



CHROMOSOMAL DIVERSITY AMONG DIFFERENT ECOTYPES OF *ACORUS CALAMUS* L. REPORTED FROM RANCHI JHARKHAND, INDIA

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Abstract: The chromosomal diversity was studied among ten ecotypes of the medicinally important genus *Acorus calamus* L. from Jharkhand, India and their chromosome counts have been reported for the first time. The chromosome number and size are discussed in finding and phylogeny, evolution and interrelationship of taxa. The ten ecotypes of *Acorus calamus* reveal differences in chromosome number i.e. $2n = 14, 18, 21, 27$ with diploid, triploid and tetraploid status. Detailed chromosome analysis of the ecotypes reveals heterogeneity in size, form and number of chromosomes between dissimilar ploidy level cytotypes. This is suggestive of the incidence of alteration in chromosome structure. The aberration coupled with ploidy appears to have played a major role in evolution among these ecotypes. The occurrence of chromosomal variations generates flexible variations among the ecotypes which are sustained through vegetative propagation. The karyomorphological studies provide a insight into role of chromosomal and genomic versatility in diversification of the species.

Key word: *Acorus calamus*, Chromosomal diversity, Ecotypes.

INTRODUCTION

Acorus calamus Linn commonly known as sweet flag or 'Bach' in India belongs to family Araceae. It is an important medicinal and aromatic plant having wide usage in almost all herbal based systems. *Acorus calamus* L. has rich ethno botanical aspects [1,8,10,13]. It is an important medhya drug capable of improving memory and intellect and is a highly valued herbal medicine in India. This is a polymorphic species, wide spread in North temperate region, tropical Asia and Eastern North America.

In India *A. calamus* grows in varying agroclimatic conditions right from the tropical South and subtropical plains to temperate marshes from Kashmir to the north east ascending to an altitude of 1500-2200m in the Himalayan ranges. In the present investigation ten ecotypes were collected from local areas of Ranchi, Hazaribagh, Khunti, Tamar, Namkum and Palandu and their detailed cytological studies were performed.

MATERIALS AND METHODS

All the ten ecotypes of *Acorus calamus* L. were collected from different localities of Jharkhand, India. Acetocarmine squashes of root tips fixed in 1:3 acetoalcohol with large or medium sized chromosomes were treated with 0.002M aqueous solution of 8-hydroxy quinoline for 3½ hour at 4°C prior to fixation. Ten best metaphase plates were observed under high power and length of long and short arms were measured. Microphotographs were taken with Nikon D SLR Camera-D-70S.

RESULTS AND DISCUSSION

The data for karyotype observations in the ten ecotypes of *A. calamus* L. collected from Palandu, Namkum, Hazaribagh, Tamar, Khunti and Ranchi are presented in (Table 1) and fig.1-20. The root tip cells showed basic chromosomal number as $x = 9$ in the five ecotypes (Palandu collection II, Hazaribagh collection I and II, Tamar collection and Birsa chawk Ranchi collection) and $x = 7$ were reported in the ecotype (Palandu collection I, III and IV, Namkum collection and Khunti collection). The length of all the ecotypes ranged between 3.48 μ to 0.51 μ .



Fig. 1 Palandu collection I

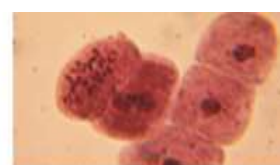


Fig. 2 Palandu collection II



Fig. 3 Palandu collection III

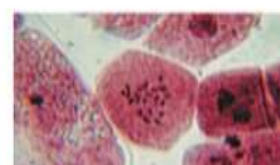


Fig. 4 Palandu collection IV



Fig. 5 Namkum collection

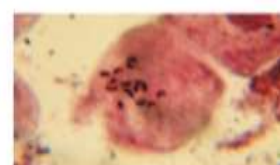


Fig. 6 Khunti collection

Figure 1-6: Mitotic metaphase chromosomes of six ecotypes of *Acorus calamus* L.

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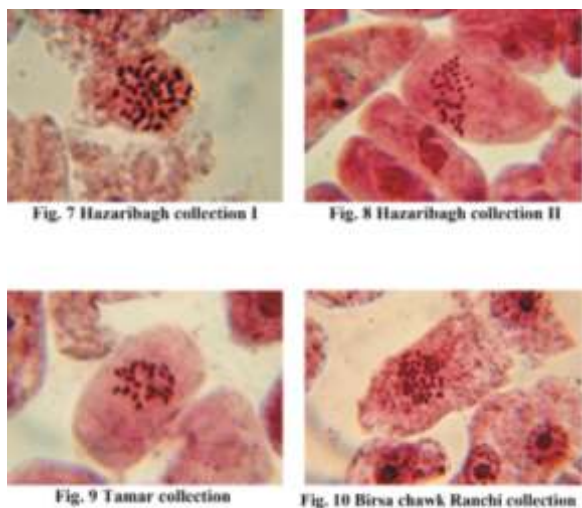


Figure 7-10: Mitotic metaphase chromosomes of four ecotypes of *Acorus calamus* L.

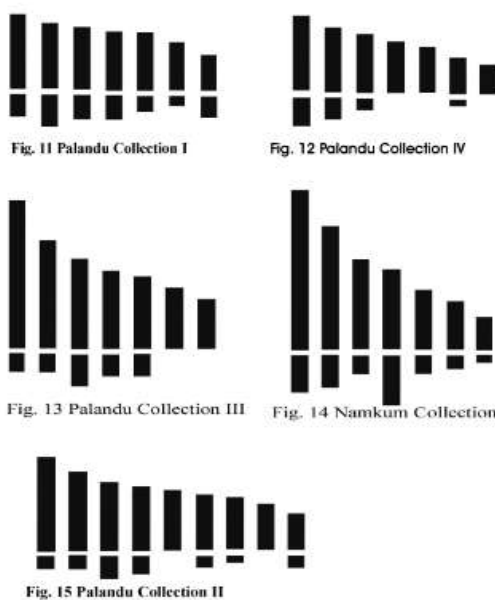


Figure 11-15: Idiograms of ecotypes of *Acorus calamus* L.

Table 1: Chromosomal diversity among different ecotypes of *Acorus calamus* L.

Sl. No.	Ecotypes under consideration (<i>Acorus calamus</i> L. collected from Ranchi, Jharkhand)	Present study		
		Chromosome number		Chromosome size (μ)
		n	2n	
1.	Palandu collection I	7	21	0.91 – 1.83
2.	Palandu collection II	9	27	0.84 – 1.94
3.	Palandu collection III	7	14	0.91 – 2.93
4.	Palandu collection IV	7	21	0.51 – 1.84
5.	Namkum collection	7	21	0.62 – 3.48
6.	Hazaribagh collection I	9	27	0.77 – 2.27
7.	Hazaribagh collection II	9	27	1.10 – 2.93
8.	Tamar collection	9	18	0.99 – 2.31
9.	Khunti collection	7	14	1.02 – 2.97
10.	Birsa chowk Ranchi collection	9	27	0.66 – 2.93

S. No.	Ecotypes under consideration (<i>Acorus calamus</i> L.)	Chromosome number		Chromosome size	Author year
		n	2n		
		1.	South India (Kerala)	9	
2.	South India (Ooty and Kodoikanal, Tamilnadu)	12	24	1.4 μ m – 2.2 μ m	D. Subramanian and M. Munian (1988)

Based upon ploidy status and geographical distribution. *A. calamus* L. has been classified as

- (i) Diploidy variety ($2n = 2x = 24$; North America)
- (ii) Triploid variety ($2n = 3x = 36$; Europe)
- (iii) Tetraploid variety ($2n = 4x = 48$; East Asia, India and Japan)
- (iv) Hexaploid variety ($2n = 6x = 72$; Kashmir area, India).

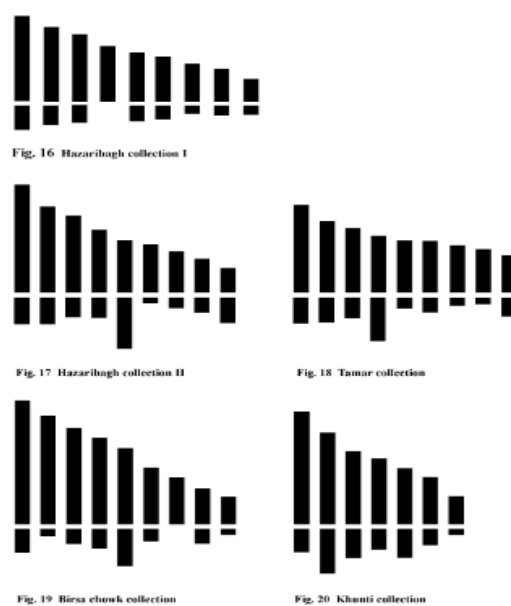


Figure 16-20: Idiograms of ecotypes of *Acorus calamus* L.

The species has been primarily defined on the basis of genomic differences [11]. In the family Araceae as a whole, the basic chromosome number 7, is suggested as the ancestral basic chromosome number of the family. Aneuploid changes of chromosome number might have produced basic number of $x = 6, 7, 8, 9$ and 10 in early evolution of the family [12]. Previous reports on chromosome number in *Acorus calamus* L. have indicated 9, 11 and 12 as base number [2,6]. Similarly several chromosome counts have been reported for *A. calamus* L. suggesting additional basic chromosome numbers e.g. $x = 9$ ($2n = 45$ from South India, $2n = 54$ from Kashmir India) and $x = 11$ or aneuploidy based on $x = 9$, $2n = 44$ from Thailand [5]. The chromosome count of $2n = 35$ is indicative for aneuploidy derived from the triploid cytotype with $2n = 36$ [4]. The *Acorus calamus* L. of European countries were recorded triploid $2n = 36$, indicative of 12 as the base number. Whereas the Kashmir population with $2n = 54$ [3] and $2n = 72$ [7] are designated as hexaploids.

In the present study the changes in the diploid chromosome complement among the ecotypes of *Acorus calamus* L. clearly indicated that aneuploidy have played any major role in evolution. The basic chromosome number may be $x = 7$ and from it $x = 9$ might be derived through duplication of chromosome or by non-disjunction at anaphase. Mookherjea [9] stresses the basic chromosome number in *Acorus calamus* as $x = 9$. *Acorus calamus* L. appears to follow a diversity in chromosome number with respect to their geographical distribution.

Besides the numerical changes discussed above, the karyotypes in *Acorus calamus* also indicates variations in chromosome size with their geographical distribution indicating changes in their nuclear DNA in evolution.

The size of chromosome in the present study was reported between 3.48μ to 0.51μ in length. Whereas, the size of South Indian *Acorus calamus* L. chromosome ranged between 0.75μ and 2.1μ in length [12]. Short sized chromosomes (2.2 to $1.4\mu\text{m}$) have been observed in *Acorus calamus* from South Indian [14].

Karyotypes show differences in absolute chromosome size indicating changes in nuclear DNA content in evolution and mostly acentric chromosomes may have derived. Reduction in chromosome size appears to have been an adaptation to an aquatic habitat.

CONCLUSION

On the basis of above finding it may be concluded that all the ten ecotypes of *Acorus calamus* L. under investigation were not stable due to difference in their basic chromosome number. Chromosomal diversity was observed among ecotypes reported from Ranchi Jharkhand India.

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