A. cerana indica* (5.14). There was no fruit set recorded in treatment (T2) pollination without insect (Table 1). The present findings are more or less in

Table 1. Yield parameters of bottle gourd affected by different pollination treatments

Treatment	No. of fruits/ plant	No. of fruit drop	Per cent fruit set	Per cent malformed fruit	Fruit diameter (cm)	Fruit weight (g)	Yield (kg/ plant)	Yield (kg/ha)	BC ratio
T_1 : Open pollination	5.38	3.69*	59.67 (50.58)	25.09 (30.06)	6.84	961.24	5.17	25,836	22.49:1
T_2: Pollination without insect	00.00	00.00*	00.00 (00.00)	00.00 (00.00)	00.00	00.00	00.00	00.00	00:1
T_3: Pollination with *A. cerana indica*	5.14	4.57*	54.03 (47.31)	20.43 (26.87)	6.76	878.57	4.52	22,607	4.69:1
SEm. ±	0.16	0.25	1.15	1.48	0.19	28.44	0.21	1069.08	
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	
CV (%)	7.87	9.30	6.23	13.82	6.39	8.18	11.68	11.68	

Figures in the parentheses are arc sin transformed value
*figure indicate square root transformed value

conformity with reports of Walters and Bradley (2006) observed that addition of honey bee increased the fruit number per hectare in *Cucurbita spp.*

As regard the number of fruit drop affected by different pollination treatments, the highest number of fruits drop were observed in pollination with *A. cerana indica* (4.57) followed by open pollination (3.66). There was no any fruit drop recorded in treatment (T2) pollination without insect. On the basis of number of female flower and number fruit set, the percent fruit set was worked out for each treatment. The analysis of data revealed that maximum per cent fruit set was observed in treatment (T1) open pollination (59.67%) followed by pollination with *A. cerana indica* (54.03%). There was no any fruit set recorded in treatment (T2) pollination without insect (Table 1).

The present results endorsed by the finding of Shwetha *et al.* (2012) reported in cucumber that highest number of fruit set was observed in case of open pollination (94.60%) compared to honey bee pollination. Srikanth (2012) observed in bottle gourd that fruit set was maximum in open pollinated plot with use of attractant compared to open pollination without attractant. However, Alam and Quadir (1986) reported that fruit set of *L. siceraria* pollinated by honey bee (*Apis cerana*) was 15 per cent compared with hand pollinated flowers (8.33%) and isolated plants (3.33-5.00%). Singh (2002) observed that due to bee pollination fruit set increases up to 30 to 100 per cent in muskmelon. Hossain *et al.* (2018) reported highest fruit set in cucumber by hand pollination (70.68%) compared to other mode of pollination.

The number of healthy and malformed fruits was recorded separately for each treatment and per cent malformed fruits were worked out and presented in Table 1. The data on per cent malformed fruits revealed that maximum per cent of malformed fruits were recorded in treatment of (T1) open pollination (25.09%) followed by treatment (T3) pollination with *A. cerana indica* (20.43%). No malformed fruits were recorded in treatment (T2) pollination without insect (00.00%). The present finding is in close agreement with Meena Thakur and Rana (2008) reported in cucumber that maximum per cent of misshapen fruits was in open pollination (20.05%) followed by hand (14.1%) and honey bee (8.05%) pollination. Hossain *et al.* (2018) recorded in cucumber that per cent of misshapen fruits (24.35%) was maximum in without honey bee pollination.

The diameter of fruit was measured by vernier caliper and analyzed statistically. The data on diameter of fruits revealed that maximum average fruit diameter was recorded in treatment (T1) open pollination (6.84cm) followed by (T3) pollination with *A. cerana indica* (6.76cm). The present results are more or less in conformity with Hossain *et al.* (2018) observed that in cucumber fruit diameter (27.1cm) was highest in hand pollination compared to other mode of pollination. As regard the weight of fruit affected by different pollination treatment, the maximum average fruit weight was recorded in the treatment (T1) open pollination (961.24g) followed by pollination with *A. cerana indica* (878.57g). The present findings are in line with the reports of Shwetha *et al.* (2012) found in cucumber that fruit weight was maximum in open pollination (1619.09g) compared to honey bee pollination and among different bee species, the fruit weight (1510.68g) was maximum in pollination with *A. cerana indica.* Srikanth (2012) observed in bottle gourd that fruit weight were maximum in open pollinated plots with attractant compared to open pollination without attractant. However, Meena Thakur and Rana (2008) stated that in cucumber weight of fruits (1184.5g) was highest in honey bee pollination as compared to other mode of pollination.

The data on average fruit yield of bottle gourd revealed that highest average fruit yield per plant was recorded in treatment of open pollination (5.17 kg/plant) followed by treatment of pollination with *A. cerana indica* (4.52 kg/plant). There was no fruit set observed from treatment (T3) pollination without insect. The present findings are more or less in conformity with Singh (2002) reported that *A. mellifera* plays a key role in pollination of muskmelon and improve the fruit yield in protected condition. Motzke *et al.* (2015) reported that flower visiting bees were responsible for 75 per cent increased in yield. The benefit cost ratio was highest in open pollination (22.49:1) followed by pollination with *A. cerana indica* (4.69:1). In case of pollination without insect, no any income obtained due to absent of fruit per plant (Table 4).

From above results it can be concluded that, the availability of pollinators fauna is very essential for the fruit formation in bottle gourd, without pollinators there were no fruit formation in bottle gourd and ultimately no yield. There was no any difference between different quantitative parametric value and it was almost same in both, open pollination and honey bee pollination but cultivation in protected condition increase the cost of cultivation ultimately lead to lower profit.

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