



Pollination of *Apis mellifera* and *Trigona biroi* on the Productivity of Solanaceous Crops

JOSE T. TRAVERO*

Bohol Island State University, Bohol, Philippines

Email: jose_travero@yahoo.com

IAN L. NUEZ

Bohol Island State University, Bohol, Philippines

WELLIE S. SAGLIBA

Bohol Island State University, Bohol, Philippines

Received 16 December 2011 Accepted 12 March 2012 (*: Corresponding Author)

Abstract This study was conducted to determine the effects of bee pollinators (*A. mellifera* and *T. biroi*) on the productivity of solanaceous crops. Two observation sites were selected for conducting this study. One was intended for the *A. mellifera* and other site for *T. biroi*. A randomized complete block design (RCBD) was laid out with four blocks and three replicates. Solanaceous crops used in the study were eggplant, tomato and sweet pepper. Of the three solanaceous crops, analysis of variance showed that *A. mellifera* had a highly significant effect at 1% level of significance on the percent pollinated flowers of eggplant. However, both bee pollinators had shown the same significant effects on sweet pepper and tomato. Furthermore, this study revealed that both *A. mellifera* and *T. biroi* are very efficient pollinators of eggplant crop. Eggplant is the best solanaceous crop with highest pollination efficiency to *A. mellifera* and *T. biroi*.

Keywords bee-pollinated, pollinators, solanaceous, stingless bees

INTRODUCTION

Pollinators strongly influence ecological relationship, ecosystem conservation and stability, genetic variation in the plant community, floral diversity, specialization and evolution. In farmed areas, bees are needed for the pollination of many cultivated crops for fruit and seed set and for maintaining biodiversity in 'islands' of non-cultivated areas. The main role of bees in the different ecosystems is their pollination work.

Being tropical, stingless bees are active all the year round although they are less active in cooler weather. The *Trigona* species is one of the known species of honeybees that are endemically living in the Philippines. This kind of bees is lacking of sting; in fact, they are harmless to humans but they defend by biting if their nest is disturbed. They are noted as good pollinators, the behavior of the most efficient pollinators carry plenty of pollens, visit several flowers of the same species in succession and move frequently from flower to flower and plant to plant. Foraging of these bee workers are mainly for pollen-gathering due to a very short tongue needed for gathering nectar.

On the other hand, honeybee or *Apis mellifera* originated in Europe and is widely popular among beekeepers for honey production is now widely used in commercial pollination. Beekeepers may quote a figure, courtesy of the USDA, that honeybees pollinate 80% of the U.S. crops that require pollination. According to researches, bee pollination increased crop production by 30% (Baconawa, 2002). This was the reason why the researchers came up with this idea to study about bee pollination among the solanaceous crops chosen for this research. Through natural pollination of the stingless bees, it would determine if it could contribute to productivity and increase yield quality and quantity. Hence, this study was conceptualized and conducted through actual and practical field observations.

OBJECTIVES

The primary aim of the study was to determine the pollination efficiency of both Honeybees (*Apis mellifera*) and Stingless bees (*Trigona biroi.*) to three solanaceous crops, namely; (a) Eggplant (*Solanum melongina*), (b) Tomato (*Lycopersicon esculentum*), and (c) Sweet pepper (*Capsicum anuum*). Specifically it sought to determine the percentage of fruit set between bee pollinated and non-bee pollinated.

METHODOLOGY

Research design and the research environment: The study on stingless bees was conducted at the upland area of the Oikos Peace Garden in Zamora, Bilar Bohol. The type of soil was sandy loam. The solanaceous plants were exposed to sunlight during the whole day. While the honeybees are at the Eco-farm, BISU-Bilar, Zamora, Bilar, Bohol, it is a flat open area with sufficient sunlight, alkaline soil and good drainage.

Randomized Complete Block Design (RCBD) was laid out at the experimental areas. The experimental lot had an area of 263.44 sq.m. There were four blocks representing the replication that had three plots per block measuring 3.2 m x 3.6 m per plot. One meter distance between blocks and plots served as an alleyway and at the same time the borders in the whole area. The planting distance was 60 cm. between hills and rows, allowing distance of 80 cm. in between the bee-pollinated and non-bee pollinated plants to provide a space for the construction of covers.

Research materials: The materials used in the study were the following: plow, meterstick, bamboo slats, wood, nails, honeybee colony, stingless bee colony, fine nets, solanaceous crops (eggplant, tomato, sweet pepper), bolo, seedling trays, vermicast, hammer, and weighing scale.

The plants opened for bee pollination were labeled Bp or Bee-pollinated, while the plants that were not pollinated by bees were labeled NBp or Non bee-pollinated. The code used for eggplant was 1(one), 2 (two) for tomato and 3 (three) for sweet pepper.

Construction of net covers: The construction of net cover was done by block one month after transplanting and after the second fertilizer application. The first ten plants from the right side of a plot were the Non-bee pollinated constructed with net covers. The net cover was 1.6 m in height.

Introduction of honeybees and stingless bees: The introduction of honeybees and stingless bees was done before transplanting to provide enough time for them to adjust the condition of the area. The hives were installed at a distance of 50 m. from the experimental area. Six hives were used in the study.

Data collection and analysis: Data collection started from the flowering stage up to the fruiting stage. Counting the flowers per hill for three times with an interval of one week was done to gather the total number of flowers per treatment. The same process was done during the fruiting and the harvesting stages.

The gathered data were tabulated and analyzed through the assistance of the Statistician. Analysis of Variance (ANOVA) was used for the statistical treatment of data.



Fig. 1 One of the two experimental areas (left) and colonies of stingless bees

RESULTS AND DISCUSSION

Table 1 shows the average percent pollination of stingless bee. It shows that Eggplant had the highest percent of pollination of 54.80 while Tomato had the lowest percent of pollination of 32.87.

Table 1 Average percent pollination of stingless bee

Crops	Block				Treatment total	Treatment mean
	I	II	III	IV		
Eggplant	36.36	56.25	72.72	53.85	219.18	54.80 ^a
Sweet pepper	27.10	37.54	36.16	37.60	138.40	34.60 ^b
Tomato	34.13	30.59	32.32	34.45	131.49	32.87 ^b
Grand Total					489.07	
Grand Mean						40.76

Means within treatment mean column followed by a common letter are not significantly different at 0.05 level of probability using Least Significant Difference (LSD) test

Table 2 Analysis of variance on the average percent pollination of stingless bee

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F	
					5%	1%
Block	3	328.359	109.453			
Treatment	2	1188.56	594.279	8.46*	5.14	10.92
Expt'l Error	6	421.718	70.2864			
Total	11	1938.63				

cv = 20.6%, * = Significant at 5% level

Table 2 presents the analysis of variance on the average percent pollination of stingless bee. It shows that there is significant ($P < 0.05$) difference among treatments since the computed F value of 8.46 is higher than the Tabular F value at 5% level (5.14) but lower than 1% level (10.92) of significant. On the other hand, Eggplant is the best solanaceous crops with highest pollination efficiency of stingless bee (*Trigona biroi*) compared to sweet pepper and tomato (Table 1). This implies that stingless bees are more efficient on eggplant crops compared to sweet pepper and tomato.

Table 3 shows the average percent pollination of honey bee. It shows that eggplant had the highest percent of pollination of 86.45 while sweet pepper had the lowest percent of pollination of 25.68.

Table 3 Average percent pollination of honey bee

Crops	Block				Treatment total	Treatment mean
	I	II	III	IV		
Eggplant	100.00	55.69	90.11	100.00	345.80	86.45 ^a
Sweet pepper	22.77	13.61	40.33	26.01	102.72	25.68 ^b
Tomato	18.88	23.22	48.12	20.18	110.40	27.60 ^b
Grand Total					558.92	
Grand Mean						46.58

Means within treatment mean column followed by a common letter are not significantly different at 0.05 level of probability using Least Significant Difference (LSD) test

Table 4 presents the analysis of variance on the average percent pollination of honey bee. It shows that there is significant ($P < 0.01$) difference among treatments since the computed F value of 28.46 is higher than the Tabular F value at 5% level (5.14) but lower than 1% level (10.92) of significant.

Furthermore, eggplant is the best solanaceous crops with highest pollination efficiency of honey bee (*Apis millefera*) compared to sweet pepper and tomato (Table 3). This implies that Honeybees are more efficient on eggplant compared to sweet pepper and tomato.

Table 4 Analysis of variance on the average percent pollination of honey bee

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	Computed F	Tabular F	
					5%	1%
Block	3	1260.66	420.219			
Treatment	2	9546.67	4773.33	28.46**	5.14	10.92
Expt'l Error	6	1006.36	167.726			
Total	11	11813.70				

cv = 27.8%, ** = highly significant at 1% level

CONCLUSION

Based on the findings of the study, the researchers concluded that both honeybees (*A. mellefera*) and stingless bees (*Trigona biroi*) are efficient in pollinating solanaceous crops. *A. mellefera*, however is more efficient than *T. biroi* particularly on eggplants. This can be attributed to the bigger size of the flower of eggplant compared to the size of the flower of other solanaceous crops under study. Other factor could be the size of *A. mellefera* which is obviously bigger comparatively with *T. biroi*.

REFERENCES

- Amano, K., Nemoto, T. and Heard, T. 2000. What are stingless bees, and why and how to use them as crop pollinators? A review of JARQ 34(3), 183-90.
- Baconawa, Antonio Jr. 2000. The economics of bee pollination in the Philippines.
- Bispo dos Santos, Roselino, S.A.A.C., Hrcir, M. and Bego, L.R. 2009. Pollination tomatoes by the stingless bee *Melipona quadrifasciata* and the honey bee *Apis mellifera* (Hymenoptera, Apidae), 8(2), 751-757.
- Heard, T.A. 1999. The role of stingless bees (Meliponinae) in crop pollination. Annual review of entomology, 44: 183-206
- Pollinator Partnership Protection and Funding Farm Bill Programs, 2008.
- Stinglessbees-Wikipedia, The free Encyclopedia, June 2009. <http://en.wikipedia.org/wiki/stinglessbee>.
- Squidoo. 2000. Stingless bees-2009, <http://www.squidoo.com/stingless-bees>.
- Yousef Ahmad Al-abbadi, S. 2009. Efficiency of different pollination treatments on solanaceae yields grown in Plastic House. J. Biot. Sci., 9P 463-469, http://emkercei.com/articles/ns/pollination_Philippines.htm.