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Reproductive Biology of *Capparis decidua* (Forsk.) Pax

Somendra Sharma

Department of Botany, M.D. College, Parel, Mumbai-400012 (India)
dr.somendra@rediffmail.com

Abstract

Capparis decidua (Forsk) Pax, commonly known as Kair, is an important indigenous shrub found growing along farm boundaries, orans, gochars (local grasslands) and wastelands, widely distributed in arid and semi-arid tracts of India. It is a densely branched shrub, a height of 4-5 m, with a clear bole of 2.5 m. Reproductive biology was studied in plants growing at Agra. Time of anthesis, stigma receptivity, pollen fertility, pollen germination, pollen-ovule ratio and pollination biology were studied.

Knowledge of reproductive biology is essential for the effective protection of endangered plants, especially for species with small populations[7,17,18]. Successful reproduction is crucial in maintaining a viable population size, which is of critical concern to highly endangered taxa facing extinction[9,14]. Understanding the details of reproduction in plants has been a fascinating area of multidisciplinary research with immense value not only for extending the frontiers of fundamental knowledge but also for genetic improvement of plants and optimal utilization and conservation. Improvement, protection and management of plants particularly of tree species are imposible without clear understanding of reproductive biology[11,13]. In this regard reproductive biology plays special role for the solution of problems of conservation of Biodivrsity[3].

Capparis decidua commonly known as *Kurrel* or *Karer* in the family (Capparidaceae), is densly brached shrub or a small tree. It is met with chiefly in dry places in the tropical and warm temperate regions. The present study has been undertaken to study the flowering phenology, floral biology, pollen viability and pollination biology (foraging behavior of flower visitors and mechanism of pollination) in *Capparis decidua*.

Present study was conducted on five marked ***C. decidua*** trees (Fig. 1) growing in different locations at Sahaganj, Agra.

Pollen production :

Pollen production per flower was calculated by first counting the number of pollen per anthers and multiplying this figure by number of anthers per flower[6]. Total number of pollen/anther was measured by a heamo cytometer. Mature anthers were crushed in lactophenol glycerine with aniline blue.A known dilution was placed on the grid and 10

replicate counts were made using a haemo cytometer[2].

Pollen ovule Ratio :

The number of pollen grains divided by the number of ovules per flower yield the pollen- ovule ratio[6].

Pollen viability :

(a) 1% Tetrazolium chloride (TTC) Test
Anthers were crushed and their pollen grains were dusted from freshly dehisced anthers in 1 % TTC solution prepared in 0.15m, Tris HCl Buffer, pH 7.8. The slides were Kept at 33ºC in dark and observed after 30-60 minutes.

(b) In pollen germination test
In pollen germination studies were also made on pollen grains collected from the freshly dehisced anthers by hanging drop method after Brewbaker and Kwack's[4]. Composition of nutrient medium at pH 7.3.

(c) In pollen germination
The pistils were fixed in Carnoy's mixture (Absolute alcohol: Chloroform: Glacial acetic acid 6:4:1) for 12 hours. The fixed pistils were transferred to water through a descending series of ethanol and finally to a few ml of the staining mixture for 12hrs. The stained pistils were transferred to the clearing and softening mixture for 24 hours at 45ºC. The material was washed twice in lactic acid then mounted in mounting medium.

Pollination biology :

Pollination mechanism under different environmental conditions was studied. Observations on types of pollinators their population and visitation rates were recorded. Pollinators were also fixed in 70 percent alcohol and identified. Pollination efficiency of different pollinators was checked by observing the body part of pollinators under microscope[12].

Controlled Pollination studies :

(a) Flower buds of suitable stage *i.e.* the oldest bud prior to anthesis and anther dehiscence were selected for controlled pollination studies.
(b) The floral buds were opened carefully, causing minimum disturbance to the floral parts, all the anthers were excised (emasculated) with forceps.
(c) The emasculation buds were bagged.
(d) On the day of natural pollination, the bag was carefully opened and little pollen from freshly dehisced anthers was rubbed on the receptive surface of stigma.
(e) The pollinated flowers were bagged.
(f) After 8-10 days from pollination, bags were removed and each pollinated flower was observed, all dried and abscised flower were counted as unsuccessful pollination. The flowers which shows fruit formation was counted as successful pollinators.

Capparis decidua is a densly branched, perennial evergreen shrub with small caduceus

leaves found only on young shoots. The height of plant is 5-6 m. The flowers are pinkish red o scarlet red in colour and are arranged in lateral corymb (Fig. 2&3).

Floral Biology :

The observations on floral biology are described separately in the following paragraphs:

Anthesis :

It is clear from table1 that flowers open in the evening at 6.00-9.30 pm. However, some flowers were also open in the morning at 5.00 10.00 am.

Time of anther dehiscence :

Table-1 shows that the dehiscence of anther at about 6.30-7.00 pm in the evening. It is interesting to note that pollen grains dehisced by longitudinal slits, while in the morning, open flowers anthers are dehisced at 5.30- 6.30 am.

Time of stigma receptivity :

It is also clear from table 1 that stigma received the pollen grains between 7.00- 8.30 pm in the evening this time the stigma becomes receptive. However, in the morning open flowers stigma becomes receptive at 6.00-9.00 am.

Ultra-Violet Absorption spectra of stigmatic Exudates :

Table-2 shows that the UV absorption spectra of stigmatic exudates *C. decidua*. The highest peak was exhibited at the wave length of 350.0 nm with the absorbance of 2.430. The other two lower peaks are seen at the wave length of 226.0 and 215.0 nm with absorbance of 0.150 and 0.002respectively. The composition of exudates varies greatly from species to species. It generally contains varying proportion of lipids, carbohydrates, phenolics and proteins[10]. The functions of different components of exudates are not clear. The phenolic compounds play an important role in pollen germination, pollen nutrition and in selective promotion or inhibition of pollen germination on the stigma[15].

Pollen Fertility :

Pollen grains prolate, tricolporate, trilobed, 13.9 ± 0.45 in diameter, exine smooth. Table 3 shows the extent of pollen fertility during the entire flowering period of *C. decidua*. It is clear from data in the table 3 that during flowering period the pollen fertility was 86±5.8 percent as tested by Alexander stain[1] and was 76.2±2 percent as tested by 1%TTC.

In Pollen Germination :

The percentage of in pollen germination and pollen tube growth in Brewbaker and Kwack's medium and in different concentrations of sucrose solution are described separately in the following paragraphs:

Brewbaker and Kwack'smedium :

The data on Brewbaker and Kwack's medium is shown in table 4. It is evident from table 4 that pollen germination in Brewbaker and Kwack's medium is 26.13±0.84 percent

(Fig. 4&5). The average pollen tube length recorded as 230± 9.62µm. It is also clear from the table 4 that the highest pollen germination (29.49±2.72%) with longest pollen tube length (293.16±24.49µm) was recorded in 10% sucrose solution as compared to 10% and 20% sucrose solutions.

In Vivo Pollen Germination :

In pollen germination percentage and pollen tube length in is shown in table 5. It is evident from the table 5 that the maximum pollen load on stigma is 35.3±0.12. However, the number of germinated pollen grains is only 59.47±0.05 with 190.0±15.98 µm long pollen tubes. While the number of non-germinated pollen was recorded as 59.47±0.05. Therefore, these pollen tubes are very short and failed to grow into the long style and thus ovules remain unfertilized.

Pollen Production And Pollen- Ovule Ratio:

Table-7 clearly indicates that average number of pollen grains produced per anther was 430±7 however pollen grains per flower was 8680±397 during maximum flowering period. It is also evident from the table that the pollen ovule ratio was 868± 39:1. Pollen ovule ratio also indicates that the species is xenogamous, although geitonogamy and autogamy (only induced, not spontaneous) were also recorded. The species is self-compatible. However, 949:1 pollen –ovule ratio shown by the plant studied presently as per Shivanna[16]. According to Cruden[6] plants with values lying between 31.9 and 396.0 are facultative autogamous.

Table-1. Floral Biology of *Capparis decidua*

S.No.	Parameters	Observaton
1	Time of Anthesis	6.00- 9.30 pm
2	Time of Anther dehiscence	6.30- 7.00 pm
3	Time of stigma receptivity	7.00- 9.00 pm

Table-2. UV absorption spectra of stigmatic exudates of *Capparis decidua*

S.No.	Wave length (nm)	Absorbance
1	350.0	2.410
2	226.0	0.145
3	218.0	0.003

Table-3. Pollen fertility in *Capparis decidua*

S.No.	Medium (Stain)	Pollen fertility (%)
1	Alexander stain	84-86
2	T.T.C. (1%)	76-80

Table-4. *In vitro* pollen germination in *Capparis decidua*

S.No.	Medium	Concentration (%)	Germination (%)	Pollen tube length (µm)
1	Brewbaker and Kwack' s medium		26.13 ± 0.84	230.04 ± 9.62
2	Sucrose	5	7.3 ± 0.48	85.92 ± 15.98
		10	29.49 ± 2.72	293.16 ± 24.49
		15	20.37 ± 4.62	218.16 ± 16.12
		20	20.52 ±2.63	191.64 ± 23.28

Table-5. In vivo pollen germination in *Capparis decidua*

S.No	Parameters	Observations
1	Pollen load on stigma	35.3±0.012
2	Germinated pollen grains	59.47±0.05
3	Non-germinated pollen grains	59.47±0.05
4	Pollen tube length (µm)	190.00±15.98

Table-6. Pollen production and pollen ovule ratio in *Capparis decidua*

S.No.	Parameters	Observations
1	No. of pollen grains/anther	430±79
2	No. of pollen grains/flower	8680±397
3	No. of ovules/flower	9-10
4	Pollen ovule ratio	868±39:1

Table-7. Percentage of fruit set under different modes of pollination in *Capparis decidua*

S.No.	Parameters	Fruit set (%)	Seed set (%)
1	Open	39-40	20-24
2	self	16-20	11-15
3	Cross		
	(i) Xenogamy	35-36	20-25
	(ii) Geitonogamy	35-45	26-40

Table-8. Floral visitors and pollinators of *Capparis decidua*

S.No.	Zoological Name	Common Name	Vector Order	Nature
1	*Apis cerana*	Honey bees	Hymnoptera	PC
2	*Apis mellifera*	Honey bees	Hymnoptera	PC
3	*Papilio polytes*	Mormon butterfly	Lepidoptera	PC
4	*Polistis orientalis*	wasps	Hymnoptera	NR
5	*Anoplolepis gracilipes*	Ant	Hymnoptera	NR
6	*Camponotus parius*	Ant	Hymnoptera	NR
7	*Polyrachis spp*	Ant	Hymnoptera	NR
8	*Cinnyris osea*	Sun bird	Trochiliformes	NR

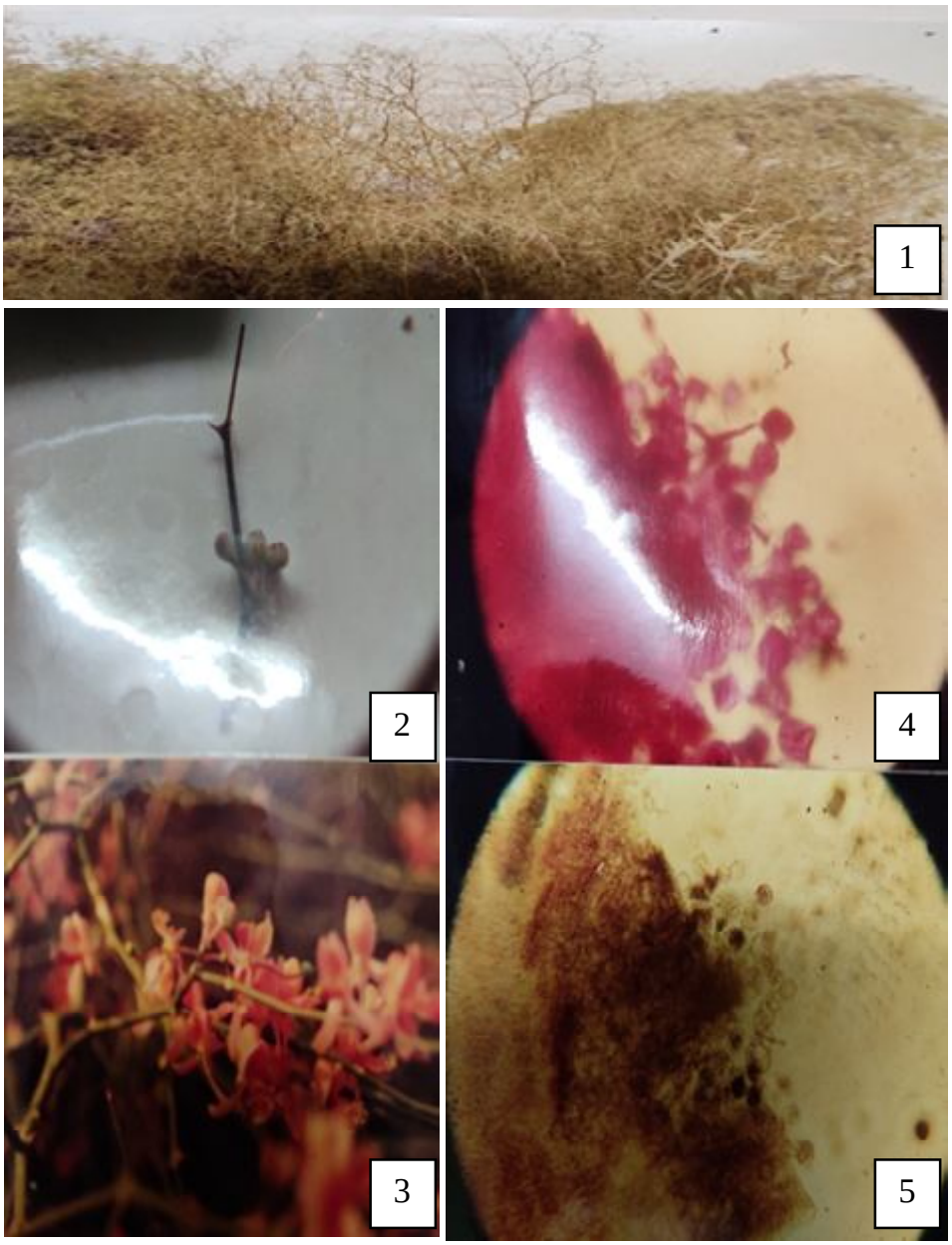

Fig. 1: Showing *Capparis decidua* plant
Fig. 2: Initation of Bud Formation
Fig. 3: Showing Full bloom of Flowering
Fig. 4&5 Showing Pollen load on stigma

Floral visitors :

It is evident from table 8. that the floral visitors of *C. decidua* are Honey bees (Apis cerena, Apis mellifera), Mormon butterfly (Papilio polytes), wasps (polistis orientalis) and Cinnyris osea (Sun bird). Large quantity of nectar also attracts wide range of ants (*Anoplolepis gracilipes*, *Camponotus parius* and *Polyrachis* spp.), but they are only nectar robbers. These belong to different orders viz. Hymenoptera, Lepidoptera, and Passeriformes. It is interesting to note all of them are not polen carrier. On the basis of their visitation rate, pollen load on their body parts, *Apis mellifera*, *Apis cerana* and *Mormon butterfly* are found to be the most efficient pollinators. However, Wasps, Ant and sunbird act as a nectar robber.

Breeding System :

Absence of pollen on hanging slides greased with glycerine indicated that wind plays no role in the pollination process. Freihat *et al*.[8] have also found wind plays little or no role in pollination process. In order to ascertain breeding behaviour (autogamy, geitonogamy and xenogamy) hand pollination experiments were carried out.

The results of open and experimental pollination of are presented in table-7 and there is 38 – 40 % fruit set and 20-24percent fruit set was observed under open pollination. On the other hand, results on self-pollination fruit set percentage are only 15-20 percent. However, the fruit set percentage enhanced by cross pollination (xenogamy and geitonogamy). The percentage of fruit is 34 -35 percent by Xenogamy and 35-45 percent by geitonogamy respectively. It is also clear from Table-7 that there is 34-40 seed set percentage on open pollination and 10-15 seed set percentage by self pollination. There are considerable differences was obtained by xenogamy and geitonogamy. The percentage of seed set is 20-25percent by Xenogamy and 25-40 percent by geitonogamy respectively.

Breeding system plays crucial role in reproductive success and in the level and distribution of genetic variability, it lies at the very heart of population heath and maintenance. Reproductive success or fertility is assessed as the product of the fraction of lowers producing fruits by the fraction of ovules producing seeds[5]. Comparing with the flower number, the rate of fruit setting was very low. Plants and fruits seem to be attacked by various insects.

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