GROWING *COLOCASIA* EMBRYOS IN CULTURE

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COLOCASIA ESCULENTA, commonly known as taro or dasheen, is an important tuber crop extensively cultivated in most tropical countries and is used as a subsidiary food. Several varieties of it are grown in India, China, Japan, Florida and Hawaii and other Pacific Islands. The only method of propagation known in this is vegetative, either the main root stock or the smaller side tubers being used for this purpose. Though the plant sets seeds they have never been seen to germinate in nature and the plant has so far been considered sterile. This possibly explains why no breeding work has been done on this important crop so far.

The sterility in *Colocasia antiquorum* has been investigated previously by Maeda[3] and Banerji.[1,2] Maeda determined the haploid chromosome number as $n = 14$ and also observed certain irregularities in the microsporogenesis of the plant and suggested that this might be the cause of the sterility. Banerji[1] suggested the non-formation of seeds in *C. antiquorum* as being due to the nondevelopment of the female gametophyte. Later he (Banerji[2]) studied the micro- and mega-sporogenesis in the plant in detail. He confirmed Maeda's findings regarding the irregularities in microsporogenesis and also gave a detailed account of the degeneration of the female gametophyte, which he considered to be responsible for the sterility.

During the past four years the cytology of 15 varieties of *Colocasia esculenta* and two varieties of *C. antiquorum* have been studied. In both species, it was found that the somatic chromosome number in the diploids is 28 and in the triploids 42. The microsporogenesis in both diploids and triploids were investigated. In the diploids it was found that the course of meiosis was regular, the abnormalities reported by Maeda and Banerji being observed only rarely and probably accountable by variations in temperature or other environmental factors. In any case, these few abnormalities could not account for the reported sterility in the diploid plants. The pollen grains were over 90% normal and completely filled as indicated by staining tests with iodine and acetocarmine. Germination tests also showed that the pollen grains are normal and viable. The development of the fruit and seeds also appeared normal.

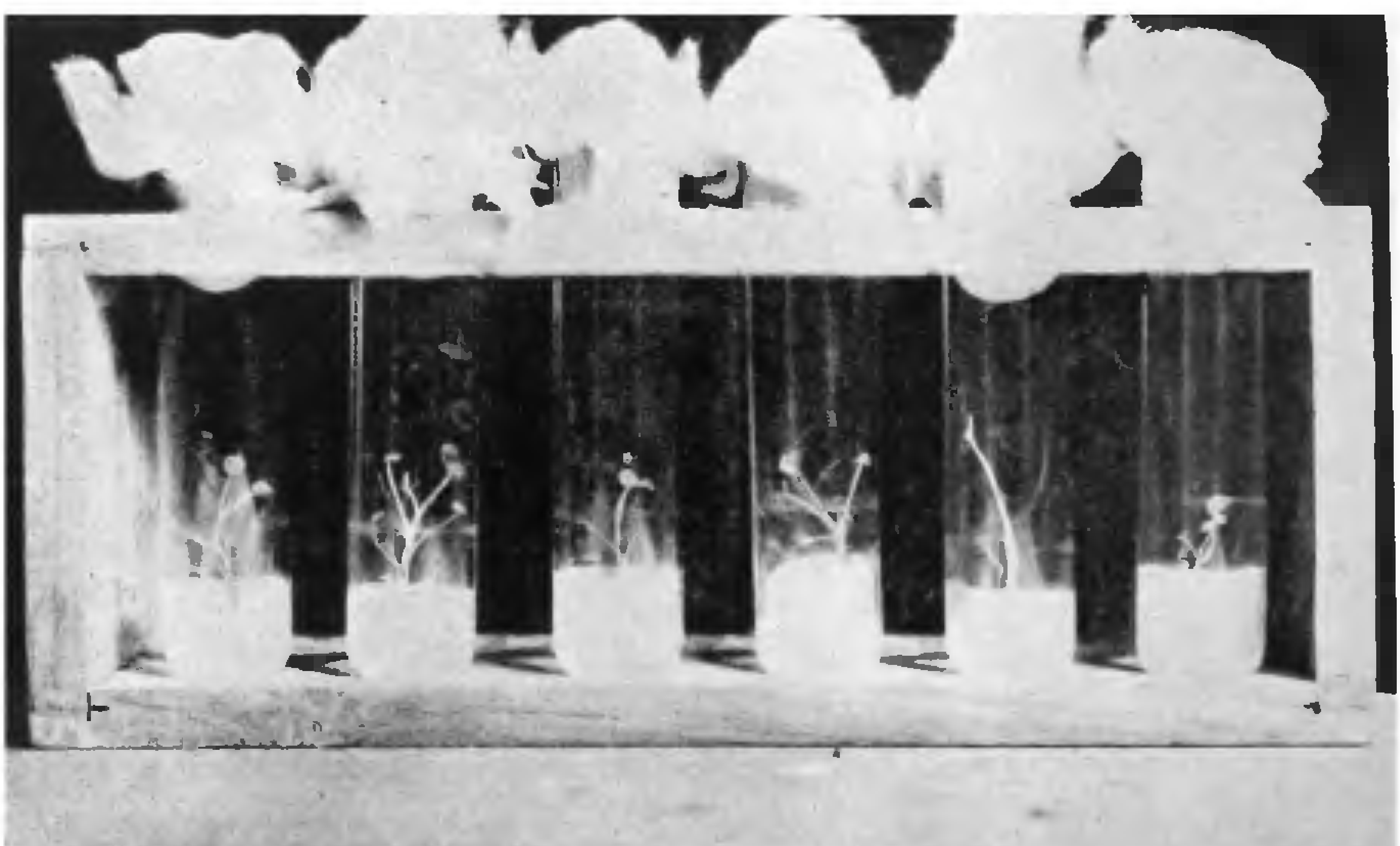

FIG. 1. Culture tubes containing 4 weeks-old seedlings of *Colocasia antiquorum* (3 on the left) and *C. esculenta* (3 tubes on the right).

Aborting seeds or seeds without embryos were only seldom seen. The seeds though small were fully developed. The embryos, which are small, are well formed and not shrivelled as in the case of really abortive seeds. They range in size between 0·6 mm.–0·9 mm. in length and 0·3 mm.–0·4 mm. in diameter. It was felt that seeds fail to germinate under ordinary treatments probably due to some unfavourable conditions and therefore embryo-culture technique was tried.

The fruits of diploid plants of *Colocasia esculenta* and *C. antiquorum* were sterilized by dipping in 90% alcohol and flaming. The embryo was dissected out under a binocular microscope. By holding the seed gently pressed down with one needle, the testa is broken with another at the micropylar end and by a gentle pressure over the seed the embryo slides out of the endosperm. It sticks to the needle and is easily transferred to the culture tubes containing modified White's medium autoclaved and sterilised as usual.

During the first four to six days the embryos showed little visible change. But later growth was rapid and in 20-30 days the seedlings had grown over an inch in height with four to five small leaves. They were then transferred to soil in pots and developed into normal healthy plants. Among the plants thus raised appreciable variation in easily recognisable morphological characters was noted. This may be due to the heterogeneous nature of the parent plant or due to natural cross-pollination.

It is clear that the sterility in *Colocasia* is not the result of either microspore or megagametophyte abortion, as previously reported, or due to the disturbed embryo, endosperm and pericarp relations ("somatoplastic sterility" of Cooper and Brink[3]) as in the case of interspecific hybrids. In *Colocasia* the embryo reaches full growth in the seed. The embryo fails to develop into seedling under ordinary conditions probably because the food supply from the endosperm is inadequate or due to other causes still unknown.

The present investigation clearly shows that cultivated as well as wild strains of diploid *Colocasia* species produce normal viable embryos and it is easy to raise seedlings from them by embryo-culture technique. This opens up possibilities of improvement in this crop by intervarietal and interspecific hybridisation. Work on this is in progress in this laboratory.

This work was done under a scheme of research on Miscellaneous Tuber Crops financed by the Indian Council of Agricultural Research.

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2. —, *Jour. Ind. Bot. Soc.*, **1937**, **16**, 159.
3. Cooper, D. C. and Brink, R. A., *Genetics*, 1940, **25**, 593.
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ORIGIN OF THE SOLAR SYSTEM

NOTWITHSTANDING the fact that the origin of the solar system has been the subject of scientific investigation from century to century, it may truly be said that the problem is yet unsolved and is likely to remain a perpetual one. Any theory of the origin of the solar system should explain in a consistent manner the considerable degree of order that is observed in it. In this context the new approach suggested by Woolfson (*Nature*, 1960, 187, 47) deserves notice. The model which he proposes for the formation of the solar system, in common with some others which have been advanced, envisages the passage of a star into the neighbourhood of the Sun. He considers a star of one hundred Sun masses moving with a velocity of 100 km./sec. and approaching the Sun to within a distance of ten times the solar radius.

The Sun is imagined as initially spinning about an axis not in the plane of the orbit of the star. A tide is raised on the surface of the Sun which increases in height as the star approaches. Eventually a position is reached where a portion at the tip of the tidal bulge facing the star is under a greater gravitational pull from the star than from the Sun itself, and this portion then breaks away and, moving under the combined gravitational attractions of the star and the Sun, forms the planet Pluto.

This loss of material at the solar surface sets up waves which will travel around the Sun from the unaffected obverse tidal bulge towards that part of the Sun facing the oncoming star. The wavecrest approaches the oncoming star which eventually draws off another portion of the solar material to form the planet Neptune. A new wave is initiated to give the planet Uranus, and then Saturn and Jupiter are formed in a similar way. At this stage the star is approaching most closely and is able to draw material out from the Sun almost continuously, a great deal of which material it may even capture. Indeed a large planet could have been formed at this stage and captured by the star. The residue of the ejected material forms the belt of asteroids, which lie for the most part between the orbits of Jupiter and Mars. Finally, as the star recedes, the four smaller planets—Mars, Earth, Venus and Mercury—are formed.