

Two powdery mildew resistance mutations induced by ENU in *Pisum sativum* L. affect the locus *er1*

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Abstract The alkylating compounds and strong mutagens methylnitrosourea (MNU) and ethylnitrosourea (ENU) were used to widen the genetic variability of pea (*Pisum sativum* L.) via experimental mutagenesis. Amongst multiple mutations of agronomical interest, for the first time two mutations conferring broad-range resistance to powdery mildew (*Erysiphe pisi* Syd.) were induced in pea. Mutagenic treatments were carried out on seedlings using a technique that ensures very high mutagenic efficiency. Two-hour exposure of cv. Solara seedlings to chemical mutagens resulted in almost non noticeable lethality and sterility in the M1 generation and very high mutation rates: ~39% families with visible mutations in the M2 generation. The influence of the cell cycle phase on the process of mutagenesis was studied in cv. Frilene using a previously developed technique for synchronization of shoot apical meristem cells. The cell cycle phase at which cells were treated apparently did not influence the lethality and sterility in the M1 generation, while the visible mutation rate, assessed in the M2 generation, showed a clear cell cycle dependency. Seedlings treated at the

G2 and M phases gave rise to progenies exhibiting the highest mutation rate, over 50% of M2 families with visible mutations. The powdery mildew resistant (PMR) mutant S(*er1mut1*) was induced by treatment of cv. Solara seedlings for 2 h with ENU, while the PMR mutant F(*er1mut2*) was induced by treatment of cv. Frilene seedlings with the same chemical mutagen for 1 h during the G2 phase of the cell cycle. The genetic analysis of the novel PMR mutant lines showed that both resistances are inherited as monogenic recessive traits. The performed genetic complementation analyses revealed that both mutations affect the same locus—*er1*, which determines most of the natural sources of PMR in pea. A project aiming at the isolation of the powdery mildew resistance mutated gene via map based cloning is currently under way.

Keywords Chemical mutagenesis · Cell cycle · Ethylnitrosourea · Methylnitrosourea · *Pisum sativum* · Powdery mildew · Powdery mildew resistance

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