Haplotype-phased and chromosome-level assembly of Puccinia polysora, a giga-scale fungal pathogen causing southern corn rust

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Abstract

Rust fungi are characterized by large genomes with high repeat content, and have two haploid nuclei in most life stages, which makes achieving high-quality genome assemblies challenging. Here, we describe a pipeline using HiFi reads and Hi-C data to assemble a gigabase-sized fungal pathogen, Puccinia polysora f.sp. zeae, to haplotype-phased and chromosome-scale. The final assembled genome is 1.71 Gbp, with ~850 Mbp and 18 chromosomes in each haplotype, being currently the largest fungal genome assembled to chromosome scale. Transcript-based annotation identified 47,512 genes with a similar number for each haplotype. A high level of interhaplotype variation was found with 10% haplotype-specific BUSCO genes, 5.8 SNPs/kbp, and structural variation accounting for 3% of the genome size. The P. polysora genome displayed over 85% repeat content, with genome-size expansion, gene losses and gene family expansions suggested by multiple copies of species-specific orthogroups. Interestingly, these features did not affect overall synteny with other Puccinia species with smaller genomes. Fine-time-point transcriptomics revealed seven clusters of co-expressed secreted proteins that are conserved between two haplotypes. The fact that candidate effectors interspersed with all genes indicated the absence of a "two-speed genome" evolution in P. polysora. Genome resequencing of 79 additional isolates revealed a clonal population structure of P. polysora in China with low geographic differentiation. Nevertheless, a minor population drifted from the major population by having mutations on secreted proteins including AvrRppC, indicating the ongoing evolution and population differentiation. The high-quality assembly provides valuable genomic resources for future studies on the evolution of P. polysora.

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Genome Assembly Form MER.docx available at https://authorea.com/users/488787/articles/572782haplotype-phased-and-chromosome-level-assembly-of-puccinia-polysora-a-giga-scale-fungalpathogen-causing-southern-corn-rust

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Figure 6 comparative genomic analyses.pdf available at https://authorea.com/users/488787/ articles/572782-haplotype-phased-and-chromosome-level-assembly-of-puccinia-polysora-agiga-scale-fungal-pathogen-causing-southern-corn-rust









