Chromosome Elimination in Trisomics of *Coix aquatica* Roxb.

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**Summary.** Somatic chromosome elimination was identified and its patterns studied in a trisomic (2n = 11) with marker genes in *Coix aquatica* Roxb. In a cross between a recessive trisomic with green base and white style (cco ii ss) and a dominant disomic having purple base and purple style (CC II SS), all the F1 seedling progeny were purple based because of the presence of C, I and S. For C to be expressed in seedling base, either I should be absent or S should be present with I. In style colour, however, irrespective of the presence of I and S, C produces purple phenotype.

In one trisomic (Ccc ii ss) plant (designated as 4 - 15) of the F1 progeny, a part of the seedling base was green. All the tillers coming up from the green side of the main tiller also had green base, and those arising on the purple side were purple based. Similarly, the pistillate spikelets on the green side of the main culm and on the tillers with green base were white styled, and the male spikes showed 10 chromosomes. Female spikelets on the purple side of the main tiller and on the tillers with purple base were mostly purple styled and the male spikes had 11 chromosomes. In some of the purple based tillers, however, there were both 11 and 10 chromosomes in different regions or different inflorescence clusters on the tiller. In these tillers, where the chromosome number was 11, style colour was purple, and white style occurred when there were 10 chromosomes. In one tiller, the style colour was purple but the chromosome number was 10.

The recessive phenotype of the style in the trisomic conceivably resulted from an elimination of the extra chromosome carrying the dominant allele C. On the basis of the morphological features of the extra chromosome, such as length, centromere position and distribution pattern of the hetero- and eupycnotic regions, it was identified as chromosome No.2 in the complement. It was therefore possible to place with certainty the gene c on this chromosome. Sometimes, however, the extra chromosome carrying c also was eliminated giving 10 chromosomes and purple style.

In the other trisomic plants of the F1 progeny, one plant showed 11 chromosomes but in a tiller there were only 10 chromosomes and white styles. In two other plants, although the chromosome number was 11 throughout, white style was present in a single cluster of inflorescences in one plant, and in one pistillate spikelet in the other. In the latter two cases, white style was believed to have arisen as a result of a mutation from c_C to c or somatic crossing over, giving the genotype ccc in the affected regions. In a single plant, chromosome elimination was observed in only one cell.

Apparently the 10-chromosome sectors arose from the 11-chromosome condition by selective elimination of the extra chromosome during mitosis in the primordium giving rise to these sectors. In the affected plants, elimination did not obviously occur at the same stage but at different times in their ontogeny. Instability is probably governed by one or a few major genes, associated with a number of modifiers, exhibiting incomplete penetrance and variable expression. Chromosome elimination did not apparently follow any particular pattern but was erratic. Probably some intracellular environment is necessary to trigger the mechnism governing the elimination into action. The unstable system, occurring in combination with other favourable features like the functional nature of the aneuploid gametes, sexual reproduction, monoecious condition favouring cross pollination and tolerance of extra chromosomes by the sporophyte, could be an important factor in the cytogenetic evolution of the species.

**Introduction**

The view that all tissues and cells of an organism have the same chromosome number had to be modified with the discovery of B-type chromosomes, whose number varies between different tissues or even different cells of the same tissue (Jones 1975). Also, there is evidence that the normal chromosomes of the complement in several species and hybrids show variation within the same individual (see Sachs 1952; Lewis 1962; Shahare and Shastry 1963; Khoshoo and Narain 1967; Davies 1974). While mosaics (or chimeras) involving genome reduplication or particular gene mutations causing phenotypic changes are well documented, the phenomenon of addition or deletion of single or fewer chromosomes resulting in mosaics of varying proportions in plants is believed to be rare. In trisomics of crop plants (e.g., maize, datura, tomato, spinach etc.) the presence of an extra chromosome is often associated with a recognizable phenotype. In spinach (Ellis and Janick 1959), loss of the extra chromosome from a portion of the trisomic plant brings about diploid features in a sector so that trisomic and disomic features can be recognized in the same individual. But in wild species (e.g., *Clarkia unguiculata*, Vasek 1956; *Colletia heterophylla*, Dhillon and Garber 1960), the presence of
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Materials and Methods

In *C. aquatica*, purple seedling base and purple style are dominant over green seedling base and pearly white style (hereafter referred as white style), respectively (Rao 1974). Purple colour of seedling base is controlled by three independent, dominant genes C, I and S. C, the basic colour factor, is necessary for anthocyanin formation. I is the inhibitor of C and S is the anti-inhibitor suppressing the action of I on C. Thus the genotypes C-I-S-, C-ii S- and C-ii ss show purple base and all others green base. C is pleiotropic and also affects the style colour. Its expression in style colour, however, is not inhibited by I irrespective of whether S_S is present or not. Thus, the genotype C.__~ give purple style and c__cc white style. The genotype of the parent with green base and white style is designated as cc ii ss and that of the other parent with purple base and purple style as CC II SS.

The genome of *C. aquatica* is unstable and the occurrence of intraplant variation in chromosome number is not uncommon, and aneuploids occur in selfed and cross pollinated progenies of diploids (Venkateswarlu and Chaganti 1973; Venkateswarlu, Rao and Chaganti 1968; Rao, unpublished). Bearing these facts in mind, in the present study, whenever a plant appeared in the population that showed morphological features deviating from the normal (e.g., narrow leaves, larger capsular spathes etc.), a cytological study was made of it. In most instances, however, such phenotypic abnormalities were not associated with any cytological aberrations. During one such examination, one individual (appearing in the selfed progeny of the strain with green base and white style) was found to be a trisomic with 11 chromosomes, in which one of the longer chromosomes of the complement was in excess. From a comparison of the centromere position and distribution pattern of the hetero and eupycnotic regions of the extra chromosome at pachytene, diplotene and diakinesis, with the pachytene chromosome morphology established for this species (Venkateswarlu, Chaganti and Rao, unpublished), this chromosome was identified as the No. 2 chromosome. The genotype of the trisomic plant, depending on whether any of the c, i and s genes were carried on the No.2 chromosome, would be ccc ii ss, cc iii ss or cc ii ss; if not cc ii ss.

The transmission of the extra chromosome to the progeny was studied by crossing the recessive trisomic as female with a diploid plant having the homozygous dominant characters of purple base and purple style. 38 seedlings were raised of the F1 generation. All the F1 seedlings showed, as expected, purple base but one of them exhibited a large sector of green base comprising about one-third of the culm circumference. This exceptional seedling, designated as 4 - 15, which was removed to the greenhouse, together with the rest of the F1 progenies constituted the material for this investigation.

Results

Seedling 4 - 15 was transferred to a pot in the greenhouse at 4-leaf stage and the remaining F1s were planted in the field. In plant 4 - 15, new tillers were examined for base colour as they came up. Those arising from the green side of the main culm showed green base. Tillers that developed later from these also showed green base. Tillers that arose from the purple side of the main tiller and all others originating from them showed purple base (Fig. 1). The ori-