

BRIEF COMMUNICATION

The Effect of Secondary Cosmic Rays on Spontaneous Mutability

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Within the scope of a wider study of the problem of the relations of spontaneous mutability to the secondary components of cosmic rays, various biological testing methods of both radiobiological and radiogenetical character have been tested (CURTIS 1963, ONG 1964, PFISTER 1966, SOSNA 1957).

The currently used control for the tests, i.e. exposure on the surface of the earth at low altitudes, is not really a control because zero values cannot be obtained. The effort to get as near to zero values as possible led us to elaborate a complicated method of study of biological material under the surface of the earth even if meson components can be physically registered hundreds of meters under the earth.

With the tested biological material, *Equisetum arvense* L., *Equisetum silvaticum* L., *Equisetum palustre* L., the possibility of simple detection of abnormal plastids in the cells of prothalli has been used (SOSNA 1949, 1963). The frequency of these abnormalities has a significant stability as has been shown in the course of four years. On the other hand the irradiation of the spores of the given species of *Equisetum* at the beginning of their germination by ionising radiation (photon or corpuscular character), leads to a disturbance of the mechanism for the division of plastids and to deformed shape.

These observations have been used to study the effects of cosmic rays. The cultivation of the prothalli of *Equisetum* was carried on in sterile surroundings in an agar medium in chambers with artificial light (strictly spectrally defined sources). The biological and physical control of temperature, pressure and radiation factors, was complete.

Simultaneously sown spores on Petri dishes, always in three variations, were exposed in two places. On the surface of the earth (altitude 250 m above sea level) and under the ground (at a depth of 1340 m). After 18 days'

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exposure, the germination of spores, the development of prothalli and the numbers of cells with abnormal plastids were evaluated ($n = 10.000$).

Table 1. The germination of spores and prothalli with abnormal plastids at *Equisetum arvense* L., *Equisetum silvaticum* L. and *Equisetum palustre* L. in relation to the different intensity of cosmic rays

		Germination %	Prothalli with abnormal plastids %
+ 250 m	<i>E. arvense</i>	90.3 ± 0.32 s = 0.57	0.0093 ± 0.000012 s = 0.000018
	<i>E. silvaticum</i>	87.6 ± 0.52 s = 0.91	0.0084 ± 0.000012 s = 0.000026
	<i>E. palustre</i>	82.0 ± 0.57 s = 1.00	0.0078 ± 0.000012 s = 0.000026
- 1340 m	<i>E. arvense</i>	90.0 ± 0.33 s = 0.58	0.0015 ± 0.000012 s = 0.000022
	<i>E. silvaticum</i>	88.0 ± 0.58 s = 1.00	0.0014 ± 0.000013 s = 0.000027
	<i>E. palustre</i>	32.3 ± 0.32 s = 0.32	0.0014 ± 0.000012 s = 0.000022

Results

The results show an identity, in quality and quantity, between all three species of *Equisetum*. The differences between exposure at +250 m/ -1340 m are significant. On the other hand the germination of the spores remains in the sphere of normal variability with both exposures.

Table 2. The significances of results

		Germination P	Prothalli with abnormal plastids P
+ 250 m	<i>E. arvense</i>	0.68	0.0001
- 1340 m	<i>E. silvaticum</i>	0.65	0.0001
	<i>E. palustre</i>	0.62	0.0001

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V rámci širšího studia problematiky spontánní mutability a účinků kosmického záření bylo nutno vyjít z fyzikálního hlediska z nulových hodnot. Těch bylo prakticky dosaženo v hloubce 1340 m pod zemí. Spóry *Equisetum arvense*, *E. silvaticum* a *E. palustre* na tomto stanovišti a na povrchu země (250 m n. m.) byly testovány na výskyt abnormálního dělení plastidů v buňkách prothalií. Výsledky ukázaly signifikantně nižší procento prothalií s abnormálními plastidy na lokalitě pod zemí — v místech bez sekundárního kosmického záření — ve srovnání s expozicí na povrchu země. Hodnota klíčivosti spór zůstala naproti tomu na obou lokalitách v rámci normální variability.

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При изучении более широкой проблематики спонтанной мутабельности и действий космического излучения было необходимо исходить с физической точки зрения от нулевых значений, что было достигнуто в глубине 1430 м под землей. Споры *Equisetum arvense*, *E. silvaticum* и *E. palustre* испытывались на аномальное деление пластинов проталлий. Результаты показали достоверно более низкий процент этих аномалий у образцов находящихся под землей, без вторичного космического излучения по сравнению с образцами находящимися на поверхности земли. Всхожесть спор у обеих экспозиций напротив оказалась в границах нормальной изменчивости.