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Plant pathogens, including plant-associated fungi, secrete during plant infection an arsenal of small secreted proteins acting as effectors that modulate host immunity to facilitate infection. Genome-wide transcriptomic studies have shown waves of concerted expression of effector genes that correspond to different stages of plant tissue infection and colonization. In parallel, effector genes were often found to be located in 'plastic' genomic regions, enriched in transposable elements. The location of effector genes in regions enriched in transposable elements has been shown to have an impact on adaptability of fungi but could also provide for tight control of effector gene expression through chromatin-based regulation. Recently, chromatin structure was shown to be an important regulatory layer of effector gene expression in several plant-associated fungi with different lifestyles. Chromatin-based control of effector gene expression is likely to provide an evolutionary advantage by preventing the expression of genes not needed during vegetative growth and allow for a massive concerted expression at particular time-points of plant infection.