

Description of Additional Supplementary Files

Supplementary Data 1. Sequencing data of *Th. intermedium* and *R. kamoji* genomes

Supplementary Data 2. Summary of Hi-C reads mapping used for *Th. intermedium* and *R. kamoji* genome assemblies

Supplementary Data 3. Statistics of *Th. intermedium* and *R. kamoji* genome assemblies

Supplementary Data 4. Assessment of genome assembly completeness using BUSCO

Supplementary Data 5. Assessment of genome assembly completeness using LTR Assembly Index (LAI) software

Supplementary Data 6. Annotated repetitive elements in *Th. intermedium* genome assembly

Supplementary Data 7. Annotated repetitive elements in *R. kamoji* genome assembly

Supplementary Data 8. Annotated repetitive elements in *Aegilops tauschii*, *Pseudoroegneria libanotica*, *Dasypyrum villosum*, and *Hordeum marinum* genome assemblies

Supplementary Data 9. Summary of transcriptome data used for *Th. intermedium* and *R. kamoji* gene annotation

Supplementary Data 10. Summary of functional annotated genes in *Th. intermedium* and *R. kamoji* assemblies

Supplementary Data 11. Summary of transcriptomic and exomic datasets of *Triticeae* diploid species used for phylogeny analyses

Supplementary Data 12. Summary of *Th. intermedium* genome re-sequencing

Supplementary Data 13. The sequences of probes used for FISH analyses

Supplementary Data 14. Summary of chloroplast sequences of *Triticeae* species used for phylogeny analyses

Supplementary Data 15. Sequences of primers used in this study