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Short–term storage of after–ripened seeds of *Acer platanoides* L. and *A. pseudoplatanus* L.

Abstract

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Freshly collected samaras of sycamore maple and short–term stored after collection samaras of Norway maple were stratified without any medium at 3°C. During stratification moisture content (m.c.) of samaras was kept at 55% and 65% (fresh weight basis for both species). When germination started, the samaras were dried at room temperature to different m.c. levels (sycamore maple 30%, Norway maple 10% and 15%) to be stored afterwards in sealed bottles. After 12 weeks of such storage at −3°C sycamore seeds germinated at 3°C or at an alternating temperature 3° ~ 20°C (16 + 8 hours/day) similarily high – about 90%. Seeds of Norway maple stored for 16 weeks at 3°C or −3° germinated at 3° above 95% for both levels of m.c. during stratification. At the alternating temperature germinability was much lower, by about 20%.

Additional key words: dormancy, germination, alternating temperature, naked stratification.

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INTRODUCTION

Samaras of Norway maple (*Acer platanoides* L.) and sycamore maple (*A. pseudoplatanus* L.) mature in the autumn and shortly afterwards fall to the ground. In natural conditions, when the temperature and moisture conditions, are favourable, the seeds germinate en masse in early spring, sometimes even already under the snow.

In nursery practice seeds of both species are sown into the ground in the autumn, immediately after colletion or after a short storage period (Tyszkiewicz 1949). It may happen, particularily during severe and snowless winters that the sown seeds will become damaged by very low temperatures, or else the period of appropriate temperature for dormancy breaking will be too short before the onset of warm spring temperatures. Then the seeds stay in the ground until next year. The range of temperatures favourable for dormancy breaking in seeds of both species lies between 0° and 10°C (Nikolaeva 1967, Nikolaeva et al. 1985).

Seeds of Norway and sycamore maple can also be sown in the spring after stratification period lasting 1.5-3 months. Before starting this treatment the period of time needed for the after–ripening of seeds of a given population is not known, thus it is difficult to determine beforehand what the exact sowing date will be. It appeared of interest therefore to undertake investigations on the possibility of inhibiting the germination process in those seeds in which dormancy has already been broken. In order to reduce the amount of work associated with the aeration of seeds during stratification and to reduce to a minimum the volume of the stratification medium, an attempt was made to stratify the maple seeds without medium but maintaining a controlled level of moisture content in the samaras, similarily as it was done for the seeds of beech by Suszka (1980) and Muller (1986).

MATERIALS AND METHODS

ACER PSEUDOPLATANUS

Seeds left in intact samaras were moistened soon after collection from a single tree to two moisture levels (55% and 65%) basing on the knowledge about the dry weight content and initial moisture level determined by drying 3 samples of 30 Samaras each at 105°C for 24 hrs. The initial moisture content of the samaras was 36.5%. The samaras themselves were placed in plastic boxes (20 × 26 × 7 cm) at a temperature of 3°C and were moistened with tap water until they attained the calculated mass, corresponding to the required moisture level. The water was added in lots over several days, so that it would not remain at the bottom of the boxes. The boxes were then covered with a perforated lid having 4 ventilation openings each 2 mm in diameter. During stratification without medium the losses in water content were replaced once weekly for 8 weeks, till first germinating seeds appeared. Then watering was discontinued, a part of the samaras was subjected to a germination test (3 replicates 25 samaras each) in a sand/peat (1:1 vol.) mixture at a temperature of 3°C or at a cyclically variable temperature of 3° ~20°C (16+8 hrs/day), and the remaining samaras were partially dried at room temperature to a moisture level of about 30%. Immediately after partial drying they were subjected to a germination test as above or placed in bottles and sealed for storage over 12 weeks at –3°C. After storage the seeds were subjected to a germination test in the same thermal conditions as above.

ACER PLATANOIDES

Samaras were collected from one tree in Poznań on Sept. 8th 1987. After partial drying of the whole samaras at room temperature to 8.5% of moisture content (the initial moisture content was 56.8%) they were stored at –3°C in sealed bottles till Nov. 25th 1987.

After storage the samaras were moistened at 3°C to two levels (55% and 65%)

in plastic boxes covered with perforated lids (similarily as for sycamore). Water losses were replaced weekly. When first germinating seeds started to appear the moistening of the seeds at 3°C was discontinued. A part of the seeds was subjected to a germination test at 3°C or at 3°~20°C (16+8 hrs/day, in 4 replicates each with 50 seeds) and the remaining seeds were partially dried at room temperature in a stream of air from a ventilator to two levels of moisture content about 15% and 10%. Immediately after partial drying a part of the seeds dried to each of the moisture levels was subjected to a germination test at 3°C and 3°~20°C and the rest was stored in sealed bottles at a temperature of 3°C or −3°C for 4, 8, 12 and 16 weeks. After each storage period the germinability was tested at 3°C and 3°~20°C.

In both experiments on stratification of seeds of sycamore and Norway maple without medium at a controlled moisture level for comparative purposes the samaras were also stratified at 3°C in a moist mixture of sand and peat (1:1 vol.) in order to determine their germinability in these conditions also.

RESULTS

ACER PSEUDOPLATANUS

Seeds stratified at 3°C for 8 weeks in moist medium (sand and peat) and subjected later to a germination test in a daily alternating temperature (3°~20°C) germinated 84% within 8 weeks of the test. During germination at 3°C, 89% of the seeds germinated. The course of germination was very similar in both temperature systems with a tendency for a somewhat more energetic germination under the daily alternating temperature conditions.

Germinability of seeds stratified without medium, moistened with the whole samaras to 55% and 65% of moisture content was comparable or even somewhat better than when stratified in a medium (tab. 1).

Partial drying of the seeds to about 30% of moisture content after first germinating seeds started to appear as observed during control moistening (after

Table 1

Germinative capacity (in %) of sycamore (*Acer pseudoplatanus* L.) seeds during germination tests conducted: A – after stratification of whole samaras without medium at two moisture content leves (55% and 65%), B – after stratification and partial drying to 30% of moisture content and C – after stratification, partial drying and storage of samaras for 12 weeks at – 3°C

Temperature of germination test °C	Moisture content during stratification					
	55%			65%		
	A	B	C	A	B	C
3°	89.3	93.3	96.0	89.3	93.3	74.7
3°~20°	90.7	92.0	85.3	97.3	86.7	90.6

8 weeks at 3°C) did not results in a lowering of their germinability. Even after storage of so dehydrated samaras for 12 weeks the germinative capacity was maintained unchanged at a level of about 90%. In all experimental variants the majority of the seeds germinated between the 4th and 8th week of the germination test, regardless of the temperature conditions (at 3°C or 3°~20°C).

ACER PLATANOIDES

The samaras stratified at 3°C in a moist mixture of sand and peat germinated at that temperature 100%. When the germination test was performed at the daily alternating temperature 3°~20°C after the first seeds started germinating at 3°C, the germinative capacity dropped to 35.5% (tab. 2), of the non-germinating seeds 55% remained healthy after termination of the stratification test lasting 12 weeks. The remaining 9.5% of seeds were empty or decayed.

Moistening of samaras during stratification without medium to a level of 55% or 65% at a temperature of 3°C practically did not influence the ability of the seeds to germinate during a germination test at 3°C compared to those which were stratified in a medium and were held for germination in the same temperature. The germinability of the seeds at 3°C after stratification without medium varied between 95.0 and 97.5%. After use of a daily alternating temperature 3°~20°C the germination capacity declined by 30% and amounted to 62–67% (tab. 2).

Partial drying of the samaras after first germinating seeds appeared (after 60 days) during stratification without medium to two moisture levels of about 10% or 15% did not lower the germinability when the germination test was performed at 3°C immediately after partial drying. They germinated 98.5-100%. When the germination test was performed at the daily alternating temperature 3°~20°C the germinative capacity declined substantially in the case of samaras moistened during stratification without medium to the higher level of moisture content 65%. The partial drying of the samaras to 15% and 10 % led to a germination level of the seeds 53.0% and 76.5% respectively. Such a decline in the germination level was not observed when the stratified samaras were moistened to a 55% moisture content, since in the germination test at the alternating

Table 2

Germinative capacity (in %) of Norway maple (*Acer platanoides* L.) seeds stratified at 3°C in a medium or without it at two moisture content levels (55% and 65%), subjected after stratification (A) or after drying to 10 % (B) or to 15 % (C) to a germination test at 3°C or 3°~20°C

Temperature of germination test	Stratification in medium	Moisture content during stratification without medium					
		55%			65%		
		A	B	C	A	B	C
3°	100.0	95.0	100.0	98.5	97.5	100.0	99.0
3°~20°	35.5	67.0	83.0	93.0	62.0	76.5	53.0

Table 3

Germination capacity (in %) of Norway maple (*Acer platanoides* L.) hydrated during stratification without medium to 55 % or 65 % of m. c. in whole samaras till the appearance of first germinating seeds and then partially dried to 10% or 15 % of m. c. and stored in sealed bottles for 4-16 weeks at 3°C or −3°C. After storage germination tests were performed at3°C or 3°~20°C (16+8 hours/day)

Moisture content during stratification	Moisture content after drying	Storage temperature	Storage (weeks)							
			4		8		12		16	
			Temperature of germination tests							
			3°	3°~20°	3°	3°~20°	3°	3°~20°	3°	3°~20°
55 %	10 %	3°	100.0	80.5	97.0	79.0	98.5	75.5	98.0	66.0
		-3°	97.0	85.0	96.0	84.0	96.0	85.0	95.5	75.5
	15 %	3°	99.0	81.0	98.0	75.5	96.0	70.5	96.0	75.5
		-3°	99.0	92.5	96.0	79.5	96.5	78.0	97.5	83.0
65 %	10 %	3°	95.5	81.0	98.5	86.5	96.5	74.5	96.0	82.0
		-3°	99.0	82.5	98.0	80.0	98.5	69.0	94.5	76.0
	15 %	3°	96.5	72.0	98.5	66.0	94.5	72.5	96.0	76.5
		-3°	96.5	73.0	97.0	64.5	98.5	71.5	98.0	74.0
Mean			97.8	80.9	97.4	76.4	96.9	74.6	96.4	76.0

temperature 93.0% seeds germinated when partially dried to 15% and 83.0% when partially dried to 10% (tab. 2).

The storage of stratified without medium and partially dried seeds for 4, 8, 12 and 16 weeks in sealed bottles at a temperature of 3°C or –3°C also did not differentiate the germinative capacity of the seeds subjected after storage to a germination test at 3°C. The germinative capacity was maintained at a very high level of 94.5% to 100% regardless of the moisture level of the samaras both during and after stratification without medium and regardless of the temperature regime during stratification and storage. The use of the daily alternating temperature for the germination test acted unfavourably on the germinability of the seeds stored partially dried after stratification. Except for one instance where the seeds germinated 92.5% the germination level varied from 64.0% to 86.5% (tab. 3).

DISCUSSION

On the basis of the experiments performed on the stratification of Norway and sycamore maple samaras without medium it can be said that the method is as successful as stratification in a medium. The advantage of stratification without medium is the easy method of controlling moisture (on the basis of calculated weight) which can vary in a relative wide range from 55% to 65%. It was found that at both these moisture levels the after-ripening of the seeds runs similarily as during stratification in a medium. Using a stratification without medium it is possible to significantly reduce the volume of stratification material restricting oneself only to the samaras.

Storage of partially dried samaras after termination of seed dormancy during

stratification without medium is similarily successful as the freezing of the seeds together with the stratification medium as described by Suszka (1987). In the case of freezing seeds it is necessary however to have available a chamber with a negative temperature of –3°C. Using partially dehydrated samaras of sycamore to about 30% and of Norway maple to 10-15% moisture content and a temperature of 3°C (as satisfactory as −3°C) it is sufficient to maintain full germinative capacity during a storage period of up to a dosen weeks or so. This period is fully sufficient to be able to choose an optimal period for spring sowing of the seeds the dormancy of which has already been overcome.

The results obtained indicate that the seeds of the two species of maple respond differently to a daily alternating temperature 3°∼20°C after stratification. Sycamore seeds germinated in these thermal conditions at the same level as at 3°C, while seeds of Norway maple at a level about 20% lower. This indicates that a postponement of the spring sowing of stratified Norway maple seeds may lead to a lowering of their germination since an early warming up of the ground may induce a secondary dormancy in some seeds.

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Krótkoterminowe przechowywanie skrzydlaków *Acer platanoides* L. i *A.pseudoplatanus* L. stratyfikowanych uprzednio bez podłoża

Streszczenie

Świeżo zebrane skrzydlaki jaworu oraz krótko przechowywane po zbiorze skrzydlaki klonu zwyczajnego poddano stratyfikacji bez podłoża w 3°C. Podczas stratyfikacji wilgotność skrzydlaków obu gatunków obliczaną na podstawie suchej masy utrzymywano na poziomie 55% i 65%. Po pojawieniu się pierwszych nasion kiełkujących, skrzydlaki podsuszono w temperaturze pokojowej do różnej wilgotności: jaworu do około 30%, a klonu zwyczajnego do około 10% i 15% i przechowywano w szczelnie zamkniętych butelkach. Po 12 tygodniach takiego przechowywania w −3°C nasiona jaworu skiełkowały w próbie kiełkowania w 3°C lub 3°∼20°C (16+8 godz./dobę) w bardzo wysokim

procencie (ponad 95%). Nasiona klonu zwyczajnego podsuszone po stratyfikacji bez podłoża i przechowywane przez 16 tygodni w 3°C lub –3°C skiełkowały w próbie kiełkowania w 3°C na poziomie ponad 90%, niezależnie od wilgotności skrzydlaków podczas stratyfikacji. W temperaturze cyklicznie zmiennej 3°~20°C zdolność kiełkowania nasion była średnio o 20% niższa.

Кратковременное хранение крылаток *Acer platanoides* L. и *A. pseudoplatanus* L. предварительно стратифицированных без субстрата*

Резюме

Свежесобранные крылатки явора, а также коротко хранимые после сбора крылатки клена остролистного, стратифицировали без субстрата в 3°C. Во время стратификации влажность крылаток обоих видов, высчитанную на основании сухой массы, поддерживали в границах 55% и 65%. После появления первых проросших семян крылатки подсушили в комнатной температуре до разной влажности, явора до около 30%, а клена остролистного до около 10% и 15% и хранили в герметически закрытых бутылках. После 12 недель такого хранения в –3°C семена явора проросли в пробе прорастания в 3°C или 3°~20°C (16+8 час/сутки) в очень высоком проценте (около 90 %). Семена клена остролистного, подсушенные после стратификации без субстрата и хранящиеся в течение 16 недель в 3°C или –3°C , проросли в пробе прорастания в 3°C в пределах около 95% независимо от влажности крылаток во время стратификации. В циклически изменяемой температуре 3°~20°C способность прорастания семян в среднем ниже на 20%.

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