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# Introgression Breeding for Fruit and Shoot Borer Resistance in Okra

**Vekariya Dharmik N.[1], Dr. S. S. Patil[1] and Dr. R. K. Kalaria[2]**
[1]Department of Genetics and Plant Breeding, College of Agriculture, Navsari Agricultural University, Bharuch, Gujrat
[2]Bioinformatics section, ASPEE Shakilam Biotechnology Institute, Navsari Agricultural University, Surat, Gujrat

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## INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is an annual herbaceous plant. Okra is grown widely in tropical, subtropical and warm temperate regions, under open field conditions and can be cultivated year-round in suitable climates. The flowers are mostly self-pollinated, but the large, showy and open nature of flowers also favors insect activity. The plant typically grows 1–2 meters in height with an erect, branched stem covered in bristly hairs. The immature green fruits of okra are consumed as vegetable. In 100 g edible portion, it contains 88.6 g moisture, protein 2.1 g, 0.2 g fat, 1.2 g fibre, 0.7 g minerals, 8.2 g carbohydrates, 47.0 mg vitamin C, 53.0 mg magnesium, 0.19 mg copper, 84.0 mg calcium, 1.2 mg iron, 103.0 mg potassium, 90.0 mg phosphorus, 6.9 mg sodium, 30.0 mg sulphur, 0.08 mg riboflavin, 8.0 mg oxalic acid, 0.185 mg βcarotene, 0.04 mg thiamine and 0.6 mg niacin (Habtamu *et al.,* 2014). Fruit and shoot borer can cause significant economic loss in crops, with damage ranging from 4–26% under controlled conditions to as high as 58–89% when left unmanaged. This loss results from both physical damage to plant parts and to economic parts like fruits, leading to reduced marketable yield and quality. Introgression breeding is the process of introducing desired genes from one species into another, typically through hybridization followed by backcrossing, to transfer genetic material (alleles) from the gene pool of the donor species into the recipient species' gene pool. This approach leverages the genetic diversity of wild okra relatives, which often possess natural resistance traits, to improve the resilience of cultivated okra. By crossing cultivated okra with resistant wild species and selecting progeny with desired traits, breeders can develop new varieties with enhanced resistance to shoot and borer infestation. This method not only reduces the reliance on chemical pesticides but also provides a sustainable and environmentally friendly solution to pest management in okra cultivation. The introgressed lines can be further evaluated for their agronomic performance and resistance stability, facilitating the development of high-yielding, pest-resistant okra varieties for farmers.

## STAGES OF INTROGRESSION BREEDING

1. Screening and identification of resistant/ tolerant wild species
2. Development of inter-specific hybrids
3. Generation advancement and back-crossing of amphidiploids with cultivated okra

## CASE STUDIES

**Prabu *et al.* (2009)** evaluated 21 wild genotypes belonging to nine *Abelmoschus* species and 10 cultivated genotypes of *A. esculentus* at the Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri and studied their reaction to the shoot and fruit borer (*Earias* spp.) over three successive seasons summer and *kharif* of 2004 and summer of 2005. The study revealed that *A. tuberculatus* lines 1, 2 and 3 were found immune to fruit and shoot borer infestation while *A. ficulneus*-1 is tolerant to fruit and shoot borer.

**Badiger and Yadav (2019)** screened 44 accessions of six wild okra species and two check cultivars *viz*., Pusa Sawani and Pusa A-4 of cultivated okra under natural occurrence during *kharif*-2015 at IARI Pusa. Out of 17 accessions of *A. manihot* var. *tetraphyllus* only 7 and from 16 accessions of *A. moschatus* 8 were resistant to borer is due to the presence of dense trichomes on the stem and fruit surfaces. The resistance found in 3 accessions of *A. tuberculatus* might be due to trichomes on the surface of the fruit wall. 2 *A. ficulneus* accessions included in the study were moderately resistant. In *A. angulosus* var. *grandiflorus* accessions, one accession was resistant. None of the wild species' accession was susceptible to fruit borer.

**Theophilus (2016)** performed direct crossing between *A. esculentus* and *A. caillei* in single row planting with four replications. The cross T3 × AM was found to have highest with 60% of crossability index and highest seed germination in cross ID × KP with 85%. So, these parents can be suitably used in our introgression breeding programmes for obtaining viable progenies.

**Nagaraju *et al.* (2019)** investigated the pattern of interspecific hybridization in genus *Ablemoschus* involving seven wild species with eight genotypes of cultivated species (*Abelmoschus esculentus*) during the *kharif* 2015. They found that the cultivated *A. esculentus* genotypes IIHR 285 and IIHR 10-11-594 were compatible as male parents with *A. caillei*, *A. manihot* ssp. *tetraphyllus, A. tetraphyllus* var. *tetraphyllus* and *A. tuberculatus*. However, there was limited fruit set observed in *A. angulosus* var. *angulosus*, *A. angulosus* var. *grandiflorus*, *A. moschatus* and *A. ficulneus*. The $F_1$ seeds thus obtained were failed to germinate due to non-viable seeds.

**Reddy (2015)** crossed horticulturally superior RNOYR-19 (*A. esculentus*) and *Abelmoschus manihot* sub spp. *tetraphyllus* during summer 2013. The interspecific $F_1$ hybrid plants of the above one-way cross were absolutely free from hybrid lethality and hybrid breakdown but complete sterility was observed in the $F_1$ hybrid. A restoration of partial fertility in the $F_1$ hybrid plants was achieved by treating the seedlings of the interspecific $F_1$ plants at two leaf (pseudocotyledonary) stage with 0.1% colchicine on shoot apical meristem through cotton swab method, resulting in the production of raw colchiploids (C1). A restoration of complete fertility in the raw colchiploids (C1) was achieved by single cycle of selfing resulting in the production of stabilized colchiploids (C2).

**Balakrishnan *et al.* (2011)** conducted crossing of three high yielding varieties and three resistant genotypes of okra germplasm representing four cultivated species *Abelmoschus esculentus* and two semi-domesticated species *Abelmoschus caillei* in all possible combinations and the parents and hybrids were evaluated for resistance against borer infestation. The $F_1$ hybrid of Sel 2 x AC5 identified as the best hybrid for both high marketable fruit yield and resistance to fruit and shoot borer.

## CONCLUSION

Wild relatives from nearby gene pool could be strong source for resistance against major pest like fruit and shoot borer. Introgression breeding enables breeders to tap into the genetic diversity of wild relatives, accessing resistance genes which are not found in cultivated okra. This approach allows for the introduction of multiple genes, that providing a more durable and long-lasting solution to fruit and shoot borer management. Despite challenges, the potential benefits make introgression breeding a promising strategy for enhancing okra production and mitigating economic losses due to pest infestation. Further research and breeding efforts are essential to fully harness the potential of introgression breeding for okra improvement.

## FUTURE PROSPECTS

- Satisfactory/desirable resistant source needs to be identified.
- Integrating introgression breeding with MAS.
- Exploitation of epistatic gene interaction for resistance.
- Utilization of embryo rescue technique to get viable fertile seeds.

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