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DIVERSITY OF INSECT POLLINATORS ON PEARL MILLET

Amar Singh[1]*, M M Kumawat[1], R Swaminathan[2], N L Dangi[3], M L Mehariya[3], Dama Ram[1] and Pradeep Kumar[4]

[1]College of Agriculture, Agriculture University, Jodhpur 342304, Rajasthan, India
[2]Former Emeritus Scientist, Rajasthan College of Agriculture, MPUAT, Udaipur 313001, Rajasthan, India
[3]Agricultural Research Station, Mandor, Agriculture University, Jodhpur 342304, Rajasthan, India
[4]Rajasthan College of Agriculture, MPUAT, Udaipur 313001, Rajasthan, India
*Email: amarchahar15@gmail.com (corresponding author): ORCID ID 0009-0003-0362-6711

ABSTRACT

The study on diversity of insect pollinators on pearl millet *Pennisetum glaucum* (L.) R.Br. was conducted during kharif 2022 at the College of Agriculture and Agricultural Research Station, Jodhpur. A total of six species of insect pollinators were recorded in the field at hourly intervals from 0600 to 1800 hrs during flowering stage of pearl millet. The pollinators were belonging to five families of two insect orders. The relative abundance of hymenopteran and dipteran insects was 98.53 and 1.47%, respectively. Among hymenoptera, *Apis dorsata* Fabricius observed as the most dominant species with relative abundance of 40.90% followed by *Apis florea* Fabricius (37.39%), *Lipotriches* spp. (11.01%) and *Megachile albifrons* Smith (9.23%), whereas the dipteran pollinators *Physiphora* spp. (1.12%) and Blow fly (0.35%) were least visiting insects. Maximum time spent by *Apis dorsata* is 14.70 sec/ flower followed by *Apis florea* (13.94 seconds/ flower), whereas minimum time spent by blow fly, (Calliphoridae) which about 0.58 sec/ flower.

Key words: Pearl millet, diversity, species composition, abundance, pollinators, foragers, flower visitors, time spent, hymenoptera, diptera

Pearl millet, *Pennisetum glaucum* (L.) R.Br. is a multipurpose cereal crop belongs to Poaceae family, which is commonly called as bajra, bajri, sajje, kambu, sajjalu in vernacular languages. It is generally used as staple food in many African countries as well as in western Rajasthan and used for cattle feed, and forage purposes (Arora et al., 2003). Pearl millet is considered as the most important cereal crop in the India after rice, wheat, and maize. India is the world's largest producer of pearl millet with 9.35 million tonnes of grain production from an area of 7.41 million ha with the average productivity of 1391 kg/ ha. The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, and Haryana which account for more than 90% of pearl millet acreage in the country (ICAR-AICRP, 2022). Pearl millet is a major source of energy, proteins, vitamins, and minerals. It is rich in calcium, potassium, magnesium, iron, zinc, lysine niacin, tryptophan, riboflavin, thiamine and contains more calories than wheat because of its higher oil content of 5% (Khairwal et al., 2007). Besides food and nutritional significance, it has several medicinal properties (Malik, 2015). Pearl millet is a highly cross-pollinated species and wind is supposed to be the major cross-pollinating agent. However, insects also effect cross pollination. Every plant species needs pollination and fertilization to set seeds and fruits and pollinators often play a vital role to achieve this pollination (Chittora and Tiwari, 2013). Flowers of pearl millet are allogamous and highly heterogeneous. Stigma emerge before anther emergence, resulting in high cross-pollination. The present study was planned to observe the diversity and abundance of the insect pollinators in pearl millet in arid region of the western Rajasthan.

MATERIALS AND METHOD

The experiment was carried out to document the diversity of pollinators and its abundance in pearl millet at College of Agriculture and Agricultural Research Station, Jodhpur during kharif 2022. Insect pollinators were collected by sweep method by hand net (38 cm diameter: Tempstar, Model: ICN) on pearl millet throughout the blooming (55-60 DAS) at an hourly interval from 0600 to 1800 hrs and they were killed and preserved as dry specimens. Insect collection was started after 5% flowering (40-45 DAS) and continued till end of flowering (75-80 DAS). The collected insects were differentiated as insect visitors and pollinators by observing their behaviour on flowers. Similarly, observations on frequent visiting of insect pollinators to the pearl millet flowers were recorded weekly on per

square meter area for five minutes from five random spots at hourly interval throughout the flowering period. The abundance of the different pollinators recorded on pearl millet flower were expressed as mean number of pollinators/ m^2/ 5 min. Pollinators relative abaundance data computed by using the following formula: Relative Abaundance = [No. of individual of the species/ No. of individual of all species] x 100

RESULTS AND DISCUSSION

Six species of pollen and nectar foragers were observed during the flowering period belonging to two orders viz., hymenoptera and diptera, of which four species were from hymenoptera (*Apis dorsata*, *Apis florea*, *Lipotriches* spp. and *Megachile albifrons*), two were from diptera (*Physiphora* spp. and blow fly). *A. dorsata*, *A. florea*, *M. albifrons* and *Lipotriches* spp. are foraging on both pollen and nectar and dipterns foraged only on nectar (Shakeel et al., 2019; Bhowmik and Bhadra, 2015). Among the four hymenopteran species recorded, two belonged to family Apidae, one belonged to Megachilidae and one belonged to family Halictidae. Order diptera was represented by two species under family Ulidiidae and Calliphoridae (Table 1). Similarly, Sima and Srivastava (2012) recorded insects fauna associated with pearl millets ecosystem and were belonging to coleopterans, lepidoptera, hemiptera, hymenoptera, diptera, dictyoptera, orthoptera, odonata and neuroptera.

The abundance of pollinators based on visual counts revealed that, *A. dorsata*, *A. florea*, *Lipotriches* spp. and *M. albifrons* were highest in number and together they constituted around 98.53% as compared to the other non-*Apis* foragers visiting pearl millet inflorescence at the flowering stage. Among these, *A. dorsata* was most abundant with relative abaundance of 40.90 per cent followed by *A. florea* with 37.39 per cent, *Lipotriches* spp. (11.01%) and *M. albifrons* (9.23%). However, the remaining two species were found to be negligible, i.e., 1.47% (Table 2). Sima and Srivastava (2012) reported *A. dorsata, A. florea,* and *A. cerana* were the most dominating bees that visited on pearl millet. The present results also endorse the reports of Kant et al. (2013), who reported that *A. dorsata* (37.91%) was most dominant pollinator followed by *A. florea.* on *Nigella* spp. *A. dorsata* spent maximum time (14.70 sec/ flower) on pearl millets inflorescence which varied from 12.31 to 18.72 sec/ flower during the entire flowering period. It was followed by *A. florea* (13.94 sec), *Lipotriches* (2.91 sec), *M. albifrons* (2.55 sec), *Physiphora* spp. (1.16 sec) and blow fly (Calliphoridae) (0.58 sec) (Table 3). The present result was similar Chaudhary et al. (2000), who reported the foraging speed (time spent in one panicle) of 2.71, 3.40, 5.06 and 1.70 sec by *A. cerana indica*, *A. mellifera*, *A. dorsata* and *A. florea*, respectively on litchi flowers (*Litchi chinensis*). Similarly, *A. dorsata* spent 10.22 sec/ flower then other pollinators on coriander as reported by Shivashankara et al. (2016).

Table 1. Pollinator fauna recorded on pearl millet

S.No.	Common and Scientific Name	Family	Order
1.	Giant rock bee, *Apis dorsata* F	Apidae	Hymenoptera
2.	Dwarf honey bee, *Apis florea* F	Apidae	Hymenoptera
3.	Sweat bees, *Lipotriches* spp.	Halictidae	Hymenoptera
4.	Leafcutter bees, *Megachile albifrons* Smith	Megachilidae	Hymenoptera
5.	Blow fly	Calliphoridae	Diptera
6.	Picture-winged fly, *Physiphora* spp.	Ulidiidae	Diptera

Table 2. Relative abundance of pollinators in pearl millet during inflorescence stage

Species	Number of pollinators visited*						Relative abundance (%)
	24.08.2022	29.08.2022	05.09.2022	12.09.2022	19.09.2022	26.09.2022	
Apis dorsata	66.8± 4.48#	101.6± 4.52	115.0±4.09	86.4± 3.98	85.8± 3.27	78.6± 3.65	40.90
Apis florea	78.8± 6.04	96.15± 4.81	99.6± 4.55	76.0± 4.39	71.8± 3.23	66.0± 3.13	37.39
Lipotriches spp.	16.2± 3.08	25.6± 3.44	30.6± 3.79	30.0± 3.67	22.0± 2.95	19.4± 2.67	11.01
Megachile albifrons	11.6± 3.49	22.4± 3.54	23.2± 3.55	23.6± 3.59	23.0± 3.65	16.8± 2.88	9.23
Blow fly, Calliphoridae	0± 0	0.6± 0.28	1.8± 0.46	1.6± 0.46	0.6± 0.28	0± 0	0.35
Physiphora spp.	1.0± 0.32	1.4± 0.40	2.6± 0.59	3.4± 0.67	3.2± 0.69	3± 0.63	1.12

*Total numbers of pollinators visited in a day which was observed at an hourly interval; #Standard deviation of mean

Table 3. Foraging time spent by major insect pollinators on pearl millet flower

Species	Time spent by pollinators on inflorescence (Seconds/ flower)						Mean (Seconds/ flower)
	24.08.2022	29.08.2022	05.09.2022	12.09.2022	19.09.2022	26.09.2022	
Apis dorsata	12.31± 10.45	17.67± 6.84	18.72± 5.56	13.56± 7.32	16.08± 6.16	9.86± 5.27	14.70
Apis florea	12.53± 10.68	16.4± 8.48	17.87± 7.95	12.74± 8.78	14.01± 7.33	10.09± 5.54	13.94
Lipotriches spp.	1.80± 4.44[#]	3.13± 5.29	3.71± 5.91	3.43± 6.64	3.0± 5.70	2.41± 4.67	2.91
Megachile albifrons	2.51± 4.69	2.47± 4.61	2.80± 5.36	2.93± 5.63	2.63± 5.08	1.95± 4.25	2.55
Blow fly Calliphoridae	0± 0	0.36± 2.07	1.05± 2.53	1.39± 3.43	0.68± 2.41	0± 0	0.58
Physiphora spp.	0.33± 1.87	0.88± 3.09	1.16± 3.22	1.73± 4.16	1.55± 4.05	1.29± 3.30	1.16

Blooming period: 05.09.2022 to 12.09.2022; [#]± Standard deviation of mean

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AUTHOR CONTRIBUTION STATEMENT

R. Swaminathan and N L Dangi conceptualized and designed the study, Amar Singh Conducted the study, analysed the data, and authored the report under the supervision of M M Kumawat. M L Mehariya and Dama Ram revised the draft R Swaminathan, N L Dangi and Pradeep Kumar drafted and revised original manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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