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POLLINATION MECHANISM AND ROLE OF INSECTS IN *ABUTILON INDICUM* (L.) SWEET

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Abstract

Flowers of *Abutilon indicum* (L.) Sweet are slightly protandrous, opening and closing times of flower are temperature and light dependent. Bagging experiments and pollen-ovule ratio reveal that it is a facultative autogamous taxon. Butterflies (*Lepidoptera*) and Bees (*Hymenoptera*) are the regular flower visitors. Butterflies are just visitors as they do not take any part in pollination while, *Apis* sp., and *Bembix* sp. are found to be the pollinators of *Abutilon indicum*.

Introduction

Abutilon indicum (L.) Sweet belongs to the family Malvaceae. In Paksitan it is commonly distributed in Sindh, Punjab and rare in NWFP (Abedin, 1979). A considerable work on pollination biology for the members of Malvaceae has been performed by various workers (Kadyrova *et al*., 1980; Mcdade & Davidar, 1984; Dawar *etal*., 1994; Vaidya, 2000; Hajime, 2004; Franceschinelli, 2005). However, little attention was paid to the breeding studies of the genus *Abutilon* L. (Andersen, 1988; Abid, 2006). Moreover no exclusive reports are available on *Abutilon indicum*. The study was conducted to determine the pollination mechanism and role of insects in pollination of *Abutilon indicum*.

Materials and Methods

Present studies were conducted within the vicinity of Karachi i.e., Karachi University campus, Abul Hasan Isphahani Road, Gulshan-e-Iqbal and Malir.

Floral phenology: 5-10 young floral buds/population were tagged to determine the phenological changes.

Insects (Visitors): Flower visiting insects were observed for their foraging behavior. Insects were collected by hand net and chloroformed and observed microscopically for the pollen load. The insects carrying pollen were evaluated as pollinators.

Breeding studies

Pollen–ovule ratio: The flower buds were collected prior to anthesis and pollen ovule ratio was determined by dividing the total number of pollen grains/flower by the total number of ovules/flower and following counts were made:
(i) Total number of anthers/flower (ii) Total number of pollen grains/anther (iii)Total number of pollen grains/flower (iv) Number of ovaries/flower (iv) Number of ovules/ovary (v) Number of ovules/flower.

Bagging experiments: Following Pollination treatments were given in flowering bud stage (N=25).

Control (Open pollination): Budd were tagged and left to study the normal seed set.

Direct autogamy: Buds were bagged without manipulation to determine the self-pollination.

Indirect Autogamy: Buds were hand pollinated and bagged to test the self-pollination.

Apomixis: Buds were emasculated and bagged to test the apomixis.

Geitonogamy: Pollinated by hand with the pollen grains of the other flowers of the same plant and bagged to test the geitonogamy.

Xenogamy: Cross pollinated by hand with the pollen grains of different plants of the same species and bagged to test the xenogomy.

The data was statistically analyzed among different pollination treatments by one-way ANOVA and Bonferoni's Multiple Comparison Test of (Anon., 1999).

Observations and Results

Floral phenology: A youngest bud took about 18-20 days to become a flower. The time of flower anthesis seems to be effected by temperature and light. At 25-30^{0}C temperature anthesis took place between 1-2:00 p.m. Whereas, on cloudy days flower opens at 4:0 p.m. Flower remained open for about 6-7 hours and withering of floral parts took place after 2-5 days of flower closing. Protandry seemed to be present as dehiscence of anthers took place in mature bud stage just prior to flower anthesis. Upper anthers on the staminal column dehisced earlier than the lower ones.

Insects behaviour: Different types of insects visited the flower and were attracted due to the presence of nectar, pollen grains, fragrance or colour of the flower.

Butterflies (*Lepidoptera*) namely *Pieris* sp., *Eurema* sp., *Anthocharis* sp., *Coletis* sp., *Lycaena* sp., and *Danaus* sp., regularly visited the flowers. They were merely visitors as not a single pollen grain was found on their body parts. The activity of all butterflies started just after the opening of flower and they behaved in same manner. They usually alight on petals, insert their proboscis in nectaries (at the base of sepals) and suck the nectar without coming into contact with sexual parts (Fig. 1G, H).

Apis sp., (Honey Bee) was the most common and effective pollinator. It started the activity just prior to the anthesis of flower and visited a flower for about 40-50 seconds. It is also very interesting that a group of 3-4 bees compete to visit a single flower out of which sharp ones get success and land on the staminal column and grasp it with the legs. From there, insert their proboscis in the slit between the two petals where nectar accumulated in the form of drops and sometimes they press the anthers to collect the pollen grains. Bees usually try to explore all the five nectaries of a flower by revolving or twisting on the staminal column in this way pollen grains adhere to the abdomen, thorax and legs after that they move to another flower (Fig. 1A-F).

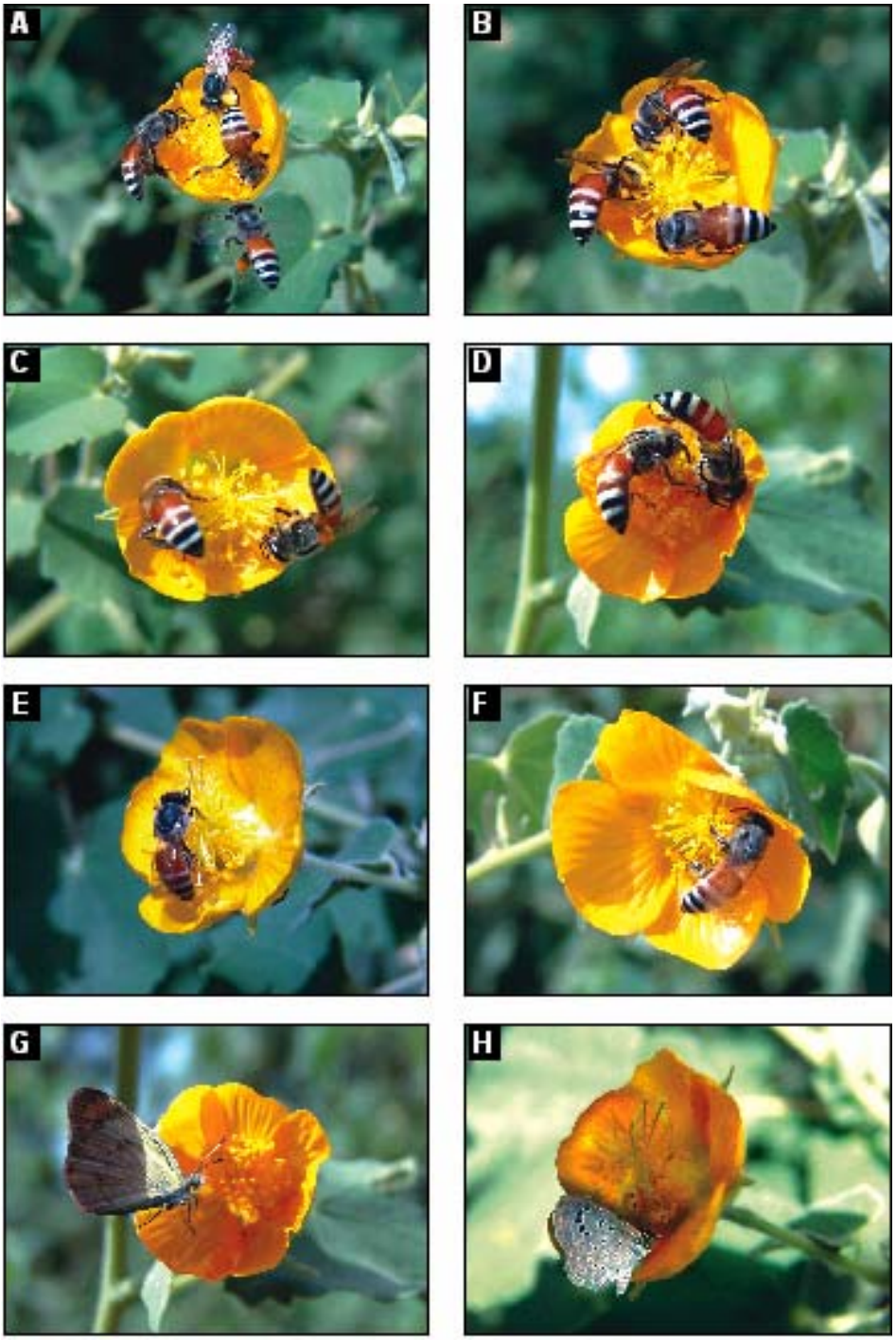

Fig. 1. Insects foraging behaviours. A-F *Apis* sp. collecting pollen and nectar; G, *Anthocharis* sp. sucking the nectar; H, *Lycaena* sp. sucking the nectar.

Table 1. Pollen ovule Ratio of *Abutilon indicum*

No. of flowers studied	Average no. of anthers / flower	Average no. of pollen/ anther	Average no. of pollen / flower	Average no. of ovaries / flower	Average no. of ovules / ovary	Pollen-ovule ratio
90	72.88 ± 2.83	210.12 ± 9.88	15313.54 ± 27.62	1.0	48.8 ± 1.66	313.65 ± 18.88

Table 2. Effect of various pollination treatments on fruit set in *Abutilon indicum*.

	One-way ANOVA				Bonferoni's Multiple Comparison Test (BMCT)		
Sv	**Df**	**Ss**	**Ms**	**F-value**	**Treatments**	**Rank**	**Mean**
Treatments	4	8526.2	2131.55		Control	1	64a
Error	15	7360.75	490.7166	4.343*	Direct autogamy	2	62.5a
Total	19	15886.95			Indirect autogamy	3	50ab
					Geitonogamy	4	18.25b
					Xenogamy	5	17.5b

Bembix sp., visited the flower for nectar and pollen. It alights on staminal column and collect the pollen grains and after collecting the pollen also insert its proboscis between the slits of petals to suck the nectar, pollen grains were found to be attached on its legs and ventral sides of thorax and abdomen and before moving to another flower insect tries to detach the heavy pollen load by moving its legs and wings then move towards the other flowers of the same or other plant.

Pollen-ovule ratio (P/O): The pollen ovule ratio was 313.65 ± 18.88 (Table 1). According to Cruden (1977), the species with this P/O value seems to be facultative autogamous.

Bagging experiments: Fruits were properly formed in all the treatments except that of the apomixis. Fruit set in all the treatments was statistically significant (Table 2). However, control and direct autogamy significantly showed the highest fruit set as compared to the geitonogamy and xenogamy where fruit set was significantly lowest.While, in indirect autogamy fruit set did not differ significantly from all of the above treatments (Table 2).

Discussion

The flowering period of *Abutilon indicum* ranges from August to December. The time of flower anthesis seems to be temperature and light dependent. The flowers are protandrous and anther dehiscence takes place just prior to flower opening but this protandrous condition is not so pronounced. Though the upper anthers mature first and till the maturation of all anthers stigmas also become mature and this protandrous condition is observed in most of the members of the family Malvaceae (Faegri & Pijl, 1980; Dawar *et al*., 1994). Mainly Bees (Hymenoptera) and Butterflies (*Lepidoptera*) are found to visit the flowers of *Abutilon indicum*. *Apis* sp. (Honey bee) seems to be responsible for pollination either by bringing the stigmas near to the anthers or by transferring pollen grains from their body parts which are adhered while visiting the flowers. A variety of butterflies (*Lepidoptera*) regularly visit the flowers of *Abutilon indicum* and may be regarded as opportunist as they suck the nectar without coming into contact with reproductive organs.Similar results were obtained by Gottsberger (1967) on some Brazilian genera of Malvaceae and Dawar *et al.*, (1994) on *Sida ovata* complex.

Breeding experiments revealed that *A.indicum* is self compatable and facultative autogamous taxon and no significant difference was found in fruit set of open pollination and autogomy. While, fruit setting was significantly reduced in geitonogamy and xenogamy. Besides this pollen ovule ratio also supports the facultative autogamous nature of the species. Thus in *A. indcum* both selfing and insect mediated crossing occur.

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