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2. Energy requirements and RBE for producing a cytogenetic phenomenon in maize by irradiating seeds with x rays and monoenergetic neutrons.

The frequency of occurrence of yellow-green (yg_2) sectors in seedling leaves that develop from irradiated Yg_2/yg_2 maize seeds was used as a criterion of radiation effect. The yg_2 phenomenon is due mainly to a break in chromosome 9 between the centromere and the Yg_2 locus, with loss of the Yg_2 -containing segment. The dose-response curves for 250 kVp x rays (1420 to 14,250 rads) and for monoenergetic neutrons (0.43, 1.25, 1.80 and 14.7 MeV) were linear (or indistinguishable from linearity) and were independent of dose rate (with x rays from 10.3 to 1758 rads/min) thus indicating that breakage of the chromosome, with loss of Yg_2 , may be due to a single charged particle. X-ray-induced yg_2 "mutation" rates were 16.4×10^{-7} and 8.3×10^{-7} per rad for cells of leaves 4 and 5, respectively. The "mutation" rates per rad for neutrons were dependent on the leaf scored and the neutron energies employed. For leaf 5 the range was from 3.9×10^{-7} (1.80 MeV) to 6.8×10^{-7} (0.43 MeV). The "effective volume" was assumed to be a sphere and, based on microdosimetric concepts, was computed to have a diameter of 1.35μ in leaf 4 and 1.10μ in leaf 5. The corresponding estimates arrived at by cytological methods were 1.52μ and 1.38μ , respectively. The results can be accounted for both relatively and absolutely on the assumption that the interphase chromosome is broken, to cause the occurrence of a yg_2 sector, when a single charged particle delivers an energy of approximately 93 KeV or more to a spherical region of the seed embryo cell nucleus that is approximately one micron in diameter but proportional to nuclear diameter.

The relative biological effectiveness of the neutron irradiations used, compared to 250 kVp x rays, ranged from 47 to 102.

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