

SEED BANK BEHAVIOUR OF VERBASCUM L. SPECIES

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Seed bank behaviour of *Verbascum austriacum* Schott and *V. lychnitis* L., two native mulleins of Hungary, were studied in a burial experiment. Both species germinated in every year of the experiment. Following four years of burial 7% and 41% germination were observed, respectively. Considering reports on earlier investigations as well as the results of our studies it seems that long term seed viability and maintenance of persistent seed banks are characteristic of the genus *Verbascum*.

Key words: burial experiment, mullein, seed bank, seed longevity, *Verbascum austriacum*, *Verbascum lychnitis*

INTRODUCTION

Practically all the flowering plants have certain type of seed bank. With lack of it very few examples can be found like some viviparous species or hybrids that reproduce by vegetative means only.

However, there are extreme differences regarding seed bank behaviour and seed longevity of species. Some of them maintain seed viability for extraordinary long time (RAMSBOTTOM 1942, LERMAN and CIGLIANO 1971, HARRINGTON 1972, PRIESTLEY and POSTHUMUS 1982, BAKER 1989), while others lose germinability soon (HARRINGTON 1972, THOMPSON and GRIME 1979, MILBERG 1993, CSONTOS *et al.* 1998).

For characterizing seed bank types of species THOMPSON and GRIME (1979) suggested a classification with four categories. More recently a three-grouped typification was also established focusing more on the time span of seed bank survival (THOMPSON 1993).

In the light of earlier studies mullein species maintain large persistent seed banks (type IV. in THOMPSON and GRIME 1979), and retain germinability for long time ("long-term persistent" according to THOMPSON 1993).

ØDUM (1965, 1974, 1978) observed germination of *Verbascum nigrum* L., *V. thapsiforme* Schrad. and *V. thapsus* L. from excavated soil samples. *Verbascum thapsus* seeds germinated from soils of four pine plantations (25, 37, 41 and 80 years old) in Massachusetts (LIVINGSTONE and ALLESSIO 1968) as well as from soils of Douglas fir and larch stands (both were 20 years old) in south-west

England (WARR *et al.* 1994). This species was also reported by ARTIGAS and BOERNER (1989) from the seed bank of pine stands in Ohio.

In two cases mulleins were involved in long-term experiments with artificially buried seeds.

DUVEL buried *Verbascum thapsus* in a longevity test and found the seeds viable throughout the 39 years long study (TOOLE and BROWN 1946). In the W. J. BEAL's experiment *Verbascum blattaria* L. and *V. thapsus* seeds remained viable after one hundred years of burial (KIVILAAN and BANDURSKI 1981).

The facts listed above might induce to ask how much the strategy of forming persistent soil seed bank is common in the genus.

To support the decision by new data, seed bank studies of two mulleins (*Verbascum austriacum* and *V. lychnitis*), not yet investigated, was decided.

MATERIALS AND METHODS

Brief characterization of the investigated species are given below (based on SOÓ 1968, MEUSEL *et al.* 1978 and HORVÁTH *et al.* 1995):

Verbascum austriacum Schott – Area includes south-east Europe from Czech Republic to Bulgaria. Native to Hungary, often found in mountainous and hilly regions, rare on the lowlands. Plant height: 0.5–1.0 m; RAUNKIAER's life-form: TH-H; flowering time: June–August; cytotaxonomy: polyploid, $2n = 32$. Prefers xerotherm oak woodlands (associations of *Quercetea pubescenti-petraeae*) but also found in some drier or more humid vegetation types. Moisture requirement in accordance with semi-dry habitats. (Syn.: *V. chaixii* var. *austriacum* Franch.)

Verbascum lychnitis L. – Area ranges from the German Lowland to south Italy and from France to the river Volga. Native to Hungary, apart from high mountains and closed canopy forests it is widespread in the whole country. Plant height: 1.0–1.5 m; RAUNKIAER's life-form: TH; flowering time: May–August; cytotaxonomy: polyploid, $2n = 32$. Prefers xerotherm grasslands (associations of *Festuco-Brometea*) sometimes occurs in xerotherm woodlands. Often found in habitats with long dry period.

Seeds of the two species were collected on 12 September, 1992 at Piliszentlászló and on 24 October, 1992 at Csévharaszt, respectively.

For each species one hundred seed units were mixed with sterilized sand and filled into flower pots then buried at 60 cm depth, in ten replicates, in Autumn 1992. This burial depth was intended to induce enforced dormancy of the seeds (FENNER 1985). Following exhumations (21.04.1993, 30.04.1994, 28.03.1995 and 25.03.1996) seeds were spread out on the surface of soil kept in plastic trays then exposed to light and moisture (26.04.1993, 03.05.1994,

29.03.1995 and 29.03.1996) in a green-house of the Botanical Garden of the L. Eötvös University. An additional tray, filled with soil of same origin, was also exposed as control next by the two test trays. The germinating seedlings were monitored at weekly intervals and removed following emergence. The experiment was terminated after 6 months or later. Six replicates are still kept in the soil for future exhumations.

RESULTS AND DISCUSSION

The rates of germination of the tested species between 1993 and 1996 are shown in Figure 1.

Both mulleins germinated in every test-years and produced apparently healthy plants. The germination success was the following: *V. austriacum*: 1993, 9%; 1994, 1%; 1995, 14% and 1996, 7%; *V. lychnitis*: 1993, 8%; 1994, 4%; 1995, 22% and 1996, 41%.

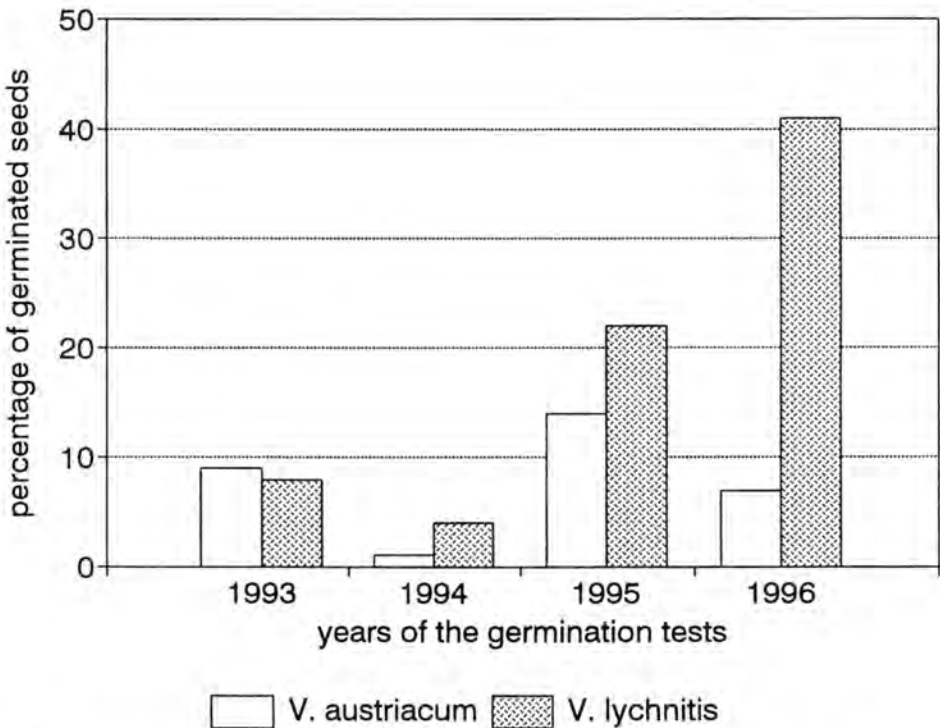


Fig. 1. Germination success of mullein species. (Seeds were collected and buried in 1992)

The decrease of germination success in the second year (1994) was caused by the late greenhouse exposition of the samples coupled with an unusual advent of summerlike weather.

The germination success of *Verbascum austriacum* was fluctuating around the average of eight percent. Similar fluctuation in the number of germinated seeds was found in DUVEL's experiment for *V. thapsus* (TOOLE and BROWN 1946).

In case of *V. lychnitis* the average rate of germination was higher (19%), and its germination pattern also differed from that of *V. austriacum*. Instead of fluctuation around an average *V. lychnitis* showed an increased rate of germination in the latest years of the experiment.

The results until now show that both species have persistent seed bank and that is more pronounced in case of *V. lychnitis*. The somewhat less expressed seed bank strategy of *V. austriacum* may be connected with adaptation to less disturbed habitats (FENNER 1985). Nevertheless, viable seeds of *V. austriacum* were also detected from deeper soil layers of abandoned vineyards (A. SENDTKO, personal communication).

With respect to the question about frequency of seed banking species in the *Verbascum* genus the results of this paper support the presumption of wide incidence. The predictive method of THOMPSON *et al.* (1993) would lead the same conclusion, since small and more or less isodiametric seeds are characteristic for mulleins (MURBECK 1933, SCHERMANN 1967).

From the viewpoint of taxonomic evaluation it is important that the five species studied until now belong to distinct infrageneric taxa (*cf* MURBECK 1933).

However, an extensive study involving more species, would be welcome. In this respect the seed bank strategy of perennial and suffruticose species found in the eastern part of the Mediterranean Basin seems to be the most interesting to investigate as they are the least weedy representatives of mulleins.

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