Stratification and Priming May Improve Seed Germination of Purple Coneflower, Blue-flag Iris and Evening Primrose

David Wees
Faculty of Agricultural and Environmental Sciences
Macdonald Campus of McGill University
Sainte-Anne de Bellevue
Quebec, Canada

Keywords: *Echinacea purpurea*, *Echinacea angustifolia*, *Iris versicolor*, *Oenothera biennis*, medicinal, wildflower, ornamental

Abstract

Several North American native wildflowers have potential for medicinal and ornamental use but have poor, erratic or slow seed germination. The goal of this project was to improve germination, using stratification or priming, of Blue-flag iris (*Iris versicolor*), evening primrose (*Oenothera biennis*), narrow-leaf purple coneflower (*Echinacea angustifolia*) and purple coneflower (*E. purpurea*). Stratification consisted of storing seeds in wet paper towels at 4°-5°C for 4 weeks (in 1997) or 3 weeks (in 1999). Priming consisted of soaking seeds in an aerated 0.1 M or 0.2 M solution of KNO_3 for 7 days in 1999; in 1997 a 0.1 M solution was used for 5 days. With *Iris versicolor* stratification, priming and the control gave respectively 58 %, 33 % and 9 % germination in 1997 and 17 %, 1 % and 0 % in 1999; germination was slow and took 24-34 days in 1997 and 12-19 days in 1999. Germination of *Oenothera biennis* was not significantly affected by stratification or priming. With *Echinacea angustifolia*, stratification, priming and the control gave respectively 22 %, 24 % and 12 % germination in 1997; germination was much poorer in 1999 and never exceeded 10 %; in 1999, stratified seeds germinated faster than the other treatments. Both stratification and priming improved % germination of *E. purpurea* from 44 % to 83 % and 69 % respectively; these treatments also reduced the time to germination from 13 days to 8 or 6 days, respectively.

INTRODUCTION

Several North American native wildflowers have potential as medicinal crops and for ornamental horticulture. The rhizomes of Blue-flag iris (*Iris versicolor*) are reported to be diuretic, stimulate bile production and help heal wounds (Foster and Duke, 1990); the species is also used as a garden plant. Leaves and roots of purple coneflower (*Echinacea purpurea*) and narrow-leaf purple coneflower (*E. angustifolia*) have been reported to stimulate the human immune system (Small and Catling, 1999; Li, 1998); *E. purpurea* is also a common garden plant. Evening primrose (*Oenothera biennis*), a biennial weed, has seeds rich in γ linolenic acid and has been used to treat pre-menstrual syndrome, eczema and arthritis (Small and Catling, 1999; Deng et al, 2001).

Some of these species can have poor, erratic or slow seed germination (Li, 1998; Hall et al, 1988). Temperature, light, seed quality, ethephon, priming (osmoconditioning) and stratification have been reported to influence their germination (Zhang et al, 2000; Li, 1998; Hall et al, 1988).

The goal of this project was to improve seed germination of *Iris versicolor*, *Echinacea angustifolia*, *E. purpurea* and *Oenothera biennis* with stratification and priming.

MATERIALS AND METHODS

Plant Materials

Blue-flag iris (Iris versicolor) seeds were collected in the Fall of 1996 and 1998 from plants in a private garden in south-western Quebec; the seeds weighed on average about 0.02 g and measured 1-2 mm by 5-7 mm.

Evening primrose (Oenothera biennis) seeds were collected in the Fall of 1998 from

Proc. XXVI IHC – Future for Medicinal and Aromatic Plants
Eds. L.E. Craker et al.
Acta Hort. 629, ISHS 2004
Publication supported by Can. Int. Dev. Agency (CIDA)

wild plants growing in south-western Quebec; the seeds weighed on average about 0.0006 g and measured 1 mm in diameter.

Narrow-leaf purple coneflower (Echinacea angustifolia) seeds were from a commercial source (Richters Herbs Ltd., Goodwood, Ontario, Canada) in 1997 or collected in the Fall of 1998 from 3-year old cultivated plants growing at the Horticultural Research Centre of Macdonald Campus of McGill University; the seeds weighed on average about 0.0035 g and measured 1-2 mm by 3-5 mm.

Purple coneflower (Echinacea purpurea) seeds were from a commercial source (Richters Herbs Ltd., Goodwood, Ontario, Canada).

Treatments

Stratified seeds were seeds stored at 4-5 °C in wet paper towels in plastic bags for 4 weeks (1997) or 3 weeks (1999). Primed 0.1 M seeds were seeds soaked in an aerated solution of 0.1 Molar KNO_3 for 5 days at 21 °C (1997) or 7 days at 24 °C (1999). Primed 0.2 M seeds were seeds soaked in aerated solution of 0.2 Molar KNO_3 for 7 days (1999 only). The control seeds were untreated, dry seeds.

Procedure

Sixty to 100 seeds were used per treatment in 1997 and 280-300 seeds per treatment in 1999. Seeds were sown about 2-4 mm deep in moist Pro-mix BX (a commercial medium containing peat, vermiculite and perlite) on Feb. 17, 1997 and Jan. 27, 1999 in a glass-covered greenhouse; air temperature was approximately 20 °C. Water was applied as needed. The number of seeds germinated was recorded daily and final % germination was calculated. Mean germination time in days after seeding (Hartmann et al, 1997) was calculated as follows:

$$\text{DAS} = \frac{\Sigma\ (\#\ \text{seeds germinated in 1 day}) \times (\#\ \text{days after seeding})}{\text{total number of germinated seeds}}$$

Statistical analyses were performed with Corel™ Quattro Pro 10™.

RESULTS AND DISCUSSION

Germination of *Iris versicolor* was generally slow and there was a very wide spread in germination time: 15-40 DAS in 1997 and 12-26 DAS in 1999. Stratification improved % germination but the effect of priming was inconsistent. Zhang et al (2000) obtained over 90 % germination with oscillating temperatures instead of a constant 21 °C but stated that germination was quite poor in the wild. Jakimow-Barras (1973) found that the endosperm had no starch and its cell walls were quite thick which could possible impede water uptake. In addition the seeds are hollow and relatively light weight: this may make seeds float but also make water uptake more difficult. These factors may explain the poor % germination obtained with untreated seeds.

Oenothera biennis had the narrowest range of germination times, 5-14 DAS, of the four species tested and there was little variation between treatments. Germination was 67-74 % regardless of treatment. Baskin and Baskin (1994) obtained 95 % germination with 6 month old seed. Hall et al (1988) and Gross (1986) suggested that high light intensity and long day lengths promoted germination but seed weight had little effect; perhaps seeding on the surface of the growing medium would have improved germination.

There was a very wide spread in germination times for *Echinacea angustifolia*: 3-19 DAS in 1997 and 5-25 DAS in 1999. Stratification and priming improved germination in 1997 but not in 1999; the poorer germination in 1999 may be related to seed source or quality as commercial seed was used in 1997 but seed from collected from cultivated plants was used for the 1999 trial.

There was a wide range of germination times for *E. purpurea* 7-19 DAS (control), 4-14 DAS (stratified) and 3-15 DAS (primed 0.1 M) although not as wide as with *E. angustifolia*. Stratification gave the best germination followed by priming.

Several authors have found, as in this study, that *E. purpurea* had better germination

than *E. angustifolia*. Baskin et al (1992) found that stratification combined with light exposure promoted germination. Baskin et al (1992) suggested 8-12 weeks stratification, much longer than the 3-4 weeks used in this study. Gao et al (1998) improved seed germination of *E. angustifolia* by priming with 5.3M KOH for 10 minutes; this was a much higher molarity but a shorter soaking time than was used in the present study. Li (1998), in his review of the research, notes that hormonal treatments, e.g. ethephon, may have a stronger effect than those of temperature.

Echinacea spp. and *Oenothera biennis* naturally grow in prairies and open places (Small and Catling, 1999); thus exposure to light may be important. *Iris versicolor* grows in wet areas (Foster and Duke, 1990) yet temperature rather than pre-soaking seemed more important for germination.

CONCLUSIONS

With *Iris versicolor* stratification improved % germination; germination was much poorer in 1999 (0-17%) than in 1997 (9-58 %): the duration of stratification may be critical. Stratification and priming had no significant effect on germination of *Oenothera biennis*; germination was over 67 % regardless of treatment and took 8-10 days. Pre-germination treatments such as stratification or priming may not be needed for adequate germination of this species. Stratification and priming improved germination of *Echinacea angustifolia* in 1997 but not in 1999; germination was much slower in 1999 (12-28 days) than in 1997 (7-14 days). It is possible that seeding depth and/or light exposure as well as seed source and/or quality may be critical for good germination. With *E. purpurea* stratification gave the best results followed by priming. Stratification may be the best treatment for this species.

Literature Cited

Baskin, C.C. and Baskin, J.M. 1994. Germination requirements of *Oenothera biennis* seeds during burial under natural seasonal temperature cycles. Canadian Journal of Botany 72:779-782.

Baskin, C.C., Baskin, J.M. and Hoffman, G.R. 1992. Seed dormancy in the prairie forb *Echinacea angustifolia* var. *angustifolia* (Asteraceae): after ripening pattern during cold stratification. International Journal of Plant Sciences 153:239-243.

Deng, Y.C., Hua, H.M., Li, J. and Lapinskas, P. 2001. Studies on the cultivation and uses of evening primrose (*Oenothera* spp.) in China. Economic Botany 55:83-92.

Foster, S. and Duke, J.A. 1990. A field guide to medicinal plants: eastern and central North America. Houghton Mifflin Co., U.S.A.

Gao, Y.P., Zheng, G.H. and Gusta. L.V. 1998. Potassium hydroxide improves seed germination and emergence in five native plant species. HortScience 33:274-276.

Gross, K.L. 1985. Effects of irradiance and spectral quality on the germination of *Verbascum thapsus* L. and *Oenothera biennis* L. seeds. New Phytologist 101:531-541.

Gross, K.L. and Kromer, M.L. 1986. Seed weight effects on growth and reproduction in *Oenothera biennis* L. Bulletin of the Torrey Botanical Club 113:252-258.

Hall, I.V., Steiner, E., Threadgill, P. and Jones, R.W. 1988. The biology of Canadian weeds 84: *Oenothera biennis* L. Canadian Journal of Plant Science 68:163-173.

Hartmann, H.T., Kester, D.E., Davies, F.T. and Geneve, R.L. 1997. Plant propagation: principles and practices, 6th ed. Prentice Hall, USA.

Hartmann, H.T., Kester, D.E., Davies, F.T. and Jakimow-Barras, N. 1973. Les polysaccharides des graines de quelques Liliacées et Iridacées. Phytochemistry 12:1331-1339.

Li, T.S.C. 1998. Echinacea: cultivation and medicinal value. HortTechnology 8:122- 129.

Small, E. and Catling, P.M. 1999. Canadian medicinal crops. NRC Research Press. Ottawa, Ontario, Canada.

Zhang, D., Hu, D. and Smagula, J. 2000. Temperature and gibberellic acid on seed germination of *Iris versicolor*. HortScience 35:448 [abstract].

Tables

Table 1. Germination of *Iris versicolor* (Blue-flag iris).

Seed Treatment	Germination (%)		Germination Time (DAS)	
	1997	1999	1997	1999
control	9.4 a[1]	0.0 a	32.4	-
stratified	58.4 c	17.3 b	24.4	19.3
primed (0.1 M)	33.1 b	1.0 a	34.3	16.0
primed (0.2 M)	-	0.3 a	-	12.0
F-Test	**[2]	**	n.s.	n.s.

[1]Means within columns followed by the same letter are not significantly different at the 0.05 level according to the LSD test.
[2]Within columns, F-test showed significant effect of treatments at the 0.01 level (**) or no significant effect (n.s.).

Table 2. Germination of *Oenothera biennis* (Evening primrose), 1999 only.

Seed Treatment	Germination (%)	Germination Time (DAS)
control	67.3	9.8
stratified	70.9	7.9
primed (0.1 M)	67.6	8.8
primed (0.2 M)	73.7	8.4
F-Test	n.s.[1]	n.s

[1]Within columns, F-test showed no significant effect (n.s.) of treatments.

Table 3. Germination of *Echinacea angustifolia* (narrow-leaf purple coneflower).

Seed Treatment	Germination (%)		Germination Time (DAS)	
	1997	1999	1997	1999
control	11.7 a[1]	2.0	13.7	28.2 b
stratified	22.2 b	9.3	10.2	12.2 a
primed (0.1 M)	23.6 b	4.0	7.3	18.9 b
primed (0.2 M)	-	9.0	-	16.9 b
F-Test	*[2]	n.s.	n.s.	*

[1]Means within columns followed by the same letter are not significantly different at the 0.05 level according to the LSD test.
[2]Within columns, F-test showed significant effect of treatments at the 0.05 level (*) or no significant effect (n.s.).

Table 4. Germination of *Echinacea purpurea* (purple coneflower),1997 only.

Seed Treatment	Germination (%)	Germination time (DAS)
control	44.1 a [1]	12.5 b
stratified	83.0 b	7.6 a
primed (0.1 M)	69.0 b	6.1 a
F-Test	**[2]	**

[1]Means within columns followed by the same letter are not significantly different at the 0.05 level according to the LSD test.
[2]Within columns, F-test showed significant effect of treatments at the 0.01 level (**).