REPRODUCTIVE BIOLOGY OF CONVOLVULUS GLOMERATUS
CHOISY FROM PAKISTAN

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Abstract

Convulvulus 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 opportunists as they get nectar without performing the function of pollination.

Introduction

Convulvulus 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 Convulvulus there are some reports available on various species. Waddington (1976) observed the foraging pattern of Halictid bees on flowers of Convulvulus arvensis. Francis & Weller (1984) studied the growth and reproductive characteristics in the biotypes of Convulvulus arvensis, where variability was found in growth and reproduction within the studied biotypes. Suarez et al., (2004) studied the reproductive biology of Convulvulus chilensis in a population of Auco (north central Chile). While Poonam et al., (2007) studied the reproductive biology of Convulvulus microphyllus. Despite various studies on Convulvulus 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.**

<table>
<thead>
<tr>
<th>Population</th>
<th>No. of flowers studied</th>
<th>Average No. of anther/flowers</th>
<th>Average No. of pollen/flower</th>
<th>Average No. of ovules/flower</th>
<th>Pollen ovule ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>22</td>
<td>1950</td>
<td>36600</td>
<td>170</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>19</td>
<td>2040</td>
<td>38760</td>
<td>208</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>23</td>
<td>2500</td>
<td>57500</td>
<td>218</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>18</td>
<td>1650</td>
<td>29700</td>
<td>210</td>
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<tr>
<td>5</td>
<td>20</td>
<td>21</td>
<td>2990</td>
<td>62790</td>
<td>230</td>
</tr>
<tr>
<td>Total</td>
<td>185</td>
<td>20</td>
<td>2226±3.665</td>
<td>45070±22.89</td>
<td>207±0.822</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>One Way Anova</th>
<th>Bonferoni’s multiple comparison (BMCT) test</th>
<th>Treatments</th>
<th>Rank</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sv</td>
<td>Df</td>
<td>Ss</td>
<td>Ms</td>
<td>F-value</td>
</tr>
<tr>
<td>Treatments</td>
<td>5</td>
<td>2088.0</td>
<td>4176</td>
<td>76.83***</td>
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<tr>
<td>Error</td>
<td>20</td>
<td>1779.21</td>
<td>59.86</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>3867.21</td>
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</table>

**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. 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.

**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.

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**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).

![Percentage of fruit set among different pollination treatments in Convolvulus glomeratus.](image)
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.
**Astaffa 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**


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