A DIRECT EVIDENCE FOR THE MISDIVISION HYPOTHESIS

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ABSTRACT

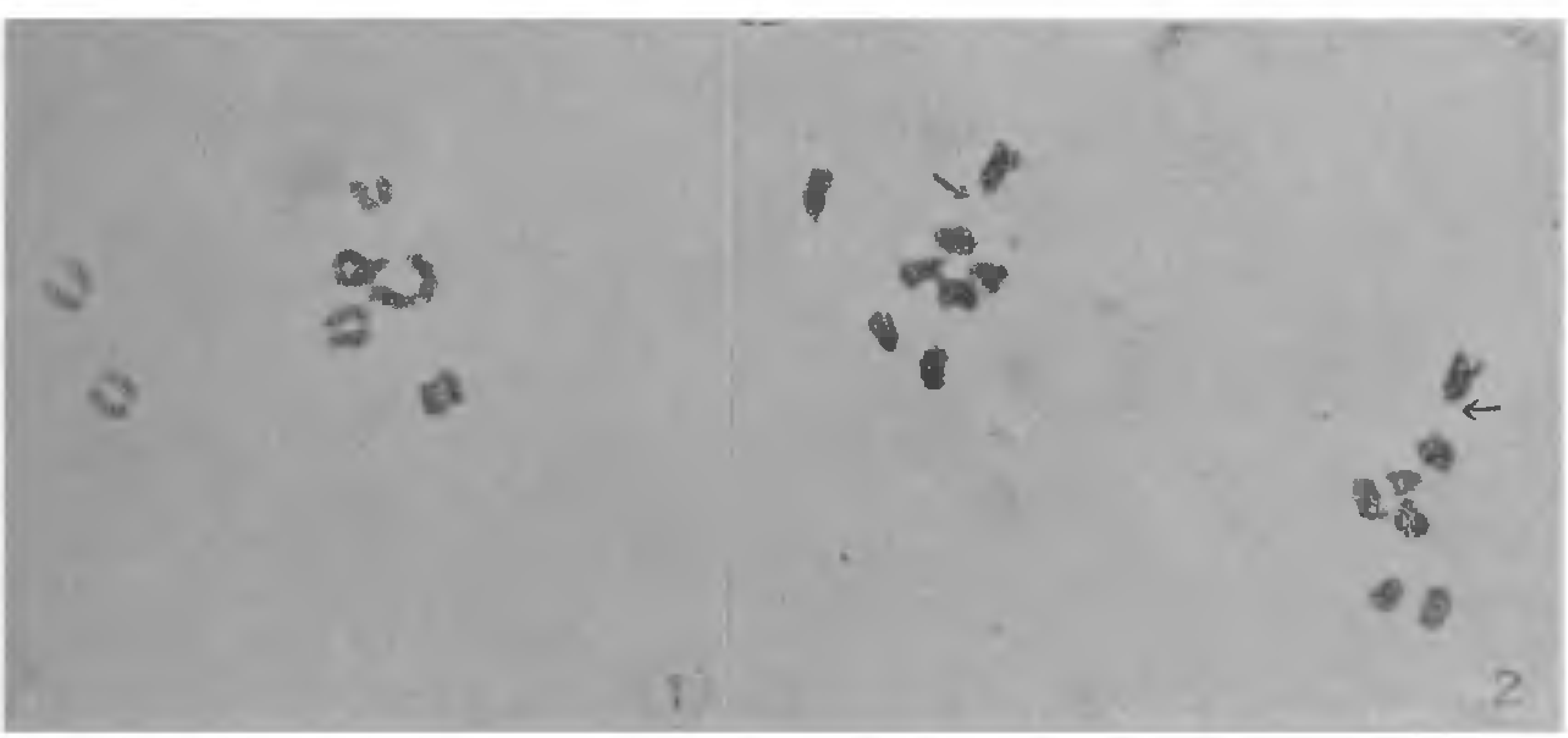
In a plant of *Pennisetum typhoides* that had arisen from gamma irradiated seeds one of the chromosomes was broken transversely at the centromere giving rise to two telocentrics, providing, a hitherto lacking, direct evidence for the misdivision hypothesis. Besides showing how the chromosome number may increase in evolution this has also shown that telocentrics can survive in nature.

INTRODUCTION

In both animal and plant kingdom variations in chromosome number, within a species and between the sexes of the same species, have frequently been reported. Apart from the differences attributed to ploidy, hyper- or hypoploidy, these variations have been explained as due to structural hybridity caused by fusion and fragmentation.[1,4,5,10] Centric fusion, termed the Robertsonian system,[9] is perhaps the commonest cytological rearrangement to account for the evolution from a high to a low diploid number. Centric fusion is accompanied by the formation of a new bi-armed chromosome, a small centric fragment that is lost in subsequent cell divisions and a reduction in division was applied by Darlington[2,3] to the phenomenon of transverse breakage of chromosomes at the centromeric region. Although misdivision was cited by Darlington[2] in *Fritillaria* and by Rhoades[8] in maize, so far, there has been no direct evidence for this hypothesis.

RESULTS AND CONCLUSION

In a plant of pearl millet, *Pennisetum typhoides*, raised from seeds irradiated with 35 kilo rads of gamma-rays, a few cells undergoing meiosis were found to contain $2n = 15$ chromosomes instead of the normal 14. In one such cell, at diakinesis, there were six bivalents and a trivalent (Fig. 1). In another cell, in late anaphase I, eight and seven chromosomes were seen in the opposite poles (Fig. 2). In



FIGS. 1-2. Fig. 1. P.M.C. in diakinesis with $1_{III} + 6_{II}$. Fig. 2. P.M.C. in anaphase I with 8 and 7 chromosomes at the opposite poles. Arrows indicate the telocentrics with terminal attachments

chromosome number by one. Opposed to centric fusion is centric fission common in plants[2] and in some *Lepidoptera*[13] wherein fragmentation of metacentric chromosome occurs to give rise to two telocentrics and so increasing the chromosome number by one. The term mis-

two of these chromosomes with terminal centromeres the spindle attachments could be clearly seen. They have apparently arisen as a result of transverse breakage in the centric region of one of the long chromosomes with a median centromere, as all the chromosomes of pearl millet have a median or near median centromere and the arm ratio ranges from a minimum of 0·27 in the nucleolus organizing chromosome to 0·85.[11] As dry seeds were irradiated and the effect of radiation is immediate this breakage must have occurred in the somatic cells. The telocentrics must have survived many somatic cell divisions to appear in the meiotic divisions of the pollen mother cells. The two telocentrics have paired to give rise to a trivalent seen in Fig. 1. The orientation of the trivalent was such that while each of the two telocentrics went to the opposite poles, their unbroken partner with a median centromere went to one of the poles increasing the chromosome number at that pole by one. Thus, a cell with eight and seven chromosomes at the opposite poles, as in Fig. 2. resulted. As the telocentrics appeared in the immediate generation after seed irradiation, it constitutes a direct evidence for the hypothesis of misdivision. The telocentrics are not only seen directly under the microscope with their terminal spindle attachments, their presence is further confirmed by the formation of a trivalent in meiosis and by the increase in the chromosome number by one.

Darlington[2] and White[12] thought that all telocentrics are unstable and hence do not survive in nature. White[12] doubted whether the chromosomes in which the centromeres appear to be terminal are really telomeric and used the term acrocentric. He argued that if the terminal structures sometimes found in acrocentrics are in fact short arms, it follows that these chromosomes will have centromeres identical to those of metacentric chromosomes and, therefore, it is the structural normality of their centromeres that account for the stability of such chromosomes. The presence of a minute second arm is immaterial for the stability of a chromosome is borne out by the present case as the chromosomes have terminal spindle attachment and there is no sign of any secondary change like translocation in these chromosomes. There is no evidence that a telocentric is unstable because its centromere is terminal. Although telocentric chromosomes rarely occur in plants, a few cases have been reported.[6]

Two types of gametes are expected to occur with telocentrics: One type would be deficient in a chromosome arm and would be at a disadvantage in competition with normal gametes unless the arm lost is genetically inert or the loss nullified by polyploidy. The other type would have telocentrics in excess of the normal. If these gametes compete successfully with the normal ones they give rise to polysomic individuals. Such polysomic individuals which are selectively disadvantageous in sexually reproducing organisms would be eliminated.

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ERADICATION AND UTILIZATION OF WATER HYACINTH—A REVIEW—AN ADDITION

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THE above review, recently published by Archana Sharma,[1] needs important additions regarding the eradication and utilization of water hyacinth. In this review, the author has not mentioned the most successful method of eradication by 2, 4-dichlorophenoxyacetic acid (2, 4-D) and also the recent work on the utilization of water hyacinth for nutrient removal from polluted waters.

ERADICATION

To eradicate *Eichhornia crassipes*, L.[3,4] Hildebrand (1946) used 2, 4-D for her experiments. Various tests performed on infestations in a