Origin of ‘Guineen’ Type of Okra (Abelmoschus) and its Nature of Resistance to Yellow Vein Mosaic Virus Disease

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The tender green fruit of okra (Abelmoschus esculentus) is prominent among the warmer region vegetables. In India, the high susceptibility of the plant to yellow vein mosaic disease spread by an insect vector Bemisia tabaci Genn. leads at times to a loss of about 94% of the crop (Shastry and Singh 1974), besides the fruit is also attacked by borer (Earias insulana). Hybridization with a ‘Guineen’ type of okra, an yellow vein mosaic resistant and pest immune species, followed by back-crossing and selection has already been taken up to incorporate the disease resistant genes while tenabling the palatability of A. esculentus fruit. For the success of such a rational crossing programme, a thorough understanding of the cytogenetic relationships between the two types would be an indispensable prerequisite. It is also important from the phylogenetic stand-point.

Materials and methods

The ‘Guineen’ type (Fig. 1) used in the present study is an accession of okra introduced by the Division of Plant Introduction, I.A.R.I., New Delhi from Ghana which was initially considered as Abelmoschus manihot but not confirmed as it closely resembles A. esculentus as well. The other one—‘Soudanien’ type (A. esculentus (L.) Moench; Fig. 2) is a race cultivated locally. The type names are as proposed by Siemonsma (1982).

Both the types and their reciprocal hybrids were grown under uniform conditions in the experimental plot. Meiotic studies were carried out by fixing the young flower buds in 1:3 acetic alcohol mordanted with ferric acetate and squashed in 1% acetocarmine.

Results

The two types are highly compatible as all the crosses attempted were successful ensuing in good seed set. The F₁ hybrids (Fig. 3) obtained reciprocally were indistinguishable from each other. Largely, the morphological characters of the hybrid were intermediate between those of the parents. But, they showed a pronounced vegetative vigor and increase in yield. Irrespective of open-pollination, selfing
or back-crossing the hybrid plants had a high fruit set. However, its pods were intermediate in size as well as in shape and contained only 2 to 3 seeds each (Fig. 4), while a few were seedless. Although a lot of seeds could be obtained, most of them were lustreless and deformed, presumably due to abortion of embryo, and were inviable. From the seedlings obtained, amphiploids were raised anticipating more fertile forms. But it was of no practical value because of their gnarled vegetative parts.

At meiotic metaphase I while *A. esculentus* had 65 II, in the 'Guineen' type 98II were discernible. The F₁ hybrid has 2n=163 chromosomes which showed a typical association of 65 bivalents and 33 univalents at meiotic metaphase I (Fig. 5). Anaphase separation was invariably highly irregular and was conspicuous in having a number of laggards. Most of the cells formed polyads (Fig. 6) resulting in sterile pollen grains which considerably varied in size and staining property.

None of the F₁ plants at its juvenile stage exhibited any symptom of yellow vein mosaic disease. However, out of 25 plants grown to maturity 2 were infected by the virus at a later stage and in the succeeding generations more than half of the population was severely affected by the disease.

**Discussion**

Interspecific crossability is significant from the evolutionary and systematic stand-
point since it throws light on the phylogeny, or at least indicates the affinity existing between the species involved. From the crossing data it is apparent that there is no barrier to successful intercrossing between *A. esculentus* and the ‘Guineen’ type since none of the crosses failed to give hybrid seed. Unlike some earlier reports (Teshima 1933, Thakur 1976) in the present case as observed by Siemonsma (1982) the hybrids could be readily obtained reciprocally with no discrepancy regarding the direction of cross.

Though several sources of resistance to yellow vein mosaic virus have been identified (Prem Nath 1970), an accentuated attention of okra breeders has been received by the ‘Guineen’ type since its introduction to India. It is irrefutably proved that both the introduced type and its hybrid with *A. esculentus* are symptomless carriers of the disease with some inbuilt genetic mechanism which did not allow multiplication of the virus fast enough to show up (Thakur 1976, Singh and Thakur 1979). So, it can be postulated that even if a disease resistant strain develops, there is high probability for it to lose this property due to some genetic and agroclimatic factors as it happened with ‘Pusa Swami’ (an *A. esculentus* variety reported earlier to be a symptomless carrier of the virus; vide Singh and Thakur 1979).

The difference in chromosome number of the types which resulted in the formation of as many as 31 to 35 univalents per cell in the hybrid disrupts the normal meiotic process and thereby virtually upsets its sexual mechanism. The ensuing high sterility of the *F₁* and succeeding generation hybrids form the chief set back to any intended programme of transferring the genes responsible for disease and pest resistance to the high yielding cultivated varieties of okra.

From the phylogenetic point of view the meiotic behaviour of the present hybrid is intriguing. The ‘Drosera Scheme’ of chromosome pairing in reciprocal hybrids indicates that the haploid complement contributed by *A. esculentus* is completely homologous with 65 chromosomes of the ‘Guineen’ type while the remaining 33 chromosomes which regularly appear as univalents showing nonhomology with *A. esculentus* complement. The latter genome may be related to *A. manihot* L. Medik (syn. *H. manihot* L.) with *n*=33 reported by Skovsted (1935) or with some other hitherto unidentified species with the same chromosome number (see Ford 1938). Thus, the ‘Guineen’ type appears to be an amphiploid comprising one genome of cultivated okra (*A. esculentus*) and the other belongs to some species with 33 gametic chromosomes. Crossability relations and meiotic behaviour of *F₁* hybrid reported by Kuwada (1957) of the aforementioned two species may refer to a different cross because of difference in number of chromosomes of the parents as well as the dissimilar meiotic behaviour of its hybrid as compared to the present one.

On the basis of phytogeographical studies Vavilov (1949–50) has suggested an Abyssinian origin for *A. esculentus*. Its wild form is reported from Sudan and a natural amphiploid has now come across from Ghana. The species is polyphyletic in origin, and Joshi and Hardas (1956) have pointed to its alloplloid nature. According to them, the basic chromosome number of the genus is uncertain and the haploid numbers *n*=29 and 36 must themselves be polyploid. The present investigation too conforms to the above contention.
Summary

Successful intercrossing has been carried out between a ‘Soudanien’ and a ‘Guineen’ type of okra, of which the latter is reported to be immune to the yellow vein mosaic (YVM) virus disease. However, due to difference in chromosome numbers of the parents the hybrid exhibited abnormal meiosis leading to sterility and thereby hinders fruitful incorporation of the disease resistant gene to the former. Phylogenetic relationship between them is discussed. Origin of ‘Guineen’ type through natural hybridization between A. esculentsus and A. manihot is suggested.

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