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# The Occurrence of Barren Tillers in a Heterozygous Rice

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**Introduction:** The formation and emergence of panicles is a season bound character in some varieties of rice. However, there is some evidence that it is also genetically controlled. Anandan and Krishnaswamy (1934) have recorded the occurrence of earless or 'Barren-Sterile' type of plants occurring as a segregant in a culture of Muthusamba. They found that one of their cultures was heterozygous and that in a population, the number of plants without panicles was nearly one-fourth of the total representing an approximate 3 : 1 ratio. In confirmation, they found that some of the apparently normal looking plants segregated similarly in the next generation. Therefore there is a probability of a single mendalian factor being concerned, the heterozygous normal being phenotypically indistinguishable from the homozygous normal plants. This type of inheritance in rice has not been recorded elsewhere and is of extreme interest. Therefore the segregating culture was kept alive at the Paddy Breeding Station, Coimbatore and study continued. The present paper deals with some new observation made in the course of study.

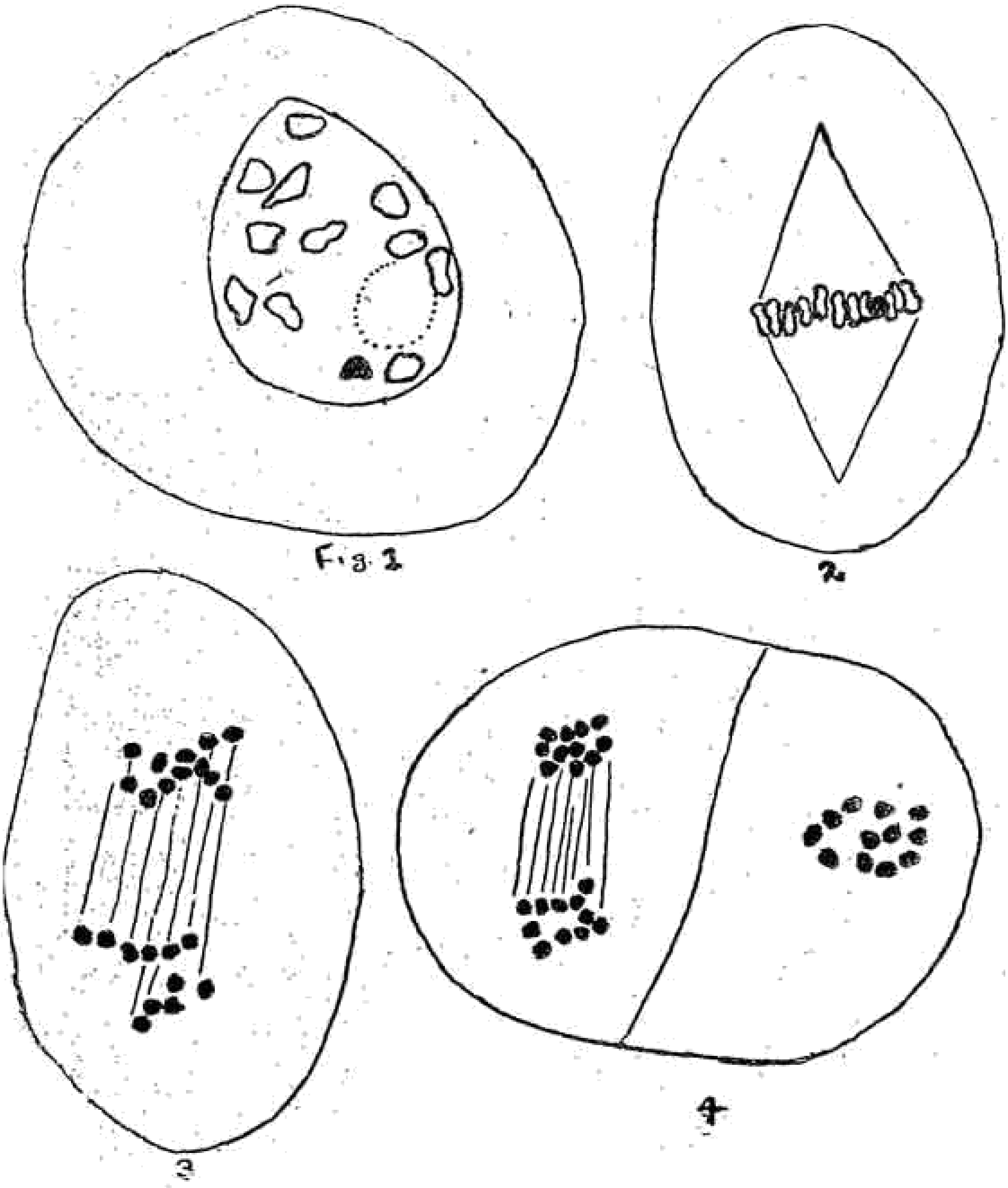
The cytology of this segregating form has been studied. From a study of mitotic divisions Sampath and Krishnaswamy (1948) found out that the somatic chromosome number of the barren plant was 22 and pointed out that this could only arise out of a 23 chromosomed plant. Also that the 23 chromosomed plant itself should have arisen from normal 24 chromosomed plant by non-disjunction of a pair of chromosomes and the formation of a 11 chromosomed gamete and its subsequent fertilization by a 12 chromosomed gamete. This 23 chromosomed (monosomic) plant would give rise to 24, 23 and 22 chromosomed plants in 1 : 2 : 1 ratio. By securing a 23 chromosomed plant both the type of plants could be maintained. Barren plants could be morphologically distinguishable from the apparently normal plants only after a growth period of 125 days. From the remaining population a random selection of 10 – 15 single plant selections has to be made. When these are sown next season, on probability, at least one selection will give rise to a segregating population. The method is wasteful and a simple method of selecting heterozygotes in the field, would be a great convenience. Pollen grain studies of the monosomic plant did not reveal dimorphism of grains. Therefore the method of identifying the heterozygotes by pollen grain size is not available. An alternative method is to study the root tip mitosis of a number of plants and pick out the 23 chromosomed plant. By chance an easier method of solving this problem arose and is given below.

**Materials and Methods:** The segregating culture was carried over year after year by single plant selections. These were sown during the main season (August – December). When necessary stubbles were planted in pots for further observation. Regarding cytological methods Craf A & B mixture was used for fixing root tips and Bouin's fluid for flower buds. Infiltration and embedding was done in paraffin. Staining was done in Newton's Iodine Gentian Violet. In this connection a definition of the term used may be made. Krishnaswamy and Anandan described the barren plants as 'Ba.ren Sterile'. Instead of this, the term 'Barren' is preferred and used here to describe earless plants This is because the words Barren Sterile are repetitive and the word Sterile may be used to describe unsetting in formed panicles only. In this case there are no panicles to show sterility.

**Observation:** In studying these segregating cultures, a plant was observed to have a few tillers producing fertile panicles and the remaining tillers were barren, the phenotype being 'Normal - Barren' (Fig. 5 a). There were two such plants and seeds from these were collected and grown next season.

The progeny showed segregation into normal and barren plants. A few Normal-Barren plants were also observed. The two types of tillers were separated and chromosome numbers were counted in secondary root tips. The mitotic count from the fertile tillers gave the number $2n=23$ and that from the barren tillers $2n=22$. The occurrence of nullisomic ($2n=22$) tillers in the heterozygous normal ($2n=23$) plants is interesting and reveals the rare phenomenon of somatic elimination of a chromosome.

A check of this observation was made by the study of meiotic chromosomes in the fertile tillers of this Normal-Barren plant. It confirmed that these tillers have 23 somatic chromosomes. In the meiotic division at Diakinesis, 11 bivalents and 1 univalent were formed. Two of the bivalents from the nucleorar chromosomes. Hence the deficient chromosome could not be from the nucleorar chromosomes (Fig. 1). A compact metaphase plate and a bipolar spindle were formed at Metaphase I. The univalent was seen lying along with the bivalents and move to one of the poles (Fig. 2). Anaphasic separation was clear and $\frac{12}{11}$ distribution most frequent (Fig. 3). The second division was normal, the univalent dividing equationally (Fig. 4). Tetrads were regularly formed. From this it is seen that 12 and 11 chromosomed gametes are formed and the progeny would consist of 24, 23 and 22 chromosomed plants.




**Meiotic Divisions in Monosomic Rice**

Fig. 1 : Diakinesis—11 bivalents and 1 univalent.

Fig. 2 : Metaphase I, side view univalent remaining at the equator.

Fig. 3 : Anaphase I, 12 and 11 distribution.

Fig. 4 : Division II, Metaphase in one daughter cell (12 chromosomed) and anaphase in the other (11 chromosomed). Fig. I × 3150 and the rest × 2200. The univalent is shaded.

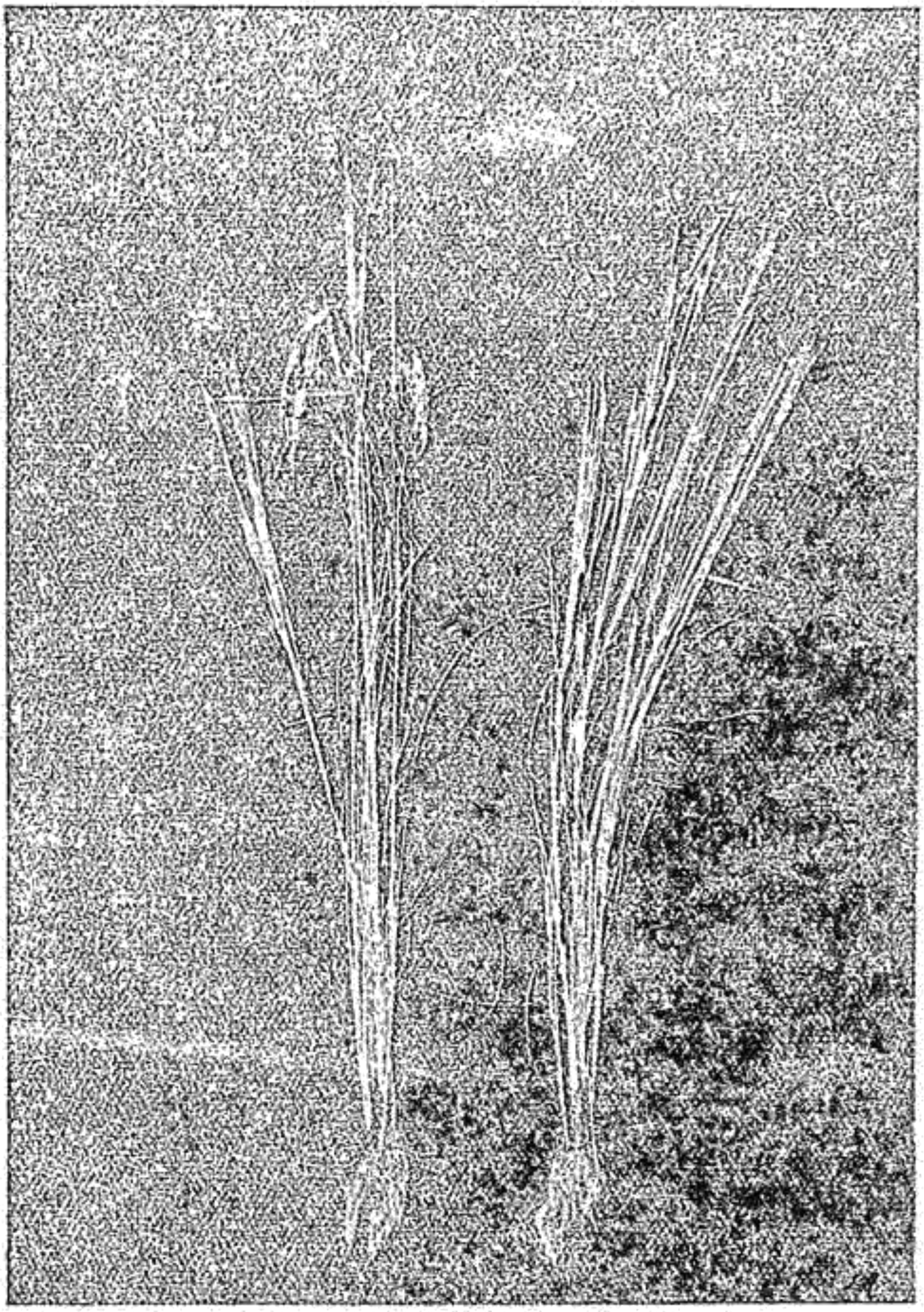


Fig. 5: Photograph showing (a) 'Normal Barren' plant and (b) Barren plant.

The genetic behaviour of seeds from 'Normal-Barren' plants were studied. The progeny showed segregation. From the two families of 855 plants, 676 were normal and 179 plants were barren. Amongst the apparently normal plants 26 had barren tillers also.

**Discussion:** The segregation requires comment. Theoretically the monosomic ($2n=23$) plants should be numerically twice as the normal ($2n=24$) as well as barren ($2n=22$). But the monosomic plants are indistinguishable from the normal and therefore the phenotypic ratio is 3 : 1. In the 3 : 1 ratio for the normal and barren plants there is a deficit in the recessive phenotype. From the study of nursery where some of the seedlings die, it is considered possible that the recessive condition namely nullisomaty is semi-lethal in effect. This mortality may account for the deficit. Amongst the normal looking plants two thirds of the population should be monosomic. Only about one-sixteenth of the population of the probable monosomics gave rise to barren tillers. The reason for this is not understood. It is probable that somatic elimination of a chromosome in tiller formation is not very frequent. Even where it occurs there is some variability in the number of barren tillers formed. Therefore the process of somatic elimination by which barren tillers are produced is an exceptional occurrence during mitotic division. The fact that it occurs is of practical use. The use is in the easy way in which 23 chromosomed (monosomic) plants can be picked out. Seeds collected from Normal-Barren plants will give rise to normal, monosomic and nullisomic plants in the next generation and the strain can be kept alive. The barren plants will not give rise to seeds, and seeds from normal plants may be homozygous for *normalcy.* In addition, pollen from 'Normal-Barren' plants can be used to hybridise other short duration varieties carrying anthocyan pigment or known linkage groups. Theoretically half the hybrids will be monosomics and by further genetical analysis it may be possible to find out if the missing chromosome carries a known linkage group.

Further study of the 'Normal-Barren' plants and its segregation may be instructive and the work is being carried on. The two problems being investigated are the following: (1) The deficit of nullisomics in the total population could be due to death in the seedling stage or due to 'Certation' the 12 chromosomed pollen being faster in tube growth and has an advantage over 11 chromosomed pollen in fertilisation, (2) some environmental factors may affect production of barren tillers.

**Summary:** A segregating culture in the long duration rice variety Muthusamba was studied. In this culture which segregated for normal and barren plants, a few plants with both fertile and barren tillers were picked. Cytological study showed that this new type was a monosomic,

add that barren tillers arose by somatic elimination of a chromosome. This work confirmed the cytological explanation for barrenness and gives a simple method of picking out 23 chromosomed plants in the field.

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**REFERENCES**

Anandan and Krishnaswamy (1934) — 'Barren-Sterile' - A new mutant in rice and its inheritance, Current Science, 3. 22.

Sampath and Krishnaswamy (1948) — A chromosome dificient Paddy type. Current Science, 17, 271.

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# Distribution of Rhizophora Mucronata, Lam., in the 'Back-Water' of the West Coast and its Economic Importance*

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**Introduction:** India possesses nearly a third of the cattle wealth of the world. Though it is far behind other countries regarding its dairy products, it stands in the forefront in the manufacture of skins and hides. In the early days, before the advent of the wattles, several indigenous tanning materials were used, namely barks of *Cassia auriculata,* L; *Cassia fistula,* L; *Acacia arabica,* Willd; pods of *Caesalpinia digyna,* Rottl. and *Caesalpinia coriaria,* Willd. and fruits of myrobalans (*Terminalia chebula,* Retz.). Prior to the first World War (1914—1918) South African wattle bark was unknown to the tanning industry of India. The war made a very big demand on the Indian tanning industry, with the result investigations were taken up at various Leather Research Institutes

* Presented to the Indian Science Congress; Calcutta, January 1952.