**Appendix A**

**Table A1 The initial seed germination percentage, hard (water-impermeable) seed percentage and thousand-seed weight (TSW) of the tested species.**

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| --- | --- | --- | --- | --- | --- | --- |
| Species | Family | Seed collection time | Seed collection site | Initial seed germination (%) | Hard seed (%) | TSW (g) |
| *Elymus dahuricus* | Poaceae | September, 2016 | Maqu, China | 85.67 ± 0.88 | — | 4.76 ± 0.08 |
| *E. nutans*  | Poaceae | September, 2016 | Maqu, China | 96.67 ± 0.67 | — | 4.31 ± 0.05 |
| *E. sibiricus* | Poaceae | September, 2016 | Maqu, China | 90.67 ± 1.20 | — | 4.49 ± 0.11  |
| *Ephedra intermedia* | Ephedraceae | July, 2016 | Minqin, China | 80.67 ± 0.88 | — | 6.24 ± 0.17 |
| *Festuca sinensis* | Poaceae | August, 2016 | Tongde, China | 98.67 ± 0.33 | — | 1.07 ± 0.02 |
| *Hedysarum multijugum*  | Fabaceae | September, 2016 | Minqin, China | 96.67 ± 1.20 | 3.33 ± 1.33 | 5.63 ± 0.09 |
| *Lepidium apetalum* | Brassicaceae | July, 2016 | Minqin, China | 97.67 ± 0.33 | — | 0.19 ± 0.01  |
| *Lolium multiflorum* | Poaceae | July, 2016 | Zhuanglang, China | 98.67 ± 0.67 | — | 4.53 ± 0.12 |
| *L. perenne*  | Poaceae | July, 2016 | Zhuanglang, China | 89.00 ± 1.73 | — | 2.34 ± 0.04  |
| *Medicago sativa* | Fabaceae | July, 2016 | Yuzhong, China | 99.67 ± 0.33 | 0.67 ± 0.67 | 2.31 ± 0.01 |
| *Onobrychis viciifolia* | Fabaceae | July, 2016 | Yuzhong, China | 84.00 ± 1.15 | 4.00 ± 1.15 | 22.99 ± 0.18 |
| *Poa crymophila*  | Poaceae | August, 2016 | Tongde, China | 87.33 ± 1.45 | — | 0.19 ± 0.01  |
| *Sorghum bicolor*  | Poaceae | August, 2016 | Jiuquan, China | 98.00 ± 1.15 | — | 26.28 ± 0.25 |
| *Trifolium pratens* | Fabaceae | August, 2016 | Zhuanglang, China | 98.67 ± 0.67 | 2.67 ± 0.67 | 1.79 ± 0.02  |
| *T. repens*  | Fabaceae | August, 2016 | Zhuanglang, China | 96.00 ± 1.15 | 2.00 ± 1.15 | 0.69 ± 0.01 |

**Appendix B Thermal times of tested species predicted by thermal time models based on five distributions at suboptimal temperatures.**

**Appendix C Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of the tested species at suboptimal temperatures.**

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**Figure B1 Thermal time of *E. dahuricus* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

Circles show the observed mean thermal times. The red dashed lines show the predicted thermal time, which was fitted by the thermal time model based on the five distributions. The same as below.

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**Figure C1 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *E. dahuricus* seeds at suboptimal temperatures.**

The red dashed lines are quadratic polynomials fitted to the residuals for better visualization of trends. The same as below.

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**Figure B2 Thermal time of *E. nutans* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C2 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *E. nutans* seeds at suboptimal temperatures.**

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**Figure B3 Thermal time of *E. sibiricus* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C3 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *E. sibiricus* seeds at suboptimal temperatures.**

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**Figure B4 Thermal time of *E. intermedia* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C4 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *E. intermedia* seeds at suboptimal temperatures.**

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**Figure B5 Thermal time of *F. sinensis* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C5 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *F. sinensi* seeds at suboptimal temperatures.**

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**Figure B6 Thermal time of *H. multijugum* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C6 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *H. multijugum* seeds at suboptimal temperatures.**

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**Figure B7 Thermal time of *L. apetalum* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C7 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *L. apetalum* seeds at suboptimal temperatures.**

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**Figure B8 Thermal time of *L. multiflorum* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C8 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *L. multiflorum* seeds at suboptimal temperatures.**

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**Figure B9 Thermal time of *L. perenne* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C9 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *L. perenne* seeds at suboptimal temperatures.**

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**Figure B10 Thermal time of *M. sativa* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C10 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *M. sativa* seeds at suboptimal temperatures.**

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**Figure B11 Thermal time of *O. viciifolia* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C11 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *O. viciifolia* seeds at suboptimal temperatures.**

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**Figure B12 Thermal time of *P. crymophila* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C12 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *P. crymophila* seeds at suboptimal temperatures.**

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**Figure B13 Thermal time of *S. bicolor* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C13 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *S. bicolor* seeds at suboptimal temperatures.**

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**Figure B14 Thermal time of *T. repens* seeds predicted by thermal time models based on five distributions at suboptimal temperatures.**

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**Figure C14 Scatter plots of thermal time against residuals (RT) for five distributions used in thermal time models of *T. repens* seeds at suboptimal temperatures.**