

24 LET Dependence for Somatic Mutation Cross Section of *Drosophila* Irradiated with Heavy Ion Beams

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Using *Drosophila melanogaster* which has X-linked white-ivory eye-color mutation *w'* and trans-heterozygous two recessive genes of multiple wing hair (*mwh*) and flare hair (*flr*) on the third chromosomes, we scored mosaic spots in eye and wing of male flies irradiated with ¹²C, ²⁰Ne (LET: 13.8-191.7 keV/μm), and X-rays at the period of larvae. Dose-frequency relationships of eye and wing mosaic spots are both linear for these radiations. Cross section for the eye-color mosaic spot is almost proportional to LET. On the other hand, cross section for the wing hair mosaic spot is almost proportional to the square of LET and reaches plateau of about 10⁻²μm² in LET region larger than 100 keV/μm. The size of 10⁻²μm² corresponds to a sphere of diameter about 0.1 μm. The size is far larger than the diameter of a DNA molecule, and a little larger than the diameter of a chromatin fibre.

25 Mutation induction on normal human cells by split dose irradiation with carbon-ion beams.

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We have investigated the effects of cell death and mutation induction on normal human cells by split dose irradiation with carbon-ion beams. The split dose irradiation was carried out under the conditions for irradiation of total dose, which obtained 10 to 20% of surviving fraction, divided by the number of fractions (1 to 5) in 24hr interval. The results for the mutation induction by split dose irradiation showed that the mutation frequency was the same level (100×10⁻⁶) for fraction 1, which was single dose irradiation, to fraction 5 by 13keV/μm-beam irradiation. In the case of 77keV/μm-beam irradiation, the mutation frequency was 100×10⁻⁶ level except fraction 1 and 4. The frequency of fraction 1 was about 10 times higher than that of fraction 2, 3 and 5 and it was the same with the control level (10×10⁻⁶) in fraction 4. The mutation yield (or mutation risk), which was calculated as multiplying the mutation frequency by the surviving fraction, for 77keV/μm-beams was smaller than that for 13keV/μm-beams. This suggests that the mutational effects by split dose irradiation by high-LET beams is smaller than that for low-LET beams.

26 Molecular Analysis of Carbon Ion Beam-Induced *gll* mutations in *Arabidopsis thaliana*

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Since ion beams transfer large amount of energy along their tracks, ion beam-induced mutations would be qualitatively different from those induced by low LET radiations. However, few investigations on the structural alterations of the DNA induced by ion beams have been carried out in plants. Therefore, we planned to analyze two *gll* mutations of *Arabidopsis thaliana* induced by carbon ions (total energy=220 MeV, mean LET=113 keV/μm). PCR and Southern blot analyses revealed that, in one *gll* mutant, entire *GLI* gene was deleted and that, in the other mutant, a break occurred within exon 3 followed by an inversion or a translocation of either upstream or downstream region of the break. From further analysis of this mutant, it was found that the upstream region was rejoined to the *Atpk7* gene and that the downstream region was rejoined to 3' untranslated region of the *Atpk7* gene with an unknown 107 bp fragment inserted in between. Since *Atpk7* was mapped very close to *GLI*, it was suggested that an inversion took place in this *gll* mutant. From the present results, it was suggested that ion beam-irradiation efficiently induces DNA strand breaks and that complex rearrangements may subsequently occur in the plant genome.