International Journal of Economic Plants 2022, 9(4):286-289

Full Research

Doi: HTTPS://DOI.ORG/10.23910/2/2022.0486b

Insect Pollinator's Role in Fruit Setting of *Prosopis cineraria* (L.) Druce

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Article History

Article ID: IJEP0486b
Received on 25th August, 2022
Received in revised form on 27th October, 2022
Accepted in final form on 15th November, 2022

Abstract

The experiment was conducted in the Ecology Field, Arid Forest Research Institute, Jodhpur (Rajasthan), India during 2020-21 to explore the role of insect pollinators in the fruit setting of *P. cineraria*. For conducting the experiments one of the branches of the selected trees was covered with a mesh bags to exclude floral visitors (pollinator exclusion). The other branch was kept uncovered for the time of the experiment (open pollination). Our findings revealed that the average fruit set under pollinator exclusion (bagged condition) was nil whereas it was 2.02% in open natural pollination. This study confirms previous studies that *P. cineraria* is a cross–pollinated species. Also, average moisture content was found to be 10.75 % in seeds and 49.21% average carbohydrate content in pods under open pollination, germination percentage was found to be 71.3% and seedling vigour index was 655.2. Present study also calculated the average seed weight, average seed length, average seed breadth, average seed thickness obtained in above experiment.

Keywords: *Prosopis cineraria* (L.) Druce, fruit setting, insect pollinators

1. Introduction

Prosopis cineraria (L.) Druce belongs to family Fabaceae – Mimosoideae. It is locally known as Khejri and deemed native to India. It is a small to medium-sized tree and can withstand extreme temperature up to 48 ° C and less than 100 mm rainfall (Krishnan and Jindal, 2015).It provides livelihood support to the people of Thar Desert. *Prosopis* species are the dominant species in Indian Thar desert (Tripathi, 2008). The trees are essential part of agroforestry systems in Rajasthan and can be seen in every field of farmers as it provides loong, fuelwood, and sangri to the people. *P. cineraria* is effective in stabilizing sand dunes and can also withstand periodic burial (Gates and Brown, 1988). It is an integral part of the resident's cultural identity and provides agro-ecological, recreational, and regulating services. Every part of *P. cineraria* tree viz., bark, flowers and leaves, are fit to be eaten. Sangri (desert beans) of the tree are used as a vegetable, and are particularly valued for their distinctive taste and nutritional benefits (Soni et al., 2022). It has therapeutic value and possess pharmacological activities like anti-fungal, anthelmintic, anti-cancer, anti-bacterial, anti-viral, anti-hyperglycemic, anti-hyperlipidemic, anti-oxidative (Velmurugan et al., 2011). The trees start flowering and fruiting at an early age; five years old coppice shoots produce as fertile seed as the older trees. The small, yellow flowers appear from March to May after the new flush of leaves. The flowers are entomophilous and hence the rate of seed setting is largely dependent on insects (Parihar and Satya, 1993). The pods are formed soon thereafter and grow rapidly in size. The pods ripen from June to August. The flowers of *P. cineraria* are entomophilous and depend on pollinating insects for seed setting.

Naturally occurring Khejri has been reported (Puri et al., 1964) from Afghanistan, Iran (Persia), Pakistan (Baluchistan and Sind), and India (Rajasthan, Delhi, Haryana, Gujarat, North Karnataka and Madhya Pradesh). Distribution of Khejri in India (from western Rajasthan to Karnataka in the south) is, however, discontinuous.In Rajasthan it is distributed in Pali, Jalore, Sirohi, Barmer, Jisalmer, Bikaner, Nagaur, Phalodi, Pokhran, Osian, Ganganagar,Churu, Sikar region (Mann and Saxena, 1960). It is one of the ingredients of famous, dry curry' Panchkuta' dish of Rajasthan. The species is predominantly cross pollinated (Bahadur and Hooda, 1994).

As it is cross pollinated in nature, it requires pollination by insect. Insect pollinators play an essential role in the pollination of plants and both partners (plant and insects) get benefit from each other due to mutualistic relationship. Wild pollinators may contribute to pollination services, even with higher efficiency than *A. mellifera*, without incurring in economic costs (Kearns et al., 1998, Kremen et al., 2002, Olschewski et al., 2006). There is a vast diversity of insect belonging to particular region and their foraging behavior also vary showing variation in visiting frequency, abundance and foraging rate during different times of the day or under different weather conditions, and even between years. There may be a shift of the most abundant and effective pollinators of a crop to another crop with time and change in weather conditions. The diversity of pollinators provides a kind of insurance that guarantee their valuable pollination services not just for current conditions, but for future conditions as well. With this background the present paper discusses the role of insect pollinators in fruit setting in *P. cineraria.*

2. Materials and Methods

The experiment was conducted in the Ecology Field, Arid Forest Research Institute, Jodhpur (Rajasthan), India during 2020-21. To assess the importance of cross–pollination mediated by floral visitors on the development of fruits, a field pollination experiment by manipulating the access of pollinators to flowers were conducted. Four trees were selected and on each trees, two branches were selected with floral buds, taking care that these branches were at the same height in the trees and had approximately the same length and exposure to sunlight. Then all floral buds/inflorescence spikes on each branch were counted and labelled with small plastic flags. After that, one of the branches was covered with a mesh bags to exclude floral visitors (pollinator exclusion T_1). The other branch was kept uncovered for the time of the experiment (open pollination T_2). Later fruit setting rate was calculated as the ratio between the initial number of floral buds in the respective branch and the number of developing fruits. The quality of fruits matured were tested for carbohydrate content, seed size, seed weight and vigour, germination percentage and moisture content. Germination and Vigor index was calculated as below:

Percent germination was calculated by using formula:

Germination %= Seeds germinated/total seeds × 100Vigor index was calculated by using formula:Vigor index (VI) = [seedling length (cm) × germination percentage]

(Dezfuli et al., 2008) .... (1)

3. Results and Discussion

Abundant flowers are produced almost every year but only a few of them set into pods in *Prosopis cineraria*. The peak period of flowering was mid–April to mid–May and flowering was asynchronous. Pod formation initiated in third week of April and pods matured in the June. In present study on *P. cineraria*, no fruit setting in bagged inflorescence suggested self incompatibility in *P. cineraria.* The average fruit setting in open pollinated treatment was found to be 2.02 percent (Table 1). Our finding were in confirmation with Singh et al. (2021) who reported that *P. cineraria* is a cross pollinated species and the average fruit set under self pollination was found nil whereas it was 2.03 per cent in open natural pollination. Native bee communities provide pollination services to the flora of that particular region and the amount differs with land management practices (Kremen et al., 2002). Narayan Lal (2019) reported that cross-pollination in litchi is essential for fruit set and fruit retention. Estimations of the role of honeybees as insect pollinators of numerous flowering plants have shown varying degrees of success in getting better seed and fruit yield (Batra, 1995; Westerkamp & Gottsberger, 2000).

Table 1: Fruit set rate under controlled (bagged) and open pollination in *Prosopis cineraria*

Tree No.	No. of flower buds		Fruit setting rate	
	Bagged	Open	Bagged	Open
1	2423	2621	Nil	1.76
2	1721	1 621	Nil	2.09
3	1782	1628	Nil	2.02
4	2104	2049	Nil	2.19
Mean	2007.5	2099.33	–	2.02

Germination percentage was found to be 71.3% after 15 days, in seeds soaked in water at room temperature for 72 hr and seedling vigour index was 655.2 (Table 3). The average length of seedling after 21 days of germination was found to be 9.1cm in open pollination treatment (T_2). Seed germination greatly influences the success or failure of any afforestation programme. As such, it is also important to know the effect cross pollination by insect on seed characteristics viz. seed weight, seed length, seed breadth, seed thickness moisture content and carbohydrate content. In the present study the following findings with respect to above parameters are (Table 2): 0.043 g average seed weight, 5.92 mm average seed length, 3.54mm average seed breadth, 0.4 cm average seed thickness, 49.21% carbohydrate content and 10.75% average moisture content in open pollination treatment (T_2). Similar findings were reported by Manga and Sen, (1995) that the germination percentage in 51 accessions of *P. cineraria* collected from the States Rajasthan, Gujarat and Haryana ranged from 30% to 100% in the laboratory and 6·7% to 90% in the field. Mohamed et al. (2018) revealed that the seed length varied from 7.9 mm to 4.26 mm, maximum seed breadth recorded as 4.9 mm whereas, minimum was 3.33 mm, thickness of seeds ranged between 1.53 to 1.1 mm, while hundred seed weight varied between 0.64 to 0.40 g.

Puri and Kumar, (1995) reported germination up to 86.6% after 15 days in seeds soaked in water at room temperature for 72 h. Poonar and Gehlot, (2000) reported total soluble sugar increased during fruit development in *P. cineraria*. TSS content was 47.1 mg g^{-1}.f.wt and increased up to 64.28 mg g^{-1}.f.wt at S5 stage as during fruit ripening process starch and sucrose are hydrolysed to glucose (Wills et al., 2000). Malik et al. (2013) reported that pods of *P. cineraria* contain 51.01±1.179% carbohydrates.

Table 2: Seed weight, Seed length, Seed breadth and carbohydrate content (pods) of *Prosopis cineraria*

Tree No.	Pod length (cm)		Thickness (cm)		Average seed weight in gm		Seed length (mm)		Seed breadth (mm)		Carbohydrate content Pods (%)		Moisture content	
	B	O	B	O	B	O	B	O	B	O	B	O	B	O
1	Nil	18.2	Nil	0.40	Nil	0.04	Nil	5.77	Nil	3.52	Nil	48.43	Nil	10.5
2	Nil	17.4	Nil	0.36	Nil	0.05	Nil	5.80	Nil	3.55	Nil	49.13	Nil	10.8
3	Nil	18.9	Nil	0.50	Nil	0.04	Nil	5.94	Nil	3.55	Nil	51.15	Nil	10.8
4	Nil	17.6	Nil	0.34	Nil	0.04	Nil	6.16	Nil	3.54	Nil	48.16	Nil	10.9
Mean	–	17.96	–	0.4	–	0.043	–	5.92	–	3.54	–	49.21	–	10.75

*B= Bagged, O=Open

Table 3: Germination, average seedling length and vigour of *Prosopis cineraria*

Germination (%)		Average Seedling length (cm)		Vigour	
Bagged	Open	Bagged	Open	Bagged	Open
Nil	71.3	Nil	9.1	Nil	655.2

4. Conclusion

There was no fruit set in bagged inflorescence. As *Prosopis cineraria* is a cross pollinated species and the average fruit set under self pollination was found nil native bee communities of the region which provide pollination services to this tree species should be conserved. Therefore farmers are hereby encouraged to conserve and protect native pollinator in their fields visiting during blossom periods of trees for maximum pod yield.

5. Acknowledgment

Authors are thankful to Director, Arid Forest Research Institute, Jodhpur, for providing necessaries facilities for conducting the investigation and valuable suggestion during the course of study and ICFRE, Dehradun for funding this study.

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