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Germination of *Euryops arabicus* Cass. Compositae from Asir Mountains, Saudi Arabia

A. Mahmoud*, A.M. El-Sheikh and S. Abdul Baset***

**Department of Biology, College of Education; **Department of Botany, College of Science, King Saud University, Riyadh, Saudi Arabia*

ABSTRACT. *Euryops arabicus* is a perennial shrub whose distribution in Saudi Arabia is limited to the high mountainous region (2280-3000 m above sea level) of the southern region and south Hijaz.

The freshly harvested seeds were germinated over a range of alternating (12 hourly) temperature regimes: 18/8, 21/10, 28/14, 32/16, 36/21 and 40/26° C.

The geobotanical distribution of *E. arabicus* is reflected in its germination temperature responses. The germination of the seeds of *E. arabicus* is not regulated by genetically fixed innate dormancy. However, the germination temperature responses of the seeds of the species serve as a mechanism specific to environmental cues, which indicate the probability of favourable conditions for subsequent growth and seedlings establishment.

The ecological significance of the temperature responses of the seeds is discussed.

Euryops arabicus Cass. is a spreadingly branched shrub whose distribution in Saudi Arabia is confined to the southern region (S) and south Hijaz (SH), (Fig. 1). It is associated with high mountain slopes (2280-3000 m above sea level).

The establishment of any species within a geographical region depends on its closely adapted responses to temperature, day length and rainfall. Thompson (1970) showed that the geobotanical distribution of different species of Caryophyllaceae in Europe was reflected in their responses to temperature at germination.The work described below attempts to investigate the germination temperature responses of the seeds of *E. arabicus*.

Senior Author Present Address: University of Gezira, Wad Medani, P.O. Box 20, Sudan.

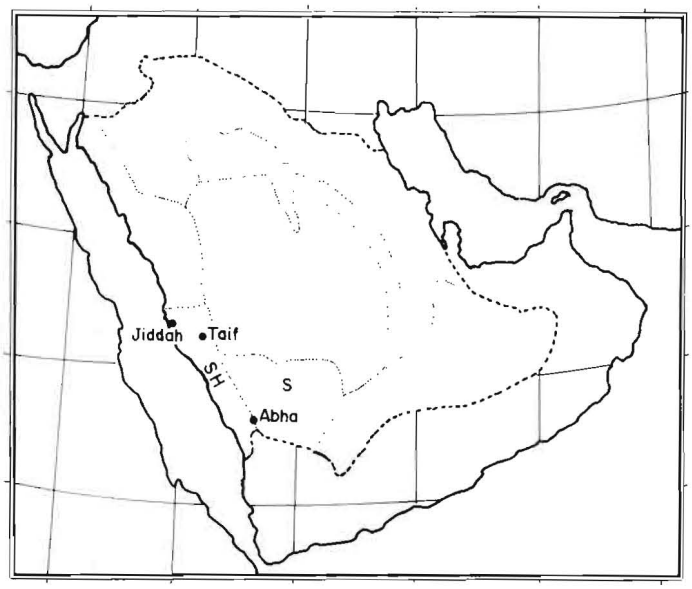

Fig. 1. Geographical distribution of *Euryops arabicus* in Saudi Arabia.
SH: South Hijaz, representing the southern part of the western region extending south of Jeddah to the Yemen boundary.
S: Southern region lying to the east of south Hijaz to the south of Najd and the North of Yemen. It includes the Abha and Najran area (Redrawn with permission from Migahid's *Flora of Saudi Arabia* 2nd ed., 1978. Copyright author).

Experiment 1

Procedure

Achenes freshly collected from Al-Souda mountain (2280 m above sea level) near Abha were germinated on moist filter paper in germination flasks. Germination took place in dark incubators variously maintained over the range of alternating (12 hourly) temperature regimes: 18/8, 21/10, 28/14, 32/16, 36/21 and 40/26° C. Four replicates (25 seeds each) were used. A seed was considered to have germinated when the radicle emerged. Germinated seeds were discarded immediately, and counts were made daily until no seed had germinated over seven successive days. In counting, the lid of the germinator was removed allowing a change of air and briefly exposing the seeds to light.

Results

The seeds germinated rapidly to near completion at the two temperature regimes 18/8 and 21/10°C, while at 28/14°C their germination decreased markedly and was notably slower (Fig. 2, Table 1); no seeds germinated at the remaining higher temperature regimes.

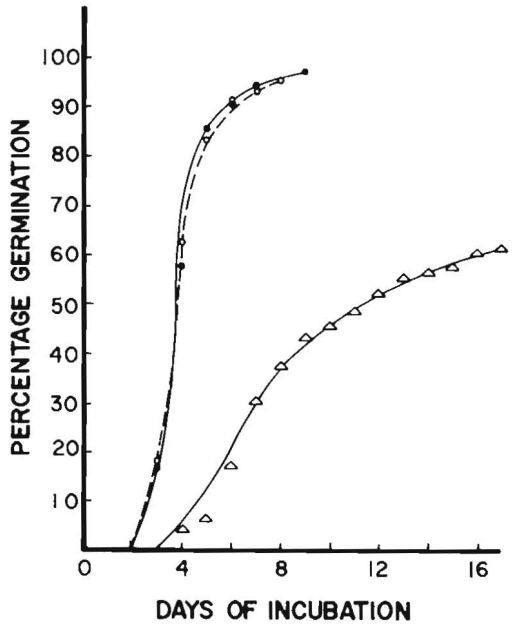

Fig. 2. Progress of germination of the seeds of *Euryops arabicus* at different fluctuating temperature regimes: 18/8°C ●———● 21/10°C ○---○ ; 28/14°C ▲—▲

Table 1. Germination percentages attained by the seeds of *Euryops arabicus* germinated at different fluctuating temperatures, and also the periods of incubation (days) required by the maximum germinated seeds to attain 50% germination; 95% confidence limits are included.

Temperature °C	% germination	Time for 50% germination
18/8	96 ± 4.500	3.825 ± 0.069
21/10	95 ± 2.755	3.650 ± 0.398
28/14	61 ± 5.276	7.100 ± 0.276
32/16	No germination	
36/21	No germination	
40/26	No germination	

Table 2. Germination percentages attained by the seeds of *Euryops arabicus* which were preincubated at 32/16, 36/21 and 40/26°C, for 15 days and did not germinate, and then regerminated at 18/8°C. The periods in days required by the maximum germinated seeds to reach 50% level and the 95% confidence limits are also included.

Temperature °C	% germination	Time for 50% germination
32/16	94 ± 2.755	3.050 ± 0.398
36/21	90 ± 2.755	2.900 ± 0.656
40/26	92 ± 7.794	2.900 ± 0.656

Experiment 2

Procedure

The seeds which were incubated at 32/16, 36/21 and 40/26°C for 15 days and did not germinate, were transferred into an incubator maintained at 18/8°C. The procedure then adopted was similar to that in Experiment 1.

Results

The seeds which were preincubated at 32/16, 36/21 and 40/26°C for 15 days, and did not germinate, germinated rapidly at comparable rates to attain comparable high germination percentages, (>90 per cent), when they were reincubated at 18/8°C (Table 2).

Discussion

The freshly harvested achenes (seeds) of *E. arabicus* showed no dormancy and germinated rapidly to near completion, under appropriate temperature and moisture conditions (Fig. 2, Table 1). The thermal range of germination of *E. arabicus* is in agreement with the temperature cycle within its natural habitat range on the cooler slopes of the high mountains in south Hijaz and the southern region where temperature is ameliorated by altitude (Fig. 3 a). Provided that adequate moisture is available, germination of the seeds of this species in Abha region, and in other areas of similar altitude, may take place throughout the year and germination peaks are expected by March when temperature and moisture conditions are most favourable (Fig. 3).

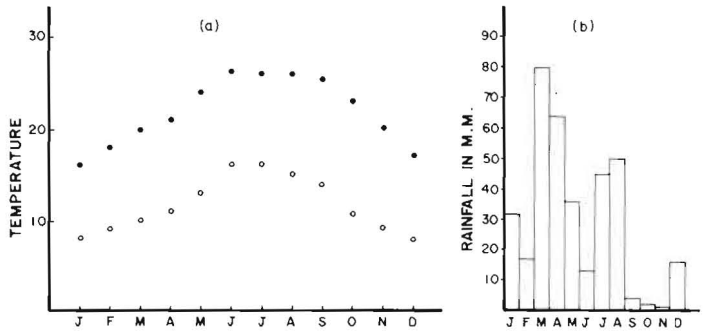

Fig. 3. Meteorological data obtained at Abha station within the habitat range of *Euryops arabicus* showing (a) mean temperature maxima (•) and minima (o) and (b) mean monthly rainfall. Data are averages of the records for the period 1972-1978.

The failure of the seeds of *E. arabicus* to germinate at 32/16, 36/21 and 40/26°C. (Table 1) is not surprising since these temperatures are not experienced within the natural habitat of the species within Abha region, where the seeds were collected, even in Summer (Fig. 3 a). In fact, the species distribution extends into areas of much higher altitude within the region, and hence cooler weather than at Abha. The rapid germination, to high percentages, of the seeds preincubated at 32/16, 36/21 and 40/26°C when they were regerminated at 18/8°C (Table 2, Experiment 2), indicates that these high temperatures enforce dormancy on the seeds which restricts wasteful germination in hostile environments.

The probability models of Cohen (1966, 1968) and Levins (1969) predict that the evolutionary response to increasing hazards of the environment would be an increased innate seed dormancy with only a part of the seed population available to germinate each year. The survival value of innate dormancy for desert plants has been reported by several workers (Koller 1969, Mahmoud 1977, Mahmoud and El-Sheikh 1978, Mahmoud and El-Sheikh 1981). However, seed germination may be controlled by environmentally-induced dormancy as well as innate dormancy (Venable and Lawlor 1980). Innate dormancy may be offset by the ability of the seed germination to be regulated by the environment in such a way that seeds depend on environmental cues which indicate the probability, in the future, of conditions favourable for growth (Freas and Kemp 1983). The degree to which seeds can precisely respond to environmental cues will reduce environmental hazards and the need for innate dormancy (Cohen 1967).

The germination of the seeds of *E. arabicus* is not regulated by genetically fixed innate dormancy. However, the germination temperature responses of the seeds of *E. arabicus* are used by the seed to identify its germination environment, and serve as a mechanism specific to environmental cues which indicate the probability, in the future, of favourable conditions for growth and seedlings establish-

ment. Environmentally-induced dormancy also in part regulates its germination. Other desert plants which adopt a similar strategy, include *Artemisia abyssinica* (Mahmoud *et. al.* 1983 b), and *Francoeuria crispa* (Mahmoud *et. al.* 1983 a).

Absence of *Euryops arabicus*, at low altitude, within its dispersal range in south Hijaz and in the southern region, is most probably attributed to the failure of its seed germination because of comparatively high temperature.

References

Cohen, D. (1966) Optimizing reproduction in a randomly varying environment, *J. theor. Biol.* **12:** 119-129.

Cohen, D. (1967) Optimizing reproduction in a randomly varying environment when a correlation may exist between the conditions at the time a choice has to be made and the subsequent outcome, *J. theor. Biol.* **16:** 1-14.

Cohen, D. (1968) A general model of optimal reproduction in a randomly varying environment, *J. Ecol.* **56:** 219-228.

Freas, K.E. and **Kemp, P.R.** (1983) Some relationships between environmental reliability and seed dormancy in desert annual plants, *J. Ecol.* **71:** 211-217.

Koller, D. (1969) The physiology of dormancy and survival of plants in desert environments, *in:* **Wollhouse, H.W. (ed.)** *Dormancy and Survival in Desert Plants; Symp. Soc. exper. Biol.*, Academic Press, New York **23:** 449-469.

Levins, R. (1969) Dormancy as an adaptive strategy, *in* **Wollhouse, H.W. (ed.)** *Dormancy and Survival in Desert Plants; Symp. Soc. exper. Biol.*, Academic Press, New York, **23:** 1-10.

Mahmoud, A. (1977) Germination of three desert *Acacias* in relation to their survival in arid environment, *Proc. First Conf. Biol. Aspects of Saudi Arabia,* Riyadh 74-94.

Mahmoud, A. and **El-Sheikh, A.M.** (1978) Germination of *Prosopis chilensis* (Molina) Stunts, *Egypt. J. Bot.* **21:** 69-74.

Mahmoud, A. and **El-Sheikh, A.M.** (1981) Germination of *Parkinsonia aculeata* L., *J. Coll. Sci., King Saud Univ.* **12:** 53-64.

Mahmoud, A., El-Sheikh, A.M. and **Abdul Baset, S.** (1983a) Germination of *Francoeuria crispa* (Compositae) from Saudi Arabia, *Arab Gulf J. scient. Res.* **1:** 289-302.

Mahmoud, A., El-Sheikh, A.M. and **Abdul Baset, S.** (1983b) Germination of *Artemisia abyssinica* Sch. Bip., *J. Coll. Sci., King Saud Univ.* **14:** 253-272.

Migahid, A.M. (1978) *Flora of Saudi Arabia, 2nd* ed., vol. 1, Riyadh University Publication, 618 p.

Thompson, P.A. (1970) Germination of species of Caryophyllaceae in relation to their geographical distribution in Europe, *Ann. Bot.* **34:** 427-449.

Venable, D.L. and **Lawlor, L.** (1980) Delayed germination and dispersal in desert annuals: escape in space and time, *Oecologia, Berlin* **46:** 272-282.

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إنبات بذور الطباق *Euryops arabicus* من مرتفعات عسير في المملكة العربية السعودية

عبدالسلام محمود*، عبدالله محمد الشيخ و سعيد عبد الباسط***.

** قسم الأحياء، كلية التربية، جامعة الملك سعود؛*

*** قسم النبات كلية العلوم، جامعة الملك سعود، الرياض - المملكة العربية السعودية*

الطباق نبات عشبي معمر ينحصر انتشاره على سفوح الجبال (٢٢٨٠-٣٠٠٠ متر فوق سطح البحر) في جنوب الحجاز وفي الجزء الجنوبي من المملكة العربية السعودية.

تمت دراسة تأثير أنظمة مختلفة من درجات الحرارة المتبادله (١٨/٨، ٢١/١٠، ٢٨/١٤، ٣٢/١٦، ٣٦/٢١، ٤٠/٢٦) °م على إنبات بذور الطباق التي جمعت حديثا.

تعكس استجابة البذور عند الإنبات للحرارة توزيع النبات الجغرافي في المملكة. لا تتمتع البذور بظاهرة الكمون التي تعمل على تنظيم الإنبات ولكن استجابة البذور لدرجة حرارة البيئة الخارجية تنظم عملية الإنبات فتجعلها ممكنة

العنوان الحالى للمؤلف الأول : جامعة الجزيرة ــ كلية العلوم ــ واد مدنى ص.ب (٢٠) ــ السودان

فقط حين حلول ظروف البيئة المثلى التي تمكن البوادر المنبثقة من البذور من أن تنمو وتتوطن بمشيئة الله.

لقد تمت مناقشة أهمية هذه النتائج بالنسبة للنبات في بيئته الطبيعية.