The cultivation of peas on board the International Space Station did not induce changes in their karyotypes

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Investigation of the influence of cosmic flight conditions on the growth of different plants is of great importance for solving various problems of plant biology and ecology in artificial anthropological ecosystems. The results of such studies would allow for the development of long-term cosmic flight strategies, technologies and for the construction of biological systems aimed at the support of life for cosmic teams. It has been previously shown that the growth, development and metabolism of plants in conditions of space flight did not differ from that of the control organisms cultivated on the Earth's surface (1,2). Cosmic flight conditions did not influence either the frequency of chromosome aberrations in meiosis or genome polymorphism as studied by RAPD analysis of *Pisum sativum* L. (3).

In the present work, we carried out a detailed comparative investigation of chromosome C/DAPI-banding pattern polymorphism and FISH localization of ribosomal RNA genes in karyotypes of a dwarf pea Line 131 samples cultivated in space and on Earth. Seeds were obtained from plants grown to complete maturation over several generations in a specialized cosmic greenhouse LADA on board the Russian section of the International Space Station (3,4). As controls, seeds harvested from pea cultivated in similar growth conditions on Earth were used.

Based on their morphology and C/DAPI-banding patterns, the individual chromosomes of all studied pea samples were identified according to the nomenclature described previously (4). The obtained chromosome C/DAPI-banding patterns were found to fit into the pea genome generalized chromosome ideograms (4). The chromosome C/DAPI-band polymorphism range between individual cosmic plants was similar to those obtained in Earth-grown plants (control). No chromosome aberrations, translocations, or other rearrangements falling outside the spectrum of normal plants were observed.

Using FISH the distribution patterns of 45S and 5S rDNA was carefully studied in karyotypes of cosmic and Earth pea samples under investigation. The 45S rDNA signals were detected in the secondary constriction regions of chromosomes 4 and 7. The 5S rDNA sites were observed on pea chromosomes 1, 3, and 5 in the expected position. No additional sites of 45S or 5S rDNA were found in karyotypes of cosmic plant. Thus, the distribution patterns of 45S and 5S rDNA was found to be similar in all studied cosmic and Earth pea samples, and corresponded well to the results of our previous pea chromosome studies (5, 6).

our investigation thus demonstrated the high karyotype stability of pea plants grown over several generations during three years in the absence of Earth's gravity. The obtained data provide us with additional arguments in favor of long—term plant cultivation over the course of many generations as part of a phototrophic system of life support for cosmic expeditions.

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