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COMPARATIVE STUDY OF MUTATIONS INDUCED BY CARBON-ION BEAM AND GAMMA RAY IRRADIATIONS IN ARABIDOPSIS THALIANA AT THE GENOME-WIDE SCALE

Mutation breeding induced by irradiation with high energetic photons and ion beams is one of the important methods used to improve plant varieties, but the mutagenic effects and the molecular mechanisms are often not entirely clear. Traditional research focused on phenotype screening, chromosome aberration test and genetic variation analysis of specific genes. Recently, the whole genome sequencing technique provides a new method for understanding the comprehensive identification of mutations caused by irradiations with different linear energy transfer (LET). In this study, eleven Arabidopsis thaliana M3 lines induced by carbon-ion beams and 10 M3 lines induced by gamma rays were re-sequenced by using the Illumina Hiseq sequencing platform, and the substitutions and small insertion-deletions (INDELs) were analysed comparatively. It was found that the ratio of substitutions to INDELs for M3 lines induced by carbon-ion beam was 2.58:1, whereas the ratio was 3.69:1 for gamma rays. The ratios of deletions to insertion for carbon ions and gamma rays were 4.9:1 and 2.65:1, respectively. The single base INDELs were more prevalent than those equal to or greater than 2 bp in both carbon-ion beams and gamma rays induced M3 lines. Among the detected substitutions, the ratios of transitions to transversions induced by carbon ions irradiation was 0.99 and 1.27 for gamma rays; these values differ greatly from the 2.73 reported for spontaneous substitutions reported. This study provides novel data on molecular characteristics of carbon-ion beam and gamma rays induced mutations at genome-wide scale. It can also provide valuable clues for explaining the potential mechanism of plant mutation breeding by irradiations with different LETs.

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