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Karyotypic Study in Urginea indica Kunth Collected from Bundu, Jharkhand

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Abstract: ***The morphologically similar or uniform group of plants having same chromosome number is reported to have separate genetic system. Therefore, to understand the evolutionary development and genetic relationship of the morphologically distinguished varieties of plants, chromosome study is an absolute device. Similarly, stomatal variations among the species are of taxonomic significance. Hence, in the present research work, Urginea indica Kunth from Bundu, Jharkhand, were collected to carry out its detailed karyotype as well as the stomatal analysis. It was observed to be diploid with 2n = 20 chromosomes, showing the asymmetrical karyotype. The stomata were of anomocytic type, being comparatively larger in size.***
Key words: Urginea indica Kunth, Karyotype, asymmetry, diploids, stomatal index, animocytic stomata.

I. INTRODUCTION

Urginea indica Kunth is a bulbous herb of Liliaceae family having a magical potential to heal several human ailments. It has long been used extensively as a source of medicine. It is commonly known with the names Indian squill and van pyaz or jungli dungli. Urginea indica Kunth exists in several distinct morphological forms and identification of such plants on the basis of cytotaxonomical and epidermal features from remote areas would be of great use in preparing the database.

Therefore, the main highlights of this research were to analyze (i) the detail karyomorphology and stomatal characters of the cytotype of Urginea indica Kunth collected from Bundu, Jharkhand.

II. RESEARCH METHODOLOGY

Bulbs of Urginea indica Kunth were collected from Bundu, Jharkhand and were brought into cultivation in experimental gardens. For the karyotypic analysis, primary roots were cut off and pretreated, fixed (with ethanol-acetic acid 3:1 for 24 hours) and preserved (in 70% alcohol). Preserved root tips were hydrolyzed in 1N HCL for five to ten minutes depending upon the thickness of the roots. Washed and hydrolyzed root tips were then stained with 2 per cent acetocarmine and slides were prepared by squash technique.

Well spread metaphase plates were selected to measure the length and width of long arms and short arms of chromosomes for karyotype analysis. The plates were then photographed in digital SLR Nikon camera. Visible chromosomes at metaphase plates were scored under 450*x* magnifications. Types of chromosome were identified and classified according to Abraham and Prasad (1983)[1].

Data obtained were analyzed statistically using the various formulae. Idiogram was prepared from the statistically analyzed data.

For stomatal studies, the leaves of the selected cytotype were taken. The epidermal peels of the leaves were obtained using a sharp, pointed forceps from both dorsal and ventral surfaces[2]. The epidermal peels were thoroughly washed with water, stained with aqueous safranin and mounted in a drop of glycerin on a glass slide. The slides were examined with the compound microscope (450*x* magnification) and the nature of distribution and dimensions of stomata were studied. The studied features included: length and width of stomata and also the stomatal index (SI) which was given as:

$$SI = \frac{\text{Number of stomata per unit area}}{\underset{\text{cells per unit area}}{\text{Number of Epiermal}} + \underset{\text{per unit area}}{\text{Number of Stomata}}} \times 100$$

Well spread metaphase plates and stomata were photographed in digital SLR camera.

III. RESULTS AND DISCUSSION

The statistical data of Karyotype and stomatal characters are presented in tables (table 1 to 3; fig. 1 to 4). Karyotype analysis including relative length of individual chromosomes and the ratio of long arm and short arm of the observed cytotype of *U. indica* Kunth are demonstrated in table 1, in which the chromosome numbers were named from I to X in accordance with their length. The cytotype of *U. indica* Kunth under investigation was reported diploid with 2n = 20 chromosomes, showing normal mitotic division

in all the examined cells. Neither secondary constriction nor satellites were observed. Although diploids of Urginea indica Kunth often shows the presence of satellites and secondary constrictions but their absence in the investigated cytotype showed that the genic constitution of such cytotype may have the adaptive value not requiring to be supplemented by satellites and secondary constrictions[3]. The absence of satellites might be due to the deletion of satellites and subsequent loss during evolution[4].

However, significant variations were observed with respect to chromosome length which was noticed to be comparatively longer ranging from very long to short (table 1; fig. 2).

This shows the asymmetrical tendency of the observed cytotype as asymmetrical karyotypes possess many chromosomes with sub terminal centromeres or great differences in size between the largest and the smallest chromosomes or both.

The species and varieties having greater number of sub-median and telocentric chromosomes should be treated more evolved than those where there are lesser number of sub metacentric and telocentric chromosomes[5].

But in the present investigation, the chromosomes constituted nearly median and nearly sub-median (-) groups with the karyotype formula: 3nm+7nsm. Therefore, the Total Chromatin Length (TCL), Total Form Percentage (TF%), Gradient Index (G.I.), Symmetry Index (S.I.) and Disparity Index (D.I.) of Urginea indica Kunth were also calculated (table 2) to find out the karyotypic type of the cytotype. And based on these factors, it was observed to possess asymmetrical karyotype.

Urginea indica Kunth is reported to show significant variation with respect to its morphology. So, to identify the potential cytotypes of this species, cytological analysis along with stomatal study can be of significant importance. Anatomical studies in plants had long been used extensively for the identification of different species and to define the taxonomic status of the species. It also helps to expand the diagnostic features of taxon.

This in turn, helps to confirm the identity of the plant species with respect to the external characters and the internal features. Among the vast anatomical features, leaf surface character is used as secondary or supporting characters in biosystematics studies[6]. Leaf anatomy including the morphology of stomata has great importance in taxonomy[7].

The study of stomata is considered as a desirable tool in taxonomic research as the genera and even families show great constancy for their possession of stomatal complex. There still remains a considerable variability among different species. Thus, stomatal studies help to understand true evolutionary relationship of monocotyledons[8].

It is also reported to show phylogenetic relationships within plants[9,10]. Furthermore, the stomatal studies (size, shape as well as number of stomata) allow detecting some genetic processes involved in speciation process and adaptation within the species to the environmental conditions[11].

Therefore, this research work presents the stomatal characters of the observed cytotype of Urginea indica Kunth. Stomatal index and stomatal size were calculated (table 3; fig. 1-4) at dorsal and ventral surfaces of the leaves in apex, middle and base portions. The stomata were observed to be present on both dorsal and ventral surfaces of leaf in all the cytotypes, but were more abundant on ventral surface of leaves.

Significant variations in the Stomatal Index were observed. Guard cells were not found to be surrounded by subsidiary cells and the stomata were reported to be of anomocytic type.

This corresponds to the earlier findings as the stomata without subsidiary cells are particularly confined to the members of Liliaceae family. This type of stomata is reported to be derived independently from the primitive types containing numerous parastomatal cells and is considered most advanced evolutionary[12,13]. The types and features of stomata are often considered helpful in defining and identifying taxa. This finding is similar to the earlier findings.

Moreover, the size of stomata was also observed which was noticed to be larger. Stomatal size is considered to be positively correlated with genome size across wide range of major taxa. Stomata size predicts genome size within angiosperms[14].

It has been reported that the larger size of stomata is correlated with the higher level of ploidy in plants and slower response to dehydration[15]. It also increases the transpiration rate which increases the photo-synthesis in turn plant grows as faster rate in wet season and invariably increase the production[16].

Thus, the present finding showed the leaf epidermal anatomy of selected cytotype of Urginea indica Kunth which are influenced by environmental conditions. These findings would be helpful to understand the taxonomic and systematic value of stomata type and distribution patterns[17].

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Table-1 : Cytotaxonomical data of Urginea indica Kunth

Cytot y-pes	Chrom. number	Arm length		Chrom. Length (µ)	Arm ratio	R. L. (µ)	F%	TCI	Classificatio n
		Long arm (µ)	Short arm (µ)						
Urginea indica Kunth	I	8.11	4.41	12.52	1.838	100	35.235	14.063	nsm(-)
	II	7.77	4.62	12.39	1.682	98.993	37.288	13.922	nsm(-)
	III	6.76	4.20	10.96	1.610	87.584	38.314	12.317	nm
	IV	6.68	4.24	10.92	1.574	87.248	38.846	12.270	nm
	V	6.17	3.02	9.20	2.042	73.490	32.877	10.335	nsm(-)
	VI	5.67	2.86	8.53	1.985	68.121	33.498	9.580	nsm(-)
	VII	4.99	2.56	7.56	1.951	60.403	33.889	8.495	nsm(-)
	VIII	4.12	2.73	6.85	1.508	54.698	39.877	7.692	nm
	IX	3.65	2.10	5.75	1.740	45.973	36.496	6.465	nsm(-)
	X	2.77	1.55	4.33	1.784	34.564	35.922	4.861	nsm(-)

R.L. = Relative Length
F% = Form Percentage
T.C.I. = Total Chromatin Index
nm = Nearly Median
nsm(-) = Nearly Sub median (Centromere away from the terminal point)

Table 2: Data related to karyotype of *Urginea indica* Kunth

TCL	Total form percentage (TF%)	Gradient index (GI)	Symmetry index (SI)	Disparity index (DI)
88.998	36.291	34.564	56.963	48.628

Table-3: Stomatal index, length and width of dorsal and ventral leaf surfaces of the three cytotypes of *Urginea indica* Kunth

SURFACEOF LEAVES	Apex Portion of Leaf			Middle Portion of Leaf			Base Portion Of Leaf		
	Stomatal Index	Length (µ)	Width (µ)	Stomatal Index	Length (µ)	Width (µ)	Stomatal Index	Length (µ)	Width (µ)
DORSAL SURFACE	10.830 ± 1.278	21.1 ± 0.430	15.6 ± 0.545	14.280 ± 1.352	20.7 ± 0.685	15.9 ± 0.513	9.246 ± 1.629	22.7 ± 0.397	15.8 ± 0.556
VENTRAL SURFACE	11.766 ± 0.086	19.7 ± 0.505	16.0 ± 0.342	12.849 ± 1.812	22.9 ± 0.549	15.9 ± 0.832	14.892 ± 1.004	23.2 ± 0.480	17.2 ± 0.500

Fig.1-4: Photograph of Urginea indica Kunth with photomicrographs showing Chromosomes at Metaphase Plate and stomata

Fig. 1: Bulb of Urginea indica Kunth

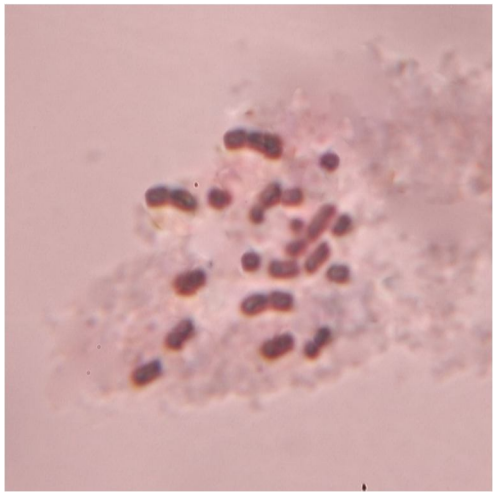

Fig.2: Chromosomes at metaphase stage

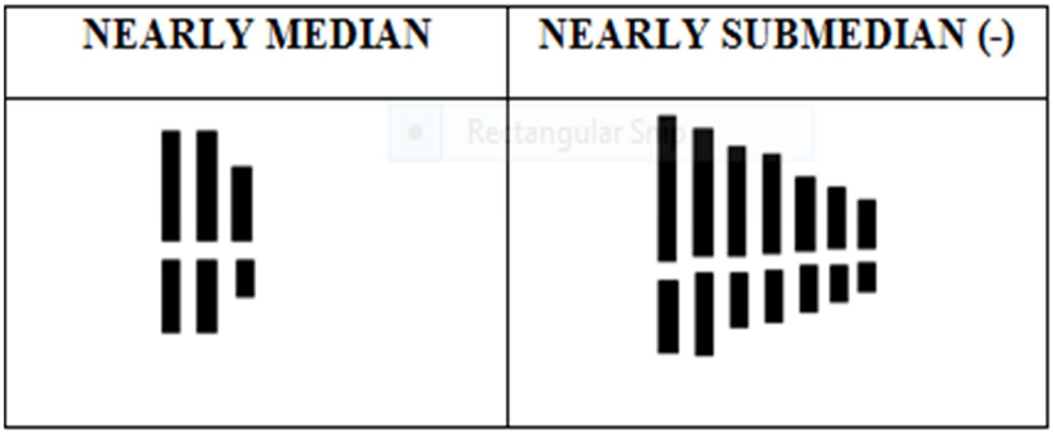

Fig. 3: Idiogram of mitotic chromosomes

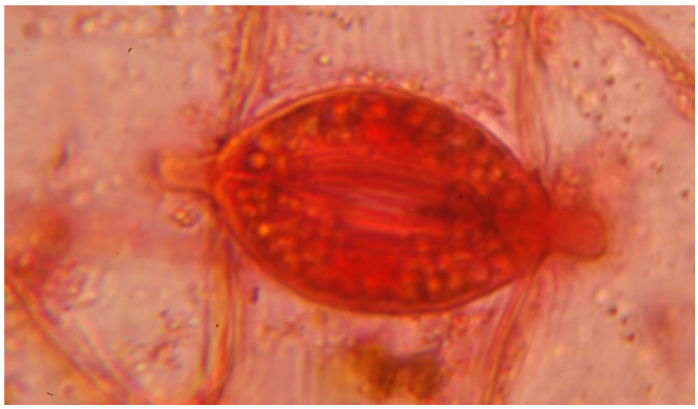

Fig.4: Photomicrograph of Stomata

IV. CONCLUSION

The present research showed the asymmetrical karyotype of the selected cytotype of *Urginea indica* Kunth with diploid (2n=20) set of chromosomes. The stomata were observed to be of anomocytic type. Thus, the present research justified the earlier findings.

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REFERENCES

[1] Kamble, Vishal, R., Agre, Dinesh, G. and Dixit, Ghansham, B. 2012. Mycorrhizal fungi in Indian squill: Drimia indica from coastal sand dunes of Konkan, India. IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS). 4 (3) : 31-36.
[2] Topno, S. and Ghosh, T.K. 1997. Comparision of epidermal characters of Cassia Linn. Columban J. Life Sci. 5 (1-2) : 239-242.
[3] Sen, Sumitra. 1974. Nature and behaviour of B-chromo-somes in Allium stracheyii Baker and Urginea indica Kunth. Cytologia. 39 : 245-287.
[4] Heitz, E. 1933. Die Somatische Heteropyknose bei Drosophila melanogaster und ihregenetische Bedeutung. Zts. Zelf. U. Mikr. Anat. 20 : 237-287.
[5] Stebbins, G.L. 1950. Variation and evolution in plants. Columbia University Press, New York.
[6] Shiva Kameshwari, M.N. and Muniyamma. 2001. Cyto-morphological Study in Three species of the genus Chlorophytum Ker Gawl. (Liliaceae). Taiwania. 46 (4) : 307-317.
[7] Wang, H., Ngwenyama, N., Liu, Y., Walker, J.C. and Zhang, S. 2007. Stomatal development and patterning are regulated by environmentally responsive mitogen-activated protein kinases in Arabidopsis. Plant Cell. 19 : 63-73.
[8] Ledyard, Stebbins G. and Gurdev, Khush S. 1961. Variation in the Organization of the stomatal complex in the leaf epidermis of monocotyledons and its bearing on their phylogeny. American Journal of Botany. 48 (1) : 51-59.
[9] Metcalfe, C.R. 1960. Anatomy of the Monocotyledons I. Gramineae. Oxford University Press, London. 731p.
[10] 221. Metcalfe C.R. 1969. Comments on “A note about Stomata” In Tomlison, P.B. (Ed.,). Anatomy of the Monocotyledons III. Commelinales-Zingiberales. Oxford University Press. 446p.
[11] Gabriel C. Corneanu, Mihaela Corneanu and Rodica Bercu. 2004. Comparison between some morpho-anatomical features at fossil vegetal species and at their actual correspondent species. Studia Universitatis Babeş-Bolyai, Geologia, XLIX. 2 : 77-84.
[12] Stebbins, G.L. and Khush, 1961. Variation in the organization of the stomatal complex in the leaf epidermis of monocotyledons and its bearing on their phylogeny. Am. J. Bot. 48 : 51-59.
[13] Esau K. 1967. Plant anatomy. Wiley, New York.
[14] Hodgson, J.G., Sharafi, M., Jalil, A., Diaz, A., Montserrantmarti, G., Palmer, C., Ceraboloinii, B., Piercce, S., Hamzehee, B., Asri, Y., Jamzad, Z., Wilson, P., Raven, J.A., Band, S.R., Basconcelo, S., Bogard, A., Carter, G., Charles, M., Castro-Diez, P., Cornelissen, J.H.C., Funes, G., Jones, G., Khoshnevis, M., Perez-Harguindeguy, N., Perez-Rontome, M.C., Shirvany, F.A., Vendramini, F., Yazdani, S., Abbas-Azimi, R., Boustani, S., Dehgan, M., Guerrerocampo, J., Hynd, A., Kowsary, E., Kazemi-Saeed, F., Siavash, B.P., Villar-Salvador, R., Craigie, A., Naqinezhad, A., Romo-Diez, L., De, Torres, Espuny and Simmons, E. 2010. Stomatal Vs genome size in angiosperms: the somatic tail wagging the genomic DOG? Annals of Botany. 105 (4) : 573-584.
[15] Hetherington, A.M. and Woodward, F.I. 2003. The role of stomata in sensing and driving environmental change. Nature. 424 : 901–908.
[16] Kumar, H.V. Anil., Muralidhar, T.S., Acharya, S., Das, Manas Jyoti and Munirajappa. 2013. Ethyl Methane Sulphonate (EMS) induced morphometric Biomass and phytochemical variations in Morus species (Genotype RFS135). American Journal of Experimental Agriculture. 3 (1) : 43-55.
[17] Hari Babu, R. and Savithramma, N. 2014. Studies on stomata of some selected grass species of Poaceae and Cyperaceae. World Journal of Pharmacy and Pharmaceutical Sciences. 3 (7) : 1268-1279.