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BRIEF COMMUNICATION

A Model Method for Testing Cosmic Radiation

M. Sosna

Institute of Experimental Botany, Department of Genetics,
Czechoslovak Academy of Sciences, Praha

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Abstract. The experiments showed that after gamma irradiation as well as after irradiation by secondary cosmic rays (hard component) *Equisetum arvense* spores produce in the first developmental phases prothalia at a changed rate, *i.e.* in favour of the females. This effect being specific for radiation cannot be produced by heat, pressure or changes of electric and magnetic field (*i.e.* factors appearing in higher sea levels with a stronger intensity of cosmic rays). It will be possible to apply the sensitivity of the mentioned method for investigating the problems of testing cosmic ray variations. The possibility of its application in spontaneous variability research is not less important.

Genetic and biological effects of cosmic radiation can be reproduced and detected, if the experiment is appropriately arranged (Eugster 1958, Sosna 1972). It is then understood that the cosmic radiation intensity has a stable value, whereas in contrary the physically followed time variation intensities were not yet evaluated as to their relation to biological processes. Due to small temporary quantitative differences so far, no representative biological test has been made. This communication is treating a test method enabling the detection of energetic radiation microquantities by a sufficiently sensitive reaction, to which further suitable correlations are looked for.

Among many investigated objects, the great radiosensitivity of germinating *Equisetum arvense* spores was found to be most effective.The spores (isospores), produced by this species have a size of 35.4 μm. Since their germinating capacity is declining very quickly (Sosna 1949), they have to remain undercooled (—20 °C) after sterile extraction in a dry medium, so that their original biologic capacity is preserved during several months.

For these experiments the spores are planted on agar plates into Petri dishes with an anorganic medium (substrate), adapted as needed (Pringsheim 1951, ref. in Prát *et al.* 1972). Besides this sterile cultivation also semi-

Address: Ke dvoru 15/16, 160 30 Praha 6, Czechoslovakia.

Table 1
Ratio of prothalli from accute and chronic irradiation

	Acute Gamma Irradiation						Chronic Gamma Irradiation			
hours	24	48	96	120	192	240	—			
dosage			10 R				8 mR	20 mR	2 R	
dose rate	10 R	10 R	10 R	10 R	10 R	10 R	40 mR	100 mR	10 R	
♀/♂ ratio of prothalli	0.51	0.48	0.60	0.65	0.83	0.83	0.84	0.56	0.58	

sterile ones can be used, *e.g.* on a porous ceramic surface. The rate of female and male prothalia grown out of the spores in normal laboratory conditions is 1 : 1 (exactly $0.98 \pm 3 \times 0.24$, $s = 0.0018$ in favour of the female ones). The germinating spores on agar plates (substrate A 41) were irradiated with gamma rays — acute as well as chronic. (Table 1.)

From the Table 1 follows that irradiation applied 120 hours (not later) after germinating has started, is changing the rate of male and female prothalia in dependence on the dosis applied. A cytologic-anatomic, radiologic and dosimetric account is given in a further paper (Space Life Sci.) As was shown experimentally, this effect can be produced neither by heat, barometric pressure nor by other changes of the electric or magnetic field (Simpson 1965).

The phenomenon of the changing rate of male and female prothalia following irradiation was further used for testing cosmic radiation effects. Stands 250 m and 1050 m above sea level with an intensity relation of 1.92 were chosen. Sterile cultivated *Equisetum arvense* spores were on both places parallely put into boxes with a standardized temperature and illumination.

Table 2
Ratio of prothalli from cosmic rays

	48	120	240	350	hours	
♀/♂ ratio of prothalli	$0{\cdot}98 \pm 3 \,.\, 0{\cdot}024 = 0{\cdot}0018$				control	
	0.94	0.92	0.91	0.91	A	250
	0.93	0.91	0.91	0.90	A	250 Pb
	0.80	0.80	0.78	—	B	1050
	0.76	0.74	0.73	0.73	B	1050 Pb

This experiment was performed in two variations, *i.e.* the one was left without lead protection, whereas the other one was protected by a 10 cm thick lead layer. Thus the boxes were protected against fall-out irradiation, as the lead cover let through only the hard component of cosmic rays. (Table 2.) The numerical data show again a shift of the male and female prothalia rates. A statistically conclusive difference between the two stands exists herefore on places with different radiation intensity. In contrary, no difference appears between total radiation and the hard component.

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BOOK REVIEWS

WOOLHOUSE, H. W.: **Ageing Processes in Higher Plants.** — Oxford Biology Readers, Band 30. Oxford University Press, London 1972. 16 pp.

In der Reihe der kurzen Monographien der Universität Oxford ist der 30. Band den Alterungsvorgängen in höheren Pflanzen gewidmet. Der Verf., Prof. der Botanik der Universität Leeds, behandelt nach einer Einführung über die Entwicklung einer verschiedenen Lebensdauer bei Pflanzen die Frage des Blühens und der Samenbildung sowie die fünf Gruppen der Pflanzenhormone in Beziehung zur Alterung. Eingehender befasst sich der Verf. mit der Blattalterung, deren Anzeichen und deren hormonalen und biochemischen Regulierung (bei Blattalterung Absinken der Photosynthesekapazität und des Carboxydismutasegehaltes, Desorganisierung der Chloroplastenstruktur, Sinken des RNS-Gehaltes). Das Büchlein ist durch 13 zweifarbige übersichtliche Abbildungen illustriert und schliesst mit einem kurzen Literaturverzeichnis (15 Zitationen, leider Druckfehler in Zitation).

INGRID TICHÁ (*Praha*)

Solnechnaya radiatsiya i produktivnost' rastitel'nogo pokrova (Sonnenstrahlung und die Produktivität der Pflanzendecke). — Institut Fiziki i Astronomii Akademii Nauk Est. SSR, Tartu 1972. 148 S., 0,76 Rbl.; in russ. mit engl. Züss.

Dieser Beitrag der Akademie der Wissenschaften der Estonischen SSR zum Internationalen biologischen Programm enthält zwei Artikel: Berechnungen der Produktivität und des Wachstums der Pflanzendecke (von H. Tooming und A. Kallis) und Theorie des Eindringens der direkten Sonnenstrahlung in einen horizontal nicht homogenen Pflanzenbestand (von J. Ross). Der erste Artikel ist der mathematischen Modellierung der maximalen Produktivität von Pflanzenbeständen bei 4 verschiedenen Blattdistributionen, verschiedenen geographischen Lagen, an klaren und bedeckten Tagen gewidmet, der zweite Artikel bringt eine neue Auffassung und mathematische Formulierung des Eindringens der Sonnenstrahlung in den Pflanzenbestand, die jedoch nicht für niedrige Sonnenelevationen gültig ist. Beide Artikel enthalten eine ausführliche englische Zusammenfassung sowie ein Literaturverzeichnis (143 resp. 6 Zitationen).

INGRID TICHÁ (*Praha*)