

Understanding the Balance of Genetic Shuffling in Plants

Meiosis is a crucial process in plants and other organisms where cells divide to produce reproductive cells, i.e., gametes, with half the usual number of chromosomes. This process involves creating and repairing DNA breaks in chromosomes inherited from both parents, which leads to chromosome exchanges and the formation of new genetic combinations essential for adaptation and evolution. However, in most organisms, only a small fraction of these DNA breaks result in chromosome exchanges. For example, in the plant *Arabidopsis thaliana*, only about 5% of breaks lead to genetic shuffling.

Our research aims to understand why only a few of these genetic breaks result in new combinations. We discovered that blocking one of the primary pathways for generating new combinations and removing a key protein involved in DNA repair unexpectedly increases the frequency of genetic shuffling by nearly five times. This suggests that different pathways for genetic shuffling compete with each other, and that some proteins might actually inhibit this process under certain conditions.

In our project, we will employ advanced techniques to investigate these genetic processes in detail. We will examine how different genetic mutations affect the frequency and distribution of chromosome exchanges. Additionally, we will explore whether similar effects occur with the loss of other essential proteins involved in DNA repair and chromosome pairing. By studying these processes across multiple generations, we aim to understand how increased genetic shuffling impacts the stability and evolution of plant genomes.

Overall, our project seeks to unravel the complex mechanisms behind genetic shuffling and explore why plants limit this process. This research could provide valuable insights into the evolutionary strategies of plants and other organisms.