

Exploring a barley fast neutron generated mutant population

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Development of barley mutant population

We developed a mutant population in barley (*Hordeum vulgare* L. cv 'Golden promise') by fast neutron bombardment. To identify the optimal dose, a pre-experiment was performed, using 12 different levels, ranging from 3.72 to 58.03 Gray units (Gy) at a seed humidity of 14%. More than 93% M₁ seeds germinated when treated with doses up to 26.55 Gy, whereas higher doses reduced the survival significantly. A larger experiment was carried out using 29.87 Gy. M₁ seeds were sown in the field and ears were harvested from 109 plants. All radiation treatments were performed at the Nuclear Institute, Lanzhou University, China.

General evaluation of the mutant population

Ten seeds from each M₁ plant (M₂ seed) were sown in the greenhouse for evaluation. The germination rate ranged from 0-100, with an average of 74.2%. Several mutant phenotypes were seen, including dwarfing, chlorophyll deficiency and changes in leaf morphology. The mutation rate is being further evaluated using RAPD analysis.



Chlorophyll mutants

Eight M₂ populations showed different types of chlorophyll mutants including pale plants, plants with white stripes and albinos. The percentage of chlorophyll mutants was 2.1.



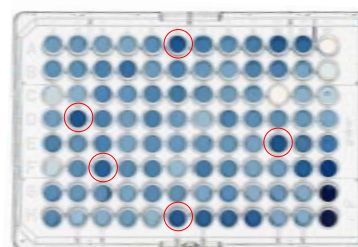
Spike mutants

Evaluation of spike mutant phenotypes in the M₂ plants revealed several different mutant phenotypes including the *brc1*-like phenotype showing 1 to several additional spikes (B), naked seeds (C), different types of branched stem (D and E) and branched stems with many short nodes (F). (A) Normal spike.

Screening for phytic acid mutants

Phytic acid (*myo*-inositol 1,2,3,4,5,6-hexakisphosphate) is the primary storage compound of phosphorus in plant seeds. In human nutrition, phytic acid acts as an anti-nutritional factor for, in particular, Fe and Zn uptake in the digestive tract, and thus potentially contributes to the 'hidden hunger' caused by mineral malnutrition. However, phytic acid might also have anti-carcinogenic and antioxidative effects. In animal husbandry, the main problem caused by phytic acid in the grain is that phosphate bound in phytic acid cannot be utilized by monogastric animals. Low-phytic acid mutant lines might help to solve the problems that high levels of phytic acid create in food and feed consumption.

A quick way to analyse the population for phytic acid mutants is to screen the M₃ seeds for an elevated level of inorganic phosphorus (Pi), as the level of Pi is inversely associated with the level of phytic acid.



Blue screen

Pi is extracted from crushed seeds with a weak HCl solution. Chen's reagent added to the extract reacts with Pi to produce a blue colour, the intensity of the blue indicates the concentration of Pi in the extract solution. Red circles indicate seeds with a high level of Pi. Column 12 shows a standard curve with known concentrations of Pi.