Supporting Information

Appendix 1. Extended text

Text legend:

(1) Analysis determining whether the completeness of species lists for sub-provinces differs from that for provinces

(2) Analysis comparing values of NRI and PDI derived from the original species lists with those having a fixed number of species for the 66 floristic regions

(3) Comparison between values of NRI and PDI derived from different sizes of species pools

(1) Analysis to determine whether the completeness of species lists for sub-provinces differs from that for provinces

We conducted a set of regression analyses in which angiosperm species richness in the 66 geographic regions (22 provinces, 44 sub-provinces) was regressed on different combinations of the following environmental variables that are thought to be major determinants of species richness: (1) sample area, (2) elevational range, (3) mean annual temperature (bio1 in WorldClim), (4) minimum temperature of the coldest month (bio6), (5) annual precipitation (bio12), (6) temperature seasonality (bio4), (7) precipitation seasonality (bio15), and (8) actual evapotranspiration. Species richness, sample area, and elevational range were log-transformed. Of all regression models with possible combinations of the environmental variables, the best model (i.e., the one with the lowest value of the Akaike information criterion) included elevational range, annual precipitation, and actual evapotranspiration, and explained 78.3% of the variance in species richness. We conducted a *t*-test to compare the residuals of species richness from this model for the provinces with those for the sub-provinces. The residuals for the provinces did not differ significantly from those for the sub-provinces ($P = 0.34$), suggesting that plant species lists for the sub-provinces are as complete as those for the provinces.

(2) Analysis comparing values of NRI and PDI derived from the original species lists with those having a fixed number of species for the 66 floristic regions

To assess whether variation in species richness among the 66 floristic regions would affect the results of our analyses, we compared values of NRI and PDI derived from the original species lists of the 66 floristic regions with those having a fixed number of species, which is the number of seed plant species for the floristic province with the smallest number of species among the floristic regions ($N = 279$). Specifically, we randomly selected 279 species from each of the floristic regions and calculated NRI and PDI for each floristic province; we repeated this process 999 times, calculated the mean of the values of NRI and PDI from the 1000 randomizations, and compared the mean values of NRI and PDI with the values of the two indices derived from the original species lists. Pearson's correlation coefficients were 0.950 for NRI and 0.893 for PDI. Because values of NRI and PDI derived from the original species lists of the 66 floristic regions were strongly correlated with their corresponding values derived from analyses with the fixed number of species for all the floristic regions, we conclude that variation in species richness among the floristic regions would not affect the result of our study. Accordingly, we used the original species lists for the floristic regions in our analyses.

(3) Comparison between values of NRI and PDI derived from different sizes of species pools

To assess whether variation in the size of a species pool would affect the patterns of NRI and PDI identified in this study, we conducted a set of analyses in which the number of species in the pool was fixed. Specifically, we randomly selected 2000 species from the entire species pool of the 29,158 seed plant species in China with their distributions in the 66 floristic regions, and calculated NRI and PDI for each floristic province; we repeated this process for 999 times, and calculated the mean of the values of NRI and PDI from the 1000 randomizations. We repeated this for four other sizes of species pool (i.e., 4000, 6000, 8000, and 10000 species) and calculated Pearson's correlation coefficient between each pair of analyses with different sizes of species pool. As shown in Table S1, values of NRI or PDI derived from different sizes of species pool are perfectly or nearly perfectly correlated (r = 0.989–1.000), suggesting that variation in the size of species pool would not affect patterns of NRI and PDI observed in this study.

Appendix 2. Extended data tables

Table legend

Table S1. Mean of the absolute values of the six correlation coefficients for each of the 16 environmental variables presented in Table 1.

Table S2. Percentage of seed plant families in China for which NRI or PDI is positively (+) or negatively (−) correlated with actual evapotranspiration (AET), minimum temperature of the coldest month (Tmin), or annual precipitation (AP).

Table S3. Pearson's correlation coefficient of NRI or PDI between each pair of analyses with different sizes of species pool for the 66 floristic regions used in this study.

Table S1. Mean of the absolute values of the six correlation coefficients for each of the 16 environmental variables presented in Table 1.

Environmental variable	Mean of the six absolute values of correlation coefficient	Rank
General environment condition		
Mean annual temperature	0.60	5
Min. temperature of coldest month	0.67	3
Annual precipitation	0.68	2
Precipitation of driest month	0.57	6
Actual evapotranspiration	0.74	1
Potential evapotranspiration	0.48	8
Climate seasonality		
Temperature seasonality	0.54	7
Temperature annual range	0.61	4
Precipitation seasonality	0.31	11
Habitat heterogeneity		
Topographic heterogeneity	0.33	10
Temperature heterogeneity	0.40	9
Precipitation heterogeneity	0.26	12
Quaternary climate change		
Temperature anomaly	0.13	16
Temperature velocity	0.14	15
Precipitation anomaly	0.26	13
Precipitation velocity	0.16	14

Table S2. Percentage of seed plant families in China for which NRI or PDI is strongly or moderately correlated with actual evapotranspiration (AET), minimum temperature of the coldest month (Tmin), or annual precipitation (AP) (+ for positive correlation, $r > 0.66$; – for negative correlation, < -0.66); W indicates weak or no correlation, $-0.33 \leq r \leq 0.33$). Of the 261 families of seed plants in China, only the 100 families that each had ≥15 species and occurred in ≥50% of the 66 geographic regions in China were considered when calculating percentages. Data presented in this table were derived from Figures 3, S6, S7, S8, S9, and S10.

Variable	+	–	W
NRI			
AET	16	44	40
Tmin	17	41	42
AP	13	41	46
PDI			
AET	32	21	47
Tmin	37	19	44
AP	43	18	48

Table S3. Pearson's correlation coefficient of NRI or PDI between each pair of analyses with different sizes of species pool for the 66 floristic regions used in this study.

	2000 species	4000 species	6000 species	8000 species
NRI				
4000 species	0.999			
6000 species	0.999	1.000		
8000 species	0.999	1.000	1.000	
10000 species	0.999	1.000	1.000	1.000
PDI				
4000 species	0.997			
6000 species	0.994	0.999		
8000 species	0.994	0.999	1.000	
10000 species	0.989	0.996	0.999	0.999

Appendix 3. Extended data figures

Figure legend

Figure S1. Map showing provinces (black lines) in China and division of large provinces into sub-provinces (blue lines).

Figure S2. Correlation coefficient between net relatedness index (NRI) and mean temperature of the coldest month (bio6) for each node and tip in the order-level phylogeny for Chinese seed plants.

Figure S3. Correlation coefficient between net relatedness index (NRI) and annual precipitation (bio12) for each node and tip in the order-level phylogeny for Chinese seed plants.

Figure S4. Correlation coefficient between phylogenetic diversity index (PDI) and actual evapotranspiration (AET) for each node and tip in the order-level phylogeny for Chinese seed plants.

Figure S5. Correlation coefficient between phylogenetic diversity index (PDI) and mean temperature of the coldest month (bio6) for each node and tip in the order-level phylogeny for Chinese seed plants.

Figure S6. Correlation coefficient between the phylogenetic diversity index (PDI) and annual precipitation (bio12) for each node and tip in the order-level phylogeny for Chinese seed plants.

Figure S7. Correlation coefficient (represented by color circle) between the net relatedness index (NRI) and the mean temperature of the coldest month (bio6) for each of the Chinese seed plant families.

Figure S8. Correlation coefficient (represented by colored circle) between the net relatedness index (NRI) and annual precipitation (bio12) for each of the Chinese seed plant families.

Figure S9. Correlation coefficient (represented by colored circle) between the phylogenetic diversity index (PDI) and actual evapotranspiration (AET) for each of the Chinese seed plant families.

Figure S10. Correlation coefficient (represented by colored circle) between the phylogenetic diversity index (PDI) and mean temperature of the coldest month (bio6) for each of the Chinese seed plant families.

Figure S11. Correlation coefficient (represented by colored circle) between phylogenetic diversity index (PDI) and annual precipitation (bio12) for each of the Chinese seed plant families.

Figure S12. Scatter plots ages (million years) of clades against correlation coefficients for the relationship between phylogenetic metrics (NRI and PDI) and environmental variables (AET, bio6 and bio12).

Figure S1. Map showing provinces (thick black lines) in China and division of large provinces into sub-provinces (thin blue lines). Codes and names for the province-level administrative regions: AH (Anhui), CQ (Chongqing), FU (Fujian), GD (Guangdong), GS (Gansu), GX (Guangxi), GZ (Guizhou), HA (Henan), HB (Hubei), HE (Hebei), HI (Hainan), HL (Heilongjiang), HN (Hunan), JL (Jilin), JS (Jiangsu), JX (Jiangxi), LN (Liaoning), NM (Neimenggu), NX (Ningxia), QH (Qinghai), SC (Sichuan), SD (Shandong), SN (Shaanxi), SX (Shanxi), TW (Taiwan), XJ (Xinjiang), XZ (Xizang), YN (Yunnan), and ZJ (Zhejiang). Note that Beijing and Tianjin Municipalities were combined with Hebei Province, Shanghai Municipality was combined with Zhejiang Province, and Hong Kong was combined with Guangdong Province.

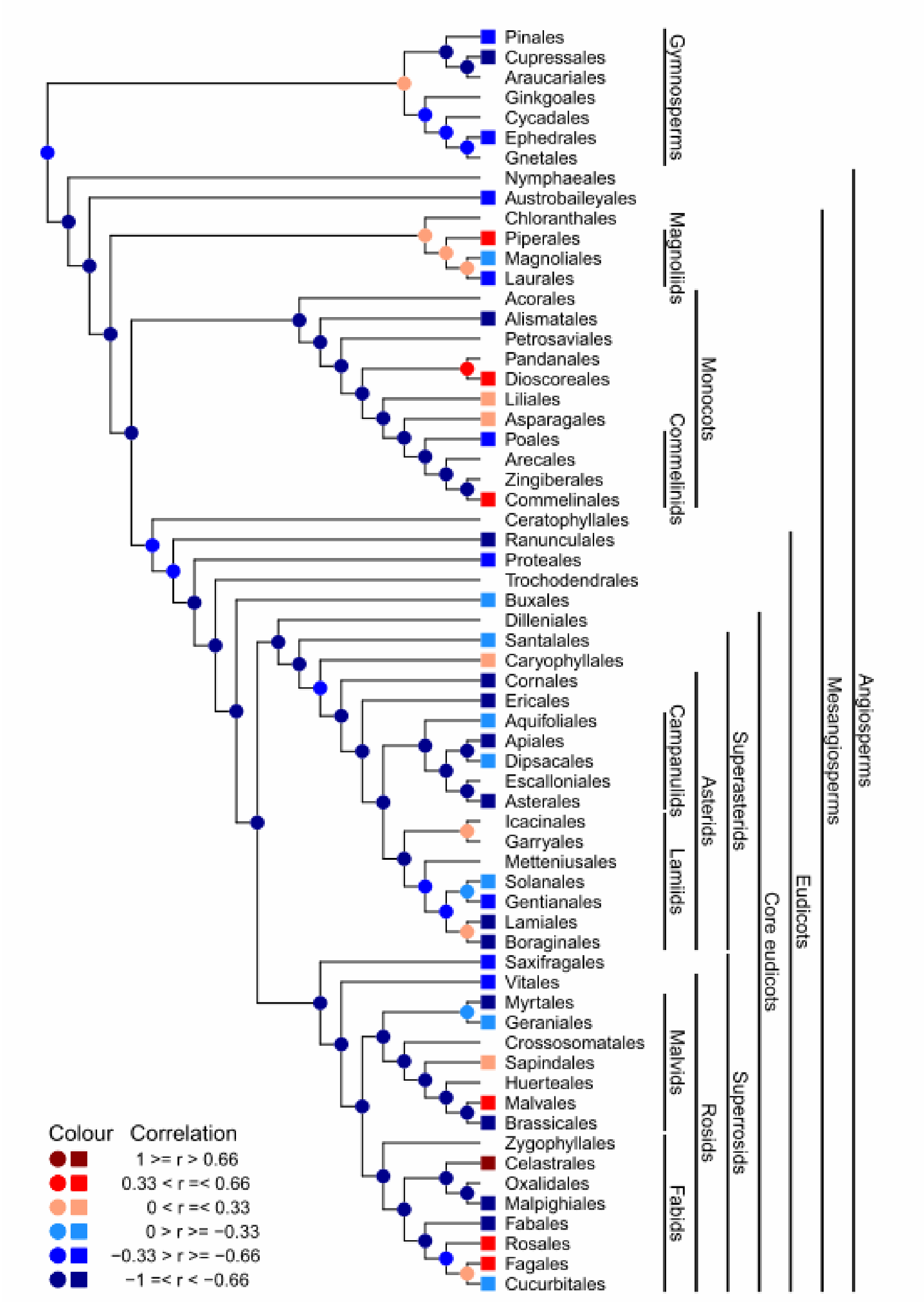

Figure S2. Correlation coefficient between net relatedness index (NRI) and mean temperature of the coldest month (bio6) for each node and tip in the order-level phylogeny for Chinese seed plants. See Figure 2 for details.

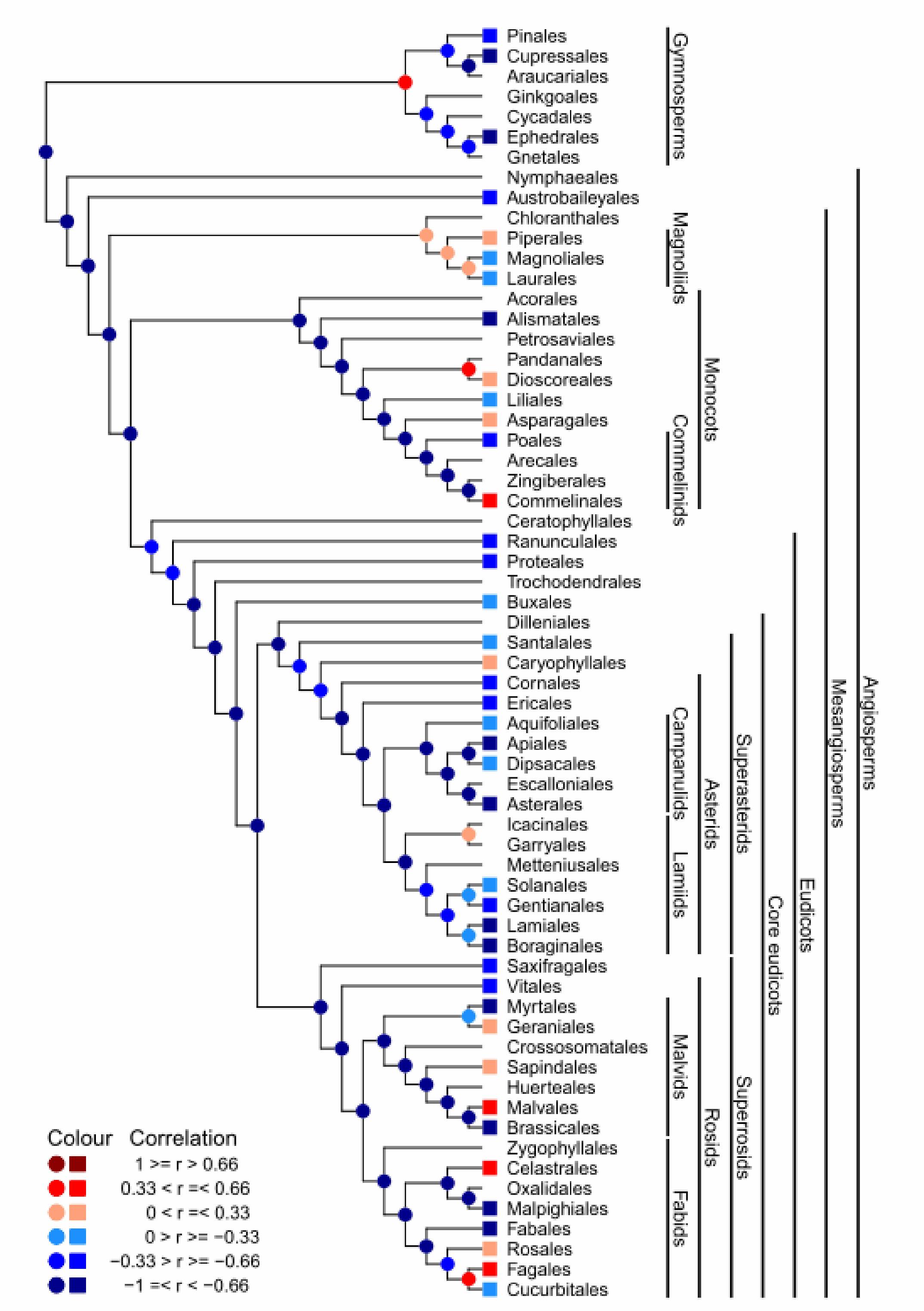

Figure S3. Correlation coefficient between net relatedness index (NRI) and annual precipitation (bio12) for each node and tip in the order-level phylogeny for Chinese seed plants. See Figure 2 for details.

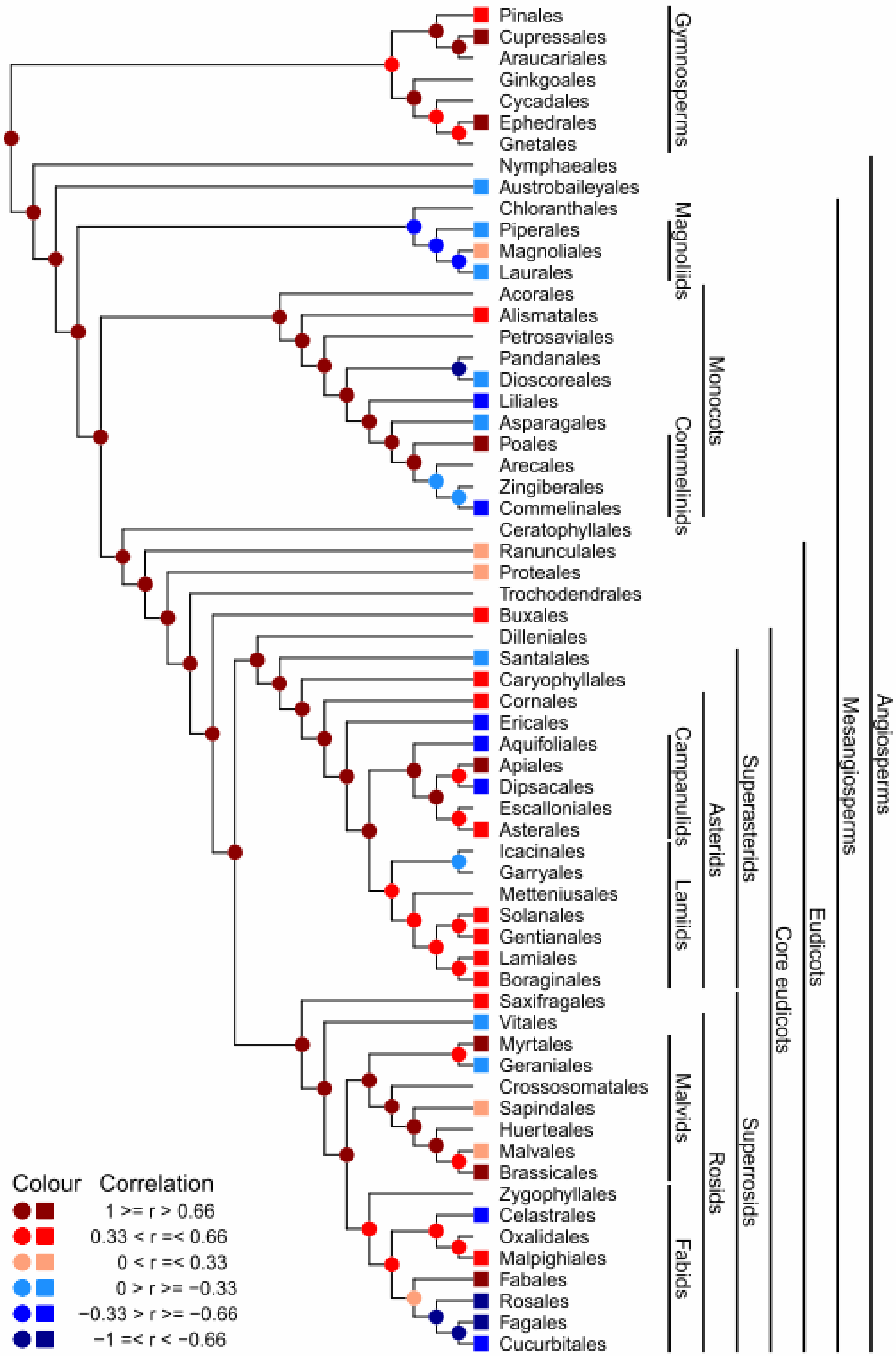

Figure S4. Correlation coefficient between phylogenetic diversity index (PDI) and actual evapotranspiration (AET) for each node and tip in the order-level phylogeny for Chinese seed plants. See Figure 2 for details.

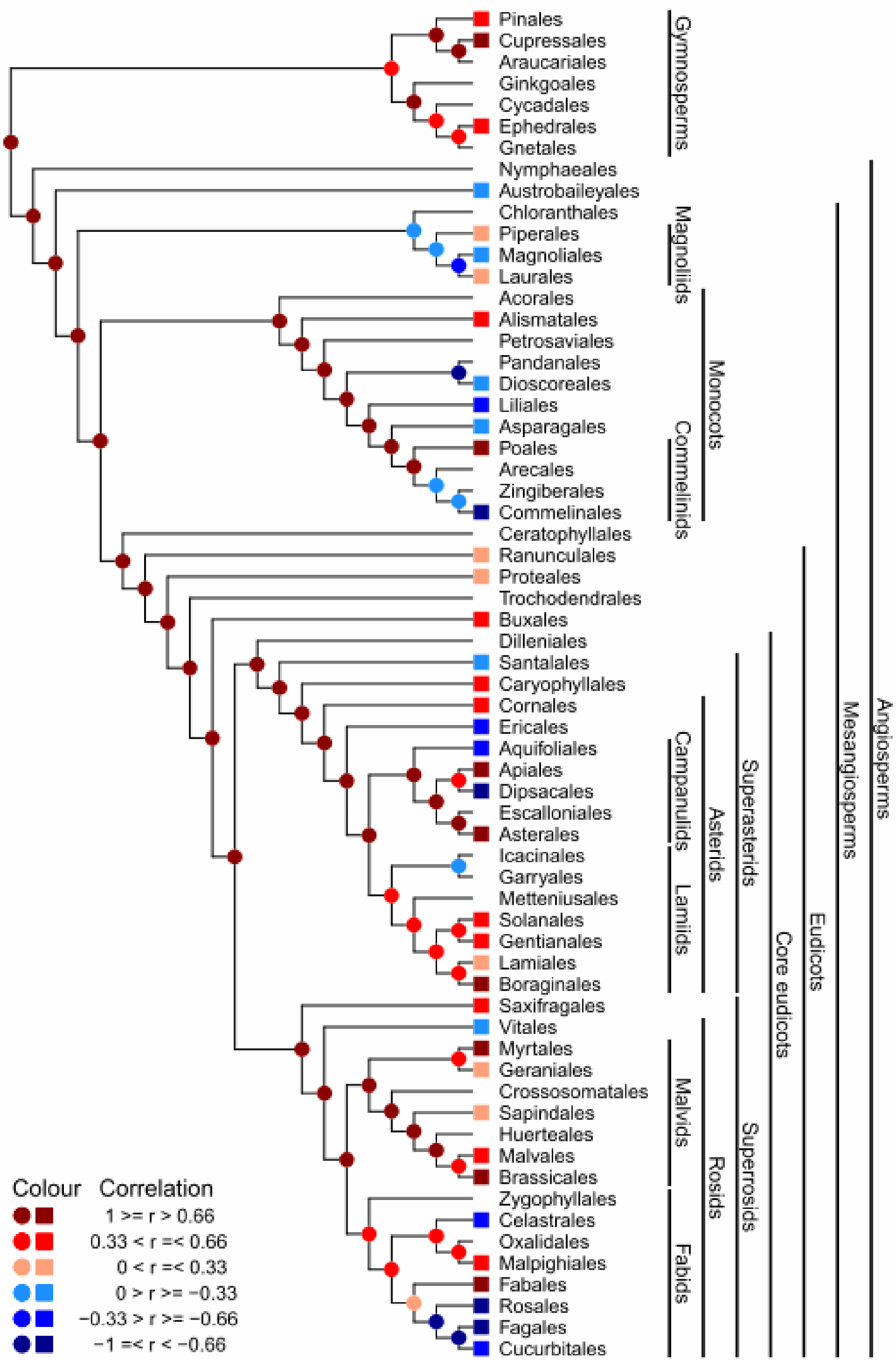

Figure S5. Correlation coefficient between phylogenetic diversity index (PDI) and mean temperature of the coldest month (bio6) for each node and tip in the order-level phylogeny for Chinese seed plants. See Figure 2 for details.

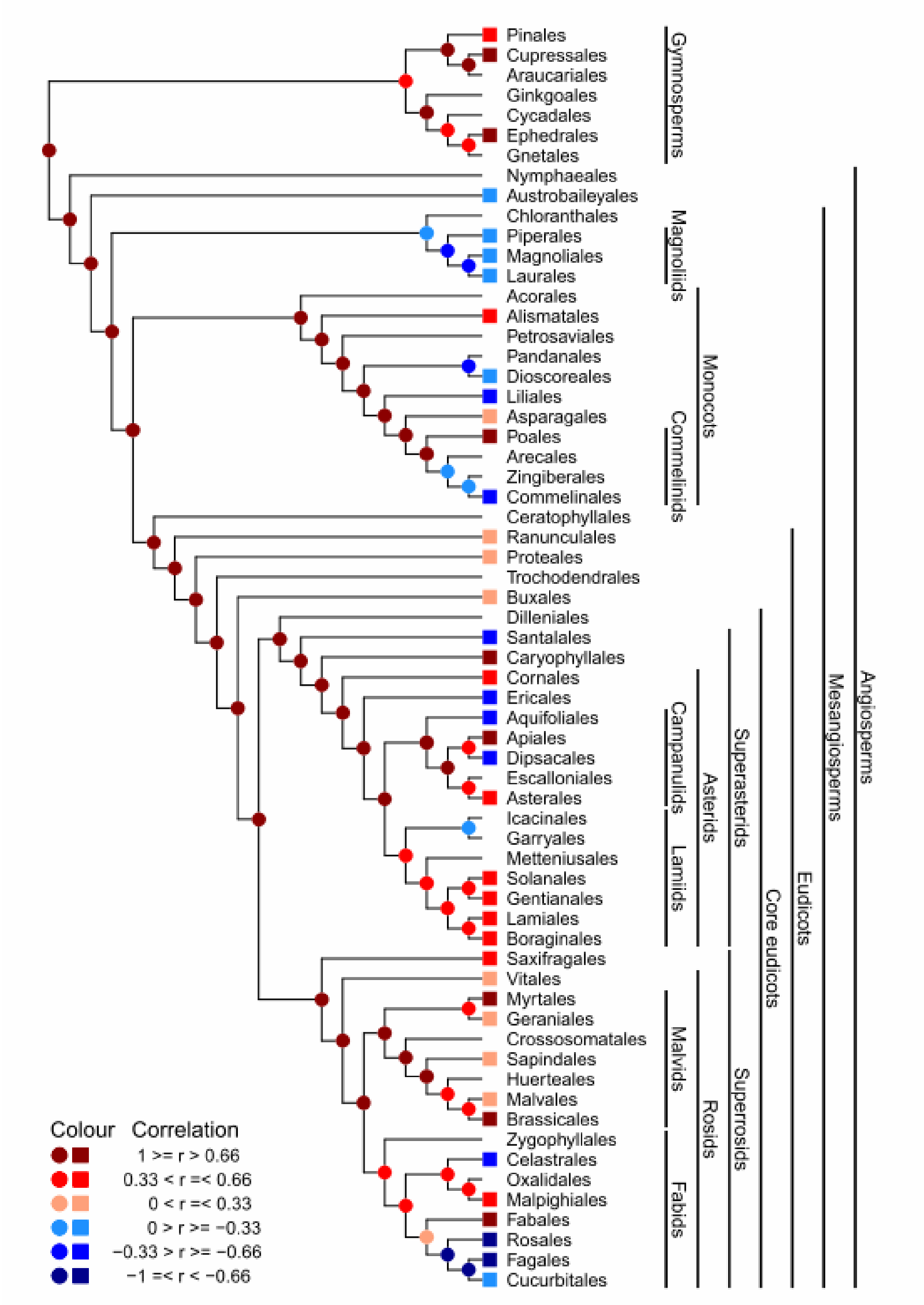

Figure S6. Correlation coefficient between phylogenetic diversity index (PDI) and annual precipitation (bio12) for each node and tip in the order-level phylogeny for Chinese seed plants. See Figure 2 for details.

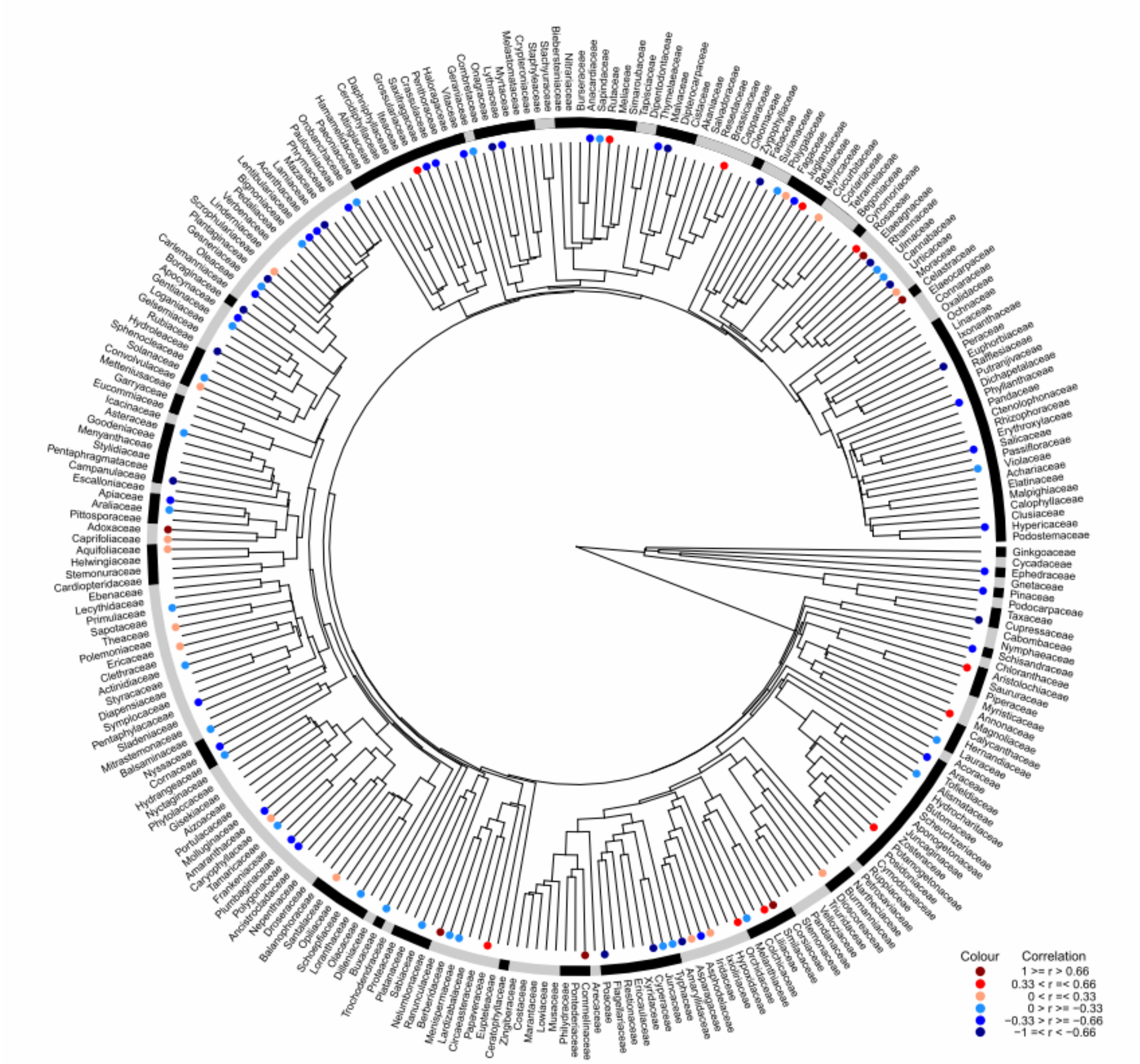

Figure S7. Correlation coefficient (represented by color circle) between net relatedness index (NRI) and mean temperature of the coldest month (bio6) for each of Chinese seed plant families. See Figure 3 for details.

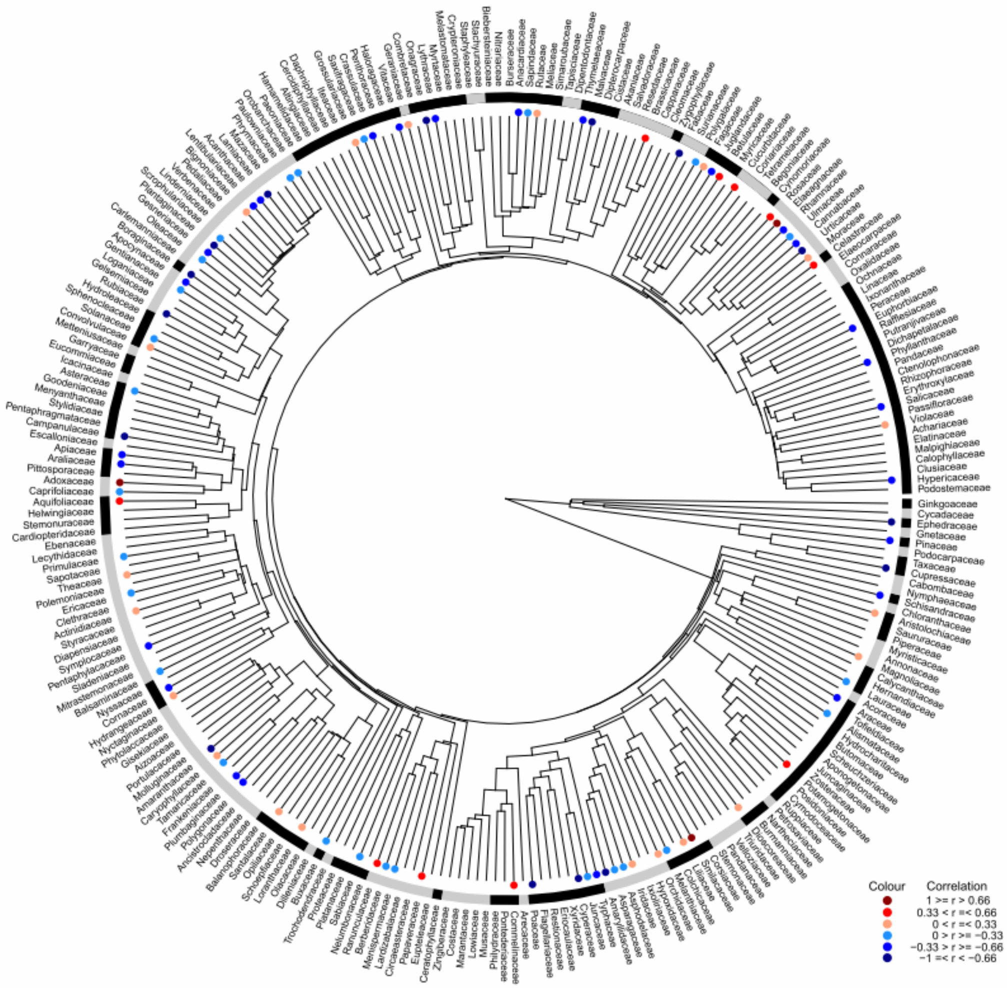

Figure S8. Correlation coefficient (represented by color circle) between net relatedness index (NRI) and annual precipitation (bio12) for each of Chinese seed plant families. See Figure 3 for details.

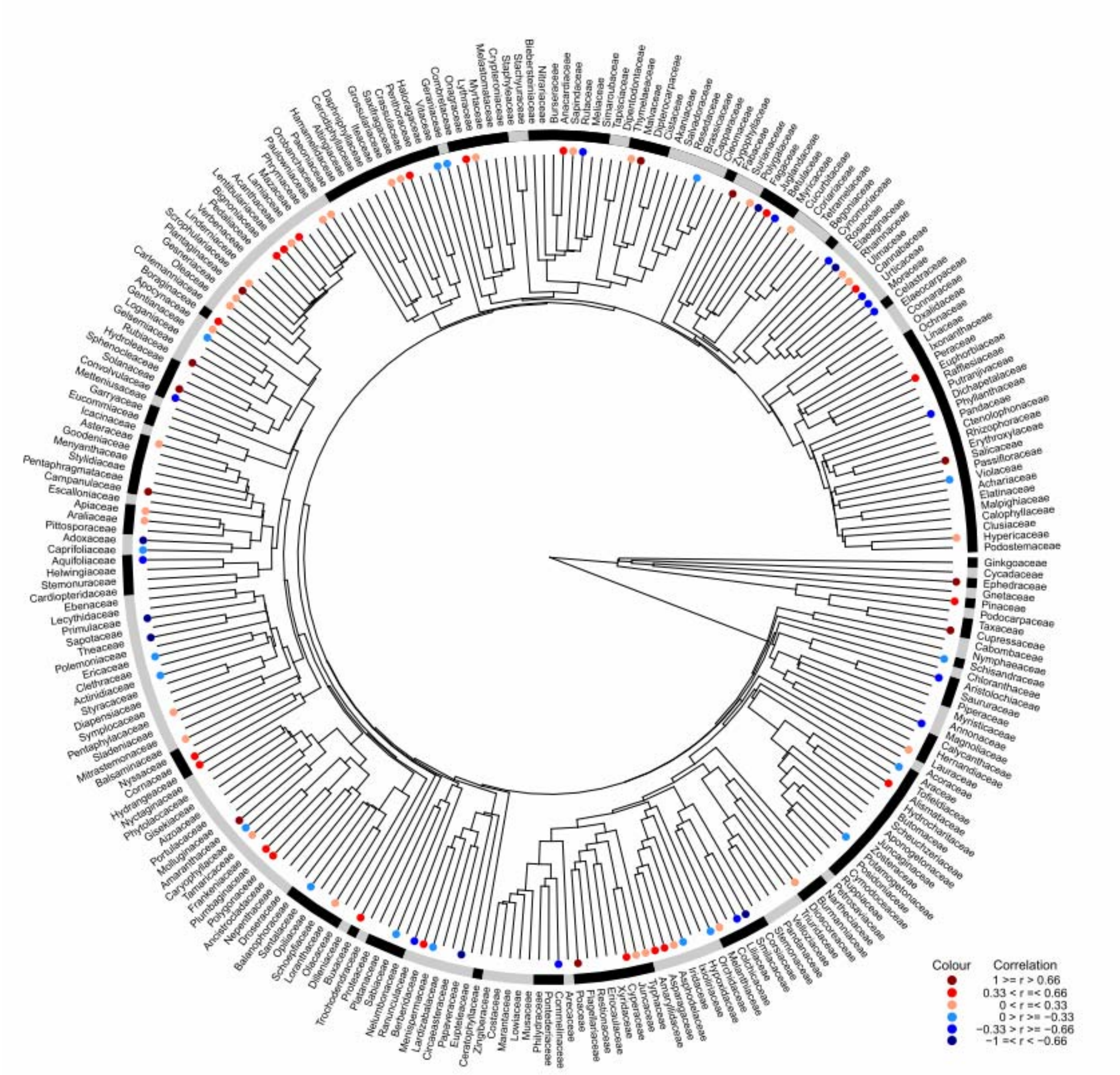

Figure S9. Correlation coefficient (represented by color circle) between phylogenetic diversity index (PDI) and actual evapotranspiration (AET) for each of Chinese seed plant families. See Figure 3 for details.

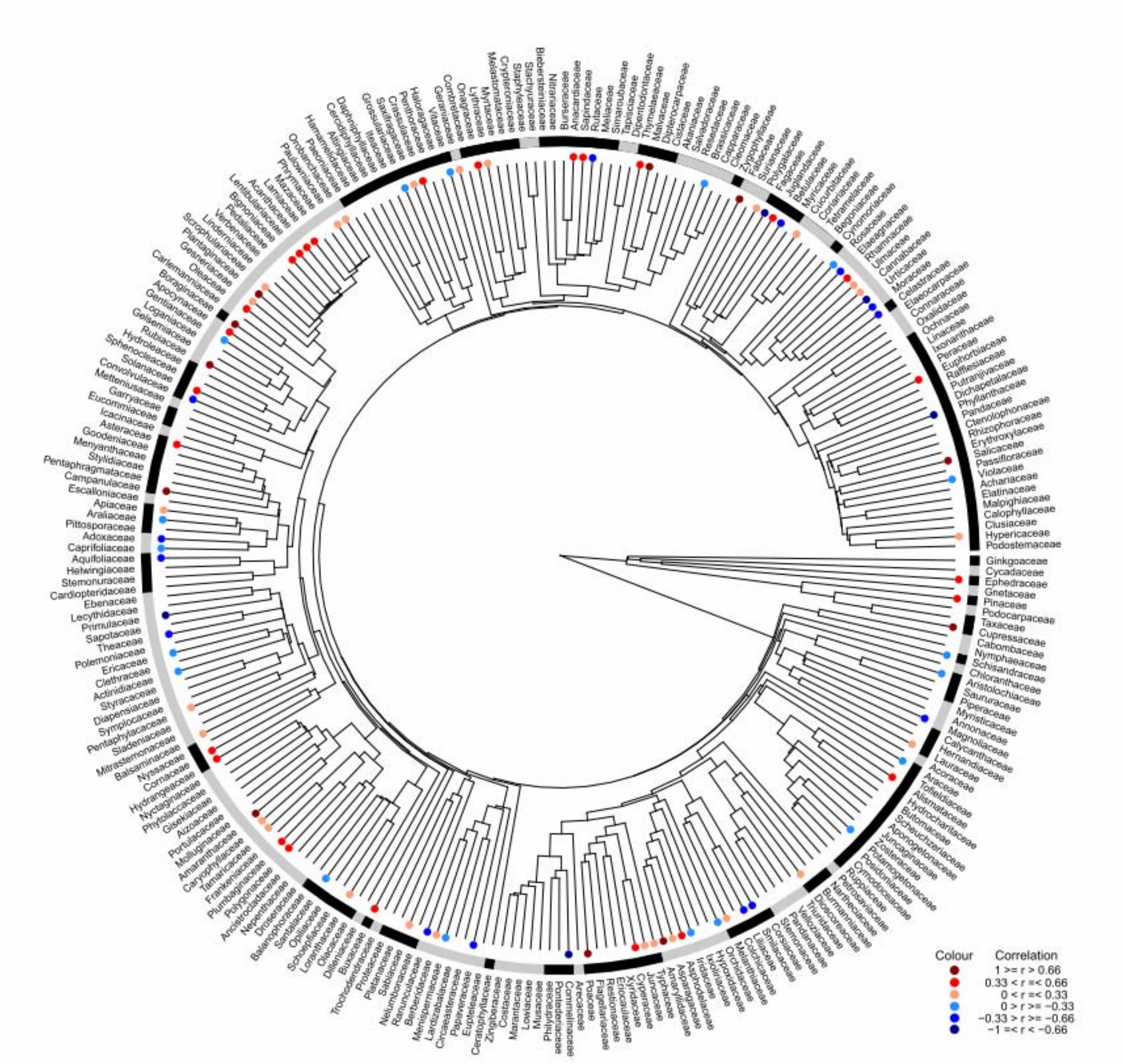

Figure S10. Correlation coefficient (represented by color circle) between phylogenetic diversity index (PDI) and mean temperature of the coldest month (bio6) for each of Chinese seed plant families. See Figure 3 for details.

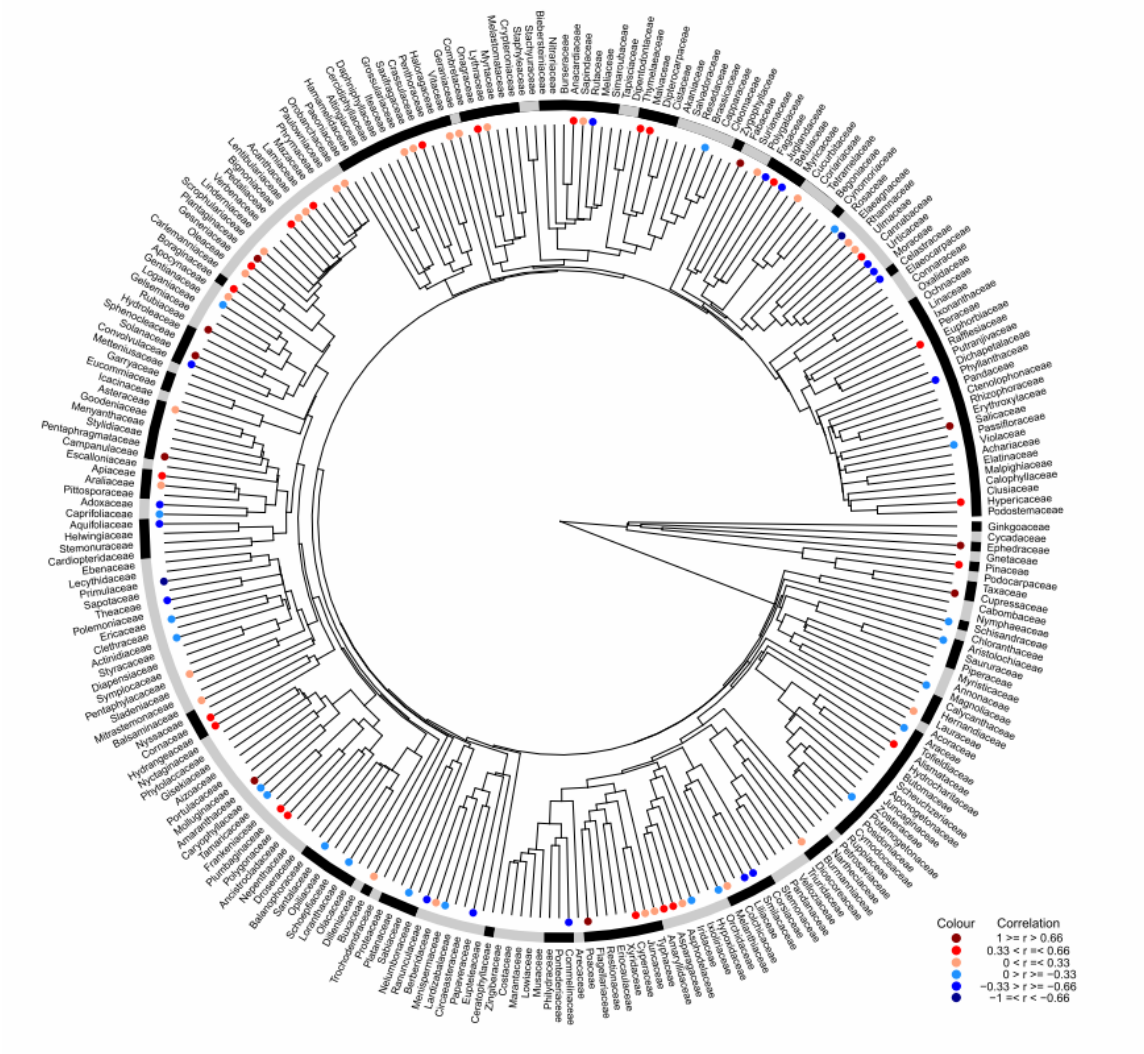

Figure S11. Correlation coefficient (represented by color circle) between phylogenetic diversity index (PDI) and annual precipitation (bio12) for each of Chinese seed plant families. See Figure 3 for details.

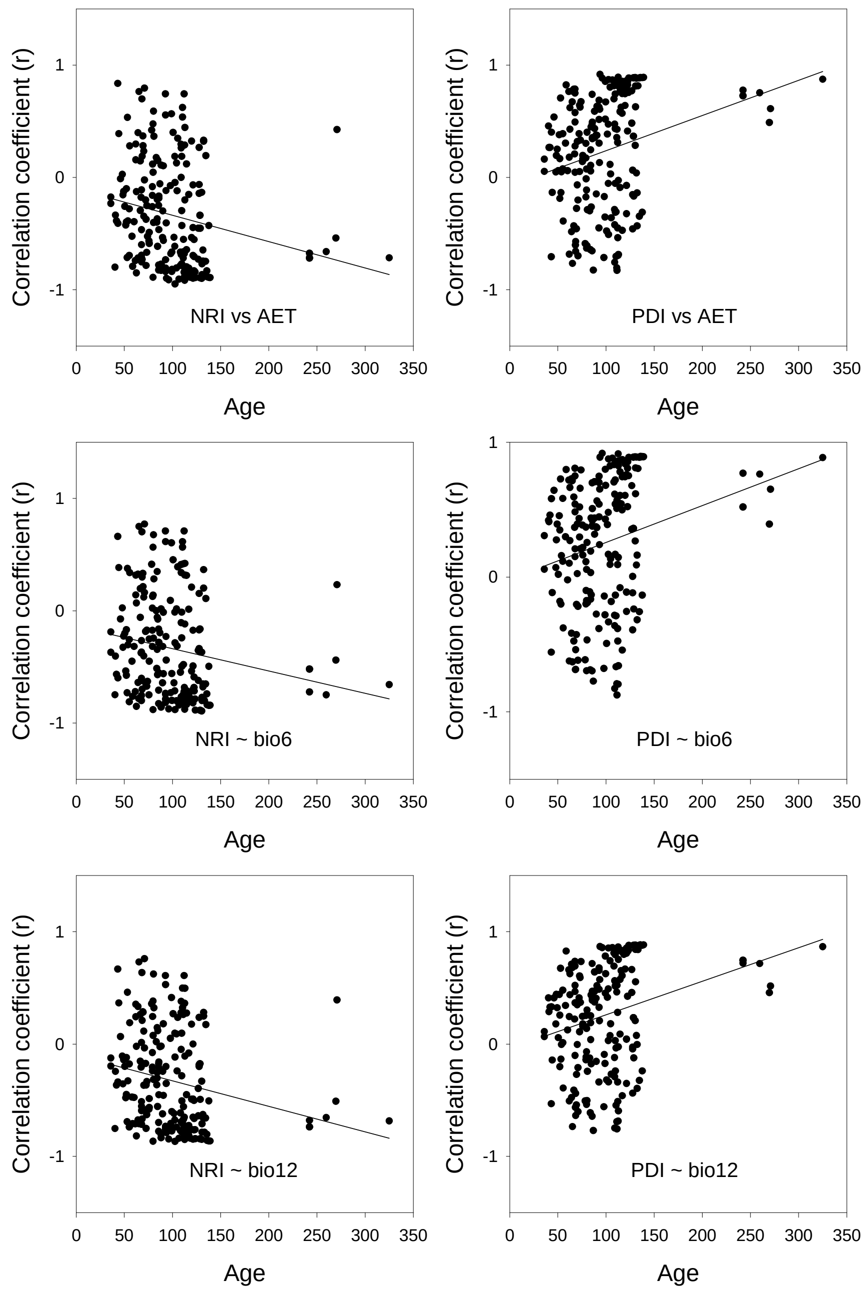

Figure S12. Scatter plots of clade ages (million years) against correlation coefficients for the relationships between phylogenetic metrics (NRI and PDI) and environmental variables (AET, bio6 and bio12). Clades are families, order and all node-based clades above the ordinal level. Ages were obtained from Smith and Brown (2018). Lines are linear least squares best fits.

Appendix 4. Extended information for families

Lists of the temperate and tropical families used in this study

Temperate families: Acoraceae, Actinidiaceae, Adoxaceae, Aizoaceae, Amaryllidaceae, Asphodelaceae, Berberidaceae, Betulaceae, Biebersteiniaceae, Butomaceae, Buxaceae, Cabombaceae, Calycanthaceae, Cannabaceae, Caprifoliaceae, Cercidiphyllaceae, Circaeasteraceae, Cistaceae, Coriariaceae, Cornaceae, Cupressaceae, Cynomoriaceae, Diapensiaceae, Droseraceae, Elaeagnaceae, Ephedraceae, Eucommiaceae, Eupteleaceae, Fagaceae, Frankeniaceae, Garryaceae, Gelsemiaceae, Geraniaceae, Ginkgoaceae, Hamamelidaceae, Helwingiaceae, Hydrangeaceae, Hypericaceae, Iteaceae, Ixioliriaceae, Juglandaceae, Juncaceae, Liliaceae, Linaceae, Loranthaceae, Magnoliaceae, Mazaceae, Melanthiaceae, Molluginaceae, Myrtaceae, Nartheciaceae, Nelumbonaceae, Nitrariaceae, Nyssaceae, Orobanchaceae, Paeoniaceae, Papaveraceae, Paulowniaceae, Penthoraceae, Petrosaviaceae, Phrymaceae, Phytolaccaceae, Pinaceae, Platanaceae, Podocarpaceae, Polemoniaceae, Proteaceae, Resedaceae, Restionaceae, Ruppiaceae, Salicaceae, Saururaceae, Scheuchzeriaceae, Schisandraceae, Stachyuraceae, Tamaricaceae, Taxaceae, Tofieldiaceae, Trochodendraceae and Zosteraceae.

Tropical families: Acanthaceae, Achariaceae, Akaniaceae, Altingiaceae, Anacardiaceae, Ancistrocladaceae, Annonaceae, Apocynaceae, Aponogetonaceae, Aquifoliaceae, Araceae, Araliaceae, Arecaceae, Aristolochiaceae, Asparagaceae, Balanophoraceae, Balsaminaceae, Begoniaceae, Bignoniaceae, Burmanniaceae, Burseraceae, Calophyllaceae, Capparaceae, Cardiopteridaceae, Carlemanniaceae, Celastraceae, Chloranthaceae, Cleomaceae, Clethraceae, Clusiaceae, Colchicaceae, Combretaceae, Commelinaceae, Connaraceae, Corsiaceae, Costaceae, Crypteroniaceae, Ctenolophonaceae, Cucurbitaceae, Cycadaceae, Cymodoceaceae, Daphniphyllaceae, Dichapetalaceae, Dilleniaceae, Dioscoreaceae, Dipentodontaceae, Dipterocarpaceae, Ebenaceae, Elaeocarpaceae, Elatinaceae, Eriocaulaceae, Erythroxylaceae, Escalloniaceae, Euphorbiaceae, Flagellariaceae, Gesneriaceae, Gisekiaceae, Gnetaceae, Goodeniaceae, Hernandiaceae, Hydroleaceae, Hypoxidaceae, Icacinaceae, Iridaceae, Ixonanthaceae, Lardizabalaceae, Lauraceae, Lecythidaceae, Linderniaceae, Loganiaceae, Lowiaceae, Malpighiaceae, Malvaceae, Marantaceae, Melastomataceae, Meliaceae, Menispermaceae, Metteniusaceae, Mitrastemonaceae, Musaceae, Myristicaceae, Nepenthaceae, Nyctaginaceae, Ochnaceae, Olacaceae, Opiliaceae, Pandaceae, Pandanaceae, Passifloraceae, Pedaliaceae, Pentaphragmataceae, Pentaphylacaceae, Peraceae, Philydraceae, Phyllanthaceae, Piperaceae, Pittosporaceae, Podostemaceae, Pontederiaceae, Posidoniaceae, Putranjivaceae, Rafflesiaceae, Rhizophoraceae, Rutaceae, Sabiaceae, Salvadoraceae, Santalaceae, Sapindaceae, Sapotaceae, Schoepfiaceae, Simaroubaceae, Sladeniaceae, Smilacaceae, Sphenocleaceae, Staphyleaceae, Stemonaceae, Stemonuraceae, Stylidiaceae, Styracaceae, Surianaceae, Symplocaceae, Tapisciaceae, Tetramelaceae, Theaceae, Triuridaceae, Urticaceae, Velloziaceae, Verbenaceae, Vitaceae, Xyridaceae, Zingiberaceae and Zygophyllaceae.