

THE EFFECT OF THE PHOTOPERIOD AND OF THE DOSE OF SUCROSE FROM THE ENVIRONMENT OVER SOME POTATOES VARIETIES CULTIVATED IN VITRO

Agud Eliza*, Maria Zăpârțan, Mircea Savatti, Zorita Dana Cap

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: eliza_agud@yahoo.com

Abstract

It was cultivated in vitro the apical meristem detached from the potatoes varieties Ostara and Eba in MS medium supplemented with 6%, 8% and 10% sucrose and supplement of Zeatin 1,0 mgs/l and 0,5 mgs/AIB (Table 1). The bottles with the inoculated explants have been kept three weeks on the dark, and then they have been exposed to a photoperiod of 8 hours light from 24 hours. The regime of the photoperiod has influenced the regeneration of potato plantlets and the formation of tubers, depending on the variety, the dose of sucrose and the hormonal balance. The tuberization at the varieties of Ostara and Eba is determined by the photoperiod and by the average concentration of sucrose (8%) and also by the presence of zeatin in the culture medium. The Ostara variety reaches superior values both concerning the percentage of regeneration and that of tuberization, in comparison with Eba. At the great dose of sucrose of 10% it appears the unwanted phenomenon of vitrification both to the strains and also on minitubers.

Key words: tuberisation, photoperiod, dose of sucrose, apical meristem, potatoes varieties: Ostara and Eba.

INTRODUCTION

The effect of the photoperiod and of the sucrose concentration in the medium has been well studied at some bulbous varieties pursuing mainly the stimulation of their bulb making process in vitro (Raicu P., E. Badea, 1990, Zăpârțan M. et al., 2006). At the *Solanum tuberosum* L specie, at some varieties pursued the photoperiod effect, of the presence of the coal plant and of some growing substances (2iP and NAA) in medium, for the purpose of tuberisation in vitro, the photoperiod proving its efficiency depending on the potato variety (Butiuc Keul et al., 1998). We started up our experiment from the fact that the obtaining of minitubers in vitro may favor the potato culture, ensuring an early culture and a more valuable multiplication material.

MATERIAL AND METHODS

The apical meristem has been detached at about 0,5 cm from the tuber sprouts, which after the disinfection was inoculated on the variants V₀ – V₆ (Table 1). The explants were placed on Murashige – Skoog – 1962 (T. Murashige., A. Skoog, 1962) medium having, supplemented with 50 mg/l thiamine, nicotinic acid and pyridoxine, 100 mg/l myoinositol and 25 g/l sucrose. The Medium was solidified with 7 g/l agar. The pH was adjusted at 5.5 prior autoclavation.

The meristem culture was maintained in dark about 2 weeks, then passed through a photoperiodic regime of 8 hours light from 24, the intensity of the 16th hours of artificial light being assured by fluorescent tubes with an 87,0 μmol/m²/s intensity and the temperature of 27-28°C. The observations were made after 40 and 80 days from the initiation of the culture, pursuing mainly the regeneration and the formation of minitubers

at both potato varieties according to the photoperiodic treatment, dose of sucrose and hormonal composition of the culture mediums.

Table 1

The culture mediums with different concentrations of sucrose experimented on potato varieties

Var.	The basic medium	Concentration Of sucrose (%)	Hormones (mg/l)		Bonus after	
			Z	AIB	40 days	80 days
V ₀	MS	Medium	Murashige- Skoog . -1972		X	XX
V ₁	MB	6	-	-	XX	XXX
V ₂	MB	8	-	-	XX	XXX
V ₃	MB	10	-	-	X	XX
V ₄	MB	6	1,0	0,5	XXX	XXXX
V ₅	MB	8	1,0	0,5	XXXX	XXXXX
V ₆	MB	10	1,0	0,5	XX	XXX

MS = Murashige – Skoog (1962) medium; MB = basic medium according to MS ; Z = zeatin; AIB = indoliylbutiric acid. Bonus: X = low; XX = satisfactory; XXX = good result; XXXX= very good result; XXXXX = exceptionaly

RESULTS AND METHODS

The influence of the photoperiod and of the content of sucrose over the *Ostara* potato variety can be seen in Figure 1 A concerning the regeneration of strains and Figure 1 B concerning the tubers formation.

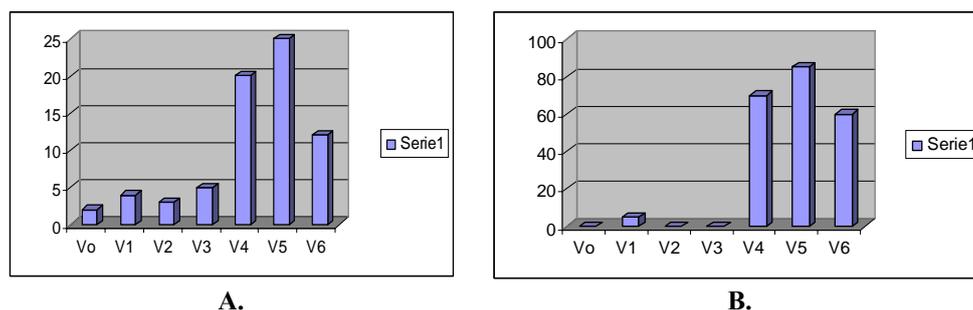
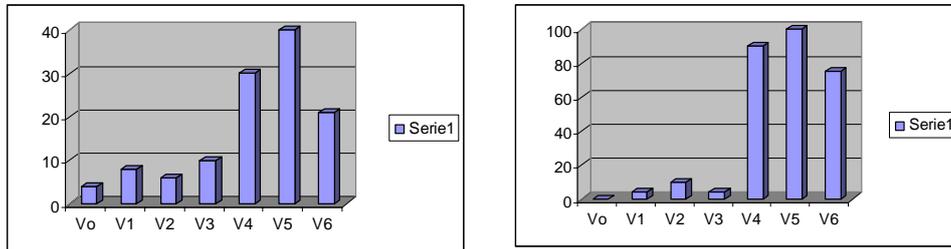


Fig.1 The role of the photoperiod and of the sucrose over the regeneration (A) and of tuberisation (B) at *Ostara* potato variety cultivated in vitro (after 40 days)

After **40 days**, the highest number of strains has regenerated in V₅ medium (with 8% sucrose and 1mg/l Z + 0,5 AIB) about 25% from explants have regenerated, followed by V₆ the variant with maximum dose of sucrose, which recorded values twice as small (about 12%). The percentage regarding the regeneration at the control medium V₀ and at the ones with different doses of sucrose V₁ V₂ and V₃ and without hormones, do not record great differences after 40 days of culture in vitro (Fig.1 A). We can still say that the photoperiod has favored the regeneration in vitro, because in conditions of normal photoperiod the percent of regeneration is much smaller (Zăpârțan, M., 1992). The tuberisation is also influenced by photoperiod, but also by a moderate dose of sucrose (see Fig. 1 B). It is only after 40 days that we can see a good percentage of tuberisation of about 85% in V₅ and 70% and 60% in V₄ and V₆. It seems that along with the hormonal balance, the great dose of sucrose and the photoperiod have stimulated a good percentage of tuberisation (relatively small tubers of 2-3 mm), a phenomenon unseen in our previous researches at Ostara variety (Agud E. et al.,2008) and neither in the literature studied by us (Baciu A., 2008).



A. B.
Fig.2 The role of photoperiod and of sucrose over the regeneration (A) and of tuberisation (B) at the *Ostara* potato variety cultivated in vitro (after 80 days)

After **80 days** the situation of the *Ostara* variety is presented in Fig. 2A and B, both under the percentage of regeneration and of tuberisation in vitro. After this period, the influence of the photoperiod is much more evident, especially over the formation of minitubers in medium with 8% sucrose and with the mentioned hormones V₅, (photo1) but also in medium with 6%(V₄), which brings us to the fact that the moderate or even low dose of sucrose favors the initiation of minitubers, who rich a percentage of tuberisation up to 100/ (Fig. 2B).

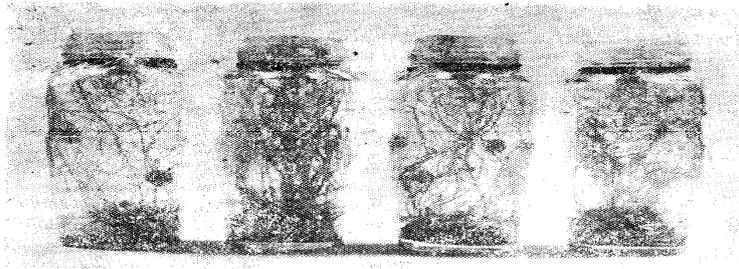
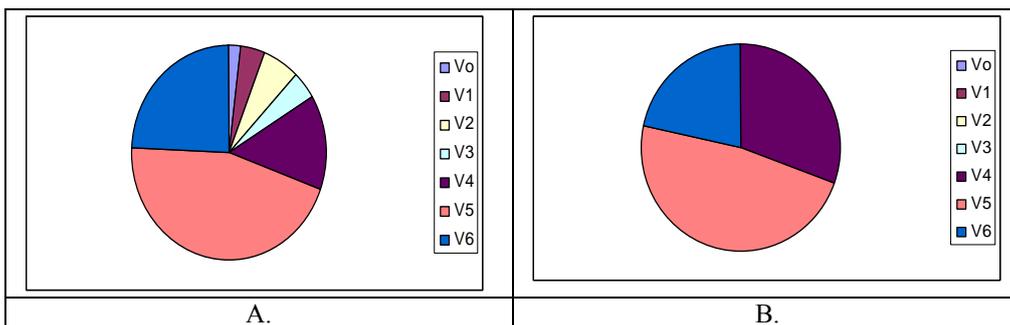


Photo 1. Minitubers obtained at Ostara potato variety (both on strainspe and in the medium)
The influence of the photoperiod and of the sucrose content over the Eba potato variety is suggestively showed in Fig. A and B.



A. B.
Fig.3 The influence of the photoperiod and of the concentration of sucrose over the regeneration (A) and of the tuberisation of the *Eba* potato variety (B) in vitro (after 40 days)

After **40 days** the *Eba* variety has a reaction in vitro inferior to the Ostara variety, a fact reported by us in our previous studies [2 – under pattern]. Both the photoperiod and

the medium or even higher dose of sucrose associated with Z and AIB, has stimulated the regeneration in vitro (V_5 and V_6), while the witness proof (V_0) and the ones with sucrose, but without growth stimulators (V_1, V_2, V_3) have reached a percentage of almost 1%, 2% and 3% (see Fig. 3A). In exchange, the tuberisation is detected only on varieties with sucrose and with increase of Z and AIB (see Fig. 3B) in small percentage of 5%-11% along with small minitubers barely formed at the ramification strains, being also known the weak reaction at the culture in vitro of the Eba variety. Still, the photoperiod and the concentration of 6 and 8% sucrose associated with growth hormones made possible the initiation of the minitubers in vitro.

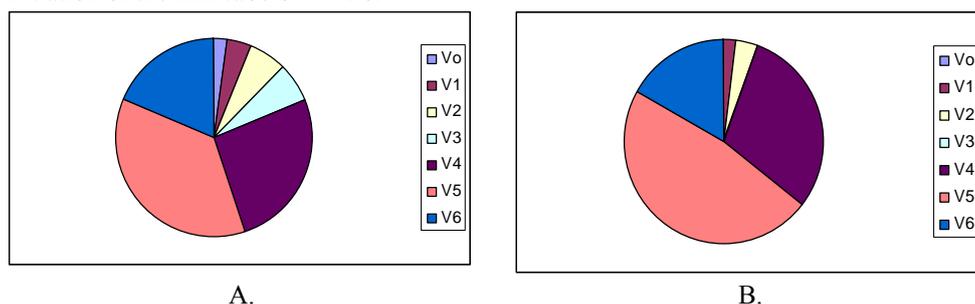


Fig. 4 The influence of the photoperiod and of the sucrose concentration over the regeneration (A) and of the tuberisation of the *Eba* potato variety (B) in vitro (after 80 days)

After **80 days** of culture in vitro, the values of both parameters are superior. The photoperiod influences positively the percentage of regenerated explants and in this case the V_5 variant reaches the highest percentage of regeneration /see Fig. 4A (photo 2). At the high dose of sucrose of 10%, the phenomenon of tissue vitrification shows up, determining the stopping of the tuberisation and the multiplication of the apical meristem. The highest percentage of minitubers at Eba variety can be also obtained in V_5 , about 51% and in V_4 , about 32% (Fig. 4B). In the V_6 medium, with high dose of sucrose, the percentage of tuberisation is of 18%, on some plantules and minitubers showing up the vitrification which, in time, slows down the development and the growth in volume of the tubers.

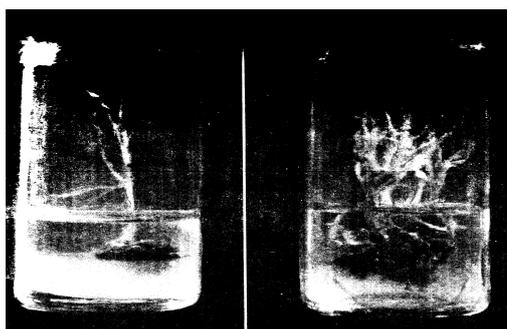


Photo 2. The vitrification phenomenon at the potato root level

CONCLUSIONS

1. The photoperiod associated with the 8% dose of sucrose and with 1mg/l Z + 0,5mg/AIB (V₅) has stimulated the tuberisation with up to 100% at the Ostara potato variety and up to 35% at Eba variety.
2. On the variant with 10% sucrose and 1mg/l Z + 0,5mg/l AIB, the tuberisation reaches a small percentage of about 18% after 80 days, showing up also the phenomenon of tissue vitrification.
3. We recommend the association of the photoperiod with the 8% dose of sucrose and with growth hormones in moderate doses in order to obtain successfully minitubers in vitro, according to the experimented variety and for assuring a quick and valuable material of reproduction.

REFERENCES

1. *Agud E., M. Savatti, M. Zăpârțan*, 2008, Hormonii de creștere implicați în tuberizarea în vitro la unele soiuri de cartof” .Analele Univ. din Oradea, Fascicula –protecția mediului, vol. 13 Ed. Univ. din Oradea, pp. 1-5
2. *Agud E.*, 2009, The in vitro multiplication of EBA potato cultivar” sub tipar la USAMV, Cluj – Napoca
3. *Baciu A.*, 2008 „Studiul privind comportamentul in vitro a unor genotipuri de *Solanum tuberosum* L., sub influența nanocompozitelor magnetofluidice bioactive” în: Biotehnologii vegetale pentru secolul XXI., Lucrările celui de al XVI – lea Simpozion National de Culturi de Țesuturi și Celule Vegetale, București, Editura Risoprint,
4. *Butiuc Keul, A., Munteanu – Deliu, C., Szabo, E., Mocan, S, Deliu, C.* 1998 „În vitro inducțion and development of microtubers in potato (*Solanum tuberosum* L.)I. Effects of growth regulators and sucrose concentration.” În: Contribuții Botanice, II, Grădina Botanică, Cluj – Napoca, pp. 195 – 201,
5. *T. Murashige., A. Skoog*,1962, Revised medium for rapid growth and bioassays with tabacco tissue cultures, *Physiol. Plant*, 15, pp. 85-90
6. *Raicu, P., E. Badea*, 1990 „Biotehnologii moderne” Editura tehnică, București,
7. *Zăpârțan, M.*, 1992 „In vitro tuberization some potato cultivars” in: *Studia Univ. Babeș – Bolyai, Biologia*, XXXVII, 2, 85 – 90,
8. *Zăpârțan M., Keul - Butic Anca, and Buzașiu, Olimpia*, 2006,„Stimularea formării bulbilor in vitro la specii din familia Liliaceae, în scopul înmulțirii rapide”. Simpozion de Culturi de Țesuturi și Celule, „Vitroculturile la cormofite, modele experimentale în cercetările de biologie” Ed. Bion, pp.164-172.