

## Effect of long-term storage at low temperature on storage losses and field performance of seed-potato cultivars

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### Abstract

The effects of 0, 5, 4, 3, 2 and 1 month(s) of 0.5 °C storage temperature on storage losses, field crop emergence and development, stem number per plant, tuber yield and size distribution of seed-potatoes of 12 potato cultivars were investigated. Cultivar Ostara was very susceptible to chilling injury; Alpha, Bea, Draga and Jaerla were susceptible to a lesser extent. Storage losses of unaffected cultivars were low; storage losses of affected cultivars varied from 4.2 % for cv. Alpha to 51.4 % for cv. Ostara. Only visibly not affected seed tubers were planted in the field. Field crop emergence of these was 99.8 %. Five months at 0.5 °C storage temperature, followed by presprouting of the seed, increased stem numbers per plant and reduced total tuber yield, but increased tuber yield in grading 28-35 mm. Potato cultivars responded very differently to prolonged exposure of 0.5 °C storage temperature.

**Keywords:** seed potatoes, long-term storage, low-temperature storage, storage losses, stem number, tuber grading, tuber yield

### Introduction

Long-term storage of seed-potatoes should take place at 3-4 °C. When stored at lower temperatures, losses may occur. Symptoms of too low temperature storage are sunken, darkbrown spots in the peel of the tuber. Cutting of affected tubers may show redbrownish to darkbrownish and brownblackish discolouration of parts of the tuber flesh. These symptoms appear as patches in the peel and also in the tissue of the potato tuber. The damage can eventually result in rot development leading to increased storage losses and poor field performance. The phenomenon of low storage temperature damage is either described as low-temperature breakdown (Richardson & Phillips, 1949, cited by Burton, 1966) or as chilling injury (Hooker, 1981).

Lynch & Coffin (1988) have shown that long-term storage of five North-American potato cultivars at temperature levels of 1, 2 and 3 °C during October-May had no effects on the yield and the growth vigour. However, lower storage temperatures (-5, -3 and -1 °C) during a short period (6-48 h) had a very negative effect on

field crop development and marketable tuber yield. Lynch & Coffin (1988) assumed cultivar differences in tolerance with respect to chilling injury in potato cultivars.

During 1984-1987 we investigated the effects of 0.5 °C storage temperature on storage losses, field crop emergence, stem number, tuber yield and tuber grading of seed-potatoes of 12 potato cultivars.

### Materials and methods

For this investigation, twelve potato cultivars were selected: Alpha, Bea, Bintje, Cardinal, Désirée, Draga, Eersteling, Hertha, Jaerla, Ostara, Sirtema and Spunta. The seed-potatoes were obtained from different commercial sources. Seed-size was 40-50 mm.

Initially the seed-potatoes were stored at the recommended temperature of 3-4 °C. For the latter part of the storage period the cultivars were stored at 0.5 °C for 0, 5, 4, 3, 2 or 1 month(s). Total storage period lasted five months (early October till early March). The cultivars were stored in mechanically cooled storage bins at ATO. Tubers visibly affected by chilling were removed before and after a pre-sprouting period at 10 °C and 20 °C, respectively.

Seed-potatoes were planted in a split-plot field trial with six replications at the ATO experimental station at Nagele, the Netherlands, during the third week of April. Each net field plot contained 24 plants. Standard cultural practices with respect to land preparation, planting, weeding and fertilizer application were maintained. During each season, simultaneous haulm killing took place on the General Netherlands Inspection Service recommended date for haulm killing class A seed-potato crops (end of July) with 4 l Reglone per ha.

Storage and field data were processed with the statistical computer package Genstat, version 4.

### Results

During all three storage seasons, Alpha, Bea, Draga, Jaerla and Ostara showed symptoms of chilling injury. Ostara was particularly susceptible. Désirée, Eersteling, Hertha and Sirtema showed chilling injury symptoms during two storage seasons. Cultivars Bintje, Cardinal and Spunta showed damage during one of the three storage seasons. Chilling injury symptoms usually occurred only after 4 months storage at 0.5 °C.

Weight losses of all cultivars and of all treatments were low and averaged 3.5 %.

Total storage losses, consisting of losses in weight and losses of rejected seed tubers, showed much greater variation. This was particularly the case with the susceptible cultivars; Ostara had very high losses (Table 1).

In each growing season, emergence was 99.8 %. Emergence and above-ground development was not visibly affected by the storage treatments. Five months 0.5 °C storage treatment generally resulted in more stems per plant, especially for Alpha, but often resulted in lower tuber yields (Table 2); however this was not the case for

# EFFECT OF LONG-TERM LOW-TEMPERATURE STORAGE ON 12 POTATO CVS

Table 1. Average total losses (loss of weight and of low storage temperature affected tubers) of seed-potatoes of five susceptible cultivars after five months storage at 3-4 °C and after five months storage at 0.5 °C.

Cultivar	Storage temperature during last 5 months	
	3-4 °C	0.5 °C
Alpha	1.9	4.2
Bea	2.7	10.5
Draga	1.5	10.9
Jaerla	1.8	18.8
Ostara	2.3	51.4
Average	2.0	19.2

Table 2. Yield reduction after storage at 0.5 °C compared to storage at 3-4 °C.

Cultivar	Duration of storage at 0.5 °C			
	3 or 4 months (av.)		5 months	
	t ha <sup>-1</sup>	%	t ha <sup>-1</sup>	%
Alpha	—	—	0.8	5.7
Bea	—	—	1.8	7.8
Draga	0.5	2.8	2.0	10.9
Jaerla	—	—	2.6	9.9
Ostara	1.1	4.4	1.8	7.6
Désirée	1.7	7.4	2.1	9.4
Hertha	—	—	1.9	10.2
Sirtema	1.4	5.8	—	—
Spunta	0.7	2.6	1.9	7.4

Bintje, Cardinal and Eersteling. It led, with the exception of Hertha and Spunta, to higher yields in the seed-potato size 28-35 mm. This yield increase averaged 1 t ha<sup>-1</sup>.

Four, three and two months 0.5 °C storage temperature resulted for cultivars Alpha, Bintje, Draga and Ostara also in higher yielding of 28-45 mm sizes. This yield increase amounted to 1.2 t ha<sup>-1</sup>.

## Discussion

Potato cultivars differ in susceptibility to long-term storage at 0.5 °C. This phenomenon is either described as chilling injury (Hooker, 1981) or as low-temperature breakdown (Richardson & Phillips, 1949, cited by Burton, 1966). In our experiments during 1984-1987, chilling injury effects became visible after four months storage at 0.5 °C. Four months storage at 0.5 °C increased storage losses for 5 of the 12 cultivars investigated. Affected tubers had sunken, reddish to darkbrown spots;

such tubers showed internal signs of dark coloured tuber tissue with a peculiar, acid smell.

Stem number per plant was higher for the seed-potato material stored at 0.5 °C for five months, possibly an effect of breaking apical dormancy due to a prolonged cold shock (van Loon, 1983). Susceptible cultivars had lower total tuber yields, although tuber yields in the grade 28-45 mm often increases.

The study by Lynch & Coffin (1988) showed no chilling injury problems with long-term (7 months) storage of five North-American potato cultivars at 1 °C. Our study involving 12 cultivars stored up to five months at 0.5 °C showed rather different results. Potato cultivars apparently have a substantial different susceptibility to long-term storage at 0.5 °C.

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