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LA RECOMBINAISON MEIOTIQUE CHEZ LES PLANTES : CONTRÔLE PAR LES FACTEURS DU MILIEU.

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Plant breeding is dependent on the genetic variation generated from crossing divergent individuals. This variation is generated by the independent assortment of recombination between parental chromosomes during the formation of gametes during sexual reproduction. Compared to mammalian species, many crop plants have less potential for reshuffling the genetic complement through either independent assortment or recombination. Unlike assortment where the chromosome number is fixed, recombination frequency is potentially plastic and under genetic and environmental control. This is of particular interest in large genome cereals such as barley and wheat, where crossovers are generally localised to the ends of the chromosomes and up to a third of the genes are situated in regions with very low recombination frequency and thus locked into particular allelic combinations. These regions are thus largely inaccessible to conventional breeding programmes, giving a stimulus to research into means of changing the recombination distribution. The use of abiotic stress to alter the recombination landscape is potentially of particular interest as it could be used with existing breeding germplasm.

Our initial work has concentrated on barley to see whether recombination can be shifted to more proximal regions changing growth temperature. We utilised a genome-wide marker set for linkage analysis combined with cytological mapping of crossover events to examine the recombination landscape of plants grown at different temperatures. We found that barley shows heterochiasmy i.e. differences between female and male recombination frequencies but in a temperature dependent fashion. In particular, we found that elevated temperature significantly changes patterns of recombination in male meiosis only, with potentially some re-positioning of class I crossovers determined by cytological mapping of HvMLH3 foci and showed that the length of synaptonemal complexes in male meiocytes increases in response to temperature.
Subsequent experiments have been able to repeat this finding with a short heat stress in a more reproducible experimental set up. Although the recombination shifts are significant they are not dramatic and potentially relate to the plant's adaptive response to changes in the environment. The potential utility of this approach and changes in other abiotic factors such a nutrient availability will be discussed as potential breeding tools.

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