Pak. J. Bot., 44(5): 1745-1748, 2012.

REPRODUCTIVE BIOLOGY OF *CONVOLVULUS GLOMERATUS* CHOISY FROM PAKISTAN

RUBINA ABID AND NOUREEN SARWAR

Department of Botany,
University of Karachi, Karachi-75270, Pakistan

Abstract

Convolvulus glomeratus Choisy is a facultative autogamous taxon and favours both direct and insect mediated selfing or crossing. Flower opening and closing times are fairly regulated by light and temperature. Pollen and nectar were the main rewards to attract the various kinds of insects including flies, bees and butterflies. However, butterflies are regarded as opportunist as they get nectar without performing the function of pollination.

Introduction

Convolvulus glomeratus Choisy of the family Convolvulaceae is a climber, commonly distributed in Sindh, Balochistan and salt range (Austin & Ghazanfar, 1979). Concerning to reproductive biology of *Convolvulus* there are some reports available on various species. Waddington (1976) observed the foraging pattern of Halictid bees on flowers of *Convolvulus arvensis*. Francis & Weller (1984) studied the growth and reproductive characteristics in the biotypes of *Convolvulus arvensis*, where variability was found in growth and reproduction within the studied biotypes. Suarez *et al*., (2004) studied the reproductive biology of *Convolvulus chilensis* in a population of Auco (north central Chile). While Poonam *et al*., (2007) studied the reproductive biology of *Convolvulus microphyllus*. Despite various studies on *Convolvulus* there are no exclusive reports available on pollination biology of *C. glomeratus*. The present studies were carried out to confirm the mode of breeding in *C. glomeratus*, for this purpose flower phenology, bagging experiments, pollen ovule ratio, and insects behaviour were also studied.

Materials and Methods

Study sites: Studies were mainly conducted within the vicinity of Karachi University campus i.e., (i) Near Department of Chemistry (ii) In front of Department of Mass Communication (iii) Near Department of Geography (iv) Near Department of Physiology (v) and Main Super highway, Karachi.

Floral phenology: 5-10 buds were tagged to observe the phenological changes. The following observations were made (i) Time of flower opening (ii) Time of flower closing (iii) Time of anther dehiscence (iv) Time of stigma receptivity (v) Life duration of flower from initiation of bud to the withering of flower and fruit formation.

Pollen-ovule ratio: The pollen ovule ratio was determined by using standard procedure of Cruden (1977). It was calculated 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 per flower (ii) Total number of pollen grains per anther (iii) Total number of ovules per flower.

Bagging experiments: Breeding experiments were performed in all the selected populations. Following treatments were given in flowering bud stage following Radford *et al*., (1974) and Dawar *et al.*, (1994).

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

Self pollination

a. Direct autogamy: Buds were bagged and left to test the direct autogamy.
b. Indirect autogamy: Pollinated with hand and bagged to test the indirect autogamy.

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

Cross pollination

a. Geitonogamy: Pollinated by hand with pollen from different flowers of the same plant and bagged to test the geitonogamy.

b. Xenogamy: Buds were cross pollinated by hand with pollen grains of different plants to test the xenogamy. The data was statistically analysed among different pollination treatments by one way ANOVA and Bonferoni's Multiple Comparison Test (Anon., 2002)

Insects (pollinators or visitors): Flower visitors (insects) were observed and their behaviour was recorded. Different movements of insects were captured during foraging through photography. Insects were collected by hand net and dispatched with chloroform, then transferred individually to clean vials and transported to laboratory to check the pollen load on insects body.

Observations and Results

Floral phenology: Period of maximum flowering was from November to August. Flower opening and closing times greatly varied, depending on temperature and light intensity. At 35°C-40°C, flower anthesis took place at 7:30-8:00 a.m and remained open for about 4-5 hours. At lower temperature flower opening and closing times were delayed by 2-4 hours. Once after opening, flowers did not

open again. An initiated bud took about 9-12 days to become a mature bud and that was bloomed as a white flower after 2-3 days. During the opening of a flower anthers and stigma also matured and very soon dehiscence of anthers started. Nectaries were located at the base of tube of fused petals from which nectar oozed out till after 2-3 hours of flower opening. After 14-18 hours sepals, petals and stamens completely withered and ovary started to mature and turned to pale yellow. After 5-7 days fruits matured to liberate the seeds.

Pollen–ovule ratio (P/O): The pollen ovule ratio was 215.66±16.68 (Table 1) which clearly pointed out that *Convolvulus glomeratus* seemed to be facultative autogamous.

Bagging experiments: Bagging experiments revealed that *C. glomeratus was* partially autogamous species. Production of fruits was slightly reduced in crossing. However, no fruit production was observed in apomixis (Table 2; Fig. 1).

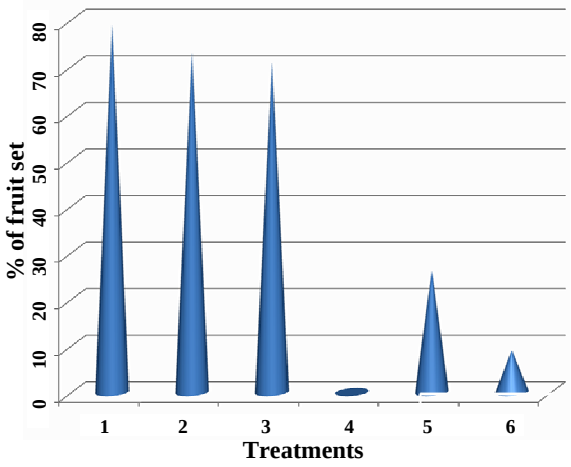
Table 1. Pollen ovule ratio of *Convolvulus glomeratus*.

Population	No. of flowers studied	Average No. of anther/flowers	Average No. of pollen/anther	Average No. of pollen/flower	Average No. of ovules/flower	Pollen ovule ratio
1	50	22	1950	36600	170	215.29
2	45	19	2040	38760	208	186.34
3	20	23	2500	57500	218	263.76
4	50	18	1650	29700	210	141.42
5	20	21	2990	62790	230	273.00
Total	**185**	**20**	**2226±3.665**	**45070±22.89**	**207±0.822**	**215.66±16.68**

Populations: (i) Near Department of Chemistry (ii) In front of Department of Mass Communication (iii) Near Department of Geography (iv) Near Department of Physiology (v) Main Super highway, Karachi

Table 2. Effects of various pollination treatments on fruit set in *Convolvulus glomeratus*.

One Way Anova					Bonferoni's multiple comparison (BMCT) test		
Sv	**Df**	**Ss**	**Ms**	**F-value**	**Treatments**	**Rank**	**Mean**
Treatments	5	2088.0	4176		Control	1	72a
Error	20	1779.21	59.86	76.83***	Direct autogamy	2	69ab
Total	25	3867.21			Indirect autogamy	3	66ab
					Geitonogamy	4	23c
					Xenogamy	5	7d



1= Control, 2= Direct Autogamy, 3= Indirect Autogamy, 4= Apomixis, 5= Geiotonogamy, 6 = Xenogamy

Fig.1. Percentage of fruit set among different pollination treatments in *Convolvulus glomeratus.*

Insect's behaviour: Insects visitation were started just after the anthesis and continued till about 3-5 hours of flower opening. Insects were mainly flies, bees and butterflies (Fig. 2).

Lepidoptera (butterflies): All butterflies including *Coletis* sp., *Sylepta* sp., *Pieris* sp., and *Appias* sp., behaved in same manner. They visited the flowers for sucking the nectar, alighted on the petals and inserted their proboscis towards the nectaries (Figs. 2A, B). After visiting a flower they turned their attention towards other flower of the same plant or another plant.

***Musca* sp.:** It alighted on petals and licked the anthers through its thick and long proboscis. During licking it grasped the anthers through its forelegs in this way stigma also came into contact and after few seconds insect tried to detach pollen from legs. Single flower was visited for about 6-7 seconds after which insect turned its attention towards the other flower and behaved in the same manner (Fig. 2C, D).

***Helictus* sp.:** It started the visitation of flower just after the opening. They also alighted on the petals then started to collect the pollen grains by pressing the anthers through its forelegs then it crawled deeply at the base of petals and completely bent its body around the filaments from here it inserted its proboscis towards the nectaries in this way pollen were also deposited on dorsal body parts. After visiting a flower they usually turned their attention towards the other flowers. Thus the insect foraged both pollen as well as nectar (Fig. 2E, F).

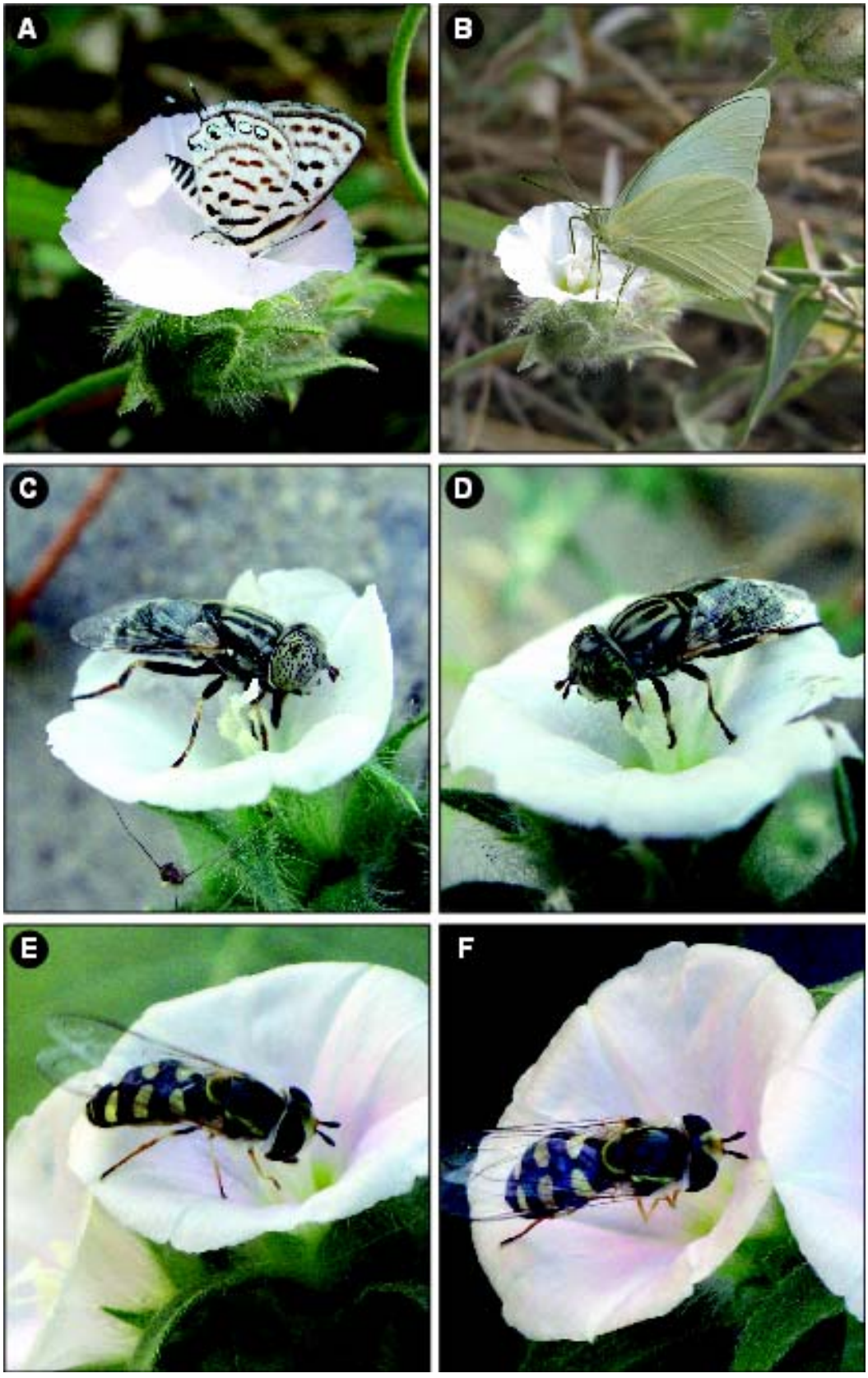


Fig. 2. Insects behaviour with *Convolvulus glomeratus.* A, *Sylepta* sp.: sucking the nectar; B, *Appias* sp.: sucking the nectar; C,D, *Musca* sp.: licking the pollen grains; E, F, *Helictus* sp.: collecting the pollen grains.

***Astata* sp.:** It was also attracted towards the flower for nectar. As the insect alighted on petals it crawled deeply to suck the nectar at the base of petals where nectaries were located. So in this way pollen were also deposited on its dorsal body parts. After visiting 2-3 flowers they usually departed from the population.

Discussion

Breeding system is important in understanding genetic variability by determining the proportion of selfing or crossing within different taxa or population (Kittelson & Maroon, 2000). Previously some of the species of *Convolvulus* viz., *C. microphyllus* (Poonam *et al*., 2007) and *C. arvensis* (Francis & Weller, 1984) were reported as self incompatible. In contrast to the previous observations on the breeding system on different species of *Convolvulus* our results clearly indicate that *C.glomeratus* is a facultative autogamous taxon, showing a mixed breeding system as it reproduces through selfing and crossing. However, highest fruit setting was in various autogamous treatments i.e.,control followed by direct autogamy and indirect autogamy (Table 2). These results are further strengthened by pollen ovule ratio (215.66) that *C. glomeratus* is a facultative autogamous taxon. So pollen ovule ratio is a good indicator of breeding system (Cruden, 1977). Flowering period of *C. glomeratus* ranges from November–August. Whereas, flower anthesis and nectar production was greatly influenced by temperature and humidity. Similar to the earlier observations on the various species of *Convolvulus* (Waddington, 1976; Poonam *et al*., 2007) dry and high temperature favours early opening and closing of flowers or vice versa. Flowers of *C. glomeratus* offer nectar and pollen to attract the insects including, *Musca* sp., *Helictus* sp., *Astata* sp. and a variety of butterflies. However, butterflies were only interested in nectar as they inserted their long and thin proboscis directly to the nectaries situated at the base of tube of the fused petals (Waddington, 1976) without touching the reproductive organs. So butterflies may be regarded as opportunist as they suck the nectar without performing the function of pollination (Gottsberger, 1967; Abid, 2010). Thus *C. glomeratus* mainly serves as a primary attractant and favours both direct or insect mediated selfing as well as crossing.

References

Abid, R. 2010. Pollination mechanism and role of insects in *Abutilon indicum* (L.) Sweet. *Pak. J. Bot.*, 42(3): 1395-1399.

Anonymous. 2002. SPSS Ver. 10 for Windows, SPSS, Inc., Chicago.

Austin, D. and S. Ghazanfar. 1976. Convolvulaceae. No. 126. In: Flora of West Pakistan (Eds.): E. Nasir and S.I. Ali. Dept. Bot. Univ. Karachi and National Herbarium (Stewart Collection) Agriculture Research Council, Islamabad.

Cruden, R.W. 1977. Pollen-ovule ratios: A Conservative indicator of breeding system in flowering plants. *Evolution*, 31: 32-46.

Dawar, R., T. Ali and M. Qaiser. 1994. Hybridization in *Sida ovata* complex II. Evidence from breeding studies. *Pak. J. Bot*., 26(1): 83-97.

Francis, P.D. and S. Weller. 1984. Growth and reproductive characteristics of Field Bindweed (*Convolvulus arvensis*) biotypes. *Weed Science*, 32: 523-528.

Gottsberger, G. 1967. Observations on the flower biology of Brazlian Malvaceae. *Osterr. Bot.*, 2, 114(4/5): 349-378.

Kittelson, M.P. and J.L. Maroon. 2000. Out crossing rate and inbreeding depression in the perennial yellow bush lupine, *Lupius arboreus* (Fabaceae). *Amer. J. Bot*., 87(5): 652-660.

Poonam, C., K.A. Geetha and M. Satyabrata. 2007. Reproductive Biology of *Convolvulus microphyllus* (Convolvulaceae)- A memory stimulating drug plant of Ayurveda. *The Indian Jour. of Genetics and Plant Breeding*, 67: 257-263.

Radford, A.E., W.C. Dickison, J.R. Massey and C. Ritchie Bell. 1974. *Vascular Plant Systematics*. Harper & Row Publisher, New York, London.

Suarez, H.L., W.L.Y. Gonzalez and G. Ernesto. 2004. Reproductive biology of *Convolvulus chilensis* (Convolvulaceae) in a population of Auco (North-central Chile). *Rev. Chil. Hist. Nat*., 77(4): 581-591.

Waddington, K.D. 1976. Foraging patterns of Halictid bees at flowers of *Convolvulus arvensis. Psyche*, 83: 112-119.

(Received for publication 15 October 2011)