IMPROVEMENT OF AFTER-RIPENING AND GERMINATION OF APPLE AND PEAR SEEDS
PĒCBRIEDES UN DĪGTSPĒJAS UZLABOŠANA ĀBEĻU UN BUMBIERU SĒKLĀM

Pitera E. and Odziemkowski S.
Department of Pomology and Basic Natural Sciences in Horticulture Warsaw Agricultural University – SGGW, Nowoursynowska 159, 02-776 Warsaw, Poland.

Kopsavilkums

Pētījuma mērķis bija novērtēt sējeņu audzēšanas jauno metodi, kura izveidota Varšavas Lauksaimniecības Universitātē. Šķirņu 'Golden Delicious', 'Ligol' un 'Melrose' krustojumu āboli tika ievākti oktobrī un glabāti 2-3°C līdz februārim. Tad sēklas izdalītas no āboliem un iesētas kastēs ar mitru sfagnu sūnu substrātu, kurš bagātināts ar barības vielām. Šīs kastes novietotas 2-3°C temperatūrā uz 59 dienām un tad pārvietotas uz neapkurināmu plēves seguma siltumnīcu. Dīgšanas spars izvērtēts kā vidējais dienu skaits, kurš nepieciešamas līdz dīgļlapu izdīgšanai. Līdzīgi pētījumi tika veikti arī ar bumbieriem, kuru sēklas tika iegūtas no četriem *Pyrus communis* L. un *Pyrus pyrifolia* Nakai šķirņu krustojumiem. Ābelēm 86.7-97.1% sēklu sadīga vidēji 2.5 - 4.2 dienās. Metode atzīta par piemērotu.

Abstract

The aim of this study was to assess the suitability of a new method of after-ripening of apple seeds, developed at the Warsaw Agricultural University, for raising seedlings in a breeding process. Apples of 'Golden Delicious', 'Ligol' and 'Melrose'**,** obtained from twelve different cross combinations, were harvested in October and stored at 2-3°C till February. Then seeds were removed from fruits and sown individually in trays filled with moist sphagnum peat, enriched with nutrients. Trays were placed in cold storage at 2-3°C for 59 days and then transferred to an unheated plastic tunnel. Germination was recorded daily and germination rate expressed as an average number of days required for emergence of cotyledons. A similar treatment was applied to pear seeds obtained from four interspecific cross combinations, involving cultivars belonging to *Pyrus communis* L. and to *Pyrus pyrifolia* Nakai. In total, 2880 apple and 960 pear seeds were investigated. Percentage of germinating apple and pear seeds was high (86.7-97.1%). Seeds germinated very fast, within 2.5-4.2 days. The presented method is easy to apply, does not require drying of seeds and provides a high output of seedlings in a short time after stratification.

Keywords: apple cultivars, breeding, pear hybrids, after-ripening, stratification, seed germination

Introduction

Seeds of woody plants are often heterogeneous in respect to the length of dormancy period (Nielsen, 1988). Suszka (1989) found that for germination of undried seeds of crab apple (*Malus sylvestris* Mill.) a 14-week stratification at 3°C was needed while for dried seeds – 15 weeks. When stratification at 3°C was continued, more than 90% germinated within 6 weeks. Czynczyk *et al*. (1974) showed that length of dormancy of 'Antonovka' seeds differed between years; from 70 to 86 days were needed for the stratification of dry seeds for starting germination. Considerable differences in the length of the seed dormancy period present a problem in production of seedlings. Conventionally stratified seeds sown outdoors do not overcome dormancy completely. High temperature and dry soil can induce the secondary dormancy of such seeds (Kamiński and Zagaja, 1974). To prevent this undesirable phenomenon, in some apple breeding programmes seeds are inspected during stratification. The germinating ones are sown on trays in a greenhouse (Blažek, 2000). Modifications of stratification treatment of seeds were also applied (Tylkowski, 1978; Lateur *et al*., 2000).

A new method of after-ripening of apple seeds, adapted to the production of seedlings in an unheated plastic tunnel, has been developed at the Department of Pomology and Basic Natural Sciences of the WAU (Pitera, 2003; Pitera *et al*., 2004). The main advantage of this method, in comparison to the conventional stratification, is that practically all the seeds overcome dormancy. It is very easy to apply, does not require the drying of the seeds and allows to obtain a high percentage of

seedlings in a short time after stratification. The aim of the experiment, conducted in the years 2004 and 2005 was to assess the suitability of this method for raising apple and pear seedlings in a breeding programme. Pear seeds obtained from interspecific crosses of cultivars (*P. communis* and *P. pyrifolia*) have never been investigated in Poland.

Materials and Methods

Apples of 'Golden Delicious', 'Ligol' and 'Melrose', obtained from 12 different cross combinations, were harvested on October 7, 2004 and stored at 2°C till February 14, 2005 (Table 1). Then the seeds were removed from the fruits and individually sown in trays filled with moist sphagnum peat enriched with nutrients. Trays were placed in cold storage at 2-3°C, for 59 days (till April 14, 2005). A similar stratification treatment was applied to pear seeds. It differed only in the harvest date and length of fruit storage. Fruits were obtained from 4 interspecific cross combinations between 'Conference' (*Pyrus communis*) and 'Chojuro', 'Hosui' and 'Shinseiki' Asian pears (*Pyrus pyrifolia*) – Table 2. Fruits were harvested on September 14 ('Chojuro'), and September 22, 2004 ('Conference'). Seeds were stratified for 59 days in the same way as apple seeds. The length of stratification of seeds in cold storage was established according to previous experiments (Pitera *et al*., 2004).

All trays with apple and pear seeds were transferred on April 15 from cold storage to an unheated plastic tunnel. The stratification treatment consisted of 4 replications, each of 60 seeds. The total 2880 seeds of apple and 960 pear seeds were investigated. The germination of seeds was recorded when cotyledons emerged above the substrate and the germination rate were expressed as an average number of days required for germination of a seed. The germinating seeds were recorded daily. The results were elaborated by analysis of variance. The significance of differences between treatment means was evaluated using the Newman-Keuls test, at α=0.05.

Results and Discussion

The results, presented in Table 1 and 2, show a high or very high percentage of germinated apple and pear seeds, ranging from 86.7% ('Melrose' × 'Gala') to 97.1% ('Ligol' × U 6407). Out of nine pollinators used for 'Melrose', only 'Gala' resulted in a significantly lower (by 9.3%) germination of 'Melrose' seeds, in comparison to the 'Melrose' seeds obtained from pollination with 'Sawa'.

The cumulative germination percentage of pear seeds obtained from four interspecific cross combinations was high ranging from 90.7 to 93.1% (Table 1).

Table 1. Percentage of apple seeds germinated in an unheated plastic tunnel – after extraction from fruits stored at 2 -3°C and stratification in trays for 59 days at 2 -3°C

Cross combinations	Seed number	Germinated seeds, %	Germination rate, No. of days	**Harvest date**
Golden Delicious × U 6407	240	96.3 b[1]	4.2 c	Oct. 7, 2004
Ligol × U 6407	240	97.1 b	3.8 bc	Oct. 7, 2004
Ligol × U 641	240	96.7 b	4.0 c	Oct. 7, 2004
Melrose × Gala	240	86.7 a	4.0 c	Oct. 7, 2004
Melrose × Gala Must	240	87.9 ab	4.0 c	Oct. 7, 2004
Melrose × Idared	240	94.6 ab	2.7 a	Oct. 7, 2004
Melrose × McIntosh	240	90.0 ab	2.6 a	Oct. 7, 2004
Melrose × Rajka	240	87.9 ab	3.3 b	Oct. 7, 2004
Melrose × Rubin	240	93.8 ab	3.2 b	Oct. 7, 2004
Melrose × Sawa	240	96.0 b	3.3 b	Oct. 7, 2004
Melrose × U 641	240	93.8 ab	2.6 a	Oct. 7, 2004
Melrose × U 7156	240	90.7 ab	4.0 c	Oct. 7, 2004

[1] Mean separation by Newman-Keuls test, at α=0.05.

The percentage of germination of 'Conference' (*P. communis*) seeds was not influenced by Asian pear (*P. pyrifolia*): cultivars 'Chojuro', 'Hosui' and 'Shinseiki', used as pollinators. Germination

percentage of seeds of Asian pear 'Chojuro' pollinated by 'Conference' was very similar to that of seeds of 'Conference' pollinated by Asian pear cultivars.

Table 2. Percentage of germinated pear seeds in an unheated plastic tunnel – after extraction from fruits stored at 2 -3°C and stratification in trays for 59 days at 2-3°C

Cross combinations	Seeds number	Germinated seeds (%)	Germination rate (No. of days)	**Harvest date**
Chojuro × Conference	240	91.3 a[1]	2.5 a	Sep. 14, 2004
Conference × Chojuro	240	91.8 a	2.9 ab	Sep. 22, 2004
Conference × Shineseiki	174	90.7 a	2.7 a	Sep. 22, 2004
Conference × Hosui	240	93.1 a	3.2 b	Sep. 22, 2004

[1] For explanations see table 1

Apple and pear seeds germinated fast after transfer from cold storage to the unheated plastic tunnel (Fig. 1 and 2). Average day & night temperatures during first six days after sowing ranged from 14 to 18°C. Germination rate was low (2.5-4.2 days) and influenced by some pollinators (Table 1 and 2).

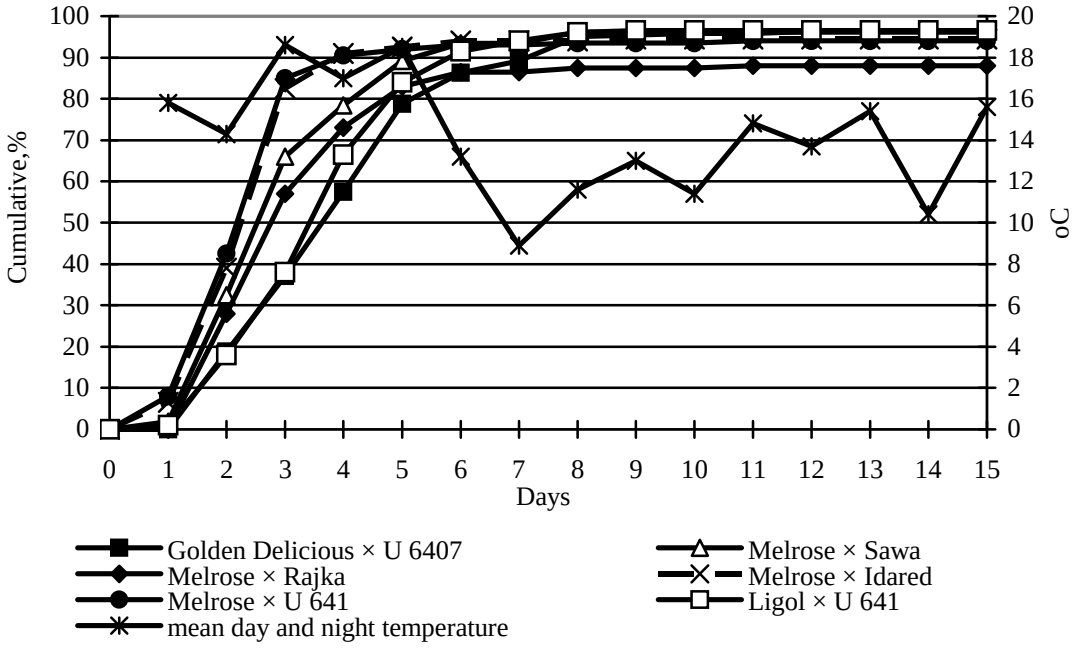

Figure 1. Cumulative seed germination of selected apple progenies

The percentage of germination of seeds of 12 apple and 4 pear progenies (from interspecific crosses) was high and very high. The new method of after-ripening has proved to be useful in conventional apple and pear breeding. It can be also used in the production of rootstocks (Odziemkowski *et al*., 2004). The main advantage of this method, in comparison to the conventional one, is that practically all seeds overcome dormancy. This was possible because seeds were stratified after individual sowing in trays filled with moist sphagnum peat. The proper length of stratification must ensure the breaking of the dormancy of all seeds. In the course of stratification at 2-3°C, seeds with short dormancy germinated in the tray below the surface of the medium (Tylkowski, 1978; Pitera *et al*., 2004). In our

experiment 59 days of stratification was enough for breaking the dormancy of most seeds, because after transferring them to the plastic tunnel they germinated in a short time. The temperature in the plastic tunnel was relatively high (Figure 1 and 2).

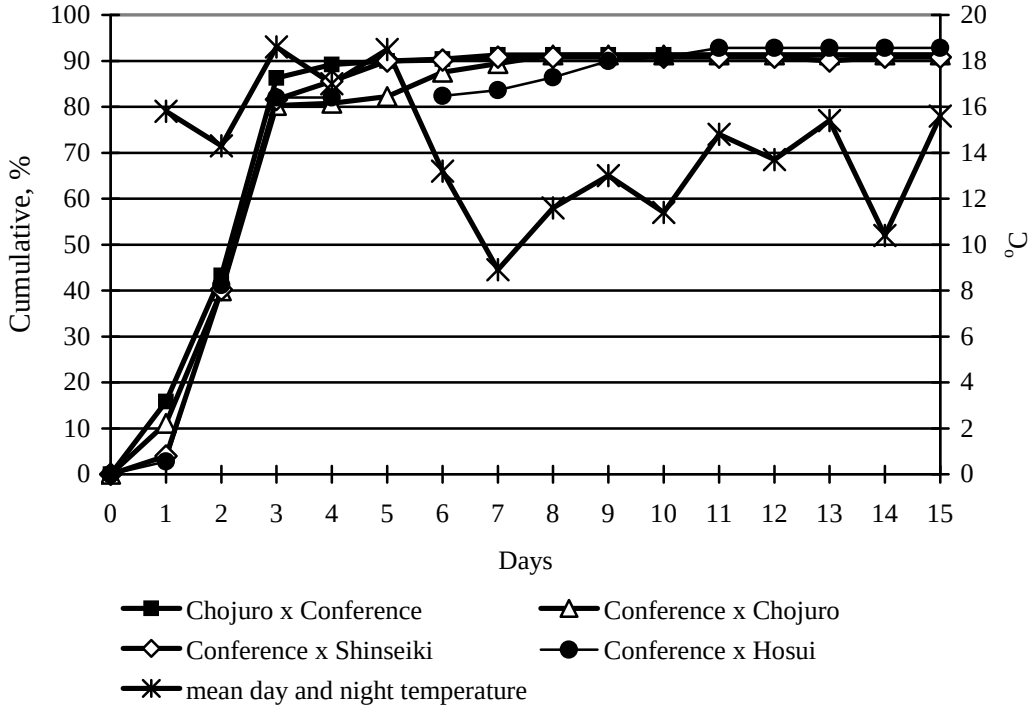

Figure 2. Cumulative seed germination of pear progenies from interspecific crosses

The shorter stratification than used by other breeders may be explained by the treatment of seeds in fruits during storage at 2-3°C. Seeds from fruits stored at that temperature need a shorter period of stratification than dry seeds (Bartlett, 1961; Grzyb *et al*., 1969; Pitera and Odziemkowski, 2003). Tylkowski (1978) used a similar method of stratification for determining true germinability of dry seeds. He showed that the highest percentage of germination of 'Antonovka' seeds was obtained when they were transferred to a temperature of 15°C after 80 days at 3°C. Lateur *et al*. (2000) stratified individual apple seeds in humid peat pots for 90 days at 3-4°C; however, he used dry seeds.

Conclusions

A method of after-ripening of seeds presented in this experiment is useful in the production of apple and pear seedlings. It is easy to apply, doesn't require the drying of seeds and ensures a high output of seedlings in a short time after stratification.

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