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EXPERIMENTAL PAPER

Biology of germination of medicinal plant seeds. Part XIXb. Diaspores of *Inula helenium* L. from *Asteraceae* family

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Summary

Morphological features of diaspores and seedlings of *Inula helenium* L. were described. A four-year cycle of monthly germination analysis was carried out. It was found that accessible light and various temperatures (30°C over 8 hours, 20°C over 16 hours) were optimal for the analysis of *Inula helenium* fruit germination ability. In these conditions, the percentage of germinated achenes was up to 90%. Diaspores stored in unheated room kept their viability even up to seven years after harvest.

Key words: *Inula helenium*, germination, diaspores

INTRODUCTION

This work continues the investigation on the biology of germination of species from *Asteraceae* family [1]. Elecampane (*Inula helenium* L.) comes probably from Central Asia [2]. Currently, the species is common in Europe, Asia and North America. In Poland, *I. helenium* grows in thickets, on the edge of forests, grasslands and on steep banks.

I. helenium is a hardy perennial with branchy rhizome and thick root. The stem is grooved and straight and up to two-metre high. The upper part of the stem is slightly branched. Its basal leaves are large, oval or elliptic, tapering gradually to long leaf stalks, whereas the leaves of the stem are cordate-oval, sessile or decurrent. The bottom of leave is densely hairy. *I. helenium* flowers from July to October.

Its yellow flowers gather in inflorescence growing individually or in small groups at the top of stem. The inflorescence is surrounded by many rows of involucre leaflet, of which internal leaves are cordate-oblong, outer are ovate. There are two types of flowers: ligulate flower on the edge of the inflorescence and tubular flower inside [2].

Underground organs such as root and rhizome are raw materials of this species [3]. They have individual, aromatic scent and a bitter and fiery hot taste. *I. helenium* root contains bitters and essential oils, and therefore belongs to the *amaro-aromatica* group of raw materials. One of the main substances of the essential oils is helenine – a form of mixture of different sesquiterpene lactones (alantolactone, isoalantolactone, dihydroalantolactone, etc.) and other sesquiterpenes (alantic acid, alantol), dammarane- and friedelane type triterpenes, azulene, phytosterols (β-sitosterol, stigmasterol) and thymol derivatives [3-5]. Amount of polysaccharide – inulin found in the raw material oscillates up to 45% [3].

The root and rhizome of the studied species have medicinal properties. Its pharmaceutical preparations are taken for respiratory track diseases such as: inflammation of the oral mucosa, sore throat, bronchitis, cough, and in case of difficult expectoration [3]. It is mainly due to its essential oils that the root of *I. helenium* can be used as a medicine for the diseases mentioned above. They help stimulate secretory function of the mucous membrane of the throat and bronchi making it easier for the patient to cough up. Helenine substances, due to their restraining bacterial flora development properties, can be applied in skin and mucous membrane disinfection. While alantolactone has an anthelmintic effect [6]. In recent years, some countries have limited applying raw material of the studied species. According to German Commission E medicinal properties of the species is unsatisfactorily documented [7].

The aim of the study is to elaborate the course of germination capability and viability of diaspores of *I. helenium*

MATERIAL AND METHODS

The research on germination capability of *I. helenium* diaspores was carried out. Tested material, coming from our own cultivation, was picked in autumn 2007–2010. Monthly analyses were done in yearly cycles. The viability of seed material was determined using fruits cropped in 2003–2011. Analyses of diaspores germination capability and viability were conducted according to the seed estimation methodology established by International Rule for Seed Testing (ISTA) [8]. The study was carried out in four repetitions in three different physical conditions. Temperature, light or lack of it were changing factors. When the temperature was constant, it was set at 20°C. When the seeds were kept in the darkness, the temperature was 30°C for 6 hours and 20°C for 18 hours, while in the case of using light the temperature was 30°C for 8 hours and 20°C for 16 hours. Jacobsen apparatus and climatic chamber were used as supportive tools. Seed material was tested in Petrie' dishes padded

with chromatographic paper. Fruits viability was tested in light and at changing temperatures (30°C for 6 hours and 20°C for 18 hours). Till the beginning of the analyses the achenes had been stored at unheated room.

RESULTS AND DISCUSSION

Inula helenium fruit is a small, brown four-angular achene (fig. 1). The diaspore shape is elongated, in some samples slightly bended. The surface of the achene coat is grooved.

Figure 1.
Fruits of *Inula helenium* L.

The fruit has easy coming off pappus with hairs about 7 mm long. The length of the diaspores oscillates between 3.3 mm and 5.6 mm, the width from 0.7 mm to 1.2 mm, and the thickness from 0.6 mm to 0.9 mm. 1.000-fruit weight varies from 0.90 to 1.60 g.

The small seedling is light green (fig. 2). Cotyledons are set on quite long stalks. Their shape is oblong-oval. No clearly venation on the cotyledon surface was observed. The first pair of leaves is densely hairy. The root is poorly branched.

Figure 2.
Seedlings of *Inula helenium* L.

It was found that laboratory conditions, light and various temperatures (30°C over 8 hours, 20°C over 16 hours), were optimal for the analysis of *I. helenium* fruit germination ability.

It was observed that up to five months after harvest diaspores germinated very well (fig. 3). The percentage of germinated fruits varied from 60% to 90%, depending on physical conditions. There was a slight drop in diaspores germination capability in April, May and June. Another increase in percentage of germination was started in July. It lasted to November, and came up to above 80%.

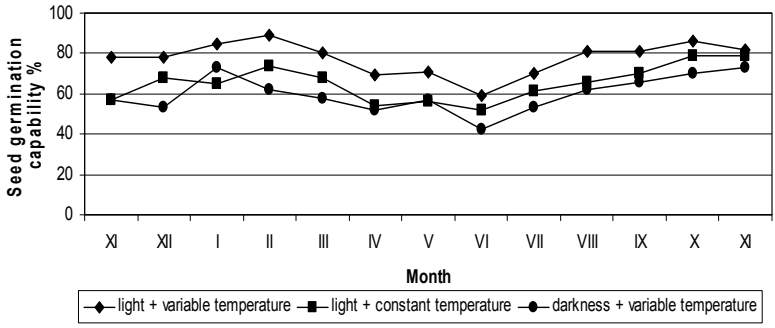

Figure 3.

Germination capacity of *Inula helenium* L. diaspores in the first year after harvest (the average of 2007–2010). The figure shows the fluctuation curve of germination capacity in each month during the year in different laboratory conditions

The fruits started to germinate in the first week of the experiment. The radicle appeared on the narrow part of the seed between the 5th and 8th day since the beginning of the test. The radicle was white and thick. Well-developed cotyledons was observed between the 10th and 12th day of the test.

The diaspores viability tests were carried out on the basis of the seed material collected in 2003-2011 (fig. 4). Fruits were analyzed in light and at various temperatures.

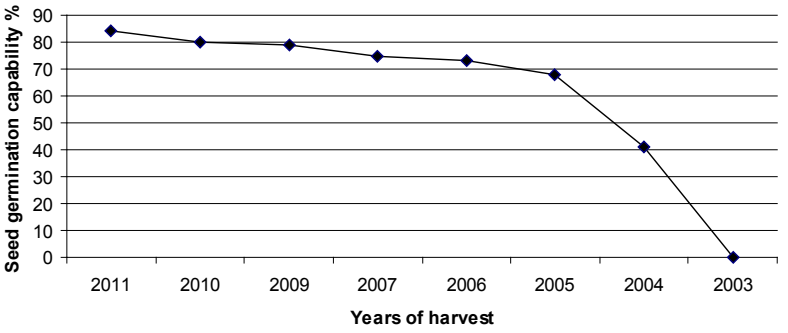

Figure 4.

Germination capacity of *Inula helenium* L. diaspores stored at unheated room. The figure shows the fluctuation curve of germination capacity in each year during the storage time

In the literature have been shown that diaspores kept their germination capability by 1–3 years [9,10]. Although there was no date concerning their storage. In our study the viability of *I. helenium* fruits was longer. In the first and in the second year after harvest the diaspores germinated very well – up to 80%. Between the third and the fifth year after harvest the germination capability slightly decreased. In the sixth year of the storage, the germination capability was very high – nearly 70%. Less than half of the fruits germinated in the seventh year after harvest. Eight years after harvest time, the achenes did not germinate.

REFERENCES

1. Formanowiczowa H, Kozłowski J, Szczyglewska D. Biologia kiełkowania nasion roślin leczniczych. Cz. XIX/a. Materiał nasienny gatunków z rodziny złożonych (*Compositae – Asteraceae*). Herba Pol 1998; 44(2):95-102.
2. Zarzycki K. Rodzaj *Inula*. In: Pawłowski B, Jasiewicz A (eds.). Flora Polska vol. 12, PWN Warszawa-Kraków 1971:181-188.
3. Ghedira K, Goetz P, Le Jeune R. *Inula helenium* L. (*Asteraceae*): aunée. Phytothérapie 2011; 9:176-179.
4. Zhao YM, Wang YJ, Dong M, Zhang ML, Huo CH, Gu YC et al. Two new eudesmanes from *Inula helenium*. Chemistry of Natural Compounds 2010; 46(3):373-376.
5. Stojakowska A, Malarz J, Kisiel W. Thymol derivatives from a root culture of *Inula helenium*. Zeitschrift fűr Naturforschung 2004; 59(7-8):606-608.
6. Trease GA (ed.). A textbook of pharmacognosy (5th ed.). Baillière, Tindall and Cox London 1949.
7. Rośliny Lecznicze w Fitoterapii. Kompendium roślin leczniczych uszeregowanych według zakresów stosowania na podstawie monografii opracowanych przez Komisję E Federalnego Urzędu Zdrowia RFN. Instytut Roślin i Przetworów Zielarskich, Poznań 1994.
8. International Rules for Seed Testing. Rules 2009. ISTA Bassersdorf 2009.
9. Dorywalski J (ed.). Nasionoznawstwo roślin uprawnych. PWRiL, Warszawa 1956.
10. Kołodziej B (ed.). Poradnik dla plantatora. Uprawa ziół. PWRiL, Poznań 2010.

BIOLOGIA KIEŁKOWANIA NASION ROŚLIN LECZNICZYCH. CZ. XIXB. DIASPORY *INULA HELENIUM* L. Z RODZINY *ASTERACEAE*

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Streszczenie

Opisano cechy morfologiczne diaspor i siewek omanu wielkiego *Inula heleninum* L. Przeprowadzono czteroletni cykl comiesięcznych badań zdolności kiełkowania. Stwierdzono, że optymalnymi warunkami fizycznymi przeprowadzania analiz jest dostęp światła i temperatura zmienna (30°C przez 8 godzin, 20°C przez 16 godzin). W tych warunkach odsetek kiełkujących niełupek wynosił do 90%. Diaspory zachowywały żywotność do 7 lat po zbiorze.

Słowa kluczowe: *Inula helenium*, *kiełkowanie, diaspory*