



**SRI VENKATESWARA INTERNSHIP PROGRAM
FOR RESEARCH IN ACADEMICS
(SRI-VIPRA)**



SRI-VIPRA

Project Report of 2024: SVP-2445

**“Preliminary investigation on the cytological aspects in
Codiaeum variegatum (L.) Blume”**


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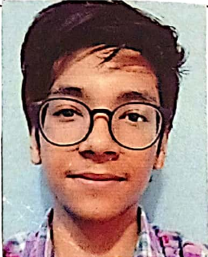

SRIVIPRA PROJECT 2024

Title: Preliminary investigation on the cytological aspects in

Codiaeum variegatum (L.) Blume

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Certificate of Originality

This is to certify that the aforementioned students from Sri Venkateswara College have participated in the summer project SVP-2445 titled "Preliminary investigation on the cytological aspects in *Codiaeum variegatum* (L.) Blume." The participants have carried out the research project work under my guidance and supervision from 1st July, 2024 to 30th September 2024. The work carried out is original and carried out in an online/offline/hybrid mode.


Signature of Mentor 10.10.2024

ACKNOWLEDGEMENTS

At the outset, we are grateful to that Almighty, for giving us all the strength to carry out this research. Without God's blessings, we wouldn't have been able to manage our everyday challenges to complete this work.

We all researchers are extremely grateful to our mentor Dr. Madhu Raina from the Department of Botany, Sri Venkateswara College, University of Delhi. She was the driving force behind us. Her vast knowledge and expertise in the subject truly helped us overcome all the challenges we faced throughout this research work. This would not have been possible without her constant support, guidance and encouragement which greatly inspired all of us.

Our sincere gratitude to Prof. Vajala Ravi, Principal, Sri Venkateswara College for igniting a spark of research in students and providing us with such an important opportunity. The Sri Venkateswara Internship Program for Research in Academics (SRIVIPRA) experience has not only offered a wet lab research platform but also endowed with the spirit of teamwork, resilience and cooperation.

Our acknowledgement extends to Dr. P. Jayaraj and Dr. Haokam Vaiphei, SRIVIPRA-2024 convenors for providing us with such an interesting learning opportunity.

We convey our deepest thanks to the Department of Botany and its non-teaching staff especially Mr. Rakesh and Mr. Raveesh for their assistance in providing the lab resources required during this study. We greatly appreciate the team managing the vegetation in the Campus, because of whom we could access the plant specimen very easily when needed.

Words are falling short in thanking our parents and family for their constant and unconditional love, care and support. Their selfless behavior, motivational words and encouragement kept us going. Thank you so much for believing in us, your love and support mean the world to us!

Last but not the least; we deeply appreciate all those who rendered a helping hand in this or that way to the overall success of this work.

Sincerely,

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Preliminary investigation on the cytological aspects in *Codiaeum variegatum* (L.) Blume

INTRODUCTION

Family Euphorbiaceae with 300 genera and approximately 8,900 species encompasses herbs, shrubs and trees (Fahmy et al., 2022). Also known as spurge family, most of its members are characterized by the production of milky, often toxic sap from vegetative parts (Binckley and Zahra, 2023). They are widely distributed in tropical and sub-tropical regions of the world including America, Australia, Bermuda, Eurasia and Africa (Xu and Deng, 2017). Genus *Codiaeum* of Euphorbiaceae includes nearly 200 species (Fahmy et al., 2022). Of them, *C. variegatum* (L.) Blume is one. Commonly known as Croton or Joseph's coat, *C. variegatum* is native to Malaysia, Pacific islands and northern Australia (Gayatri et al., 2004). There are different varieties of croton in wild but none of them is cultivated. However, those grown across globe comprise the varieties of *C. variegatum* (Gayatri et al., 2004). The plant is primarily grown as an ornamental owing to its variegated foliage but several species have long been used in traditional medicine (Fahmy et al., 2022). Different parts of the plant are known to be effective in different ailments like cancer, constipation, diabetes, digestive issues, dysentery, wounds, fever, high cholesterol, hypertension, inflammation and malaria (Salatino et al., 2007). Also compounds like proanthocyanidins, alkaloids (e.g., taspine), flavonoids and diterpenes (e.g. clerodanes, labdanes) extracted from the plant show anti-inflammatory, antimalarial, antimicrobial, antiviral and anticancer properties (Salatino et al., 2007). Despite holding medicinal importance, the latex from the bark, roots and leaves contain 5-deoxyingenol which is toxic in nature. Consequently, the bark and roots are likely to cause burns in the mouth and prolonged exposure to the latex can even lead to eczema in gardeners. Nevertheless, the plant's

exudates, which irritate the skin, are also traditionally used as a purgative for humans and domestic animals (Bronson, 2005; Ogunwenmo et al., 2007).

Croton is a tropical evergreen shrub, generally attaining a height of 3 to 6 feet (Pyngrope et al., 2022). Known for its variegated foliage, the leaves display a spectrum of colors, size, shape and pattern. The cytological studies on *C. variegatum* are fragmentary with basic chromosome number of the species still remaining ambiguous (Deng et al., 2010). Some studies have suggested the existence of intraspecific cytotypes with $2n=60$, $2n=80$, $2n=100$ and $2n=120$ (Gill et al., 1973) while others speculated it to range from $2n = 16- 72$, $80-100$, $100-124$ in different varieties (Sharma and Bal, 1958; Chennaveeraiah and Wagley, 1985; Deng et al., 2010). In light of this, the present study aims to carry a preliminary investigation on the cytological status of the species from north India.

MATERIALS AND METHODS

Three Plants of *C. variegatum* (Fig. 1) growing at 77.16703°N Latitude and 28.589096°E Longitude in the Campus of Sri Venkateswara College, University of Delhi were selected to conduct the study. Flower buds were fixed as per Sharma et al. (2010). Anthers from these fixed buds were squashed in 1% acetocarmine. Chromosomal behavior of different pollen mother cells (pmc) was analyzed under microscope and photographed using two mobile phones; IQOO 3 with 48 megapixels and Realmenarzo 60x with 50 megapixels resolution.

OBSERVATIONS AND DISCUSSION

C. variegatum is a monoecious plant that flower during the months of mid-August to April. The male flower around 1.9 cm long, comprises of approximately 38 stamens (Fig. 2). A total of 166 pmcs were observed at different stages of meiotic division (Table-1). Of these, approximately 38.5% of pmcs were at Metaphase-I (Figs.5 a,b) followed by 19.87% at Anaphase I (Fig. 7), 10.2% at Prophase (Fig. 4) and least percentage was observed for pmcs at Telophase I (Fig. 8) accounting for nearly 1.2%. However, nearly 4.21% of cells were observed at Interphase (Fig. 3) which represents the preparatory phase. Owing to the size constraints and separation ambiguity, the exact number of chromosomes could not be ascertained. Instead, a range was observed. At Metaphase-I, pmcs at two different chromosome counts were observed viz. $2n = 24$ (approx) and $2n=64$ (approx). Similarly, at early Anaphase I pmcs with nearly $2n=36$ chromosomes were captured. Likewise, other stages that were observed and captured include Early Anaphase-I (Fig.

6), Anaphase- II (Fig. 9) and Telophase-II. In addition to the dividing cells, nearly 13.8% of cells were not assigned any stage of division due to ambiguous nature of chromosomes. The observed data also provides valuable insights on tetrad formation (Fig. 10) and the subsequent stage of pollen formation (Fig. 11). However, the number of such pmcs was 12, suggesting the completion of meiotic division.

The exact number of chromosomes could not be resolved due to their clumping together during cell division. Instead, a significant number of pmcs with varying number of chromosomes was observed. This might suggest some cytological abnormalities or asynchronous meiotic progression which can be on account of environmental stress, genetic factors or hybridization and possibly become a cause of polyploidy in most varieties (Mendes-Bonato et al., 2001; Kiihl PRP et al., 2011).

Table-1: Quantitative analysis of different meiotic stages in *C. variegatum*

Total number of pmcs per focus	Interphase	Prophase	Metaphase I	Early Anaphase	Anaphase I	Telophase I	Tetrad	Ambiguous
4	-	4	-	-	-	-	-	-
3	-	2	-	-	-	-	-	1
1	-	-	1	-	-	-	-	-
5	3	-	2	-	-	-	-	-
10	-	4	2	-	-	-	-	4
14	-	1	13	-	-	-	-	-
16	-	2	7	-	-	-	-	7
10	-	1	9	-	-	-	-	-
5	-	1	4	-	-	-	-	-
11	2	-	9	-	-	-	-	-
7	-	-	-	1	3	-	-	3
6	-	-	3	-	3	-	-	-
7	-	-	2	5	-	-	-	-
21	2	-	1	1	12	-	-	5
9	-	-	-	-	7	-	-	2
5	-	-	-	1	4	-	-	-
6	-	-	2	-	3	1	-	-
13	-	2	9	-	1	-	1	-
5	-	-	-	-	-	1	3	1
8	-	-	-	-	-	-	8	-
Total=166	7	17	64	8	33	2	12	23

Variation in chromosome number ranging from $2n=24$ to 124 in Nigeria (Ogunwenmo et al., 2007) and $2n=60$ to 120 in India (Gill et al., 1973) has also been put on record in *C. variegatum*. Given the variation in the number of pms at different stages, it can be hypothesized that *C. variegatum* may be experiencing some form of genomic instability or environmental stress. Interestingly, *C. variegatum* offers diversity in foliage patterns. It is equally likely that the cytological irregularities might correlate with the morphological variability vis-à-vis variegated pattern of the foliage.

Being a preliminary study, further research along the lines of cytological aspects could be instrumental in explaining the correlation, if any, exists between morphological and cytological parameters. This would further provide important insights into fertility and breeding behavior of *C. variegatum*.

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FIGURES

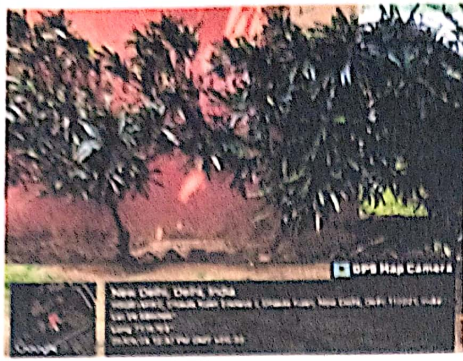


Fig 1: Plant morphology of *Codium variegatum*



Fig 2: Male flower of *C. variegatum*



Fig 3: A PMC at Interphase

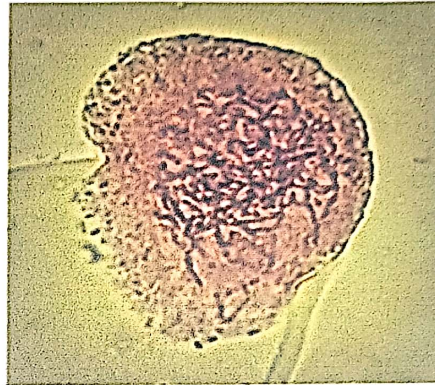


Fig 4: A PMC at Prophase



(a)



(b)

Fig 5: PMCs at Metaphase I with (a) $2n = 24$, (b) $2n = 64$

FIGURES



Fig 6: A PMC at Early Anaphase



Fig 7: A PMC at Anaphase I



Fig 8: A PMC at Telophase I



Fig 9: A PMC at Anaphase II



Fig 10: A Tetrad



Fig 11: Pollen grains of *C. variegatum*