Changes in germination ability during genebank storage at some medicinal plant seeds belonging to the *Solanaceae* family

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Key words: seed germination, seed storage, seed treatment, *Solanaceae, Datura stramonium, Datura innoxia, Hyoscyamus niger*

Summary: In the present work we have examined the changes of germination ability of some medicinal plant species belonging to the *Solanaceae* family (*Datura stramonium* L., *Datura innoxia* Mill. and *Hyoscyamus niger* L.) during 5–6 years' storage period. According to our results, all the three species showed an after-ripening behavior. Potassium nitrate and gibberellic acid increased significantly the rate of germination in the case of *Datura* species. During the storage period tested (1995–2001), the species maintained their germination ability which is favourably but not significantly influenced by the cooled gene bank conditions. The degree of ripeness affected considerably the proportion of germinated seeds at all the three species. As a consequence of our results we emphasise that propagation with completely ripe seeds is proposed, however, half-ripe seeds developped in an unadvantageous vegetation period can be also utilized in the practice. The effect of vegetation year on stramony seeds manifested in the length of after-ripening period, while in the case of henbane the germination ability was also influenced.

Introduction

Preservation of endangered plant taxa is a spreading program in the developed countries. Maintenance of special chemical races, which may serve as basis for production of biologically active ingredients is an even more emphasised, world-wide prospect. However, information on the genebank, especially seed storage technologies of the majority of medicinal plant species are insufficient for the effective and wide-ranging work.

Therefore scientific examinations were performed in the frame of our genebank activity at the Department of Medicinal and Aromatic Plants of SZIU. In the course of this project germination- and propagation-biological investigations, long-term storage experiments are carried out.

The effects of seed treatments, storage duration, storage temperature, ripening phase and vegetation year were studied on the germination ability of *Datura stramonium*, *Datura innoxia* and *Hyoscyamus niger*.

Materials and methods

The seeds of tested species were collected in 1994 and 1995 from wild populations (*Datura stramonium* and *Hyoscyamus niger*) and from genebank collection in 1995 *(Datura innoxia)*.

After drying at room temperature to body-balance, the seeds were stored at room temperature as well as under cooled conditions (at 4°C), in well-closed glasses.

In the case of the three species we evaluated the effects of the following treatments:

- duration of storage
- storage temperature (room temperature and low temperature condition at 4°C)
- vegetation year
- ripening stages (unripe, half-ripe and full ripe)
- seed treatments (0.2% KNO_3 and 500 ppm GA_3)

The germination tests were achieved in the laboratory of the Department of Medicinal and Aromatic Plants in thermostate (Hotpack Illuminated Chambers 352622, at alternate temperature of 30°C/day and 20°C/night).

The starting germination trials were carried out according to the Hungarian Standards (*Anonym*, 1992) (100 seeds/Petri dishes in 4 repetitions) and the further tests were applied according to the international regulation (*Anonym*, 1984) with 50–100 seeds/Petri dishes in 3 repetitions.

To evaluate biometrically the germination properties affected by different treatments, one – and two-factor analysis of variance were used applying Microsoft Excel 7.0 software.

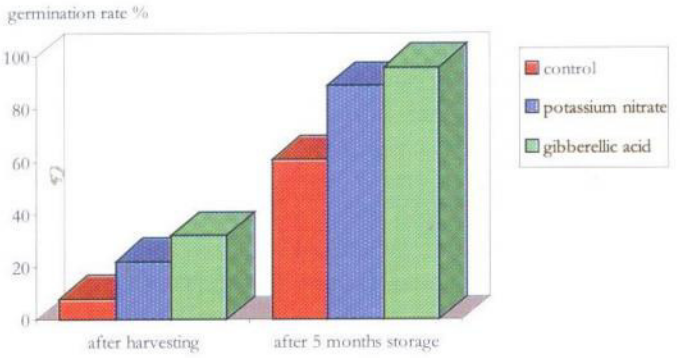

Figure 1 Effect of different seed treatments on the seeds of *Hyoscyamus niger* L.

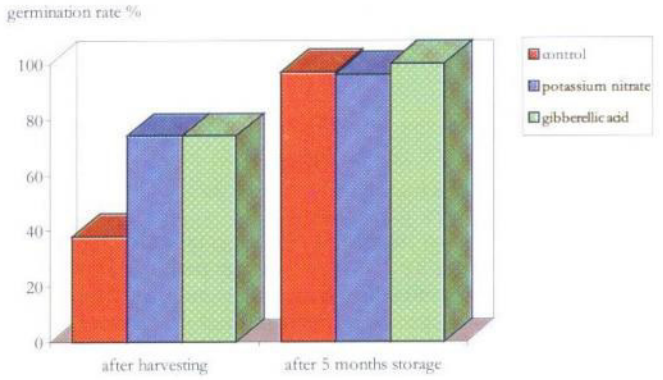

Figure 2 Effect of different seed treatments on the seeds of *Datura stramonium* L.

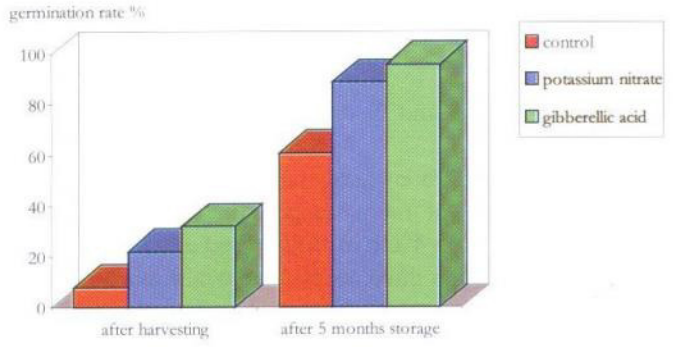

Figure 3 Effect of different seed treatments on the seeds of *Datura innoxia* Mill.

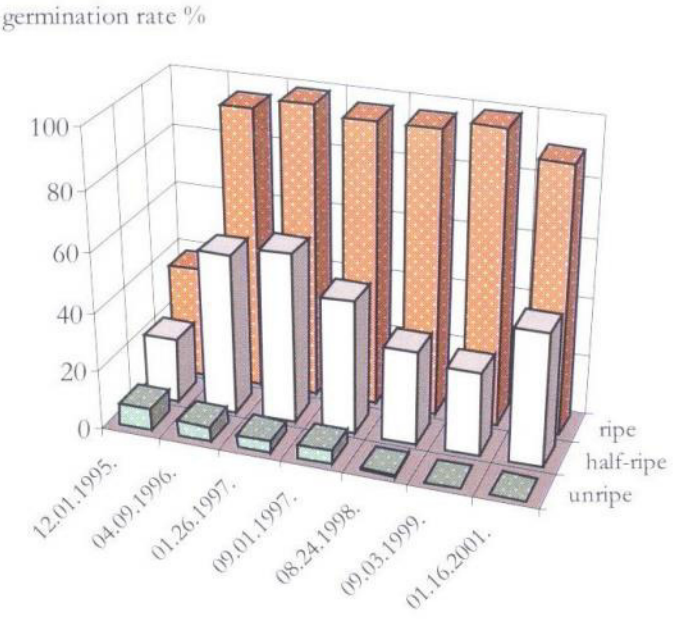

Figure 4 Effect of ripening stages on germination ability of stramony seeds

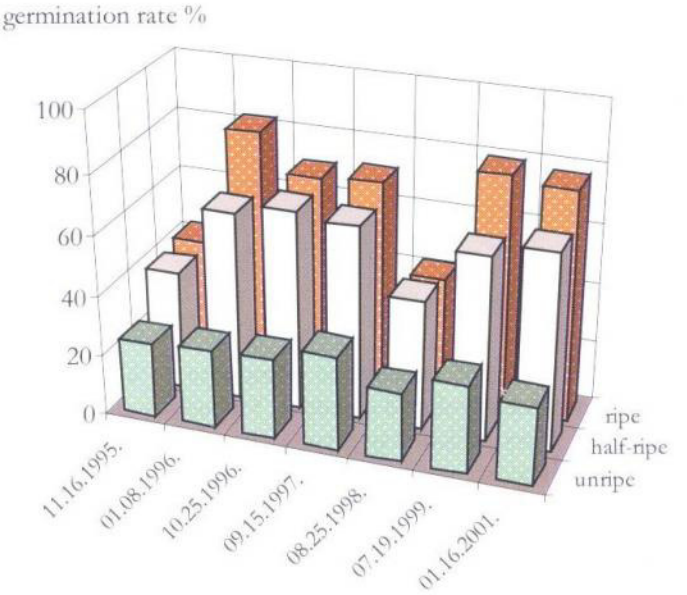

Figure 5 Effect of ripening stages on germination ability of henbane seeds

Results and discussion

Effect of seed treatments

According to previous authors the freshly collected seeds of these three species may cause severe problems, they require cold or other treatments for eliminating germination inhibitors (e.g. *Szabó*, 1983; *Zutsi* and *Atal*, 1970). The after ripening dormancy could be discontinued with growth regulators. According to our data the related three species do not react in the same way to the applied stimulators. In our experiment the gibberellic acid and potassium nitrate concentrations were not effective at all in case of the henbane *(Figure 1)*, but it resulted an increase in germination ability in case of indian datura and stramony. These two *Datura* species reacted differently for seed treatments. After harvesting the germination ability of stramony seeds increased twofold (74%) by the effect of both treatments, but after 5 months of storage period the germination rate of control seeds reached the 90% and the stimulators did not cause important changes *(Figure 2)*.

The seeds of indian datura germinated significantly better when treated by both regulators in both times *(Figure 3)*.

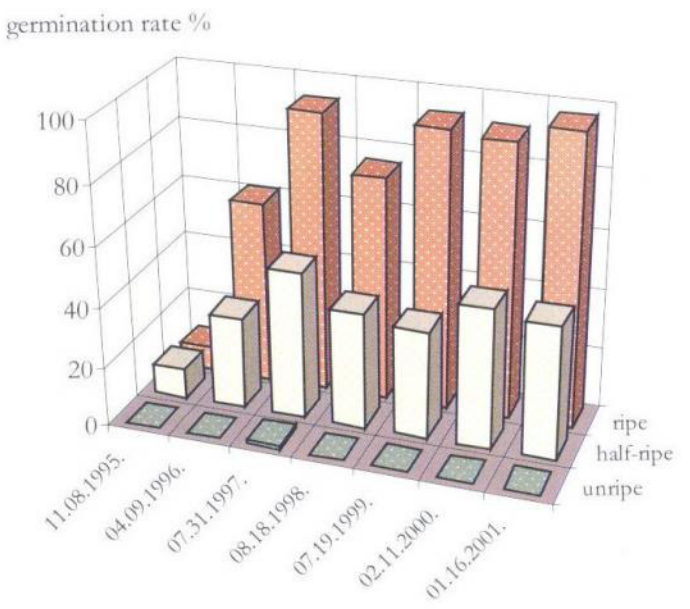

Figure 6 Effect of ripening stages on germination ability of indian datura seeds

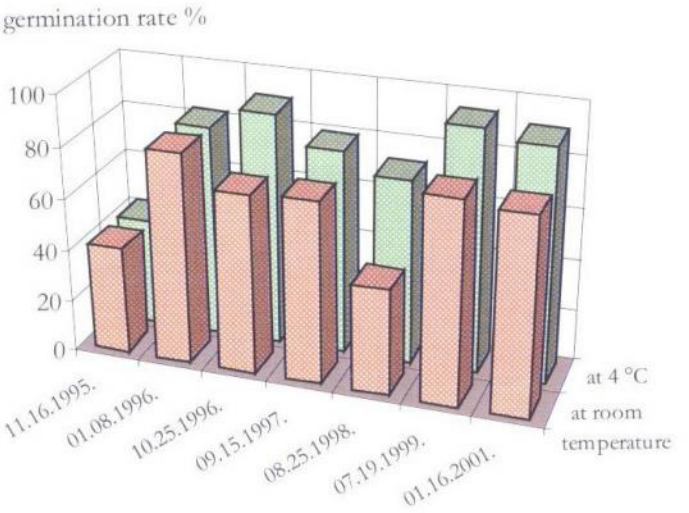

Figure 8 Effect of storage condition on germination ability of henbane seeds

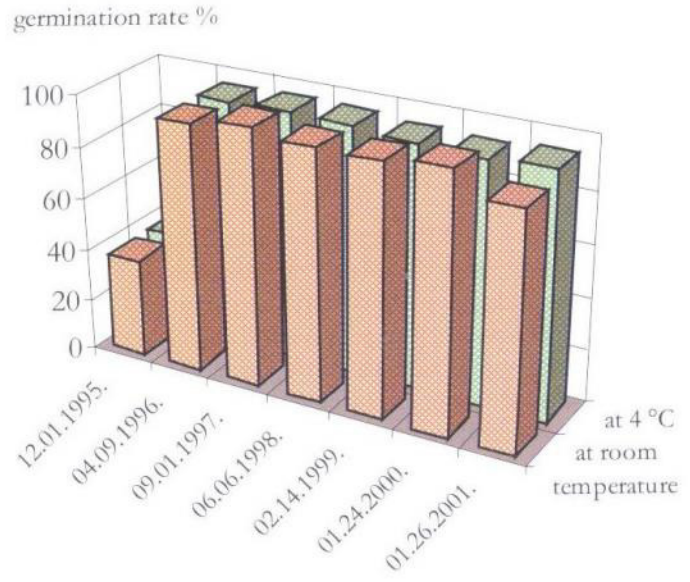

Figure 7 Effect of storage condition on germination ability of stramony seeds

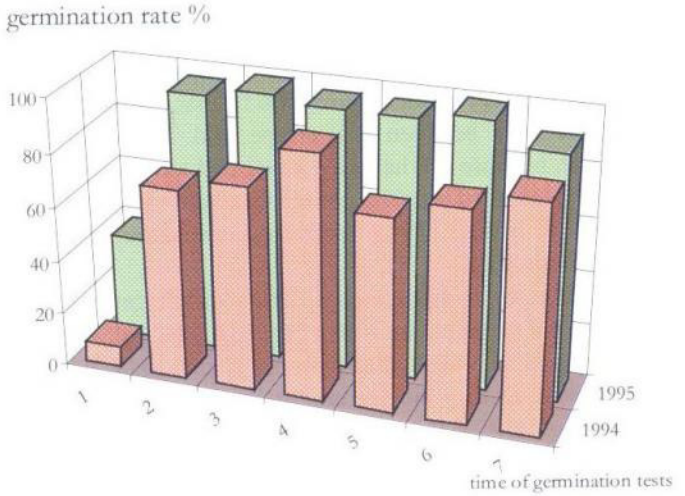

Figure 9 Effect of vegetation year on germination ability of stramony seeds

After harvesting, the control seeds germinated only in 8%, while treating by potassium nitrate, the germination ability increased up to 22% and in case of gibberellic acid stimulation it changed to 32%. Our results indicate, that the dormancy of the seeds of indian datura is considerable, also in comparison with the other two species. After 5 months' storage period, the germination tests showed significantly higher results. Both stimulators raised the germination ability of the seeds, however, the germination rate of control seeds was yet 61%, while the effectiveness of gibberellic acid (+35%) was striking.

The necessity of stimulation is also known from previous references. The stratification, the scarification or pre-treatment of steeping in warm-water deserve attention mainly in the case of the henbane (*Heeger*, 1956, *Ruminska*, 1973).

Effect of ripeness

Among the examined factors ripeness of seeds exhibited the strongest effect on germination. In the case of *Datura stramonium* L. *(Figure 4)* the initial germination capacity of the unripe seeds (8%) have been decreased to zero during the storage period. The half-ripe seeds germinated after harvesting in 22%. After a half year storage period the germination rate increased up to 54% and it didn't changed

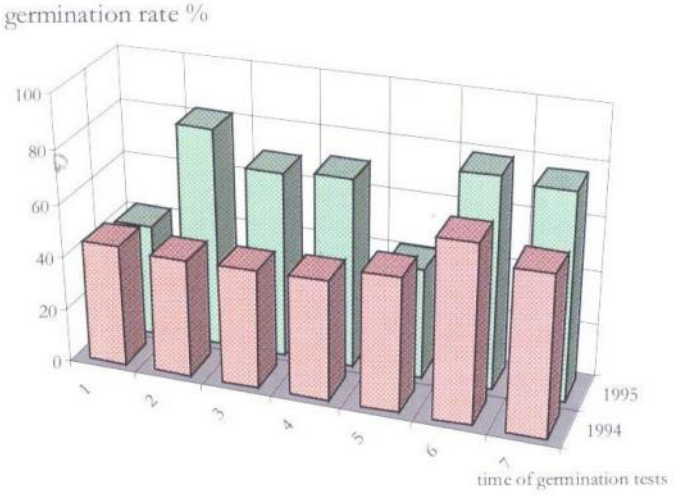

Figure 10/a Effect of vegetation year on germination ability of henbane seeds stored at room temperature

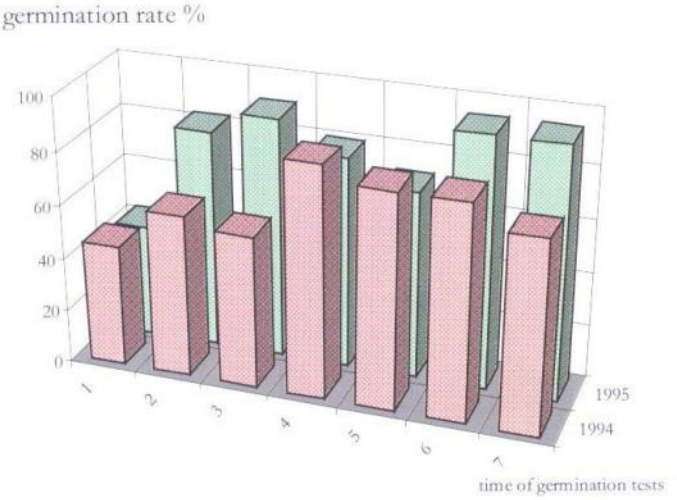

Figure 10/b Effect of vegetation year on germination ability of henbane seeds stored at cooled condition

significantly during the further storage. The occurrence of after-ripening was observed at the full ripe seeds, too. Germination rate increased from 38% to 95%.

In the case of *Hyoscyamus niger* L. *(Figure 5)* the behavior of the unripe seeds widely differs from the other two ripening phases: the initial germination capacity was 24% and it didn't change during the further storage period. The difference between the unripe and half-ripe phase increased, because the half-ripe seeds had an after-ripening period till the third test (the germination rate increased from 42 to 66%). In case of ripe seeds the germination rate grew from 45% to 80%.

The unripe seeds of indian datura didn't germinate in either of the germination tests *(Figure 6)*. Its half-ripe and ripe seeds need longer after-ripening period than the other two species. During the 16 months long storage period the germination rate of the half-ripe seeds increased from 10% to 49% and the ripe seeds from 8% up to 93% and it haven't changed significantly during the further storage.

Effect of storage temperature and duration

It has been proved to be the main common characteristic, that the germination-ability of all the three species is rather low (maximum 40%) after harvesting and it increases the following period. In consequence of an after-ripening process, the germination ability has been already reached the characteristic ratio during the first 5–16 months of the storage. Usually the authors examining the effect of longer storage (e.g. *Jámbor*, 1960.) did not mention this first – very important – period, however others (e.g. *Bochenska* and *Holynska*, 1967; *Gupta* and *Madan*, 1972) count on the after-ripening. Consequently this period takes 2–8 months.

During further 5 years of storage at room temperature the stramony keeps its advantageous germination-ability *(Figure 7)*, there was no significant effect of cooled condition. According to these data we can corroborate the statement of *Heeger* (1956), that germination ability of stramony seeds after 6 years' storage period didn't decrease considerably.

In case of the other two species we found, that during storing at room temperature they kept the germination ability, but with relatively bigger fluctuation - germination rate of henbane varied from 82% to 41.33% *(Figure 8)*, and that of the indian datura from 96.66% to 74.66%.

Effect of vegetation year

Germination biological features could be modified by weather conditions of the given year. In our experiments the germination ability was effected by this conditions in case of two examined species. The germination ability of the freshly collected stramony seeds was lower from the year of 1994 and they needed longer after-ripening period *(Figure 9)* than the seeds from 1995.

In the case of henbane during the storage period the effect of vegetation year appeared in tendency of germination ability. The seeds from the year 1994 stored at room temperature didn't show after-ripening (germination rate varied 44% to 66%), while the germination rate of seeds stored under cooled conditions increased up to 86% by the time of the 4th test (*Figure 10/a* and *10/b*). The germination ability of the seeds collected in 1995 raised with 40% by the time of the 2nd test independently from the storage temperature. My results were contradictory with ascertainment of *Jámbor* (1960) whereas according to her the vegetation year influenced the level of germination rate but didn't influence the behavior of the henbane seeds during the storage period.

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