The interplay between DNA damage and plant immune responses

Summary: DNA damage repair and immune responses are two fundamental processes that have been characterized extensively, but the links between them remain largely unknown. We previously identified multiple genes that play a dual role in homologous recombination and transcriptional regulation of plant-defense genes. Moreover, we discovered that multiple microbial bacterial, fungal and oomycete plant pathogens with diverse life styles induce double-strand-breaks to host plant DNA. These suggested an interplay between DNA damage and plant immune responses. Here we report that poly(ADP-ribosyl)ation plays an important role in plant immune systems in response to infection. Poly(ADP-ribosyl)ation is a post-translational modification and contributes to multiple molecular and cellular processes with a prominent role in DNA damage repair. Human PARP1, the founding and most characterized member of the PARP family, accounts for more than 90% of overall molecular and cellular PARP activity in response to DNA damage while PARP2 supplies a minor portion of this PARP activity. We found that Arabidopsis PARP2 rather than PARP1 plays the predominant role in poly(ADP-ribosyl)ation and organismal resilience in response to either chemically-induced DNA damage or pathogen infections. Hence, core aspects of plant poly(ADP-ribosyl)ation are mediated by substantially different enzymes than in animals, indicating the likelihood of substantial differences in regulation. Collectively, our findings suggest that the two ancient surveillance mechanisms, DNA damage and plant immune responses, are intricately interconnected.