Modification of genetic effects of gamma radiation by laser radiation

Mutants obtained by means of ionizing radiation and chemical mutagens often show low viability and productivity that makes their use in plant breeding difficult. Methods reducing the destructive mutagen action on important functions of plant organism and increasing quality and practical value of induced mutants would be interesting.

We believe that one method for increasing efficiency of experimental mutagenesis in plants is the application of laser radiation as a modificator of genetic effects of ionizing radiation and chemical mutagens. Combined exposure of wheat seedlings to a gamma radiation dose of 2 kR and to laser radiation with the wave lenth of 632.8 nm (power density - 20 mVt/cm^2, exposure - 30 min.) resulted in reducing the chromosomal aberration percentage from 30.5% in the gamma version to 16.3% in the combined treatment version.

A radiosensibilizing effect was observed at additional exposure of gamma irradiated wheat seeds to laser light with the wave length of 441.6 nm where chromosomal aberration percentage increased from 22% in the gamma-irradiation version to 31% in the combined treatment version. By laser radiation it is also possible to normalize mitotic cell activity suppressed by gamma irradiation. Additional seedling irradiation with the light of helium-neon laser (632.8 nm) resulted in recovery of mitotic cell activity from 21% to 62% and increasing the average content of DNA per nucleus by 10%.

The influence of only laser radiation on plant variability was also studied and it was shown that irradiation of wheat seeds and seedlings with pulsed and continuous laser light of visible spectrum resulted in phenotypically altered forms in M_2. Their frequences was dependent upon power density, dose and radiation wave length. Number of altered forms increased in going from long-wave to short-wave spectrum region. In comparing efficiency of different laser types of pulsed and continuous exposure (dose - 180 J/cm^2) 2% of altered forms in M_2 was observed after using the light of helium-neon laser of red spectrum 6.1% from helium-cadmium laser radiation (λ = 441.6 nm) and 12.3% using powerful pulsed radiation of the second harmonic of neodymium laser (λ = 530 nm) but 9% for ruby laser radiation (λ = 694 nm).

In combined action (gamma radiation + helium-neon laser light) the yield of phenotypically altered forms was lower (from 7.4 up to 10.9% depending on exposure) than in a version of only gamma irradiation (14.0 - 17.6%).

The most interesting fact for plant breeding is that additional exposure of gamma irradiated wheat seeds and seedlings to laser radiation resulted in an expansion of the induced variability spectrum: in versions of combined treatment we selected alterations, which did not occur in plant progenies after their exposure only to ionizing radiation, forms with alteration of agronomic characteristics occurred more often.

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