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Effect of physiological age on growth vigour of seed potatoes of two cultivars. 1. Influence of storage period and temperature on sprouting characteristics

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Zusammenfassung, Résumé p. 407

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Summary

The influence of storage temperature and storage period on sprouting capacity and incubation period has been studied for 3 years with cvs. Jaerla and Désirée, stored at 4 °C and 12 °C, as a part of a combined study on the effect of physiological age on growth vigour. During storage the sprouting capacity gradually increased to a maximum and then declined. The maximum sprouting capacity was reached about 80 to 100 days earlier when tubers were stored at 12 °C than at 4 °C, and it was reached about 50 days earlier by cv. Jaerla than by cv. Désirée at both storage temperatures.

The incubation period decreased linearly with time for both cultivars at both storage temperatures, being most rapid at 12 °C, and the period was shorter for cv. Jaerla than for cv. Désirée during the whole storage period.

Introduction

Aims of the research programme

In the past few decades research has been carried out on the effect of physiological age of seed potatoes on their growth vigour and yield potential; amongst the earliest and most cited works are those of Kawakami (1952; 1962), Madec & Pérennec (1955) and Krijthe (1962a, b). To increase our knowledge of the mechanisms of the physiological development of seed tubers, a combined research programme was initiated to study sprout growth, (bio)chemical characters and initial plant growth under controlled conditions and field performance using seed from the same batches of tubers.

The aims of the programme were:

- to develop a simple method for determining the growth vigour of seed potatoes;
- to study the possibilities of growth vigour manipulation.

The combined programme was carried out by members of the working group 'Growth vigour of seed potatoes', consisting of K.B.A. Bodlaender, H.M. Dekhuyzen and J. Marinus (Centre for Agrobiological Research, CABO); A. van Es and K.J. Hartmans (Institute for Research on Storage and Processing of Agricultural

Produce, IBVL); L.J.P. Kupers (Department of Field crops and Grassland Science of the Agricultural University); C.D. van Loon (Research Station for Arable Farming and Field Production of Vegetables, PAGV); D.E. van der Zaag (Directorate for Agricultural Research, DLO). Detailed information about the experiments and the results of the combined study is available in a report (Working Group, 1987).

Research on various tuber and plant growth characteristics is reported separately by van Es & Hartmans (1987), Bodlaender & Marinus (1987), and van Loon, (1987). A review of the literature together with an attempt to integrate the effects of seed tuber age and plant growth characteristics to ascertain the relationship between physiological age and growth vigour, is reported by van der Zaag & van Loon (1987).

Terms used

Growth vigour: the potential of a tuber to produce sprouts and plants rapidly under conditions favourable for growth.

Ageing: the processes of increasing maturity with time.

Senescence: the processes of deterioration that are the natural causes of death.

Rest period: the period during which no measurable sprout growth occurs even when tubers are stored under conditions ideal for sprouting.

Dormant period: the period when sprout growth is inhibited for any reason, including the rest period.

Sprouting capacity: the sprout weight of uniform tubers, expressed in g (fresh weight) sprouts per tuber, after a standard sprouting procedure whereby tubers that were stored at x°C were then desprouted, and sprouted again by storing for 4 weeks at 18 - 20 °C and approximately 80 % RH in darkness.

Sprout morphology: the following morphologic stages of sprouting associated with ageing are distinguished: the one sprout, multiple sprout, and branching sprout stages, and the stage of small tuber formation on the sprouts (Krijthe, 1962a).

Incubation period: the time between the onset of sprouting of the seed tuber (desprouted if sprouts were present) and tuber formation on the new sprouts, when tubers are stored in darkness at 15 - 20 °C and 90% RH.

Tuber exhaustion: a tuber is exhausted if it is no longer able to produce a plant.

Most of these definitions agree with those established by the Section Physiology of the EAPR (Reust, 1984).

Introduction to this paper

Physiological ageing appears to act primarily on the level of sprout development at planting. The growth rate of sprouts at planting is closely related to the initial growth rate of the plants and affects subsequent growth and crop yield (Toosey, 1964a, b). The changing sprout development pattern can be understood by measuring sprout growth in various ways. Wurr (1978) concluded that total sprout length and the length of the longest sprout were the most useful measurements. He also showed that when tubers were stored in light there is a good linear relationship between sprout dry weight per tuber and total sprout length per tuber. Physiological ageing seems to act primarily on the potentional of desprouted tubers to form new sprouts, and Krijthe (1962a, b) characterized the age of potatoes by determining the 'sprouting capacity' of whole desprouted tubers under controlled conditions. This capacity increased to a maximum and then declined, small tubers finally developing on the sprouts (Krijthe, 1962a, b).

Several authors also found that the growth vigour and production capacity of a plant is related to the degree of incubation or physiological age of the seed tuber (Madec & Pérennec, 1955; Münster, 1975; Reust, 1982). The incubation phase or period starts immediately after the dormant period is complete (Reust, 1982). Claver (1951) defined it as the period between sprout initiation and tuber formation on the sprouts. He showed that planting in soil is not necessary to obtain tuberization, since tubers will appear on the sprouts even when not in soil. Claver also showed that light and low temperatures prolonged the incubation period, the most favourable temperatures for rapid incubation being between 15.2 and 18.7 °C. Higher (19.4 - 21.2 °C) and lower (5.6 - 9.5 °C) temperatures increased the incubation period. There are also clear differences in length of incubation period between cultivars (Reust & Münster, 1975; Umaerus & Roslund, 1979; Reust, 1982; van Loon, unpublished). However, the length of the incubation period is not related to precocity (Madec & Pérennec, 1955) nor with the length of the dormant period of a cultivar (Reust & Münster, 1975). Sprout growth, sprouting capacity and length of the incubation period at a given time were assessed at regular intervals because these characters are possible indicators of the physiological age of a tuber.

Materials and methods

Materials

All experiments in this interdisciplinary research were carried out with seed tubers from the same batches of both cv. Jaerla and cv. Désirée, chosen because cv. Jaerla ages rapidly physiologically, whereas cv. Désirée maintains its growth vigour. The seed used was commercial basic seed (size 40 - 45 mm), originating each year from clay soils in the northern part of the Netherlands. The tubers were stored at 4 °C and 12 °C in darkness. The known planting dates, harvest dates, average tuber weight and the beginning of the storage period under controlled conditions are given in Table 1. In

Table 1. Dates of planting, harvesting, and beginning of storage under controlled conditions together with the average initial tuber weight of the seed used in all experiments for 1978, 1979 and 1980.

Date of	Jaerla			Désirée		
	1978	1979	1980	1978	1979	1980
Planting	unknown	9-05	16-04	unknown	17-04	16-04
Harvesting	unknown	1-08	6-08	unknown	11-08	29-07
Beginning of controlled storage	18-08	11-09	18-09	18-08	11-09	18-09
Average initial tuber weight (g)	unknown	58	62	unknown	55	56

Tabelle 1. Pflanzdaten, Erntedaten und der Beginn der Lagerung unter kontrollierten Bedingungen sowie das durchschnittliche Ausgangsgewicht der Knollen, die als Pflanzgut bei allen in 1978, 1979 und 1980 durchgeführten Versuchen verwendet wurden.

Tableau 1. Dates de plantation, de récolte et de début de conservation sous conditions contrôlées avec le poids moyen initial des tubercules de semence utilisés dans toutes les expériences de 1978 à 1980.

the period between harvest and storage at controlled temperature, the seed tubers were kept at ambient temperatures ranging between 12 - 18 °C. We consider 18 August as the start of all the experiments; this is indicated as day 0.

Methods

Sprout growth during storage
At the start of the storage period, batches of 40 tubers were weighed (initial tuber weight) and stored on plastic trays at 4 and 12 °C. At regular intervals, one batch per cultivar and storage temperature was withdrawn and desprouted: sprout and tuber weights were determined and the length of every sprout longer than 2 mm measured. The difference between initital tuber weight and weight of desprouted tubers plus sprout weight gives the evaporative and respiratory weight loss (g/tuber). After prolonged storage at 12 °C a few 'little tubers' were formed and these were included as sprout weight, being only a few percent of the total sprout weight.

Sprouting capacity
Samples of 40 desprouted tubers were put for 4 weeks in darkness at 18 °C. Their sprouting capacity was calculated as the resulting sprout weight expressed as fresh weight per tuber. Also the length of the longest sprout of every tuber was measured and the mean maximum length of a batch was calculated. These measurements were carried out only in 1979/80 and 1980/81.

Incubation period
The length of the incubation period was determined according to the recommendations of Madec & Perennec (1955). At regular intervals, 48 tubers per treatment (desprouted if sprouts were present) were placed for sprouting in trays filled with moist perlite: the top of the tuber was set level with the perlite which was kept moist throughout the experimental period to allow the sprouts to root and take up water. The trays were kept in a store room in darkness under controlled temperature (17.5 - 18.5 °C) and humidity conditions, (85 - 90 % RH). The date of appearance of the first sprout (with a length of at least 2 mm) and the date of appearance of the first tuber on the sprouts (of diameter at least two times stolon diameter) were recorded twice a week for each tuber. To avoid severe sub-apical necrosis on sprouts, they were sprayed every two days with an 0.01 mol/l aqueous solution of calcium sulphate as suggested by Dyson & Digby (1975). Van Loon (unpublished) has shown that spraying with calcium sulphate does not influence the length of the incubation period.

In this paper correlations for R^2 are expressed as very high (1.00 - 0.81); high (0.80 - 0.61); moderate (0.60 - 0.41); low (0.40 - 0.21); and very low (0.20 - 0.00).

Results

Sprout growth and weight loss during storage
The tubers stored at 12 °C sprouted early with only one apical sprout ('one-sprout stage'; Krijthe, 1962a) which continued to grow, although 1 or 2 smaller sprouts per tuber were subsequently formed, also mainly at the bud end of the tubers. After prolonged storage the apical sprout branched and 'little tubers' were subsequently formed.

Table 2. Influence of temperature on the storage period in which the range of maximum values of the number of sprouts and sprout length was achieved. Data are ranges of the three years.

Cultivar	Storage temperature (°C)	Storage period in which maximum values were achieved	Average maximum number of sprouts per tuber	Average maximum sprout length (cm/tuber)
Jaerla	4	300 - 350	3 - 6	1 - 2
	12	280 - 310	2 - 3	30 - 38
Désirée	4	400 - 460	6 - 8	1 - 2
	12	280 - 320	2 - 3	47 - 72

Tabelle 2. Der Einfluss der Temperatur auf die Lagerzeit, in welcher der Bereich der Maximalwerte von der Anzahl der Keime und von der Keimlänge erfasst wurde. Die Werte umfassen die drei Versuchsjahre.
Tableau 2. Influence de la température de conservation au regard des écarts des valeurs maximales du nombre et de la longueur des germes; moyenne sur trois années d'expérience.

The total sprout weight during storage increased to a maximum. When measured at regular intervals, sprout weights of Jaerla tubers stored at 12 °C varied but little, whereas those of Désirée varied from one year to another. Tubers stored at 4 °C had a longer dormancy period and when sprouting began several sprouts were formed on each tuber; Krijthe (1962a) used the term 'multiple-sprout stage' for this condition. The number of sprouts gradually increased during storage to reach a maximum after approximately 300 days (Jaerla) and 400 days (Désirée) (Table 2). After longer storage periods at 4 °C sprouts were formed at the top and on the sides of the tubers. They ultimately branched but no little tubers were formed.

During storage at 4 °C the average sprout length was very small but it increased to reach a maximum at 12 °C (Table 2). Both cultivars lost more weight due to respiration and evaporation when tubers were stored at 12 °C when there was a very high exponential relationship between the increase in sprout weight and respiration and evaporative weight loss (Fig. 1), the weight loss per unit sprout weight being highest in cv. Jaerla. At the end of the storage period the tubers were soft, except at the rose end where sprouts were growing.

Sprouting capacity

The sprouting capacity of each cultivar was influenced by the year of harvest, temperature and length of the storage period (Fig. 2). The maximum for both cultivars was reached about 80 to 100 days earlier when tubers were stored at 12 °C compared to 4 °C. At both temperatures the maximum for cv. Jaerla was achieved about 50 days earlier than for cv. Désirée. There was little difference in maximum sprouting capacity between the years of harvest when tubers were stored at 12 °C, but there were differences at 4 °C, particularly in cv. Désirée. Although there were substantial differences between years for both cultivars when stored at 4 °C, in all years during the initial sprouting period (90 - 180 days) the sprouting capacity of cv. Désirée at 4 °C stored was higher (Fig. 2) than that of cv. Jaerla. In that initial period (for 1979/80), the sprouting capacity of cv. Désirée at 4 °C was equal to or somewhat higher than that at 12 °C, whilst for cv. Jaerla it was initially greater at 12 °C than at 4 °C (Fig. 2). Using

Fig. 1 Relation between sprout weight (g fresh wt. per tuber) and total evaporation + respiratory weight loss (g fresh wt. per tuber) of tubers and sprouts during storage at 12 °C of the cultivars Jaerla and Désirée in two seasons.
Désirée: $y = 0.47 \exp(0.214x)$, $R = 0.93$, $n = 11$
Jaerla: $y = 1.40 \exp(0.225x)$, $R = 0.92$, $n = 12$

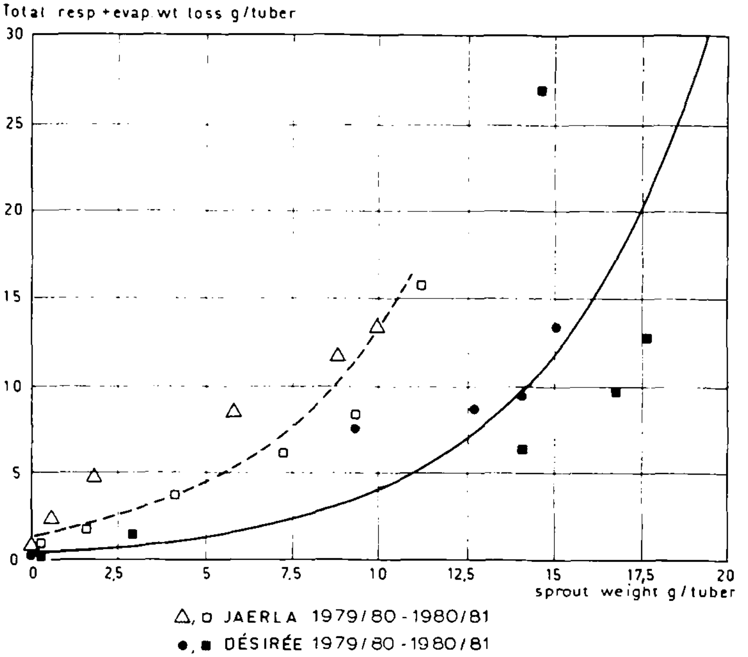

Abb. 1. Die Beziehung zwischen dem Keimgewicht (g Frischgewicht/Knolle) und dem Gesamtgewichtsverlust durch Verdunstung und Atmung (g Frischgewicht/Knolle) bei Knollen und Keimen der Sorten Jaerla und Désirée während der Lagerung bei 12 °C, aus zwei Versuchsjahren.
Fig. 1. Relation entre le poids de germes (g de poids frais par tubercule) et les pertes de poids par évapotranspiration (g de poids frais par tubercule) des tubercules germant à 12 °C pour les variétés Jaerla et Désirée durant deux saisons d'expérimentation.

the data from 1979/80 and 1980/81, there was a high to very high linear relationship between sprouting capacity and the length of the longest sprout per tuber for both cultivars at both temperatures (Table 3). As before, the maximum in both cultivars was reached about 80 to 100 days earlier at 12 °C than at 4 °C.

Incubation period
In all 3 years, there was a difference in the relationship between the lengths of the incubation period and storage period between the two cultivars and within each cultivar between the two temperatures (Fig. 3). During the whole storage period Jaerla had a shorter incubation period than did Désirée. At 12 °C both cultivars showed the most rapid decrease in the length of the incubation period and consequently earlier exhaustion of the tubers. At 4 °C and 12 °C both cultivars showed the length of the incubation

Fig. 2. Influence of the storage period, at 4 °C and 12 °C on the sprouting capacity (g fresh weight/tuber after desprouting and subsequent 4 weeks at 18 °C).

Experimental years – *Versuchsjahre – Années d'expérimentation:* ●...● 1978/79; ▲——▲ 1979/80; ■---■ 1980/81.

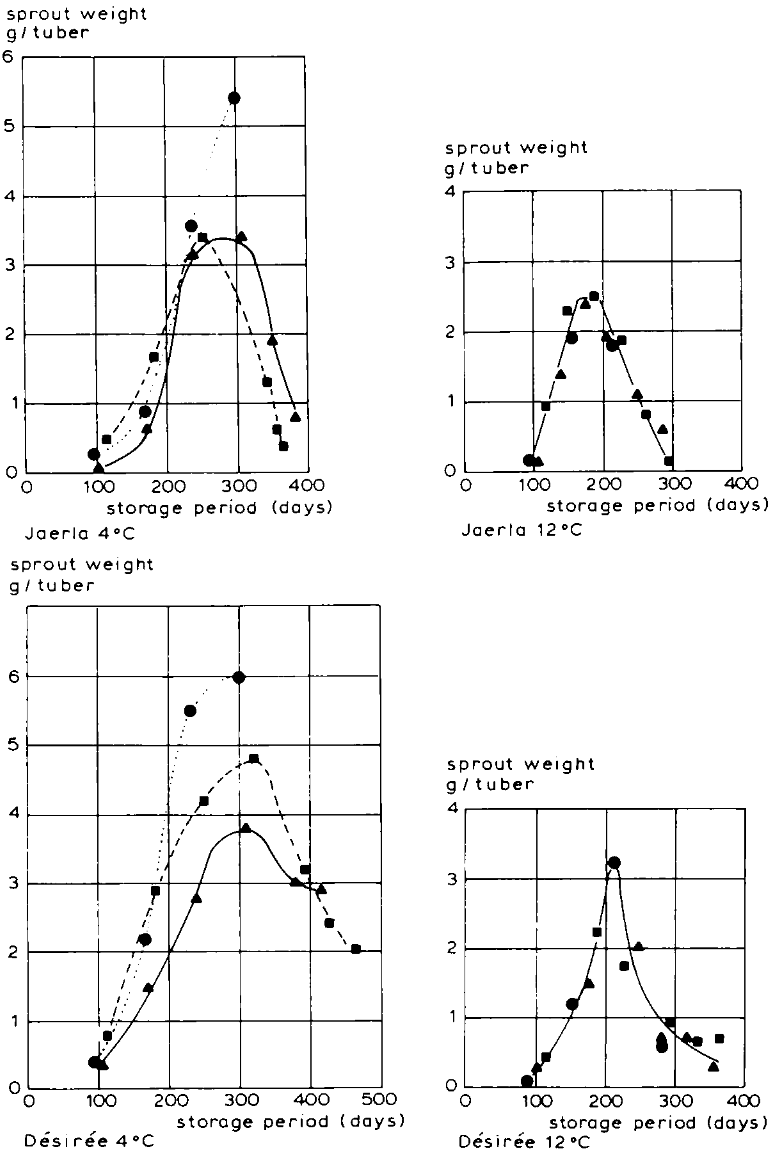

Abb. 2. Der Einfluss der Lagerzeit bei 4 °C und 12 °C auf die Keimungskapazität (g Frischgewicht/Knolle nach Entkeimung und den nachfolgenden 4 Wochen bei 18 °C).

Fig. 2. Influence de la durée de conservation à 4 °C et 12 °C sur la capacité germinative (g de poids frais/tubercule égermé puis mis en germination à 18 °C pendant 4 semaines).

Fig. 3. The relationship between the storage and the incubation periods for the cultivars Jaerla and Désirée, stored at 4 °C and 12 °C for the years 1978/79, 1979/80 and 1980/81.

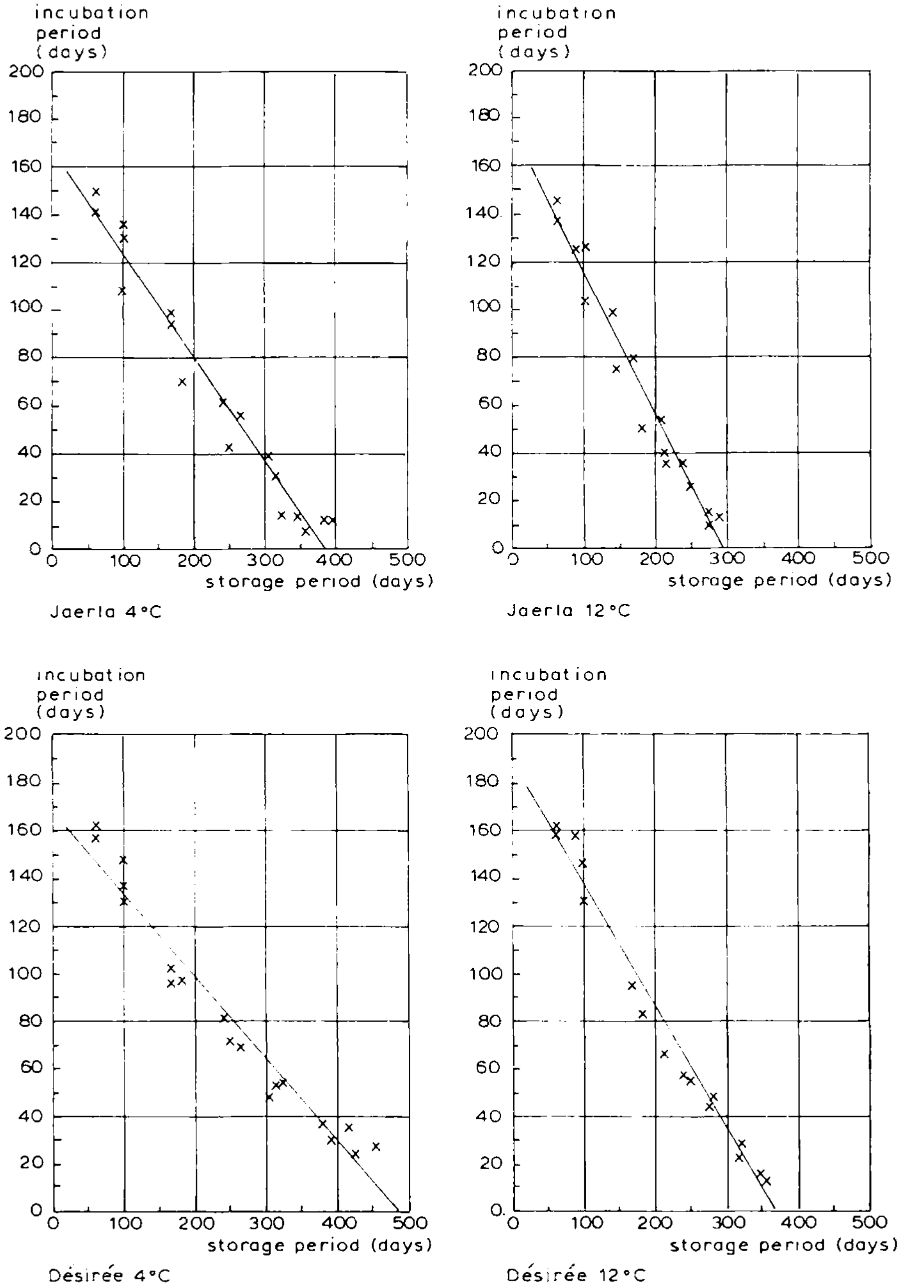

Table 3. Relationship between sprouting capacity (x) and the length of the longest sprout per tuber (y). Experimental years 1979/80 and 1980/81.

Cultivars	Storage temperature (°C)	Regression equation	Correlation coefficient	Number of observations
Jaerla	4	$y = -0.21 + 5.10x$	0.91	11
	12	$y = -1.50 + 7.63x$	0.90	11
Désirée	4	$y = -0.30 + 3.85x$	0.87	13
	12	$y = -1.95 + 7.98x$	0.97	11

Tabelle 3. Die Beziehung zwischen der Keimungskapazität (x) und der Länge des längsten Keimes pro Knolle (y). Versuchsjahre 1979/80 und 1980/81.
Tableau 3. Relation entre capacité germinative (x) et longueur du plus long germe par tubercule (y): années d'expérimentation 1979/80 et 1980/81.

Table 4. Correlation between the decrease in sprouting capacity after the maxima have been reached (x) and the incubation period (y).

Cultivar	Storage temperature (°C)	Regression equation	Correlation coefficient	Number of observations
Jaerla	4	$y = 6.40x + 6.01$	0.97	7
	12	$y = 19.60x + 8.47$	0.92	7
Désirée	4	$y = 10.92x + 0.80$	0.93	4
	12	$y = 19.95x + 17.47$	0.81	10

Tabelle 4. Die Korrellation zwischen der Abnahme der Keimungskapazität nach Erreichen des Maximums (x) und der Inkubationsperiode (y).
Tableau 4. Corrélation entre la diminution de la capacité germinative après que le maximum ait été atteint (x) et la période d'incubation (y).

Jaerla	4 °C: $y = -0.430x + 166$;	$R = -0.98$;	SE_{slope}: 0.022
Jaerla	12 °C: $y = -0.589x + 173$;	$R = -0.99$;	SE_{slope}: 0.028
Désirée	4 °C: $y = -0.346x + 168$;	$R = -0.99$;	SE_{slope}: 0.018
Désirée	12 °C: $y = -0.513x + 188$;	$R = -0.99$;	SE_{slope}: 0.019

Abb. 3. Die Beziehung zwischen der Lagerung und der Inkubationsperiode für die bei 4 °C und 12 °C gelagerten Sorten Jaerla und Désirée in den Versuchsjahren 1978/79, 1979/80 und 1980/81.
Fig. 3. Relation entre la conservation et la période d'incubation de Jaerla et Désirée, conservées à 4 °C et 12 °C pendant les années 1978/79, 1979/80 et 1980/81.

period decreased linearly with time (Fig. 3), all correlation coefficients being very high. It is noteworthy that the decrease in length of incubation period during storage is almost the same for all three years, all points being close to the regression line. Although only limited data were available, it was possible to show that when the period of maximum sprouting capacity had passed, there was a positive linear relationship between the decrease in sprouting capacity and the decrease in incubation period within both cultivars at both 4 and 12 °C (Table 4); these features are characteristic of the process of tuber ageing.

Discussion

Storage at high temperature (12 °C) caused a high degree of sprouting combined with high respiration and evaporative weight loss. Thus our findings are in agreement with those of Burton & Hannan (1957), who showed that a high degree of sprouting substantially increases moisture loss, and of Isherwood & Burton (1975), who showed a large increase in respiration of tubers plus sprouts if tubers were allowed to sprout during a storage period of about 6 months at 20 °C. Burton & Hannan (1957) and Krijthe (1962b) observed a linear relationship between sprout weight and evaporative and respiration weight loss, whereas we found an exponential relationship for both cultivars stored at 12 °C, cv. Jaerla having the higher weight loss per unit sprout weight. We stored tubers for a longer period than previous workers and the tubers and sprouts showed signs of ageing. Simon (1977) stated that senescense of plant tissue corresponds to an increase in membrane permeability, as a result of loss of membrane integrity, that results in increasing water loss which, in turn, is probably responsible for the observed higher weight loss associated with higher sprout weights (Fig. 1), after prolonged storage. The difference in physiological ageing between Désirée and Jaerla, characterized by differences in sprouting capacity and incubation period, probably explain the differences in evaporative and respiratory weight loss, perhaps due to different membrane composition. Alternatively the differences could also be due to differences in size and shape of the sprouts, the amount of sprout branching, number of sprouts or differences in tuber weight loss. These factors have not been studied, but morphologically there was little difference between the two cultivars.

To characterize the age of potatoes, Krijthe (1962a, b) determined the sprouting capacity of whole tubers which she defined as the weight of sprouts expressed as a percentage of the initial tuber weight. When so measured, sprouting capacity is biased at high storage temperatures by changes in tuber weight, no matter how caused. We therefore used a modified measure of sprouting capacity, defining it as the sprout weight expressed as g sprouts per tuber, instead of g sprouts per unit tuber weight. This required that we used tubers that were initially of uniform size because the number of sprouts per tuber increases with tuber size (Allen, 1978) and dormancy and sprout growth rate are also dependent on tuber size Krijthe, 1962a). In the initial phase of storage the sprouting capacity of cv. Désirée increased more rapidly at 4 °C than at 12 °C, whereas 12 °C favoured the sprouting capacity of cv. Jaerla. Similar effects with Désirée were reported by Wurr & Allen (1976) and it appears that for some cultivars low initial temperatures favour sprout growth when tubers are moved to a higher temperature (Allen et al., 1978; van Loon, 1983). The longest sprout length per tuber and the sprouting capacity, both characterize changes in sprouting behaviour due to storage temperature and/or physiological age, and showed high to very high linear correlations. Measuring sprout weight, although destructive, is the prefered method for characterizing physiological age since the measurements of the longest sprout may not be adequate when, for example, the sprouts branch or when necrosis of the apical region occurs due to calcium deficiency (Dyson & Digby, 1975).

The most rapid decrease in the length of the incubation period occurred at 12 °C, as was also found by Claver (1951) and Madec & Perennec (1955). Differences in maximum sprouting capacity and subsequent decrease in sprouting capacity of the cultivars were also demonstrated. It is not known if seed tubers stored at 12 °C were ageing faster due to the higher temperature per se or due to the high degree of sprouting and subsequent weight loss at this temperature.

Both sprouting capacity and incubation period seem to provide useful tools for characterizing the physiological ageing of seed tubers.

Acknowledgements

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Zusammenfassung

Der Einfluss des physiologischen Alters auf die Wachstumintensität von Pflanzkartoffeln bei zwei Sorten. 1. Allgemeine Einführung und der Einfluss der Lagerzeit und der Temperatur auf die Keimungsmerkmale

In der allgemeinen Einführung wird das Ziel der gemeinsamen Forschung, den Einfluss des physiologischen Alters auf die Wachstumintensität zu untersuchen, beschrieben, und es werden spezielle Ausdrücke definiert, die in dieser und in den folgenden Mitteilungen verwendet werden. In dieser gemeinsamen dreijährigen Untersuchung (1979-1981) sind Pflanzknollen der Sorten Jaerla und Désirée aus gleicher Herkunft verwendet worden, die bei 4 °C und 12 °C gelagert wurden (Tab. 1).

Es wird der Einfluss der Lagerzeit und der Temperatur auf das Keimgewicht diskutiert, auf den Gewichtsverlust durch Atmung und Verdunstung und auf die Keimungskapazität, die Keimlänge und auf die Inkubationsperiode. Bei einer Lagertemperatur von 12 °C wurden das Keimgewicht pro Knolle und der durch Atmung und Verdunstung bedingte Gewichtsverlust der Knollen und Keime kräftig stimuliert (Tab. 2). Bei beiden Sorten wurde während der Lagerung bei 12 °C eine exponentielle Beziehung zwischen dem Keimgewicht und dem Gewichtsverlust durch Atmung und Verdunstung gefunden, wobei die Sorte Jaerla einen höheren Gewichtverlust pro Keim aufwies (Abb. 1). Die bei 12 °C gelagerten Knollen der Sorte Jaerla keimten früher als diejenigen der Sorte Désirée und erreichten eine höheres durchschnittliches Keimgewicht. Die Keimungskapazität und die Inkubationsperiode wurden während der Lagerung in Abständen durch Entkeimen der Knollen und Wiederaustreiben lassen bei 18 °C bestimmt.

Die Keimungskapazität wurde nach 4 Wochen bestimmt an Hand des Keimfrischgewichtes pro Knolle, ausserdem wurde die Länge des längsten Keimes bestimmt. Die Inkubationsperiode wurde definiert als der Zeitraum zwischen der Keimung und der Bildung kleiner Knollen an den Keimen. Die Keimungskapazität erreichte während der Lagerung ein Maximum, um danach abzufallen (Abb. 2). Dieses Maximum wurde etwa 80 bis 100 Tage früher erreicht, wenn die Knollen bei 12 °C gelagert wurden. Bei beiden La-

gertemperaturen war die maximale Keimungskapazität bei der Sorte Jaerla etwa 50 Tage früher erreicht als bei der Sorte Désirée.

Die maximale Länge des längsten Keimes korrespondiert in nahezu allen Fällen mit der maximalen Keimungskapazität, wobei zwischen beiden Merkmalen eine gute bis sehr gute lineare Beziehung besteht (Tab. 3). Bei beiden Sorten und beiden Lagertemperaturen verringerte sich die Inkubationsperiode linear mit der Zeit, und zwar am schnellsten bei der höchsten Lagertemperatur.

Die Inkubationsperiode der Sorte Jaerla war in allen Fällen kürzer als diejenige der Sorte Désirée (Abb. 3).

Wenn das Maximum der Keimkapazität überschritten wird, besteht bei beiden Sorten und bei beiden Temperaturen, 4 °C und 12 °C, eine positive lineare Beziehung zwischen dem Abfallen der Keimungskapazität und der Verringerung der Inkubationsperiode (Tab. 4).

Résumé

Effet de l'âge physiologique sur la vigueur de croissance du plant de pomme de terre de deux variétés. 1. Introduction générale et influence de la durée et de la température de conservation sur les caractéristiques germinatives

Dans l'introduction générale l'objectif des recherches concertées concernant l'influence de l'âge physiologique sur la vigueur de croissance est décrit et plusieurs termes employés ici et dans plusieurs articles antérieurs sont définis.

Les études ont été réalisées durant trois ans (1979 - 1981) avec des plants des variétés Jaerla et Désirée de même origine conservés à 4 °C et 12 °C (tableau 1). L'influence de la durée et de la température de conservation sur le poids de germes, les pertes de poids par évapotranspiration, la capacité germinative, la longueur des germes et la période d'incubation est discutée. Le poids de germes par tubercule, les pertes de poids dues à l'évapotranspiration et la germination sont fortement stimulés à 12 °C (tableau 2). Il existe une relation exponentielle entre le poids de germes et les pertes de poids des tubercules dues à l'evapo-transpiration pour les deux variétés convervées à 12 °C, avec toutefois une perte plus élevée par poids de germes pour la variété Jaerla (figure 1). Les tubercules de cette dernière conservés à 12 °C germent plus rapidement que ceux de Désirée et ont un poids moyen de germes plus élevé.

La capacité germinative et la période d'incubation sont déterminés à intervalles réguliers durant la conservation par égermage des tubercules suivi d'une germination à 18 °C. La capacité germinative est déterminée après quatre semaines par la mesure du poids frais des germes par tubercule et la longueur du plus long germe. La période d'incubation est définie comme étant le temps s'écoulant entre le début de la germination et la formation de petits tubercules sur les germes. La capacité germinative durant la conservation augmente dans le temps puis décline (figure 2). Le maximum est d'environ 80 à 100 jours plus précoce lorsque les tubercules sont conservés à 12 °C. Pour les deux températures de conservation, la capacité germinative maximum est pour Jaerla approximativement de 50 jours plus précoce que pour Désirée.

La longueur maximum du plus long germe correspond dans preque tous les cas au maximum de capacité germinative avec une haute ou très haute corrélation (tableau 3). La période d'incubation diminue linéairement avec le temps pour les deux variétés et les deux températures de conservation, bien que plus rapidement pour la température la plus élevée. La période d'incubation de la variété Jaerla est dans tous les cas plus courte que celle de Désirée (figure 3). Lorsque la capacité germinative maximum est passée, il existe une relation linéaire positive entre la diminution de celle-ci et la diminution de la période d'incubation au sein de la même variété pour 4 °C et 12 °C (tableau 4).

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