J. Indian bot. Soc. ISSN - 0019 - 4468 Vol. 93 (3&4) 2014 : 281-283

KARYOTYPIC STUDIES IN GENUS *ZANTHOXYLUM ARMATUM* ROXB.- A HIGH VALUE MEDICINAL PLANT FROM UTTARAKHAND

S. GUPTA[1] AND A. KUMAR[2]

1. Department of Botany, Govt. Degree College, Karanprayag, Uttarakhand, India
2. Department of Botany, Govt. Degree College, Chaubattakhal, Uttarakhand, India

The genus *Zanthoxylum armatum* was explored karyotypically. The somatic chromosome count was found to be 66. Most of the chromosomes of *Z. armatum* were of 'sm' and 'm' type. However 'M' type chromosomes were also present in low frequency. About 12% of the chromosome complement had arm's ratio > 2:1 and the largest to smallest chromosome ratio was about 2.8. The total length and volume of chromosome complement was found to be 28 µm and 0.079 μm^3. The *Z. armatum* had 2B type of karyotype i.e. slightly asymmetrical.

Key words: Karyotype, *Zanthoxylum armatum* Roxb.

The genus *Zanthoxylum armatum* Roxb. is a member of family Rutaceae. It is found as forest undergrowth and in hot valleys up to 1800 meters in the Himalayas. The plant is highly medicinal and the seeds and bark are used as an aromatic tonic in the treatment of fevers, dyspepsia and cholera (Kala 2005). The seed germination in the genus has always been a problem. Since the seeds are good source of Zanthoxylum oil most of the earlier works were concerned with the methods for increasing oil production. Very less cytogenetic studies have been made in this genus (Singhal *et al.* 1983).

MATERIALS AND METHODS

For studying karyotype 20 root tips of about 1mm were cut and pretreated with colchicine. The 0.05% and 0.5% colchicine pretreatment for two hours and half hour were found to be most suitable for inducing c-metaphase. The pretreatment was carried out in dark at 4°C.

The roots were then washed thoroughly with water and fixed in 3:1 absolute alcohol and glacial acetic acid having a pinch of $FeCl_3$. After 24 hours of fixation the root tips were boiled in 2% aceto-orcein and left for overnight. After that these were smeared and squashed in 1% aceto-orcein.

Details of karyotype were analyzed using the following parameters as per Srivastava and Purnima (1990), Srivastava and Kalra (1996) and Malik and Srivastava (2009).

(1) Total length of the chromosome of a complement (TLCC),
(2) Length of long and short arms and of a chromosome,
(3) Arm's ratio (AR),
(4) Total length of all short arms (TLSA),
(5) Total length of all long arms (TLLA),
(6) centromeric index (ci),
(7) Gradient index (GI),
(8) Symmetry index (SI),
(9) Total chromatin length (TCl %),
(10) Relative length of the chromosome of a complement in relation to the longest chromosome of the cell,
(11) Mean radius of a chromatid of the chromosome of a complement,
(12) Volume of long arms, short arms and the whole chromosomes, and
(13) Relative volume of the chromosome of a complement in relation to the largest volume of the chromosome of the cell and
(14) Total volume of the chromosome complement (TVCC).

Arm's ratio, ci, GI, SI, TCl%, and relative length, and volume were worked out using the following formulae:

$$\text{Arm's ratio} = \frac{\text{length of long arm of a chromosome}}{\text{length of short arm of a chromosome}}$$

$$\text{Arm's ratio} = \frac{\text{length of long arm of a chromosome}}{\text{length of short arm of a chromosome}} \times 100$$

Received on May 9, 2014 Accepted on May 14, 2014

$$ci = \frac{\text{length of short arm of a chromosome}}{\text{total length of the chromosome}} \times 100$$

$$GI = \frac{\text{length of shortest chromosome of the complement}}{\text{length of longest chromosome of the complement}} \times 100$$

$$SI = \frac{\text{total length of all short arms}}{\text{total length of all long arms}} \times 100$$

$$TCl\% = \frac{\text{total length of a chromosome pair}}{\text{total length of the gametophytic chromosome set}} \times 100$$

$$\text{Relative length} = \frac{\text{length of a chromosome}}{\text{length of the longest chromosome of the cell}} \times 100$$

$$\text{Relative volume} = \frac{\text{volume of a chromosome}}{\text{largest volume of the chromosome of the cell}} \times 100$$

Volume = $\pi r^2 l$

The volume of the chromosome was calculated assuming a chromosome as two cylinders corresponding to two sister chromatids. The microphotographs were taken from temporary and permanent preparations.

RESULTS AND DISCUSSION

The somatic chromosome count was established to be 66. The chromosome number reported is in conformity with earlier report (Singhal *et al.* 1983). To the best of our knowledge very scanty work is available on karyotype of *Z. armatum*, though effect of colchicine has been done on some accessions of *Z. armatum* by Ramdas *et al.* (2012). Data pertaining to TLSA, TLLA, TLCC, TVSA, TVLA, TVCC, GI and SI are given in table 1. The centromeric index varied from 26-50 and total chromatin length from 3.43 to 9.86. Selected photomicrograph of typical mitotic cell showing c metaphase is presented in Fig.1. Three dimensional ideogram prepared by plotting lengths and widths of chromosomes are shown in figure 2. The chromosomes were divided into five categories A, B, C, D and E on the basis of the total length. These chromosomes were further assorted into different types on the basis of the arm's ratio as per Levan *et al.* (1964). The data related to various parameters listed with materials and methods is given in table 1. The karyotypic formula of the genus is

X[2A(m)+1A(sm)+2B(m)+1B(sm)+1C(M)+5C(m)+7C(sm)+3D(M)+3D(m)+7D(sm)+1E(M)]

X = width of the chromosome (0.03 μm).

Stebbins (1958) classified the karyotypes into twelve categories 1A, 2A, 3A, 4A, 1B, 2B, 3B, 4B, 1C, 2C, 3C and 4C using combinations of two parameters

i) Proportion of chromosomes with arm's ratio > 2:1 and

ii) Ratio between the largest vs. smallest chromosome of the complement.

Most of the chromosomes of *Z. armatum* were found to be 'sm' and 'm' type however 'M' type chromosomes were also present in low frequency.

About 12% of the chromosome complement had arm's ratio > 2:1 and the largest to smallest chromosome ratio was about 2.8. According to karyotype type given by Stebbins (1958) the present genus *Z. armatum* had karyotype belonging to 2B type i.e. slightly asymmetrical.

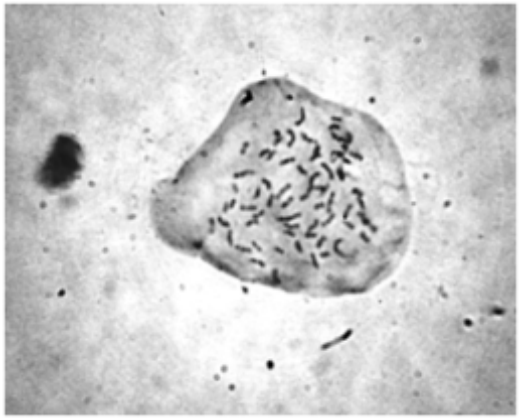

Figure 1. Photomicrograph of a typical mitotic cell of *Z. armatum* showing C metaphase.

The authors are thankful to the Uttarakhand Council of Science and Technology, Basant Vihar Dehradun for the financial support.

Table-1. Data related to karyotype of *Zanthoxylum armatum* Roxb.

2n	TLSA (μm)	TLLA (μm)	TLCC (μm)	GI	SI	TVSA (μm^3)	TVLA (μm^3)	TVCC (μm^3)
66	17.1	10.9	28	34.8	63.7	0.031	0.048	0.079

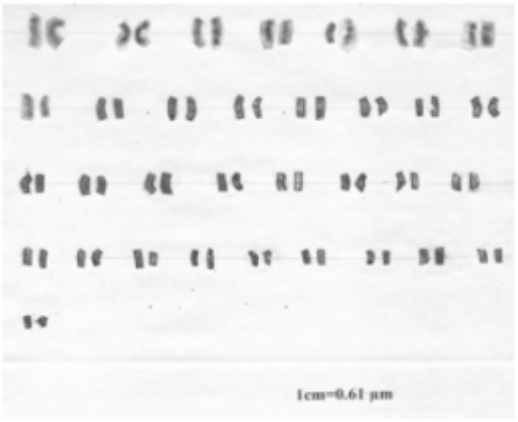

Figure 2. Karyotype of *Z. armatum*.

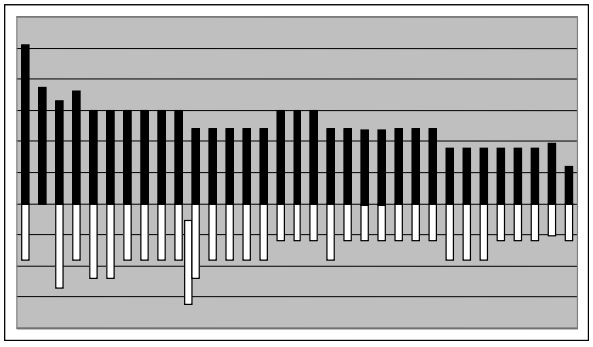

Figure 3. Karyogram of gametophytic set of chromosomes of *Z. armatum*.

REFERENCES

Hwertog WH and Wiersum KF 2000 Timur (*Zanthoxylum armatum*) production in Nepal Dynamics in non-timber forest resource management. *Mountain Research and Development* **20(2)** 136-145.

Kala CP, Farooquee NA and Dhar U 2005 Traditional uses and conservation of timur (*Zanthoxylum armatum* DC.) through social institutions in Uttaranchal Himalaya, India *Conservation and Society* **3** 224–230.

Malik and Srivastava AK 2009 3D Somatic karyotype analysis in *Carthamus tinctorius. Cytologia* **73 (4)** 365-370.

Ramdas, Dhingra GK and Pokhriyal P 2012. Physiological and Cytogenetical Variations in Colchiploid Plants of *Zanthoxylum armatum* Roxb (Rutaceae). *ARPN Journal of Science and Technology* **2** (2) 68-78.

Singhal VK, Gill BS and Bir SS 1983 Cyto palynology of some members of the Rutaceae. *Proceedings of the Indian Academy of Sciences Plant Sciences* **92**(5) 381-386.

Srivastava AK and Purnima 1990 Numerical and structural insonstancy in *Belamchanda chinensis* DC (Iridaceae). *Proc Indian Acad Sci* **100** 205-210.

Srivastava AK and Kalara R 1996 Three dimensional analysis of karyotype in *Carthamus*. *J Cyto Genet* **31** 139-144.

Stace HM, Armstrong JA and James SH 2005. Cytoevolutionary patterns in Rutaceae. *Plant Systematic and Evolution* **187(1-4)** 1-28.