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The effect of temperature on seed dormancy in an alpine meadow on the eastern Tsinghai-Tibet plateau

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Key words: seed dormancy, alpine meadow, temperature treatment, seed germination, Tsinghai-Tibet plateau

Introduction In this experiment, the temperature effects on dormancy levels of 159 plants (20 families) occurring in an alpine meadow on the eastern Tsinghai-Tibet plateau, were investigated. The objective was to determine the effects of varying temperature on the seed dormancy and the differences of dormancy responses to temperature among families.

Material and method The 5 temperatures were chosen (Figure 1). Experiment includes three replications of 50 seeds of each species per temperature treatment. Seeds were incubated under darkness treatment for 60 days. Seeds not germinated were tested for viability using tetrazolium staining techniques. Results are reported as proportion of total viable seeds. Total proportion dormancy for families across temperature treatment was compared by GLM with the SPSS 13.0. All statements of significance are at $p < 0.05$ where stated.

Results Alternating temperature, family and their interaction had significant effects on seed proportion dormancy (Table 1). Generally, high proportion dormancy occurred at 10/20°C, low proportion dormancy occurred at 5/15°C and 10/25°C (Figure 1); Seeds of *Dipsacaceae* showed a higher proportion dormancy, while the proportion dormancy of *Juncaceae*, *Rosaceae*, *Caryophyllaceae* and *Asteraceae* were lower (Figure 2); There was no significant relationship between dormancy and temperature in *Fabaceae* ($p = 0.08$, $F = 2.12$). However, *Asteraceae* ($p < 0.001$, $F = 8.05$) and *Ranunculaceae* ($p = 0.01$, $F = 3.48$) differed significantly in mature seed dormancy based on the 5 alternating temperature regimes. High proportion dormancy occurred at 5/25°C in *Asteraceae*, *Fabaceae* and *Ranunculaceae*. Still temperature 5/25°C favored relatively low proportion of dormancy in *Cyperaceae* and *Gentianaceae* (Figure 3).

Table 1 Results of GLM for the effects of temperature on the proportion dormancy

Source	df	F	p
Conect model	95	4.84	<0.001
Family	19	9.64	<0.001
Temperature	4	9.45	<0.001
Family × Temperature	72	2.98	<0.001

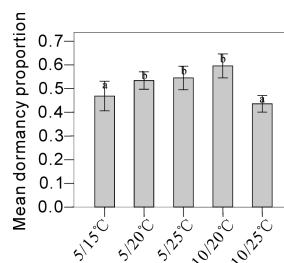


Figure 1 The effect of alternating temperature on mean (\pm SE) total proportion dormancy of 159 plants.

Figure 2 Mean proportion dormancy of seed from 20 families (mean \pm SE).

1= *Juncaceae* 2= *Rosaceae* 3= *Caryophyllaceae* 4= *Asteraceae*
 5= *Polygonaceae* 6= *Amaranthaceae* 7= *Ranunculaceae*
 8= *Plantaginaceae* 9= *Brassicaceae* 10= *Apiaceae*
 11= *Primulaceae* 12= *Liliaceae* 13= *Gentianaceae*
 14= *Geraniaceae* 15= *Scrophulariaceae* 16= *Lamiaceae*
 17= *Fabaceae* 18= *Cyperaceae* 19= *Campanulaceae*
 20= *Dipsacaceae*

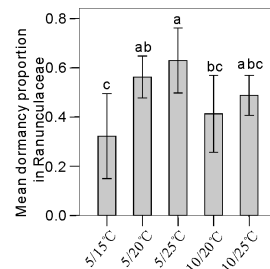
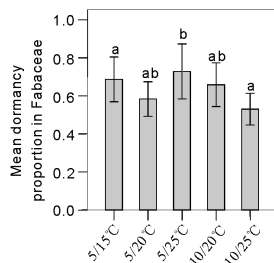
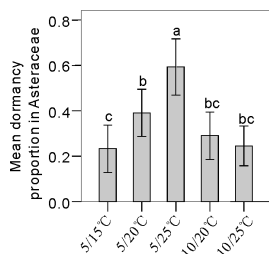
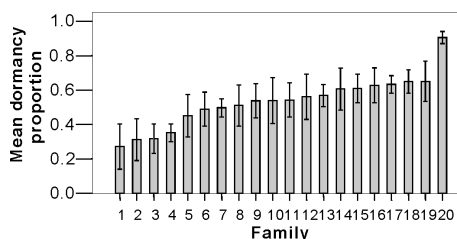


Figure 3 Final proportion dormancy of seed from 3 families at 5 temperature regimes (Mean \pm SE).

Discussion Based on the results of this study, alternating temperature has proved to be an important factor for breaking seed dormancy. It indicates that temperature may have played an important role in determining seed germination. The response to temperature among families differed significantly, and as a scale of temperature, the differentiation of proportion dormancy was presented. Low proportion dormancy occurred at higher (10/25°C) or lower temperature (5/15°C) for all seeds, especially in *Asteraceae*.