Cytomixis in *Rhoeo discolor*

Padmavathi S. Rao
P.G.Dept. of Botany,
J.M.Patelcollege , Bhandara-441 904 (M.S.)
Email-sgvrao@rediffmail.com

Abstract:

Cytomixis was observed in one of the plants of *Rhoeo discolour* in the Botanical garden of J.M. Patel college, Bhandara. The cytomictic plant was morphologically similar with normal plants. Some meicytes in cytsomictic plant was mostly connected in series of 5-30 cells in non synchronous type i,e. the cytomixis did not take place in all the pollen mother cells simultaneously. The transfer of nuclei was observed only at interphase and was not seen in subsequent meiotic stages. Further, the flow of migration of the nuclei from one PMC into another was found to be unidirectional. In few cytomictic chains, PMC without nuclei and PMC with two or three nuclei were also observed. Pollen fertility was drastically reduced compared to control. The probable reasons for this cytomixis were discussed in the present paper.

Key words:
Cytomixis, Heterozygote, Interphase, Pollen mother cell, *Rhoeo discolour.*

Introduction:

Cytomixis was first observed in pollen mother cells of *Crocus sativa* and the term was coined and defined by Gates (1911). Cytomixis generally referred to the apparent migration of chromatin material from one cell to another through cytoplasmic connections. It occurs prior to and during the prophase stage of meiosis. Since cytomixis creates variation in the chromosome number of the gametes, it could be considered a mechanism of evolutionary significance. This phenomenon has been reported in many species of angiosperms but never in *Rhoeo discolor* . The origin, development and function of cytoplasmic channels and chromatin migration has been discussed by many workers (Haslop and Harrison 1966, Guan et.al 2012).The presence of this phenomenon in a number of wild plants of Indian flora has been shown by Chata and Bir (1988). The reason for this phenomenon is unknown though it may be a response to the nutritional problem of developing reproductive cells. The real cause is still not very clear.

Material and methods:

Cytological screening of one of the plants of *Rhoeo discolor* exhibited cytomixis. For meiotic studies, flower buds of appropriate size were fixed in acetic acid alcohol (1:3) for 24 hrs. and later transferred to 70% alcohol and stored at 8°C till use. The anthers were stained with 2% acetocaramine.

Result and discussion:

The cytomictic plant under investigation was morphologically similar with normal plants. Cytomixis was noticed in fresh and fixed flower buds of cytomictic plants. The meiocytes in the cytomictic plant was mostly connected in series of 5to 30 cells (Figure1 and 2). The nuclear migration was of a non-synchronous type i,e. the cytomixis did not take place in all the PMCs simultaneously. The transfer of nuclei was observed only at interphase and was not seen in subsequent meiotic stages (Table). The normal PMCs exhibited translocation heterozygotes at diakinesis and stickiness and clumping at metaphase I. But Subsequent meiotic stages upto telophase II were normal. Further, the flow of migration of the nuclei from one PMC into another was found to be unidirectional. 52% of the PMCs were involved in cytomixis and remaining 48.00% of the PMCs become normal. Some of the cytomictic PMCs became empty due to the migration of the nuclei (Figure3). Meiotic abnormalities such as bridges, laggards and fragments were not observed in present study. In very few cytomictic PMCs, PMC without nuclei and PMCs with two or three nuclei were also observed. Pollen stainability as a measure of pollen fertility was 20% in cytomictic plant, therefore it was totally sterile. The origin and evolutionary implication of cytomixis are not precisely understood. Various viewpoints have been put forward to explain the probable origin of cytomixis. These includes the effect of fixatives (Haslop-Harrison 1966), Unknown physiological disturbances or unbalanced genetic systems of the plants (Morisset 1978), abnormal pathological conditions Bobak, Herich 1978), nutritional deficiency (Belluci 2003) and environmental stress and pollution (Haroum 2004). Cytomixis noticed both in fixed and fresh flower buds of the present study suggest that it is possibly not due to the action of fixatives. Normal and cytomictic plant was grown in the same locality and all the material for the cytological analysis was fixed more or less at the same time, therefore, the occurrence of cytomixis in only plant of the present study could not be attributed to temperature fluctuations. Gametocide induced cytomixis was reported in *Viciafaba* by Kaul (1971) and EMS induced cytomixis was reported in *Physalis peruviana* by Padmavathi et.al. 1990). In the present investigation chemical treatments were not given so it is possible that, unbalanced genetic systems influenced the process of cytomixis by disturbing the nucleoplasmic relations among the cells, a view point also shared by Morrisset (1978) working with *Ononis* (Leguminosae). Only cytoplasmic connections between PMCs were reported in some angiosperms by Heslpo-Horrison, 1966.

In the present investigation cytomixis was observed only in interphase. In cytomixis, the cells are connected together by thin cytoplasmic strands through which the interphase nucleus of the PMC are involved, simultaneously the nuclei passes from one into second to third and so on. The flow is unidirectional. Such a unidirectional migration has been recorded now and also in members of Scrophulariaceae (Singh 1985), in *Physalisperuviana* (Padmavathi et.al., 1990). Some cytomictic PMCs become invariably empty due to the migration of the nuclei were observed in the present investigation and also in *Medicago* (Bellucci et.al, 2003). It was found that the frequency of cytomixis was invariably reduced as the meiosis advanced. The cytomictic plant of the present investigation was totally sterile as flowers failed to lose till seed formation due to unbalanced genetic system.

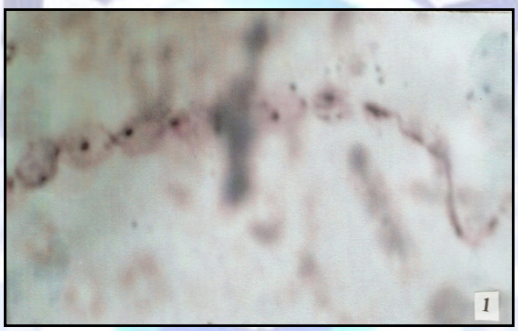

Figure. 1- Cytomixis involved in 15 cells at interphase (150X) (In *Rhoeo discolor)*

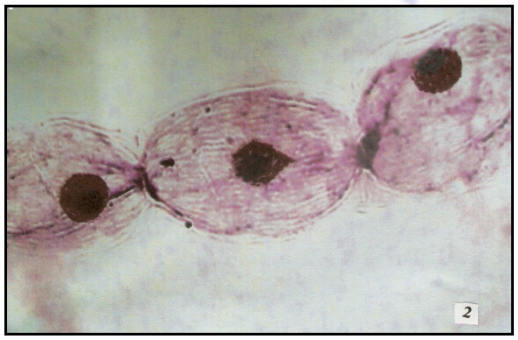

Figure. 2- Cytomixis involved in 3 cells at interphase (1500X) (In *Rhoeo discolor)*

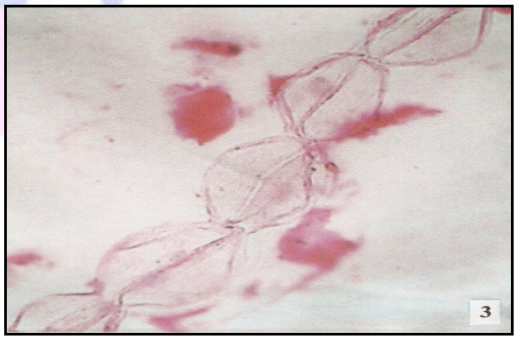

Figure.3- Empty PMC with cytoplasmic connections (1500X) (In *Rhoeo discolor)*

Table. 1-Cytomixis in *Rhoeo discolor* (Percentage indicated in parenthesis)

Stages	No. of cells involved in cytomixis				Empty cytomictic PMCs	Normal PMCs
	Two	Three	Four	>Five		
Interphase	15 (7.5)	33 (16.5)	30 15.0)	16(8. 0)	10 (5.0)	96 (48.0)

References:

Bellucci M., Roscini C., andMariani A., (2003). Cytomixis in PMCs in *Medicago sativa* L. J.ofHeridity. 94 (6): 214-218.

Bobak M., andHerich R., (1978). Cytomixis as manifestation as pathological changes after the application of Triflurine.Nucleus.21: 22-26.

Chata G.S., andBir S.S., (1988). Cytomixis in some woody Indian species. The Nucleans. 31:8-31.

Gates R.R., (1911). Pollen formation in*Onothergigas* Ann. Bot. 25: 909-940.

Guan J.Z., Wang J.J., Cheng Z.H., Lin Y. and Li Z.Y., (2012). Cytomixis and meiotic abnormalities during microsporogenesis are responsible for male sterility and chromosome variations in *Houttuynia cordata* Genetics and Mol. Research. 11(1) 121-130.

Haroun S.A., (2004). Environmental stress and pollution cytomixis in the microsporogenesis in *Vicia faba* L. Cytologia.69: 1-7

Heslop-Harrison J,. (1966). Cytoplasmic connections between angiosperm meiocytes.Ann.Bot. N.S. 30:222-230.

Kaul C.L., (1971). Investigation into cause of sterility iii gametocide induced male sterile *Viciafaba* L. Cytologia. 36: 219-228.

Morrisset P., (1978). Cytomixis in pollen mother cells of *Ononis* (leguminosae) Can. J. Genet. Cyto. 20: 383-388.

Padmavathi M.V., Suryaprabha P., and Rajarao K.G., (1990). EMS induced cytomixis in Cape goose berry (*Physalis peruviana* L.) I.J. of Cytology and Genetics. 25: 105-110.

Singh A.R.P., (1985). Cytomixis during microsporogenesis in natural populationals of some plant species. Cytologia .50: 341-346.