

MITOTIC ACTIVITY AND INCIDENCE OF CHROMOSOMAL ABERRATIONS AT *SALVIA OFFICINALIS* L.

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Key words: *metaphase, anaphase, telophase, disorder, chromosomes*

INTRODUCTION

Salvia species are an important group of plants with multiple uses. Sage generally grows about a foot or more high, with wiry stems. The leaves are set in pairs on the stem and are 1 1/2 to 2 inches long, stalked, oblong, rounded at the ends, finely wrinkled by a strongly-marked network of veins on both sides, greyish-green in colour, softly hairy and beneath glandular. The flowers are in whorls, purplish and the corollas lipped. They blossom in August. All parts of the plant have a strong, scented odour and a warm, bitter, somewhat astringent taste, due to the volatile oil contained in the tissues.

The name of the genus, *Salvia*, is derived from the Latin *salvere*, to be saved, in reference to the curative properties of the plant, which was in olden times celebrated as a medicinal herb. This name was corrupted popularly to *Sauja* and *Sauge* (the French form), in Old English, 'Sawge,' which has become our present-day name of Sage. Dried leaves and flowers of some species which have active substances are used in preparation of some drops and treatment of some illnesses. Sage has a very long history of effective medicinal use and is an important domestic herbal remedy for disorders of the digestive system. Its antiseptic qualities make it an effective gargle for the mouth where it can heal sore throats, ulcers etc. The leaves applied to an aching tooth will often relieve the pain. The whole herb is antihydrotic, antiseptic, antispasmodic, astringent, carminative, cholagogue, galactofuge, stimulant, tonic and vasodilator. Externally, it is used to treat insect bites, skin, throat, mouth and gum infections and vaginal discharge. The essential oil is used in aromatherapy. Another use of this plant is in perfumery due to the prosuse glandular hairs which contain etheric oil. Essential oils, which have fragrance, is a characteristic feature of many species of *Salvia*. Therefore, it is widely used in perfumery and as a sweetener in the

food industry (Kesercioğlu & Nakipoğlu, 1992). *Salvia* species contain monoterpenes with antiseptic characteristics (Nakipoglu, 1993).

In recent studies, it has been observed that the compounds in *Salvia* decrease DNA synthesis in the cell. This feature is important in the diagnosis and treatment of cancer. The leaves of *Salvia* species are used as tea. The gelatinous substance is produced from the seed that has mucilage. This substance is used as good varnish and sweetener in Mexico (Estilai & Hashemi, 1990). Since the increasing development of genetic methods, the chromosomal data has become a valuable tool both for cytogenetic specialists and for breeders. These studies focused on chromosomes are often employed for suggesting taxonomic and phylogenetic relationships (Stuessy, 1990). Until now, at *Salvia* species, few information are available regarding the main cellular indexes like: mitotic index, prophase, metaphase, anaphase, telophase index, the incidence of abnormalities in normal cells, chromosome features and behaviour, phylogenetic of the cultivars, etc. The rate of cell division has been depicted to reflect the rate of increase in size and weight. In addition, good mitotic indexing will generate information available for a better characterization of *Salvia officinalis* germplasm collections.

MATERIAL AND METHODS

The biological material utilized in the present study is represented by root tips from seeds germinated in Petri dishes. The root tips of about 1-1.5 mm were used for chromosome preparation. *Salvia officinalis* L. seeds, genotype – LSO65/05 were provided by Vegetable Research and Development Station Bacău, Romania. The cytogenetic studies were accomplished in meristematic root cells, stained in Carnoy fixing solution for 24 hours at 4°C then hydrolyzed with HCl for 7 minutes and colored with the basic coloring solution Carr.

The root meristems were displayed using squash technique and for each genotype and variant 1000 cells were counted. Chromosome slides were then observed microscopically. Mitotic data were subjected to statistical analysis by calculating the mitotic index (% cells in division per total number of examined cells), prophasic index (% cells in prophase per total number of examined cells), metaphasic index (% cells in metaphases per total number of examined cells), anaphasic index (% cells in anaphase per total number of examined cells) and telophasic index (% cells in telophase per total number of examined cells). In the same time we monitored the incidence of abnormalities in ana-telophases stage.

RESULTS AND DISCUSSIONS

The seeds germinated in 9 days – fig. 1, allowing the excision of roots, which were placed in Carnoy stain for at least 24 h, in refrigerator. After fixation, the roots were repeatedly washed with sterile distilled water, hydrolyzed in HCl and stained with Carnoy solution.



Fig. 1. The biological material utilized in our experiments

One of the objectives of the present study was the establishment of the main division indexes (mitotic index, prophasic index, metaphasic index, anaphasic index, telophasic index) The results, calculated for each plant are shown in table 1, 2.

Table 1. The number of cells identified in different phases of mitotic cycle at *Salvia officinalis* L. plants

	Analyzed cells	Inter-phase	Cells in division	Repartition of cells in different division phases			
				P*	M*	A*	T*
Plant 1	985	874	111	53	35	8	15
Plant 2	969	852	117	51	42	9	16
Plant 3	1020	906	114	48	38	15	13
Media	991	877	114	50	38	11	15

* P – prophase, M – metaphase, A – anaphase, T – telophase

Table 2. The values of the main indexes registered in the meristematic cells of *Salvia officinalis* L. plants

Variant	IM	Repartition of cells percentage/phases of division			
		% P	% M	% A	% T
Plant 1	11.26	47.7	31.5	7.2	13.5
Plant 2	12.07	43.3	36.2	7.6	12.9
Plant 3	11.17	42.1	33.3	13.1	11.4
Media	11.50	44.4	33.6	9.3	12.6

As it is illustrated in the previous tables, the results obtain for all variants are similar, which denotes the fact the values of media calculated for each type of index are the correct one that represents the characteristic of the repartition of cell phases in the experimental condition tested in the present study.

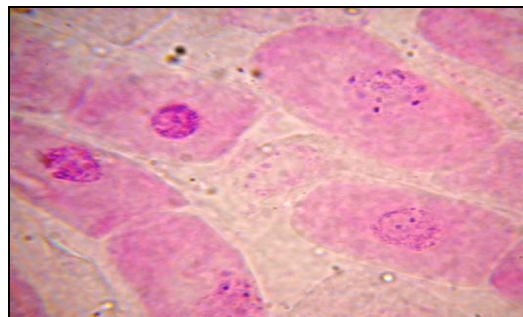


Fig. 2. Cells in interphase and prophase at *Salvia officinalis* L.

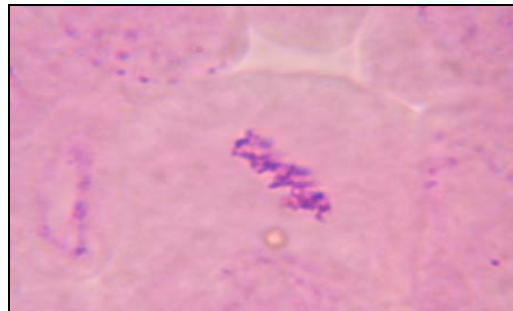


Fig. 3. Cell in metaphase at *Salvia officinalis* L.



Fig. 4. Cells in ana-telophase at *Salvia officinalis* L.

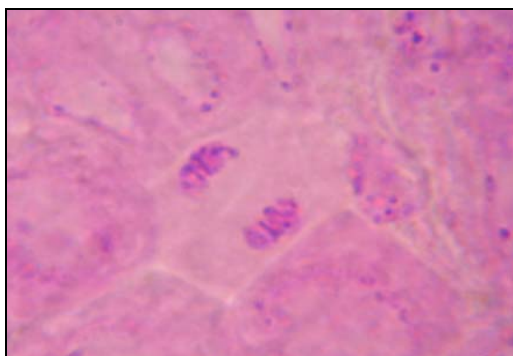


Fig. 5. Cell in telophase at *Salvia officinalis* L.

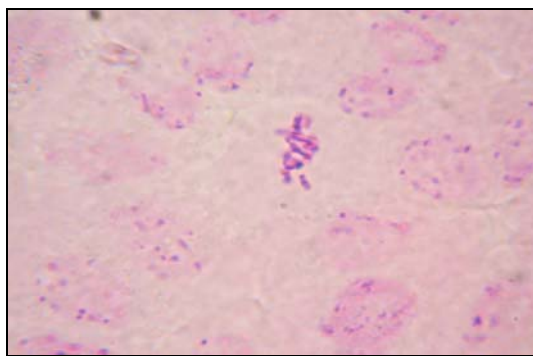


Fig. 9. Metaphase with expelled chromosome at *Salvia officinalis* L.

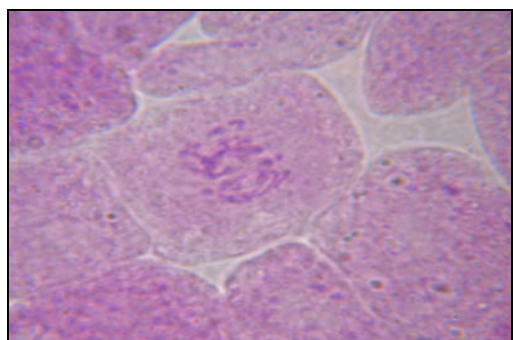


Fig. 6. A-T with multiple bridges at *Salvia officinalis* L.

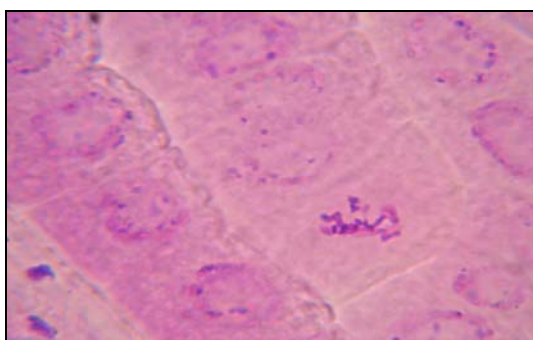


Fig. 10. Metaphase with micronuclei at *Salvia officinalis* L.

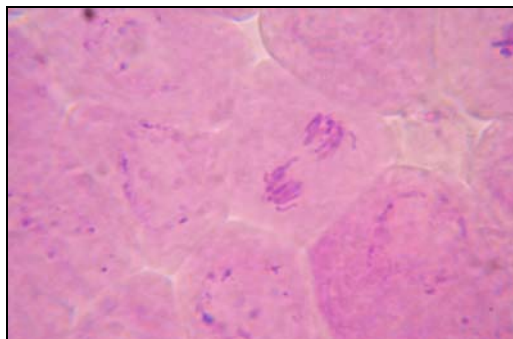


Fig. 7. A-T with delayed chromosomes at *Salvia officinalis* L.



Fig. 8. Disorganised A-T at *Salvia officinalis* L.

The repartition of cells on phases of division is as it follows: prophase (44.4%), followed by metaphase (33.6%), telophase (12.6%) and anaphase (9.3%) - fig. 2-5.

The value of the mitotic index was 11.50, which denotes that the plant was in a phase of active growth. A subsidiary objective of our study was the determination of the main types of abnormalities observed in the root cells of *Salvia*. The main incidences of abnormalities were observed in ana-telophases.

Frequently we detected ana-telophases with simple or multiple bridges and ana-telophases with fragments, but also expelled or late chromosomes and multipolar ana-telophases –figure 6 - 8. But we also observed metaphases with lagging chromosomes, expelled chromosomes or ring chromosomes, C-metaphases, etc – fig. 9 and 10.

CONCLUSIONS

Salvia officinalis has a very long history of effective medicinal use and is an important domestic herbal remedy for disorders of the digestive system. The whole herb is antihydrotic, antiseptic, antispasmodic, astringent, carminative, cholagogue, galactofuge, stimulant, tonic and vasodilator.

Due to its importance as a medicinal plant, many studies are focused on the breeding and cultivation of this specie. Until now, at *Salvia* species, few information are available regarding the main cellular indexes like: mitotic index, prophase, metaphase, anaphase, telophase index, the incidence of abnormalities in normal cells, chromosome features and behaviour, phylogenetic of the cultivars, etc.

The present study focused toward the determination of the main cellular indexes (mitotic index, prophase index, metaphase index, telophase index and anaphase index) as indicators of growth and development processes speed. In order to have more accurate results, the studies were accomplished in the root meristematic tips on three different plants, originated from Vegetable Research and Development Station Bacău, Romania.

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REFERENCES

1. NASMYTH, K., 2001 - Disseminating the genome: joining, resolving, and separating sister chromatids during mitosis and meiosis. *Annu Rev Genet.* 35:673-745
2. NICKLAS, R.B., AND P. ARANA., 1992 - Evolution and the meaning of metaphase. *J Cell Sci.* 102 (Pt 4):681-90
3. ÖZDEMİR C. AND G. RENEL., 1999 - The Morphological, Anatomical and Karyological Properties of *Salvia sclarea* L. *Turk. J. Bot.* 23: 7-18
4. ZACHARIAE, W., AND K. NASMYTH., 1999 - Whose end is destruction: cell division and the anaphase-promoting complex. *Genes Dev.* 13:2039-58

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