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Short communication

Comparative performance of various pollinators in guava

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ABSTRACT

The present study was carried out to compare the performance of pollinators through modular approach. The *Apis cerana*, *Apis dorsata*, *Apis florea*, *Xylocopa tenuiscapa*, *Lucilia sericata, Musca domestica* and *Haematobia irritans* were major pollinators included during the course of study. The performance of pollinators varied from species to species at different hours in a day as well as floral incidence. Highest performance of all the pollinators was observed during 0601 to 0700 h of the day. Of the pollinators, *A. cerana* proved to be the most efficient pollinator of guava followed by *A. dorsata*. Highest performance of *A. cerana* coincided with the peak of anthesis. The performance of all *Apis* spp. after 1100 h was reduced to nought.

Key words: *Psidium guajava,* pollinator performance, pollen deposition, visit frequency.

Guava (*Psidium guajava* L.) bears hermaphrodite, chasmogamous and thrum flowers thus, pollinators are crucial in order to accomplish pollination. Beside these, the degree of out- crossing in guava also varies from 35 to 40 % (Nakasone and Paull, 6). The chasmogamous and thrum characters of the guava flower and their degree of out-crossing show sufficient promise and scope for insect pollination. The plant-pollinator interaction is the best example of mutualism where pollinators utilize the floral rewards, while pollination is accomplished in plants. The comparison of diverse pollinator performance is a complicated investigation in plant system. Anthecologist are always inclined to determine the pollinator performance (Ne'eman *et al.,* 7). The effectiveness has been reported synonymously by numerous scientists as pollination effectiveness (Mayfield *et al*., 4) and pollinator efficiency (Singh, 11). The performance is determined on the basis of total number of pollen deposition on stigma in single visit, visit frequency, proportion of flowers with receptive stigmata and foraging duration of pollinators that overlaps with the receptivity of stigma. The comparison of pollinator performance by virtue of this modular approach is missing in guava. Hence, the present investigation was envisaged to compare the performance of guava pollinators.

The experiment was accomplished at Guava Farm of Central Institute of Horticulture, Medziphema, Nagaland. The pollen deposition on stigma by pollinators was recorded from 0501 to 1600 h, at an interval of one hour, once in a week from the commencement of bloom to its cessation. The matured and virgin flower buds were selected and marked. The matured buds were opened with forceps, stigma was capped and thereafter, the stamen was beheaded by scissor beneath the anther. The emasculated flowers were bagged, and out of those flowers, some were opened and permitted pollinators to visit on them. The flowers were immediately harvested after a single visit of pollinator and thereafter, placed in separate vials and marked with pollinator's name. The stigmas were removed and stained. The stigmas were gently crushed between slide and cover slip, and the number of con-specific pollen grains on the stigma was counted under microscope (Dafni, 1). The visit frequency of pollinators was recorded at an interval of one hour, once in a week. In order to determine the visit frequency, the number of visits of pollinator species per meter square in ten minutes was recorded with the help of stopwatch. Out of dehisced flower per meter square, proportion of receptive stigmats was calculated. Insect pollinators/ visitors were collected by sweeping method. The performance of diverse pollinator species was calculated with the modular approach formula given by Ne'eman *et al.* (7). These data were analyzed in split-split- plot design and data of each character were subjected to statistical test by applying analysis of variance technique.

The performance of guava pollinators varied significantly from species to species. Out of pollinators, performance of bees was much higher than the flies. The highest performance recorded was of *A. cerana* followed by *A. dorsata*, *A. florea, X. tenuiscapa, L. sericata and M. domestica* during 2014, and a similar trend was observed in 2015.

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Among the performance of pollinators in a day, highest performance on an average (3046/3026) was recorded for *A. cerana* during 2014/2015, respectively (Table 1). The performance of pollinator species varied significantly from hour to hour in a day. Among the hourly intervals in a day, the highest performance of all the pollinator species was recorded between 0601 to 0700 h in 2014 (1508.60) and 2015 (1377.10) years (Table 2). The performance of pollinator species also varied significantly from day to day once in a week, their population and performance coincided with the flower incidence. Among the days of observation, the highest performance of all the pollinator species (1088.43) in a day was recorded on the 12th May 2014 with the similar trend observed in 2015 (Table 1). The interaction effect of performance varied significantly from species to species and from day to day once in a week as presented in the Table 1. The combined effect of pollinator performance in a day (4205-4462) for *A. cerana* on 12th May was significantly higher than other combinations during the course of both years of studies. The interaction effect of performance of pollinator species varied significantly from species to species and hour to hour in a day as presented in the Table 2. The pollinator species, *A. cerana*, *A. dorsata*, *A. florea* and *X. tenuiscapa* performed best during 0601 to 0700 h, while *L. sericata*, *M. domestica* and *H. irritans* behaved similarly during 0701 to 0800 h in 2014 and 2015. The performance of all the *Apis* spp. after 1100 h was nought while *L. sericata*, *M. domestica* and *H. irritans* performed till the 1500 h during both the sessions of experimentation. The combined effect

Table 1. Interaction effects of pollen deposition effectiveness of pollinator and dates of blooming period 2014

Pollinator	21st Apr	28th Apr	5th May	12th May	19th May	26th May	2nd Jun	Mean	Total
Apis cerana	2633	3221	3608	4462	3154	2642	1605	3046	21325
Apis dorsata	1189	1399	1657	1922	1292	1172	692	1332	9323
Apis florea	180	239	296	374	236	208	114	235	1647
Xylocopa tenuiscapa	164	252	289	352	249	229	110	235	1645
Lucilia sericata	134	187	210	264	174	120	98	170	1187
Musca domestica	84	103	120	160	78	52	27	89	624
Haematobia irritans	38	50	63	85	44	26	12	45	318
Mean	631.71	778.71	891.86	1088.43	746.71	635.57	379.71		
Total	4422	5451	6243	7619	5227	4449	2658	5153	36069
					Sem	CD (0.05)			
Performance of pollinator species (P)					3.91	12.06			
Dates of blooming (D)					3.97	11.15			
P × D					10.49	29.50			

Interaction effects of pollen deposition effectiveness pollinator species and various dates of blooming period 2015

Pollinator	21st Apr	28th April	5th May	12th May	19th May	26th May	2nd Jun	Mean	Total
Apis cerana	2622	3117	3621	4205	3311	2701	1608	3026	21185
Apis dorsata	1243	1437	1478	1659	1292	1170	748	1290	9027
Apis florea	201	240	283	340	250	235	161	244	1710
Xylocopa tenuiscapa	139	288	298	177	225	251	132	216	1510
Lucilia sericata	139	114	181	186	147	106	77	136	950
Musca domestica	110	92	69	137	82	28	24	77	542
Haematobia irritans	37	47	58	76	34	24	18	42	294
Mean	641.57	762.14	855.43	968.57	763.00	645.00	395.43		
Total	4491	5335	5988	6780	5341	4515	2768	5031	35218
					Sem	CD (0.05)			
Performance of pollinator species (P)					5.70	17.56			
Dates of blooming (D)					3.63	10.21			
P × D					9.61	27.02			

Table 2. Interaction effects of pollen deposition effectiveness by pollinator species and hour intervals 2014

Pollinator	0501 to 0600	0601 to 0700	0701 to 0800	0801to 0900	0901 to 1000	1001 to 1100	1101 to 1200	1201 to 1300	1301 to 1400	1401 to 1500	Mean	Total
Apis cerana	3595	6467	4846	3140	2390	887	0	0	0	0	2133	21325
Apis dorsata	1658	2688	2048	1442	1025	462	0	0	0	0	932	9323
Apis florea	277	522	371	236	171	70	0	0	0	0	165	1647
Xylocopa tenuiscapa	0	513	389	275	179	142	40	87	20	0	165	1645
Lucilia sericata	83	198	257	219	155	102	88	79	6	0	119	1187
Musca domestica	50	106	161	116	81	52	26	26	6	0	62	624
Haematobia irritans	21	66	111	56	37	8	11	4	2	2	32	318
Mean	812	1508.60	1169.00	783.43	576.86	246.14	23.57	28.00	4.86	0.29		5152.70
Total	5684	10560	8183	5484	4038	1723	165	196	34	2	3607	36069
						Sem	CD (0.05)					
Performance of pollinator species (P)						3.91	12.06					
Hour intervals (H)						3.93	10.90					
P × H						10.73	29.79					

Interaction effects of pollen deposition effectiveness by pollinator species and hour intervals 2015

Pollinator	0501 to 0600	0601 to 0700	0701 to 0800	0801 to 0900	0901 to 1000	1001 to 1100	1101 to 1200	1201 to 1300	1301 to 1400	1401 to 1500	Mean	Total
Apis cerana	3395	5984	5083	3168	2648	907	0	0	0	0	2119	21185
Apis dorsata	1416	2492	2109	1476	1033	501	0	0	0	0	903	9027
Apis florea	324	500	409	248	158	71	0	0	0	0	171	1710
Xylocopa tenuiscapa	0	444	423	280	176	90	66	15	16	0	151	1510
Lucilia sericata	68	141	179	163	127	101	84	56	19	12	95	950
Musca domestica	48	50	140	76	50	70	47	43	18	0	54	542
Haematobia irritans	26	29	112	62	34	15	8	2	2	4	29	294
Mean	753.86	1377.10	1207.90	781.86	603.71	250.71	29.29	16.57	7.857	2.286		5031.10
Total	5277	9640	8455	5473	4226	1755	205	116	55	16	3522	35218
						Sem	CD (0.05)					
Performance of pollinator species (P)						5.70	17.56					
Hour intervals (H)						4.33	12.03					
P × H						11.85	32.89					

of performance of *A. cerana* and the hour interval from 0601 to 0700 h was significantly better than the other combinations during 2014 and 2015.

In the experimental area (Nagaland), *Apis mellifera* was not prevailing and beekeepers deal with only *A. cerana* in beekeeping and as a matter of fact, population of *A. cerana* was dominant. Guava bears chasmogamous flowers and the flowers were emasculated before anthesis. Thus, there was no reason to believe that the pollens were deposited by self-pollination before anthesis or during emasculation. Stigma became receptive just after anthesis (Sharma *et al.,* 10) and peak period of anthesis and dehiscence took place during 6.30 to 8.30 AM (Dhaliwal and Singla, 2). The greater abundance of honeybee resulted in it being a more effective pollinator, and visit frequency remained as an integral component of pollinator performance which varied with pollinators (Rader *et al*., 9). The significant variation of pollinator performance could be due to variation in visit frequency and variation in ability of pollen deposition. Fenster *et al*., 3, corroborated the present finding that performance of pollinator varied among different species. The

performance of pollinators varied on different dates during blooming period, and it coincided with the flower incidence. The visit frequency of pollinators correlated positively with the flower density (Mesa *et al*., 5). The initiation of foraging by pollinators began after 1 hour of anthesis commencement, while peak of foraging was observed to be at the peak of flower anthesis. The foraging cessation of *Apis* spp. occurred after one hour of anthesis cessation. These attributes show that the foraging of pollinators, especially *Apis* spp. were driven by floral reward. Polatto *et al*. (8) also observed that the foraging activity of each species was driven by floral reward.

In conclusion, seven species; *A. cerana*, *A. dorsata*, *X. tenuiscapa, A. florea, L. sericata, M. domestica* and *H. irritans* were found to be efficient pollinators and were playing pivotal role in guava pollination in this niche. The performance varied among species to species, hour to hour and day to day. Out of all guava pollinators, *A. cerana* has proved itself as the ultimate pollinator of guava in this niche. *A. dorsata* and *A. florea* were also efficient pollinators but their low visit frequency curtails their performance in guava pollination. The augmentation and conservation of these key pollinators can maximize the pollination and thereby, enhance the productivity.

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