Influence of Temperature During the Formation of Tubers in Relation with their Incubation State (Physiological Age) and Seed Value

It is well established that potatoes grown under high temperatures show an ecological decline as a result of physiological response to the growing conditions of the tubers that will be used later as seeds.

Research[1,2] has demonstrated that tubers formed at high temperatures give a considerably smaller yield than plants from tubers developed at low temperature. Studies[3] carried out in Japan show that the decline of productivity of potato crops is related to the physiological age of the seed tubers and can be prevented by using tubers of the proper age, of 4 to 6 months after the harvest. Potato crops grown in cool mountain[4–7] areas produce plants that yield more than those grown on plains. The shape, quality and yield of 3 cultivars[8–10] of tubers were also affected by high soil temperatures.

Material and method. In the present paper the effect of temperature during tuber formation without foliage was studied. A schematic diagram of the procedure is shown in Figure 1. Tubers (cv. Katahdin) harvested in March 1971 were kept in jute sacks at low temperature (2–4 °C) for 11 months. On February 1972 the tubers were transferred to wooden trays on humid vermiculite at room temperature (20 °C) and darkness. At this time tubers presented sprouts 1 cm long and with many branches. After 10 days the short sprouts began to differentiate into tubers. The essay was started at this time. Wooden trays with 50 tubers covered with humid vermiculite were placed in culture chambers at 20 °C and 27 °C in darkness. Observations were made periodically checking the formation of new tubers on the sprouts. After 15 days the developing tubers reached a diameter of 5 cm at 20 °C, whereas the tubers developed at 27 °C had wider diameters; some tubers showed deformations and secondary growth. After 1 week, they produced secondary tubers (Figure 2). By the same date the tubers at 20 °C showed normal growth (Figure 3). On April 20, 1972, 55 days after the experiment was started, the tubers developed at the 2 temperatures were harvested.

The tubers of both variables were kept at room temperature (20 °C) for sprouting. Tubers began to sprout on July 21, 1972. On August 23, they all presented sprouts 1 cm in length; no differences in the sprouting date were observed; only that the tubers formed at 27 °C had larger branching sprouts than those formed at 20 °C.

The tubers were now set in wooden trays again, with humid vermiculite in a room chamber at 20 °C for checking

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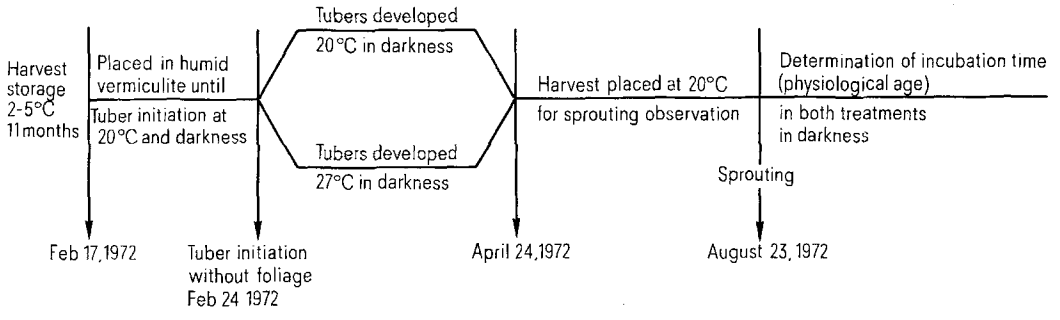

Fig. 1. Diagram showing the course of the essays.

Treatment[a]	Incubation					
	Beginning of tuberization		50% of tubers with tuber formation		100% of tubers with tuber formation	
	Date	No. days	Date	No. days	Date	No. days
Tubers formed without foliage at 27 °C; with secondary growth	20.10.1972	58	19.11.1972	88	15.12.1972	114
Tubers formed without foliage at 27 °C; normal tubers	20.10.1972	58	18.11.1972	87	15.12.1972	114
Tubers formed without foliage at 20 °C; normal tubers	26.11.1972	95	24.12.1972	123	10.1.1973	140

[a] Placed on incubation conditions on August 23, 1972 at 20 °C and darkness.
50% of the tubers formed at 27 °C reached the state of incubation 36 days earlier than tubers developed at 20 °C. No differences in the state of incubation in tubers formed at 27 °C in both normal and deformed, with secondary tuber, were observed.

the formation of new tubers on the sprouts, which demonstrate the incubation state reached.

Results and discussion. The period of incubation of tubers formed on both temperatures are shown in the Table.

Tubers formed at 27 °C were classified into 2 groups: normal and deformed tubers with secondary growth. Observations were made periodically, maintaining the vermiculite humid and checking the formation of little tubers on the sprouts. The date of tuber formation was taken when on the buds of the sprouts or on rhizomes little tubers of 3 mm diameter appeared (Table).

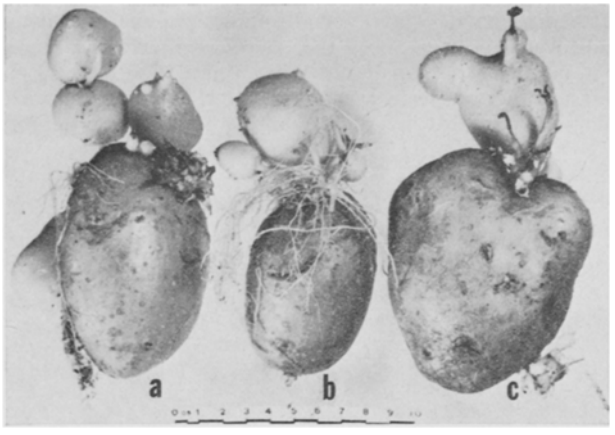

Fig. 2. Tubers formed at 27 °C after 33 days of initiation of tuberization. a) Secondary tuber formation; b) normal tuber; c) tuber formed showing second growth.

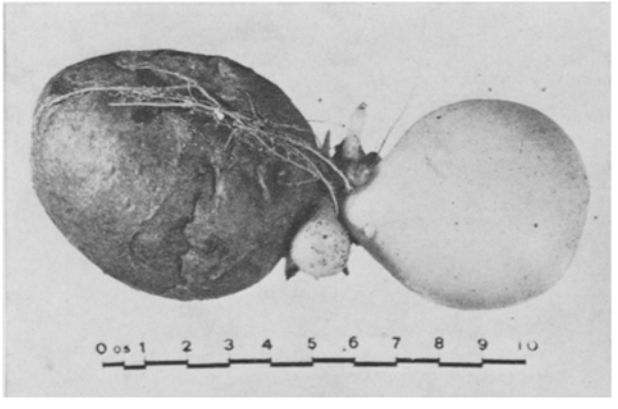

Fig. 3. Tuber formed at 20 °C after 33 days of initiation of tuberization. Normal tubers were produced at this temperature.

This would demonstrate that the effect of high temperatures induces a more rapid incubation state or accelerates the process of physiological age of the seed tubers.

The effect of the state of incubation[11,12] of the seed tuber and sprouts on tuber yield has been shown by tuber growth analysis curves. Plants developed from physiologically old seeds are weak, exhibiting a poor growth and yield.

The notion of the state of incubation reflects more clearly than physiological age the capacity of the potato seed to produce high yields of potato crops; furthermore, the state of incubation is also related to environmental[13–16] factors (temperature, humidity) during storage and also it can be defined by the presence of morphological structures. The great intra-clonal variation of the yield[17,18] is not only due to chronological age but also to other factors which influence the physiological age of the tubers.

It can be concluded that the eco-physiological decline is originated because of the alteration of the incubation state (physiological age) by hastening the senescence of the plants through high temperatures during the formation of tubers that will be used for seeds.

Resumen. En condiciones especiales se indujo la formación de tubérculos sin follaje a temperaturas de 20 °C y 27 °C. Después de la brotación se determina el estado de incubación de los tubérculos formados a ambas temperaturas. Se concluye que la declinación eco-fisiológica de los cultivares de papa se debe a la formación de los tubérculos a altas temperaturas. Las temperaturas de 27 °C inducen un estado de incubación (edad fisiológica) avanzado.

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12 June 1973.

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Cell Wall Degradation in Senescing Tobacco Leaf Discs

The involvement of hydrolytic degradation of cell wall polymers in developmental processes such as cell elongation, senescence, abscission, and cell fusion has been demonstrated in various instances (summary in MATILE[1]). In the case of cell elongation, the non cellulosic polysaccharides seem to be chiefly responsible for the dynamism of plant cell walls[2]. In contrast, the surprisingly extensive wall degradation in the senescing corolla of *Ipomoea tricolor* observed by WIEMKEN-GEHRIG[3] comprises hemicelluloses as well as (to a minor extent) cellulose. In this case, the degradation of polysaccharides is most likely brought about by a variety of hydrolases whose activities increase considerably at the onset of wilting[3]. It appears that the rise of enzyme activities and the concomitant lytic events represent phenomena of a precisely regulated process of senescence. Indeed, the hormonal regulation of one of the hydrolases possibly involved in wall metabolism of senescing leaves, a β-1,3-glucanase, has recently been investigated[4]. In senescing leaf discs of *Nicotiana glutinosa*, its activity increases dramatically in the course of incubation; however, the treatment with abscisic acid, a senescence promoting hormone, resulted in a markedly reduced activity of glucanase. Since the corresponding changes of wall con-