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Different Sex-Forms in Cucurbits

Dr. Rishee K. Kalaria[1*]
ASPEE Shakilam Biotechnology Institute, Navsari Agricultural University, Surat
Dr. Sunil R Patil[2]
College of Agriculture, Navsari Agricultural University, Bharuch
*Corresponding author: risheekal@nau.in

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Introduction

Among the vegetables, cucurbits comprise the largest group with their wide adaption to arid climates to the humid tropics. The family *Cucurbitaceae* consists of about 900 species in around 130 genera. In Asia, nearly 23 major and minor edible cucurbits are grown and consumed. Important genera of this family are *Lagenaria*, *Momordica*, *Luffa*, *Cucurbita*, *Cucumis* and *Citrullus.* In the cucurbits male and female flowers borne separately, pollination and fruit setting are mostly governed by insect pollinators. But it is not hereditary in nature while genetic manipulation is hereditary in nature.

Different sex forms in cucurbits

- ✓ Hermaphrodite
- ✓ Monoecious
- ✓ Andromonoecious
- ✓ Gynomonoecious
- ✓ Gynoecious
- ✓ Trimonoecious
- ✓ Androecious
- ✓ Dioecious

How to manipulate sex in Cucurbits?

- ✓ Controlling environment
- ✓ Use of plant growth regulators/chemicals
- ✓ Modified nutritional/cultural practices
- ✓ Genetic/Hereditary

Breeding methods

- ✓ Introduction
- ✓ Selection
- ✓ Pedigree method
- ✓ Back cross method
- ✓ Interspecific hybridization
- ✓ Intergeneric hybridization

Development and maintenance of gynoecious line

Development of gynoecious line occurs mainly due to spontaneous or chance segregation of gyno monoecious lines in segregating populations. Gynoecious lines are improved by repeated backcrossing and further maintained by selfing; growth regulators induce staminate flower for selfing. Hybrid seed production is more effective with the use of gynoecious lines and are mainly used as a female parent, which leads to high yield traits. Spray of plant growth regulators helps a lot in modifying sex expression and inducing femaleness.

Case Studies

Alhariri *et al.* (2018) studied eight parental lines including one gynoecious line PDMGy-201 (Gy-23) and their 28 F_1 hybrids obtained from half diallel analysis were used to estimate the extent of heterosis for earliness, yield and its contributing traits in bitter gourd. All the 28 F_1s exhibited significant desirable heterosis for average fruit weight and yield per plant over mid and standard parent. The best performing F_1 hybrid PDMGy-201 × PV recorded 67.5% and 67.22% higher yield over mid and standard parents respectively and 18.92% increase in number of fruits per plant over standard parent which may be exploited for commercial cultivation.

Sindhu and Kaur (2021) carried out interspecific hybridization between sponge gourd (monoecious and solitary bearing) and 'Satputia' (bisexual and cluster bearing) for the introgression of cluster bearing, high yield and gynoecism. The investigation highlighted that the reciprocal interspecific cross

(Satputia × sponge gourd) was more successful for development of F_1 hybrid and its further utilization. Fertile hybrids could be easily used to generate F_2 and BC_1P_2 and TCH segregating generations. In back cross and triple cross generations, most of the vines were monoecious except a few androecious and gynoecious lines with improved fruit size, vine growth and bearing capacity. Backcross and triple cross with sponge gourd displayed a shift towards the species.

Boopalakrishnan *et al.* (2021) performed the QTL mapping for gynoecy in cucumber by using back cross populations (BC_1F_2 & BC_1F_3) of a cross using two inbred lines; one monoecious with multiple lateral branching habit cv. Pusa Uday and gynoecious exotic line Gy14 with few lateral branches. They detected seven gynoecious QTLs in two genomic regions (chromosome 5 and 6), on which three significant QTLs (qGyn 5.1, qGyn 6.5 and qGyn 6.6) had higher LOD score and phenotypic variance in BC_1F_2 population. However, two significant QTLs (qGyn 5.1 and qGyn 6.1) accounted for gynoecism at chromosome number 5 & 6, respectively in BC_1F_3 population. Out of 82 SSR markers, three were found tightly linked and flanked to gynoecious trait QTLs (qGyn6.5 and qGyn6.6) in BC_1F_2 population at <1.5 cM, which could be used for marker-assisted selection (MAS) in cucumber improvement programmes.

Bommesh *et al.* (2020) developed and maintained the gynoecious inbred lines (Cucumber) from the gynoecious parthenocarpic cucumber hybrids Silyon hybrid, Pickling cucumber-1 (PC-1), Pickling Cucumber-2 (PC-2) and Pune Cucumber Hybrid at ICAR–Indian Institute of Horticultural Research, Bengaluru. Individual plant selections were made in F_2 population through pedigree method. Those lines were forwarded to F_4 generation based on sex expression and mean performance. F_4 populations were validated at phenotypic as well as molecular level through SSR markers linked to gynoecious trait.

Conclusion

Genetic factors affect the development and sex expression in cucurbit crops.

The gynoecious line is the most suitable as female parent for development of hybrids and hybrid seed production.

Hybrids generated by intraspecific hybridization have female related traits that resulted in high yield.

Interspecific hybridization is successful and highly fertile hybrids could be achieved for the introgression of high yield and specific flower traits.

Three SSR markers (SSR00233, SSR15516 and SSR13251) was found tightly linked and flanked to gynoecious trait, which can be used for marker-assisted selection (MAS) in cucumber improvement programmes.

The gynoecious lines namely, IIHR-434, IIHR-435, IIHR-436 and IIHR-437 were successfully developed, IIHR-437 has recorded higher yield among developed lines.