ARBORETUM KÓRNICKIE
ROCZNIK XXVII — 1982

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Thermal conditions for the presowing treatment of European elder (*Sambucus nigra* L.) and red elder (*S. racemosa* L.)*

INTRODUCTION

Both mentioned species of elder grow wild in Poland. European elder occurs in the whole country as a synantropic species growing on various waste lands such as rubbles, dumping grounds and untidy parks or old ruins etc. The natural range of red elder (*Sambucus racemosa* L.) covers southern Poland, Pomerania and the Mazury region and this species has slightly different site requirements than European elder. It can also be found in parks and forests, where it is introduced artificially in order to improve the biocenotic forest structure (Browicz and Zieliński 1973). It is suggested that both elder species play a considerable role in the biological management in post-industrial areas especially in dumps of coal, filling sand excavations, ash sediment traps of brown coal dumps (Greszta and Morawski 1972). Flowers and fruits of European elder are variously utilized in therapeutics providing diaphoretics and febrifungal drugs (Ożarowski 1976) as well as in fruit management (marmalades, wine pigments etc.).

Few data is available on the presowing treatment of European and red elder seeds. Rohmeder (1939) in his studies on germination of red elder indicated that early-autumn sowing of cleaned seeds in the ground or in pots is more advantageous than spring sowing of seeds that were not exposed to lower temperatures. Tyszkiewicz and Dąbrowska (1952) suggested that a high percent seedling emergence of both elder species could be obtained after autumn sowing to the ground of seeds early collected and after that dried for 1 - 2 months. Bärtels (1978) reported that good results could be obtained with the use of warm-followed-by-cold stratification including 2 months at 20 - - 30°C and 3 - 5 months at 4°C, however he does not cite any experimental data.

* This work was supported by grant MR II-7, from the Polish Academy of Sciences.

Hence attempts have been made in this study to determine the optimal controlled conditions for after-ripening and germination of seeds of European and red elder.

METHODS

Seeds of European and red elder have been used in this experiment. Ripe fruits of European elder were collected in September 24th 1977 in Kórnik, while those of the red elder in August 16th 1978 in a forest, located near Mieczewo village (Kórnik commune). After extraction, cleaning, getting rid of empty seeds in water and drying for 10 days at room temperature the full seeds were stored in tightly sealed bottles at −3°C.

Seeds stored till January 10 - 11th 1979 were used for the experiment. Warm-followed-by-cold (with and without a next warm period) stratification was applied while cold only stratification was used as control. The warm phase of stratification was performed at 4 different temperatures: 10°, 15°, 20° or 25°C lasting 3, 6 or 9 weeks, followed by the cold phase of stratification at 3°C. Each variant included 4 replicates (with 50 seeds in each).

After start of germination a part of the investigated seeds (2 replicates) was left at 3°C, while the remaining seeds were transferred to 15°C (second warm phase).

In order to prevent the loss of the very small seed during the checking observations that were performed weekly during the warm phases and every 2 weeks in the cold phase of stratification, as well as for aeration and replacing losses of water, the seeds were mixed with a small amount of the stratification medium (sand with peat, 1 : 1 by vol.) and were placed in a bag made of gauze. The bags were then placed in jars filled with a greater quantity of the stratification medium.

Seeds with radicles longer than one-half of the seed length were assumed as germinated. Germinated seeds were counted in the mentioned above control time-limits and then removed.

RESULTS

Water content in seeds of European elder that have been stored for approximately 16 months in tightly sealed bottles at −3°C was 8.5% (fresh weight basis). The 1000 seed weight of these seeds was 4.17 g. Water content in seeds of the red elder was 8.8% after storage over approximately 5 months in the same conditions and the 1000 seed weight was 2.84 g.

On Fig. 1 longitudinal and cross sections are shown through seeds of both elder species. They represent endospermic seeds with not fully developed embryos.

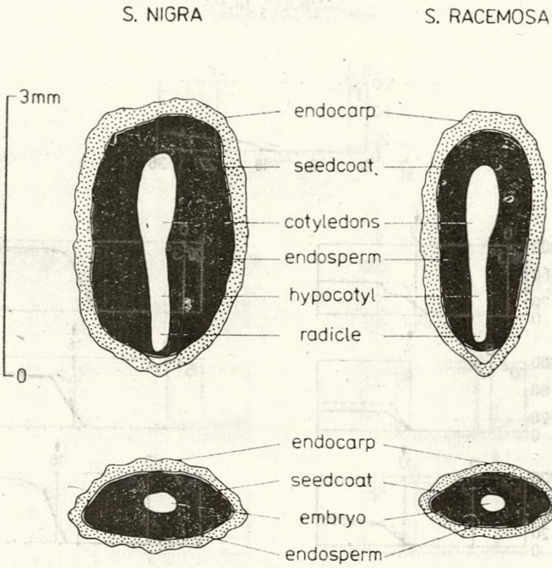

Fig. 1. Longitudinal and cross section of European (*Sambucus nigra* L.) and red elder (*Sambucus racemosa* L.) seed

The course of germination of European and red elder seeds is presented in Figs 2 and 3.

European elder (*Sambucus nigra* L.).

The start of germination was observed between the 16th and 17th week of cold only control stratification at 3°C (Fig. 2). Germinative capacity was low (24%). Following the elevation of temperature from 3° to 15°C after 26 weeks, germinative capacity remained almost unchanged (26%). The extent of the germination period was 15 weeks in both variants.

When temperature of 10°C was used in the first phase of stratification, germinative capacity increased in comparison with control and was 29 - 47% at 3°C and 31 - 45% at 15°C in the last phase of seed treatment.

The use of temperatures of 15°, 20° and 25°C during the first warm phase of the warm-followed-by-cold stratification has caused an increase of germinative capacity in the cold phase up to 73 - 92%. On the other hand, during the warm-followed-by-cold stratification with a second warm phase at 15°C germinative capacity was 68 - 90%, depending on the duration of the first warm pahse. The extent of the germination period ranged between 6 and 7 weeks at a temperature of 3°C, while at 15°C it was reduced to 3 weeks. The start of germination occurred between the 14th and 16th week of stratification at 3°C, regardless to the duration of the initial warm phase.

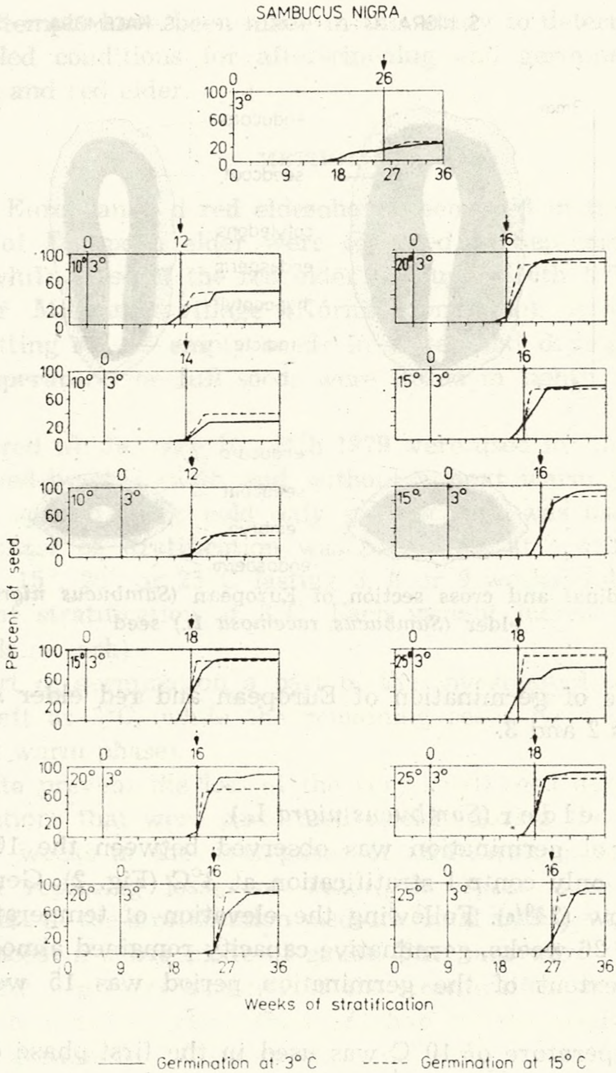

Fig. 2. Course of germination of European elder (*Sambucus nigra* L.) seeds during stratification in various thermal conditions. Arrow indicates time when part of seed transfered to 15°C

R e d e l d e r (*Sambucus racemosa* L.)

The start of germination of red elder seeds was observed in the 15th week of cold stratification at 3°C (Fig. 3). Seed germination proceeded very slowly and after 33 weks of stratification only 23% of seeds were germinated. The elevation of temperature to 15°C after 26 weeks of stratification at 3°C had no effect on germinative capacity (26%).

The warm-followed-by-cold stratification with 10°C during the warm phase was again without any effect on germinative capacity. Only when temperatures of 15°, 20° or 25°C have been used an increase of germi-

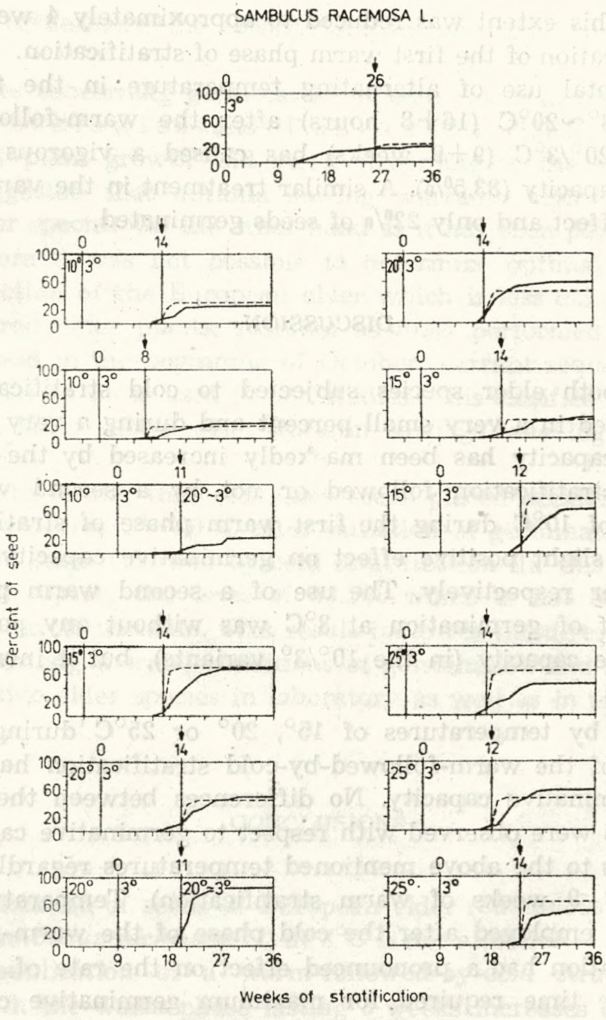

Fig. 3. Course of germination of red elder (*Sambucus racemosa* L.) seeds during stratification in various thermal conditions. Black arrow indicates time when part of seed transferred to 15°C. Black arrow with × indicates onset of time when temperature brought to 3°∼20°C (16+8 hours)

native capacity to 46 - 68% was observed (with the exception of the variant with 15°C lasting 6 weeks — germinative capacity 30%). The use of a second warm phase (15°C) after the initiation of germination at 3°C, has caused a germination of seeds on a 44 - 79% level.

Red elder seeds started to germinate between the 10th and 13th week of stratification at 3°C, regardless of the type of stratification. The extent of the germination period at this temperature was approximately 12 weeks. After elevation of temperature to 15°C following initiation of germination, this extent was reduced to approximately 4 weeks, regardless of the duration of the first warm phase of stratification.

An accidental use of alternating temperature in the twenty four hours cycle 3°~20°C (16+8 hours) after the warm-followed-by-cold stratification 20°/3°C (9+9 weeks) has caused a vigorous increase of germinative capacity (83.5%). A similar treatment in the variant 10°/3°C had no such effect and only 22% of seeds germinated.

DISCUSSION

Seeds of both elder species subjected to cold stratification at 3°C only germinated in a very small percent and during a very long period. Germinative capacity has been markedly increased by the warm-followed-by-cold stratification followed or not by a second warm phase. Temperature of 10°C during the first warm phase of stratification had no or only a slight positive effect on germinative capacity of red and European elder respectively. The use of a second warm phase (15°C) after the start of germination at 3°C was without any positive effect on germinative capacity (in the 10°/3° variants), but it increased speed of germination.

Treatment by temperatures of 15°, 20° or 25°C during the initial warm phase of the warm-followed-by-cold stratification had a positive effect on germinative capacity. No differences between the two investigated species were observed with respect to germinative capacity, after exposing seeds to the above mentioned temperatures regardless of exposition time (3 - 9 weeks of warm stratification). Temperature of 15°C that has been employed after the cold phase of the warm-followed-by--cold stratification had a pronounced effect on the rate of germination. Generally, the time required for maximum germinative capacity was reduced from 6 - 7 to 3 weeks in the case of European elder and from 12 to 4 weeks in the case of the red elder. The initial warm phase of stratification in the warm-followed-by-cold system increased the level of germinative capacity, however it was without any effect on the duration of the cold phase that is required for initiation of germination. Hence, it could be suggested, that after a warm phase the process of after ripening is initiated in much more seeds during the cold phase of stratification than during the cold stratification. This could presumably be the consequence of a more intensive growth of the not fully developed embryos (Fig. 1) provoked by the treatment with 15 - 25°C for at least 3 weeks. Bärtels (1978) suggests that a warm phase of the warm-followed-by--cold stratification should run 2 months at temperatures between 20° and 30°C. According to our results this period could be reduced to 3 weeks without any negative effect to the level of germinative capacity of seeds. Furthermore the lowest temperature limit could be reduced to 15°C.

In studies concerning germination of both elders in uncontrolled conditions Tyszkiewicz and Dąbrowska (1953) indicated great variation of plant growth and yield. According to the above studies it can be suggested that autumn sowing warrants high yield of plants of both elder species. On the other hand as it has been pointed out by the above authors it was not possible to determine optimal conditions for plant production of the European elder which is less effective than production of red elder plants. Autumn sowings performed at the end of September and in the beginning of October warrant sequence of temperatures similar to those used in our studies. This clarifies to some degree why the yield of plants after autumn sowings was higher than after spring sowing.

It is worth noting that red elder seeds placed accidentally in alternating temperatures 3°~20°C after initiation of germination in the cold phase of the warm-followed-by-cold stratification. In this case germination reached rapidly the level of 83.5% which is not observed in the remaining thermal variants. This result indicates the direction of further studies concerning thermal conditions of germination and seedling emergence of native elder species in laboratory as well as in field conditions.

CONCLUSIONS

1. Stratification of seeds of European elder (*Sambucus nigra* L.) and red elder (*Sambucus racemosa* L.) at 3°C is not effective.

2. The application of a warm-followed-by-cold stratification 15 - - 25°/3°C with the warm phase lasting 3 weeks increases effectively the germinative capacity. Seeds of European elder start to germinate in the 15th week of the cold phase while those of red elder in the 12th week of this phase.

3. An extention of the warm phase of stratification from 3 to 9 weeks does not influence the level of germinative capacity and the course of germination.

4. Elevation of temperature to 15°C after initiation of germination in the cold phase of the warm-followed-by-cold stratification shortens the extent of the germination period of the European and red elder from 7 to 3 weeks and from 12 to 4 weeks respectively.

5. Seeds of the red elder placed accidentally at alternating temperature (3°~20°C in a 24-hours cycle, 16+8 hrs) after a warm-followed-by-cold stratification germinated energetically and at a very high percent (83.5%).

SUMMARY

A high germinative capacity of seeds of European elder (*Sambucus nigra* L.) and red elder (*S. racemosa* L.) was obtained following a warm-followed-by-cold stratification 15 - 25°/3°C with a 3-week warm phase. Seeds of the European elder start germinating in the 15th week and those of the red elder in the 12th week of the cold phase. Raising the temperature to 15°C after germination begins in the cold phase of the warm-followed-by-cold stratification, reduced the extent of the germination period of European elder seeds from 7 to 3 weeks and that of red elder seeds from 12 to 4 weeks, compared to the extent of germination period obtained when the seeds are maintained at 3°C.

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LITERATURE

1. Bärtels A., 1978. Gehölzvermehrung. Verlag Eugen Ulmer, Stuttgart.
2. Browicz K., Zieliński J., 1973. Atlas rozmieszczenia drzew i krzewów w Polsce. Zeszyt 13. PAN, Zakład Dendrologii i Arboretum Kórnickie. Warszawa--Poznań.
3. Greszta J., Morawski S., 1972. Rekultywacja nieużytków poprzemysłowych. PWRiL Warszawa.
4. Ożarowski A., 1976. Ziołolecznictwo. PZWL Warszawa.
5. Rohmeder E., 1939. Die Keimung des Hirschholunders (*Sambucus racemosa*). Forstwiss. Centralbl. 61: 505 - 511.
6. Tyszkiewicz S., Dąbrowska J., 1953. Stratyfikacja nasion drzew i krzewów leśnych. Roczniki Nauk Leśnych, tom 1: 170 - 173. PWRiL Warszawa.

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Warunki cieplne przysposabiania do kiełkowania nasion bzu czarnego (Sambucus nigra L.) i bzu koralowego (S. racemosa L.).

Streszczenie

Wysoką zdolność kiełkowania spoczynkowych nasion bzu czarnego (*Sambucus nigra* L.) i bzu koralowego (*S. racemosa* L.) zapewnia stratyfikacja ciepło-chłodna 15 - 25°/3°C z trzytygodniowym okresem fazy ciepłej. Nasiona bzu czarnego zaczynają kiełkować w 15 tygodniu, a bzu koralowego w 12 tygodniu fazy chłodnej. Podwyższenie temperatury do 15°C po zapoczątkowaniu kiełkowania nasion w chłodnej fazie stratyfikacji ciepło-chłodnej skraca rozpiętość okresu kiełkowania nasion bzu koralowego z 12 do 4 tygodni, a nasion bzu czarnego z 7 do 3 tygodni w porównaniu z rozpiętością tego okresu w 3°C.

ТАДЕУШ ТЫЛЬКОВСКИ

Термические условия подготовки к прорастанию семян бузины черной (Sambucus nigra L.) и бузины красной (S. racemosa L.)

Резюме

Хорошую способность прорастания покоющихся семян бузины черной (*Sambucus nigra* L.) и бузины красной (*S. racemosa* L.) обеспечивает тёпло-холодная стратификация при 15 - 25°/3°C с трехнедельными теплым периодом. Семена бузины черной начинают прорастать на 15 неделе, а бузины красной на 12 неделе холодного периода. Повышение температуры до 15°C после начала прорастания семян в холодном периоде тёпло-холодной стратификации сокращает продолжительность прорастания семян бузины красной с 12 до 4 недель, а семян бузины черной с 7 до 3 недель по сравнению с продолжительностью этого периода при 3°C.

A high germination capacity [illegible] *nigra* L.) and red elder (*S. racemosa* L.) [illegible] warm-followed-by-cold stratification 15 - 25°/3°C with a 3-week warm phase. Seeds of the European elder start germinating in the 15th week and those of the red elder in the 12th week of the cold phase. Raising the temperature to 15°C after germination begins in the cold phase of the warm-followed-by-cold stratification reduces the [illegible] [illegible] red elder seeds from 12 to 4 weeks, and [illegible] [illegible] period compared with the seeds are maintained at 3°C.

[illegible] Kórnik, Poland

LITERATURE

1. Bärtels A., 1978. Gehölzvermehrung. Verlag Eugen Ulmer, Stuttgart.
2. Browicz K., Zieliński J., 1973. Atlas rozmieszczenia drzew i krzewów w Polsce. Zeszyt 13. PAN, Zakład Dendrologii i Arboretum Kórnickie. Warszawa-Poznań.
3. Greszta J., Morawski S., 1972. Rekultywacja nieużytków [illegible] wych. PWRiL, Warszawa.
4. Ożarowski A., 1978. Ziołolecznictwo. PZWL Warszawa.
5. Rohmeder E., 1939. Die Keimung des Hirschholunders (*Sambucus racemosa* [illegible]). Forstwiss. Centralbl. 61: 505 - 511.
6. Tyszkiewicz S., Dąbrowska J., 1952. Stratyfikacja nasion drzew i krzewów leśnych. Roczniki Nauk Leśnych, tom 1: 170 - 173. PWRiL Warszawa.

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