

-Short communication

**Chromosomal study of *Xanthomonas atrovirens* 'Variegatum Monstrum'
a member of Araceae**

Ashma Ahmed Warasy*

Department of Botany, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

Key words: Karyotype, Chromosome, Araceae

Araceae is a family of monocotyledonous flowering plants. This family also known as the arum family. Members are often colloquially known as aroids. This family consist of about 114 genera and 3750 known species (Christenhusz & Byng, 2016). *Xanthosoma* is flowering plant belongs to arum family, Araceae. Genus "*Xanthosoma*" name comes from the Greek words *xanthos* meaning yellow and *soma* meaning a body with reference to the yellow inner tissues of some species. It is closely related to *Colocasia*, *Alocasia* and *Caladium*. It is grown for its bold, tropical foliage. Several are grown for their starchy corms, an important food staple of tropical regions. Many species of this genus are used as ornamental plants. So, the different members of this genus are important for various purposes.

The genus is native to tropical America but widely cultivated and naturalized in other tropical countries (Christenhusz & Byng, 2016). In Bangladesh, it is represented by 30 genera and 89 species (Ahmad *et al.*, 2007). They are distributed throughout the different districts of Bangladesh and grown in plain, marshy land. *Xanthosoma atrovirens* 'Variegatum Monstrum' is one of the member of this genus *Xanthosoma* found in Bangladesh. 'Variegatum Monstrum' is ornamentally grown for its attractive elephant ear-like green leaves with unusual cream or white variegation. As the leaves mature the green color deepens and the cream fades to white. This species is known as the Mickey Mouse Taro because the shape of the leaves look similar to the Disney character. At the tip of the leaf a pocket with a tail forms and it also holds water like a cup. They like a bright shady site of rich moist soil and will grow upto 4-5 ft with huge variegated leaves under favorable conditions.

Xanthosoma atrovirens is an extremely variable species and has many different forms probably because its chromosomes are prone to unpredictable behavior during cell division. Because of this natural variability, many different cultivars have arisen. *Xanthosoma atrovirens* 'Variegatum Monstrum' is one of the cultivar of this species. Different regions produce many different types and even within one type there can be a marked variability over the course of a season or two. For this purpose, an authentic

* Corresponding author. E-mail: aawarasy@yahoo.com

characterization and streamlining of these germplasm are needed to avoid overlapping and misidentification for germplasm conservation.

The Bangladesh National Herbarium (BNH) has been collecting different *Xanthosoma atrovirens* from all over the country and maintained in the garden of BNH. Therefore, the sample will not be having authentic identification since any specimen may show different morphology in changed environment due to phenotypic plasticity. For example, *Colocasia esculanta* has three, *Xanthosoma violaceum* has two, *Typhonium trilobatum* has three morphological forms because of showing different morphology in changed environment. Taxonomist faced problem to identify these specimen authentically (Ara, 2000). Latter extensive cytological investigation had been carried out among different members of Araceae. The cytological data indicated sharp difference among the different form of *Colocasia esculanta*, *Xanthosoma violaceum* (Alam & Deen, 2002; Deen & Alam, 2002), *Typhonium trilobatum* (Huq *et al.*, 2007; Warasy & Alam, 2009). Generally karyotype analysis plays important role in determining the taxonomic status. For authentic identification of a specimen, genomic information is essential. Karyotype analysis is one of the conventional methods that give a preliminary idea about the genome of a specimen.

Staining properties of interphase nuclei and prophase chromosomes is another approach for distinguishing different individual. This is usually done by differential staining (Fawzia & Alam, 2011). Tanaka (1971) classified the different types of interphase nuclei and prophase chromosomes on the basis of orcein staining property. The outcome of this study showed that various taxa including varieties of many plant species could be distinguished by their staining properties. Without any detailed karyotypic features and DNA content analysis which are very basic and important information for breeding as well as molecular biological work in crop improvement programme, it is very difficult to characterize any specimen.

Therefore, a chromosomal study of *Xanthosoma atrovirens* 'Variegatum Monstrosum' was undertaken with the following aims:

- i.
- ii. to find out the staining property of interphase nuclei and prophase chromosomes.
- iii. to count the 2n chromosome number.
- iv. to make the conventional orcein-stained karyotype of *Xanthosoma atrovirens* 'Variegatum Monstrosum'.

Xanthosoma atrovirens 'Variegatum Monstrosum' was used as experimental material in this study.

Healthy roots were collected from the Botanical garden, Department of Botany, Jahangirnagar University. The optimum time of collection was 9.45 am. The collected root were pretreated with 0.002 M 8-hydroxyquinoline for 1.30 h at room temperature (28-30°C) followed by 15 min fixation in 45% acetic acid at 4°C. The pretreated roots were then hydrolyzed in a mixture of 1 N HCl and 45% acetic acid (2:1) at 60°C for 9-10 sec. Then the hydrolyzed root were soaked on a filter paper and taken in a clean slide.

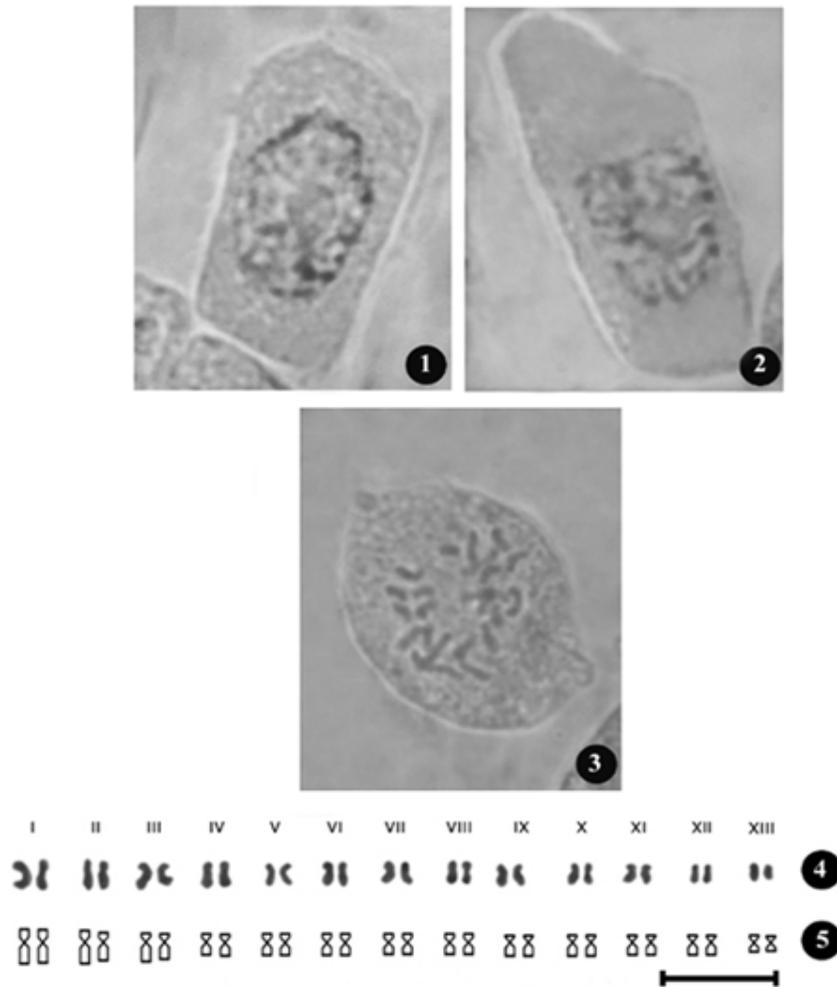
The meristematic region was cut with fine blade. A drop of 1% aceto-orcein was added to the material. A clean cover glass was placed on the material. The materials were tapped gently by a tooth pick and squashed by placing thumbs. Finally the slides were observed under microscope (Olympus BH-2) with a digital camera. For measuring the magnification, at first the magnification on the negative was calculated by multiplying the magnification of objective (100x), tube length (1.25x) and camera lens (7x). From print the final magnification was calculated.

Orcein stained interphase nuclei and prophase chromosomes: Darkly stained large heterochromatic regions were found at the peripheral region of nucleus. A distinct nuclear boundary was observed in interphase nuclei. In addition to this a big and prominent nucleolus was also found (Fig. 1). The presence of prominent nucleoli indicated the active transcription of rDNA for the synthesis of rRNA. According to Tanaka 1971 this is Complex chromocenter type of interphase nuclei.

The prophase chromosomes were darkly stained at one end and gradually become faint towards another end (Fig. 2). This type of prophase chromosome could be regarded as "Gradient type" (Tanaka, 1971).

Usually, germplasm with "Complex chromocenter type" of interphase nuclei showed "Gradient type" of prophase chromosomes. Constitutive heterochromatic nature is indicated by this observation. In this study, selected germplasm followed the general rule of heterochromatin. So the germplasm could be characterized on the basis of these characters of interphase nuclei and prophase chromosomes.

Karyotype analysis: *Xanthosoma atrovirens* 'Variegatum Monstrosum' was found to possess $2n=26$ chromosomes (Fig. 3). The range of chromosomal length was 0.69-1.45 μm indicating small size chromosome and thus no prominent gradual decrease of chromosomal length observed. Total length of $2n$ chromosome complement was 27.09 μm (Table 1). Range of relative length of individual chromosome was 0.03 to 0.05. The centromeric formula was $12m + 14sm$ (Figs. 4, 5). There was no heteromorphism in respect of centromeric position found in this material. This cultivar possessed metacentric and sub-metacentric chromosomes representing almost symmetric karyotype. According to Stabbins (1971) homogenous or symmetric karyotype is as primitive character. This material possessed as primitive karyotype. Therefore, the selected member of Araceae could be authentically identified with these chromosomal feature.



Figs. 1-5. Orcein stained mitotic interphase, prophase, metaphase, karyotype and Idiogram of *Xanthosoma atrovirens* 'Variegatum Monstrosum'. 1. Interphase nuclei 2. Prophase chromosomes 3. Metaphase chromosomes. 4. Karyotype prepared from mitotic metaphase chromosomes. 5. Idiogram based on karyotype. Bar=5 μ

Table 1. Karyotype analysis of *Xanthosoma atrovirens* 'Variegatum Monstrosum'

2n number	Total length of 2n chromosome (μ m)	Range of chromosomal length (μ m)	Range of relative length(RL)	Centromeric formulae
26	27.09	0.69-1.45	0.03-0.05	12m + 14sm

m = metacentric chromosome, sm = Sub-metacentric chromosome

Acknowledgement: Author is thankful to the Molecular Cytogenetics Laboratory, Department of Botany, University of Dhaka. The photographic part of this research was carried out in this Laboratory.

REFERENCES

- Ahmed, Z. U., Begum, Z. N.T., Hassan, M. A., Khondker, M., Kabir, S. M. H., Ahmad, M., Ahmed, A.T. A., Rahman, A. K. A. and Haque, E. U. (Eds). 2007. Encyclopedia of Flora and Fauna of Bangladesh. **Vol. 11**. Angiosperms; Asiat. Soc. Bangladesh, Dhaka.
- Alam, Sk. S. and Deen, S. S. 2002. Karyotype and isozyme analysis in three forms of *Colocasia esculenta* (Araceae). Bangladesh J. Bot. **31** (2): 95-98.
- Ara, 2000. *Colocasia falax* Schott. (Araceae) - A new angiospermic record for Bangladesh. Bangladesh J. Plant Taxon. **7** (2): 85-87.
- Christenhusz, M. J. M. and Byng, J. W. 2016. "The number of known plants species in the world and its annual". Phytotaxa. Magnolia Press. **261** (3): 201-217.
- Deen, S. S. and Alam, Sk. S. 2002. Comparative study in two forms of *Xanthosoma violaceum* (Araceae) through karyotype and isozyme analysis. Bangladesh J. Bot. **31** (1): 45-47.
- Fawzia, R. and Alam, Sk. S. 2011. Fluorescent karyotype analysis in four varieties of *Solanum melongena* L. Cytologia **76** (3): 345-351.
- Huq, S., Ara, H., Hassan, A. and Alam, Sk. S. 2007. Comparative karyotype analysis of *Typhonium trilobatum* L. and its two morphological forms. Cytologia **72** (2): 233-238.
- Tanaka, R. 1971. Type of resting nuclei in Orchidaceae. Bot. Mag. Tokyo **84**: 118-122.
- Warasy, A. A and Alam, Sk. S. 2009. Comparison of Orcein and CMA stained Karyotypes in Three Morphological Forms of *Typhonium trilobatum* L. Cytologia **74** (3): 311-316.