

Supplementary materials

- All code and dataset about this study are publicly available:

The complete time-series 3D crop point cloud dataset and code can be downloaded from <https://pan.baidu.com/s/1mNSDz4F0ZjOwmqzMuXozSQ?pwd=1234>.

- For the convenience of the reviewers, here are some supplementary figures:

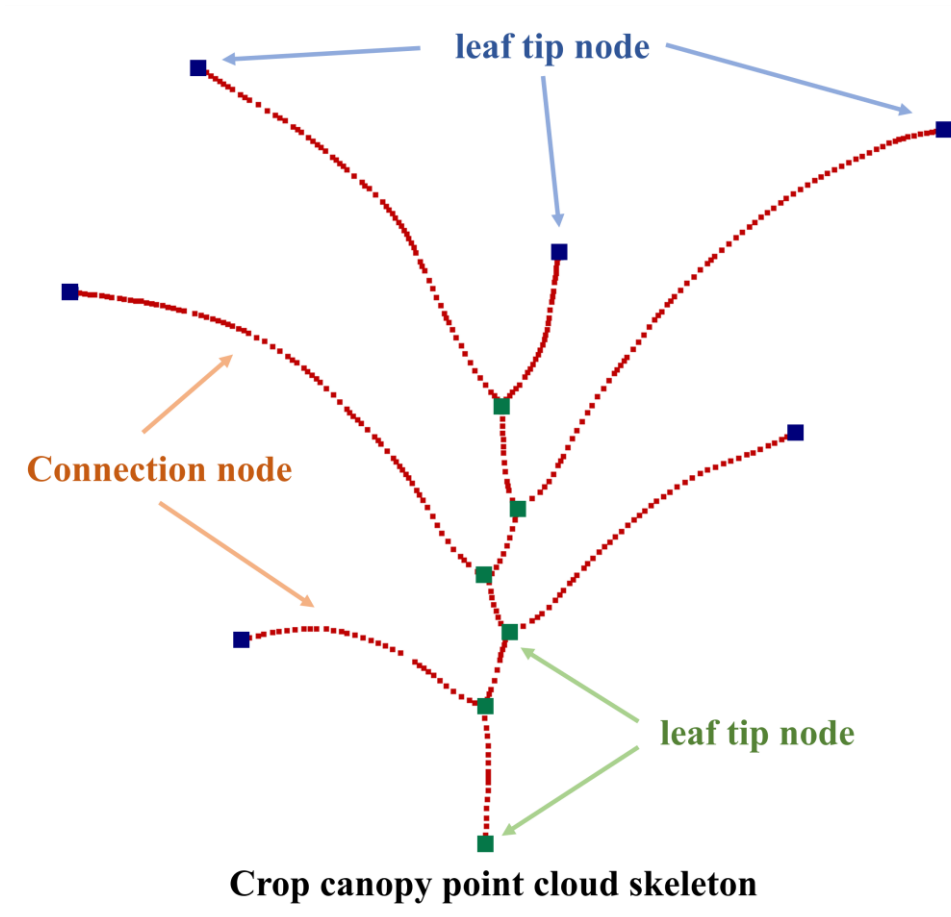


Figure S1 Schematic diagram of stem skeleton key point extraction, the corresponding relationship between node colors is as follows: stem nodes-green, leaf tip nodes-blue, connection nodes-red.

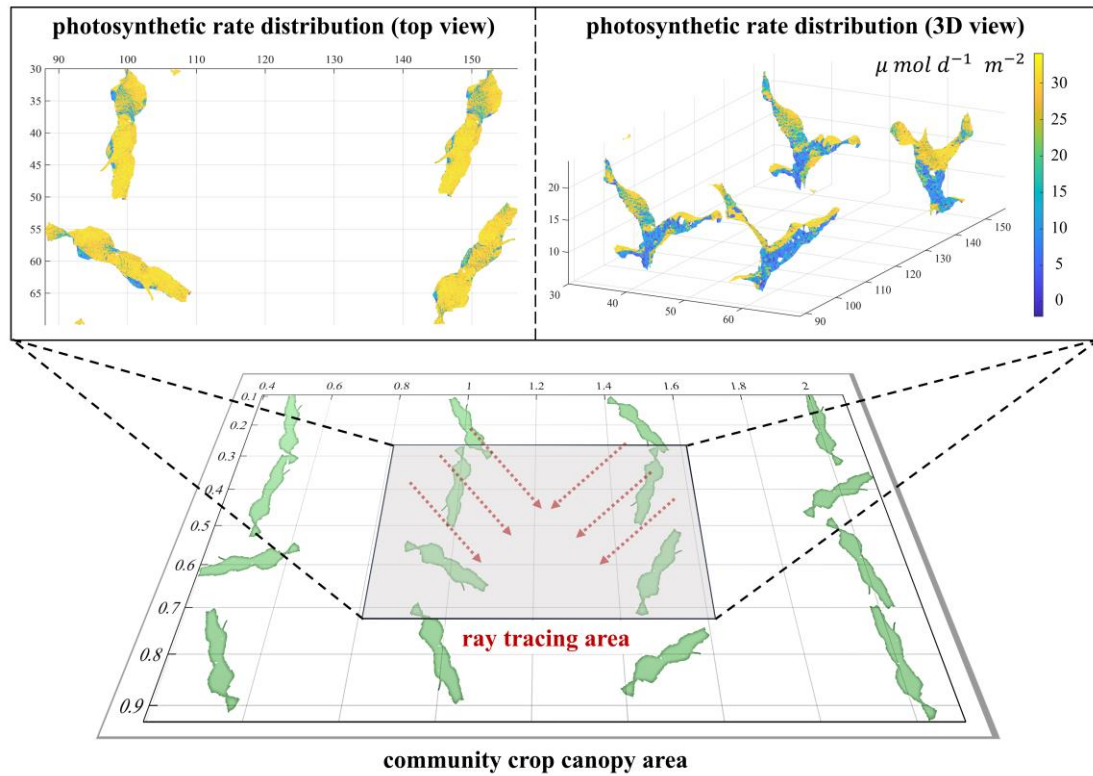


Figure S2 Schematic representation of the virtual crop canopy population model, with the gray area indicating the range of ray tracing. By applying the ray tracing algorithm, the light distribution across the entire canopy space can be accurately captured, enabling the calculation of photosynthetic rates in different regions. The figure provides a visualization of the spatial distribution of canopy photosynthetic rates from both a top-down perspective and a 3D view.

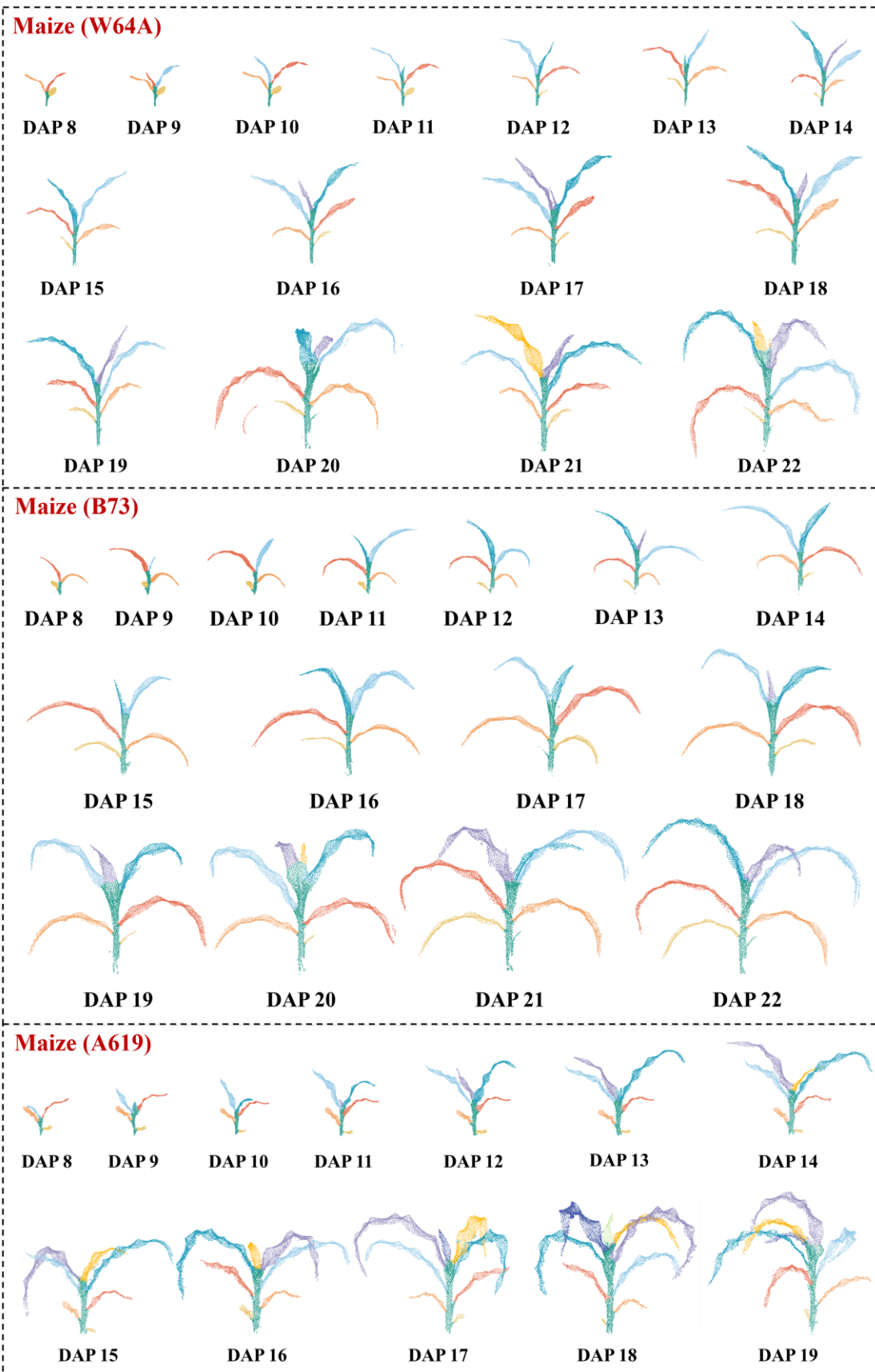


Figure S3 Segmentation effect of self-collected maize dataset, varieties include W64A, B73 and A619.

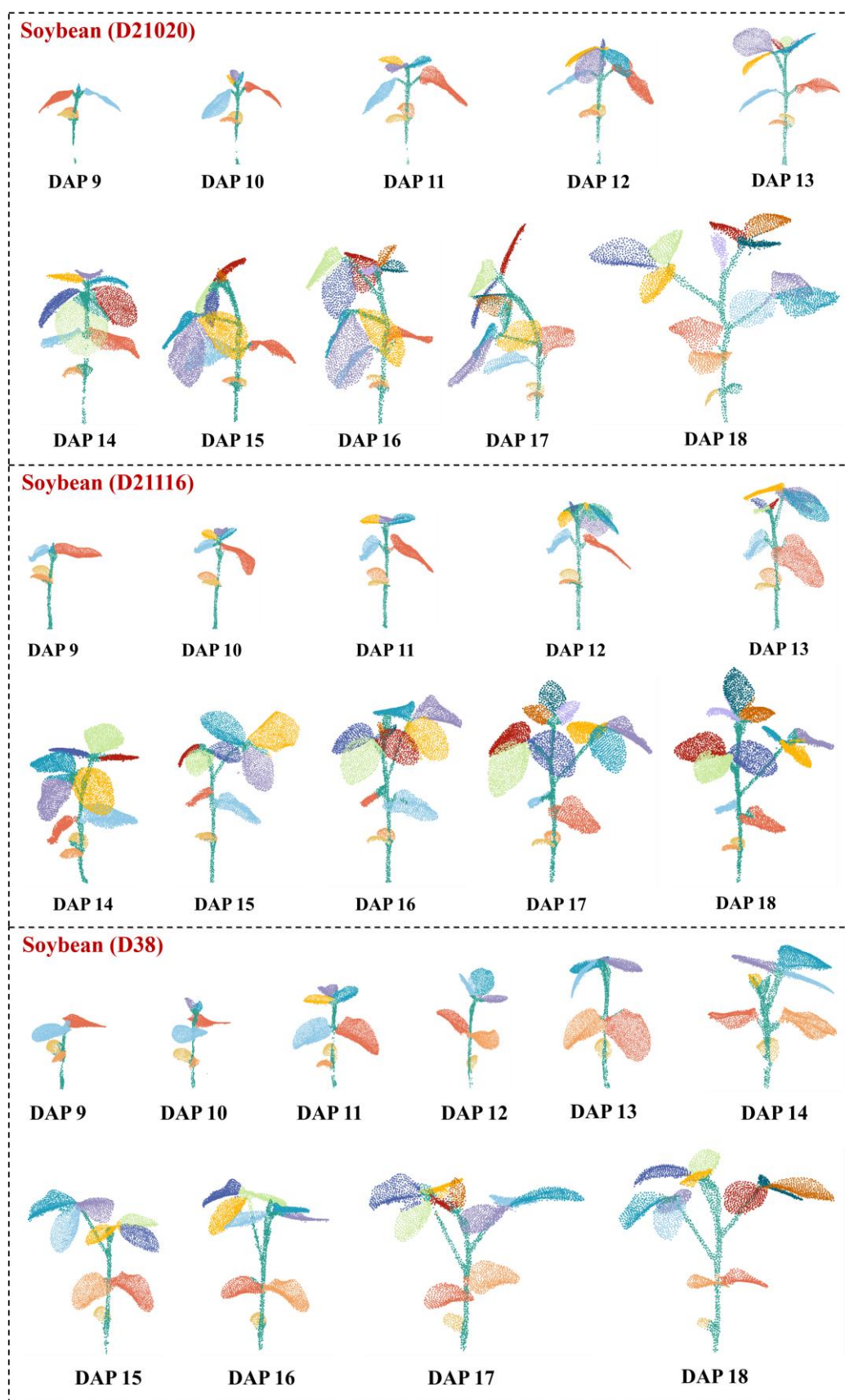


Figure S4 Segmentation effect of self-collected soybean dataset, varieties include D21020, D21116 and D38.

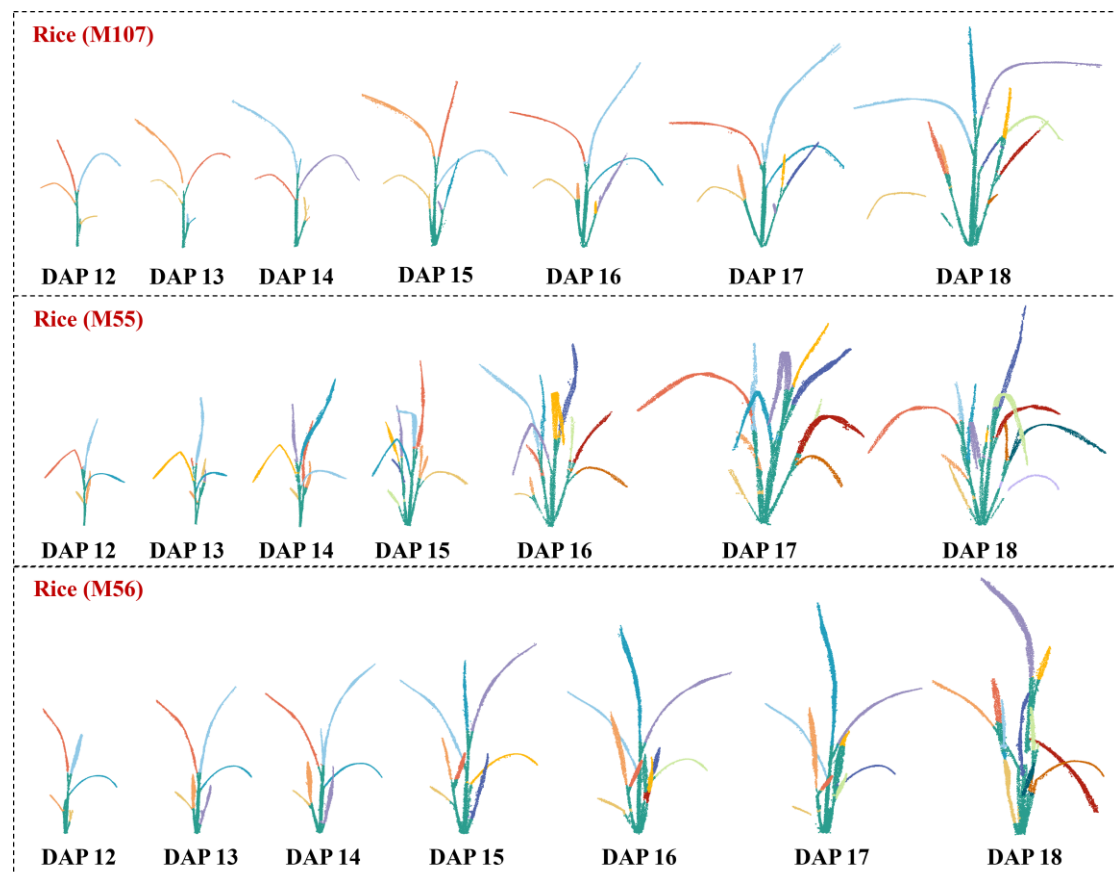


Figure S5 Segmentation effect of self-collected rice dataset, varieties include M107, M55 and M56.

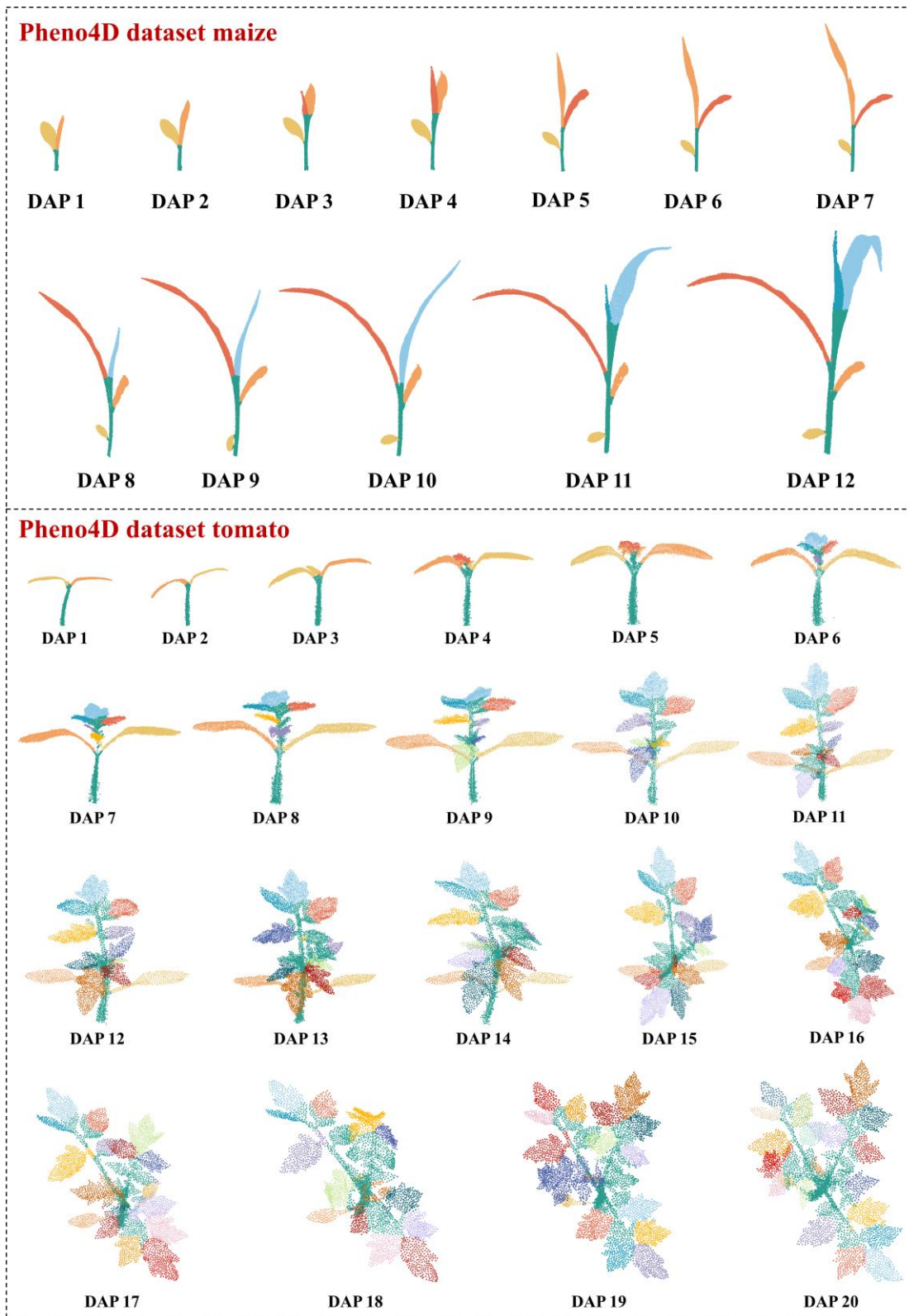


Figure S6 Segmentation effect of public dataset Pheno4D, varieties include maize and tomato.

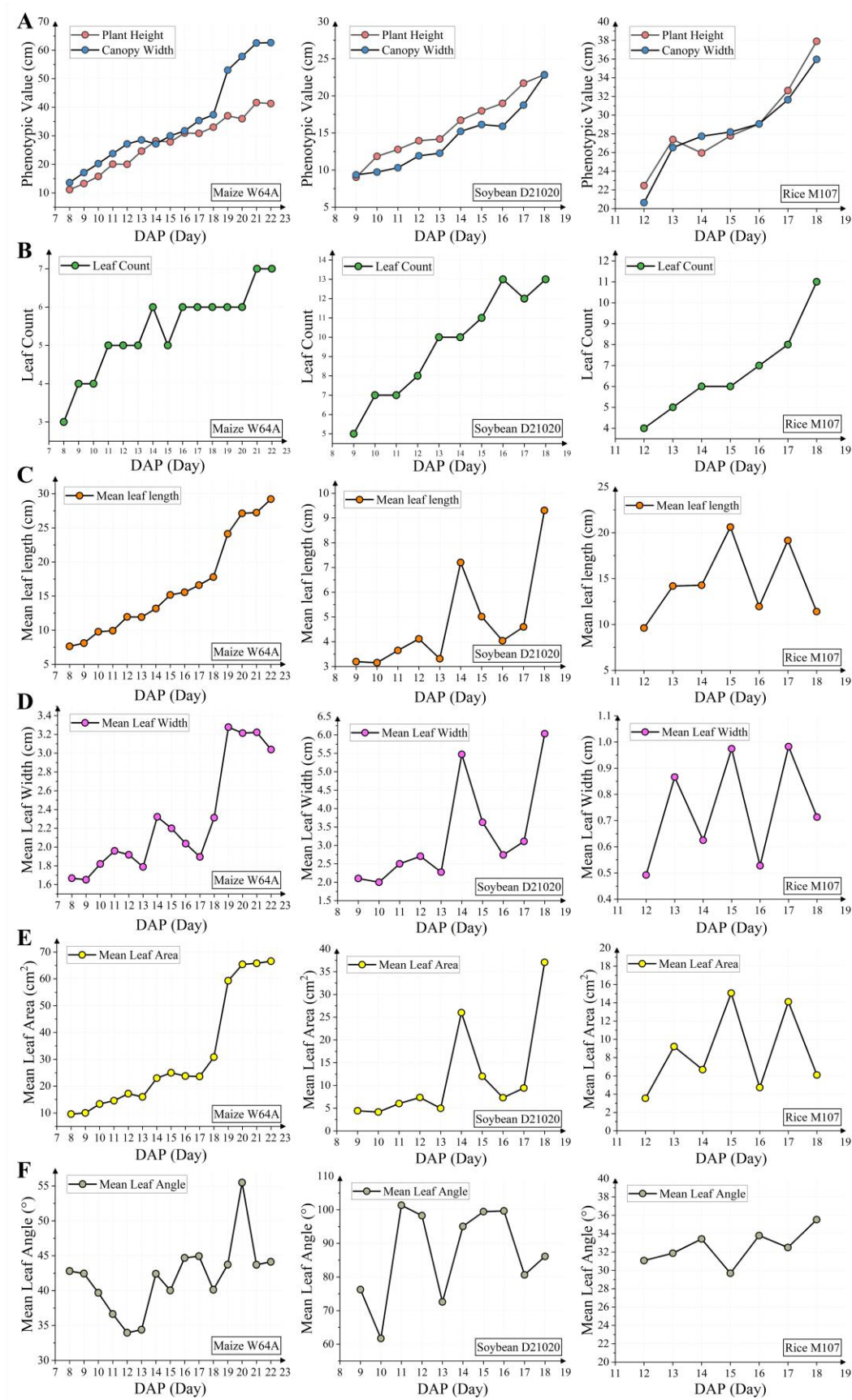


Figure S7 Time-series phenotypic changes of the three crops. (A) Plant height. (B) Canopy width. (C) Leaf count. (D) Average leaf length. (E) Average leaf width. (F) Average leaf angle.

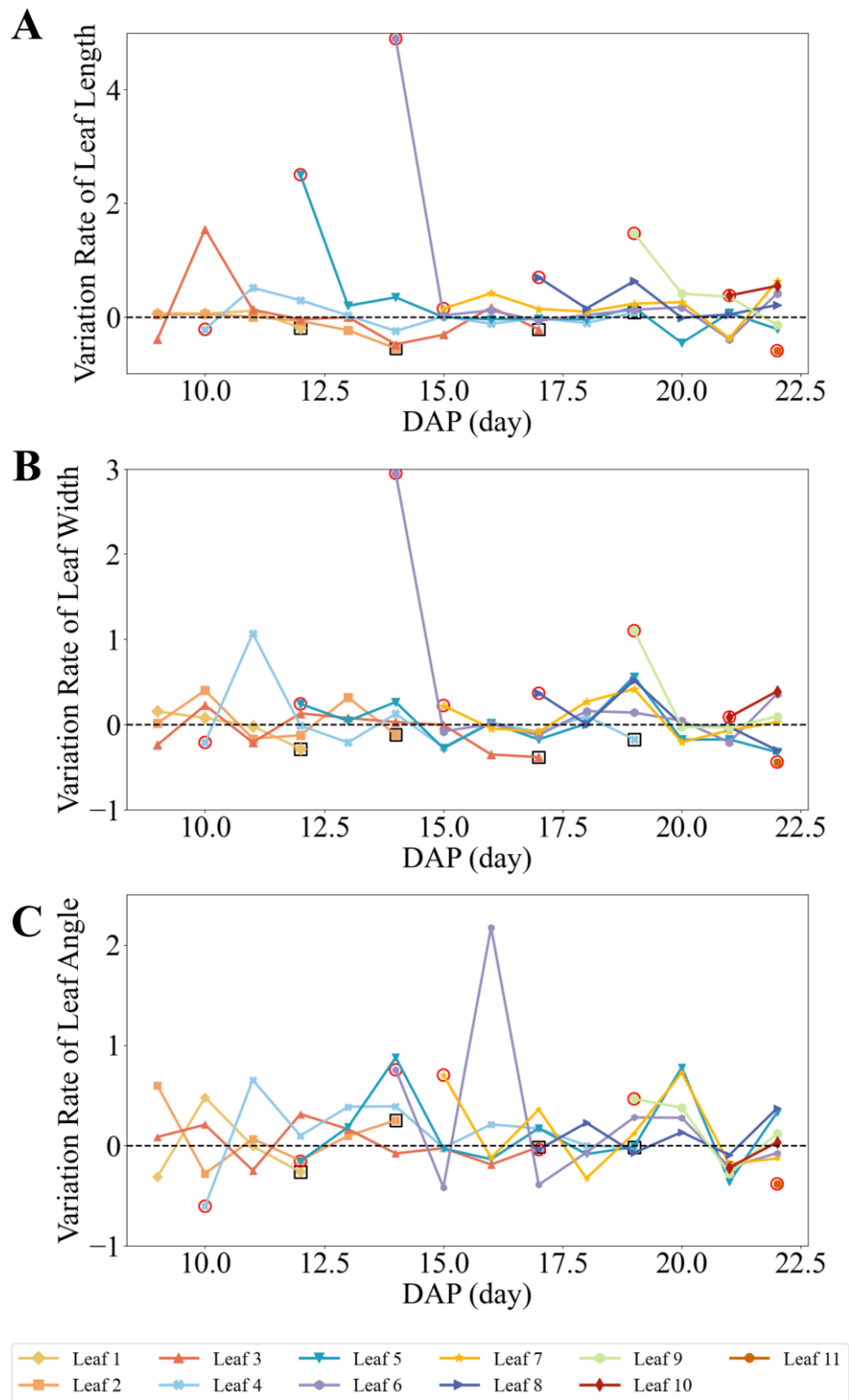


Figure S8 Time-series phenotypic variation rates of each maize leaf. (A) Variation rate of leaf length. (B) Variation rate of leaf width. (C) Variation rate of leaf angle.

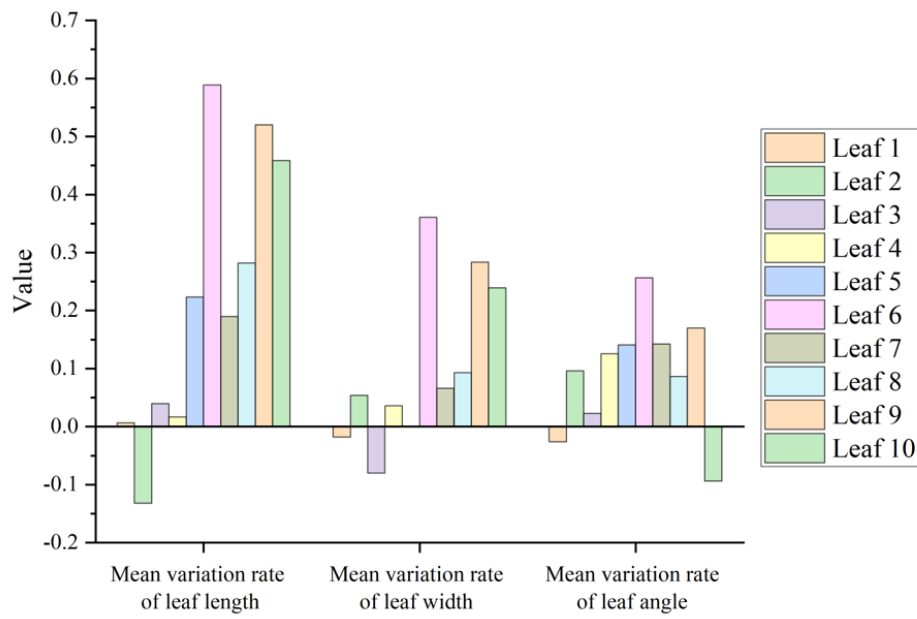


Figure S9 Comparison of the mean variation rates of leaf length, leaf width, and leaf angle among maize leaf instances.

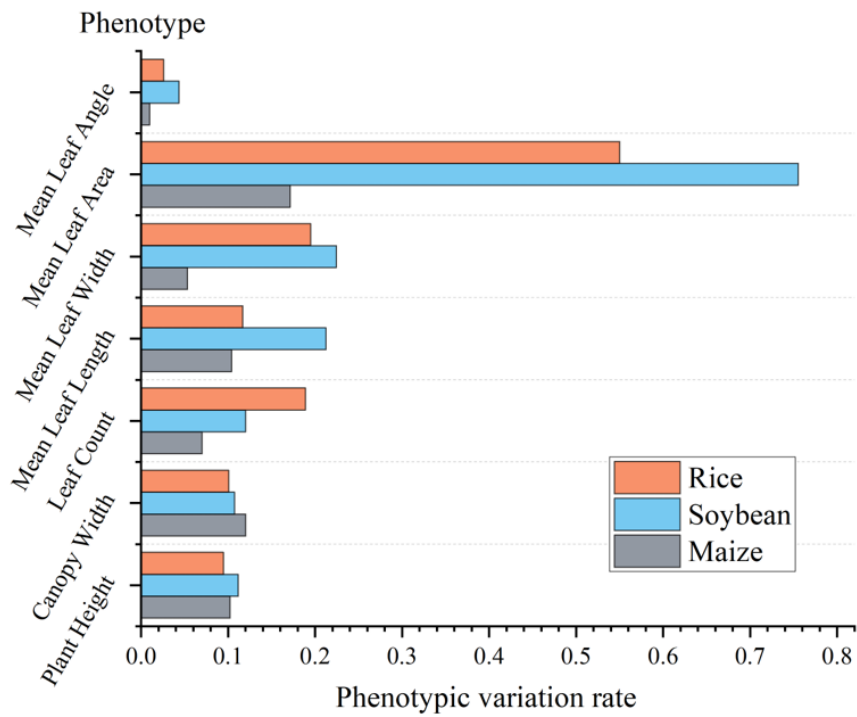


Figure S10 Comparison of the average phenotypic variation rates among three species.