Occurrence of andromonoecious form in bottlegourd, *Lagenaria siceraria* exhibiting monogenic recessive inheritance

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An andromonoecious sex form was obtained in a segregating progeny during the course of selfing in a monoecious local collection of *Lagenaria siceraria* (Mol.) Standl. F₂ and BC-1 generations derived from the crosses between a stable monoecious line and the andromonoecious sex form revealed monogenic recessive inheritance of the latter.

A variety of sex forms with varying genetic mechanisms are met in cucurbitaceous crops. *Coccinia indica* is the classical example available in this family that shows X/Y type of chromosome mechanism of sex determination of male and female plants. In watermelon, monoecious and andromonoecious sex forms are governed by a pair of alleles where the former is completely dominant over the latter. Also, digenic nature of inheritance of monoecious, andromonoecious, gynoecious and hermaphrodite conditions showing F₂ ratio of 9:3:3:1 are reported in *Cucumis melo* and *Luffa acutangula*. But, bottlegourd (*Lagenaria siceraria* (Mol.) Standl.) is considered to be strictly monoecious. While purifying a local collection, we came across an andromonoecious sex variant bearing hermaphrodite and staminate flowers in the same plant. Results pertaining to morphological features of the sex variant and its inheritance are presented here.

The andromonoecious variant of bottlegourd, *Lagenaria siceraria*, was identified in summer 1990, in a segregating population emanating from first selfing of a local strain NDBG-6 at the main experiment station, Department of Vegetable Science, Narendra Dev University of Agriculture and Technology, Narendra Nagar. The new sex form was selfed and designated as 'Andromon-6'. It was found to breed true and be quite stable in the subsequent generations of selfing. To elucidate the characteristic features of the instant variant, observations were recorded of exomorphological and reproductive features. To work out the genetics of the sex form during summer 1992, Andromon-6 was crossed as male parent with a normal monoecious long-fruited strain NDBG-10 taken as female. To raise F₁ generation, 40 F₁ seeds were taken from a well-developed fruit and sown in the following summer season of 1993. All the 34 F₁ plants that grew from the 40 F₁ seeds, were monoecious in nature with floral characteristics similar to NDBG-10. Ten pistillate flowers, in 10 different F₁ plants, were selfed to obtain F₂ seeds and another 10 pistillate flowers from another set of 10 F₁ plants were backcrossed with recessive parent Andromon-6 to get BC-1 seeds. All the fruits developed in the F₁ plants were long in shape and similar to that of NDBG-10 and at maturity had abundant (340–520) normal seeds.

Figure 1a–f. Morphological composition of flower and fruit shape in monoecious and andromonoecious forms in *Lagenaria siceraria.* a–d. Flower morphology: a, staminate flower; b, pistillate flower; c, hermaphrodite flower of Andromon-6; d, close up of mature hermaphrodite flower; e–f. Fruit shape; e, normal; f, derived from andromonoecious form.
Table 1. Segregation pattern of monoecious and andromonoecious sex forms in F₂ and BC-1 generations of bottle-gourd

<table>
<thead>
<tr>
<th>Name of sample</th>
<th>Number of seeds sown</th>
<th>Number of plants obtained</th>
<th>Number of monoecious plants</th>
<th>Number of andromonoecious plants</th>
<th>Observed ratio</th>
<th>χ² value</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>F₂ generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 1</td>
<td>250</td>
<td>238</td>
<td>173</td>
<td>65</td>
<td>2.66:1</td>
<td>0.68</td>
<td>0.3–0.5</td>
</tr>
<tr>
<td>Sample 2</td>
<td>250</td>
<td>244</td>
<td>186</td>
<td>58</td>
<td>3.21:1</td>
<td>0.20</td>
<td>0.5–0.7</td>
</tr>
<tr>
<td>BC-1 generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 1</td>
<td>250</td>
<td>232</td>
<td>121</td>
<td>111</td>
<td>1.09:1</td>
<td>0.43</td>
<td>0.5–0.7</td>
</tr>
<tr>
<td>Sample 2</td>
<td>250</td>
<td>235</td>
<td>109</td>
<td>126</td>
<td>1.16:1</td>
<td>1.23</td>
<td>0.2–0.3</td>
</tr>
</tbody>
</table>

F₂ and BC-1 generations were grown during summer 1994. For this purpose, two random samples of 250 seeds each for F₂ and BC-1 were separately taken from four good fruits and sown in four well-prepared plots.

Regarding exomorphological features, observation over the years reveal that andromonoecious sex is accompanied by certain peculiarities. Whereas the staminate flowers of Andromono-6 are similar to normal monoecious, the hermaphrodite flowers show a few variant features compared to normal female flowers. The variant features are: long corolla, 3.5–4.5 cm compared to 2.5–3.5 cm in normal (Figure 1b, c); well developed anthers encircling full grown stigma (Figure 1d) and oval ovary (Figure 1d) that develops into a drum-shaped fruit sporting 12 light grooves (Figure 1f) not yet reported in any normal form. The fruit bears prominent blossom scar and the majority of mature fruits contain a large number (400–700) of white/brown small empty non-viable seeds with underdeveloped seed coats. A few fruits bear 1–25 normal viable seeds. The full grown fruits are only about 25 cm in length and about 45 cm in circumference.

The expression of sex form, flower and fruit morphology and seed characteristics in F₁ generation show complete dominance of monoecious sex habit over andromonoecious sex, normal size corolla over large size corolla, long fruit shape over drum-shaped oval fruit, small blossom scar over large blossom scar and normal seed development over abnormal seed development.

The segregating patterns of the two sex forms in F₂ and BC-1 generations are given in Table 1. The data shown in the table suggest the possible existence of monogenic segregation ratio of 3:1 in F₂ generation and 1:1 in the BC-1 generation. The χ² values calculated assuming the above ratio show that differences in the observed and expected ratios are insignificant.

Thus, monoecious versus andromonoecious sex forms in bottle-gourd follow monogenic inheritance. Similar inheritance pattern for the given sex forms has earlier been reported by Rosan⁴ in watermelon. However, the other peculiar characteristics, such as oval ovary, large corolla, drum-shaped grooved fruits with big blossom scar, and abnormal seed development noticed in Andromono-6, appear to be linked with andromonoecious sex that are inherited consecutively. The linkage of round fruit shape with andromonoecious sex in watermelon has also been reported by Rosan⁴ and Poole and Grimball⁸ with cross-over values observed by the latter.


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Radioecological aspects of the Kaveri River environment

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We present here the results of investigations carried out in the Kaveri River Ecosystem on the background gamma radiation levels and distribution of certain radionuclides such as ²¹⁰Po, ²¹⁴Pb, ²²⁶Ra and ²²⁶Ra in water, sediment and biota. The ambient gamma radiation level ranged from 5 to 27 μR/h and it decreased with increasing distance from the river. Among the radionuclides tested, ²¹⁰Po registered the highest level of accumulation. The general accumu-