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Short Report

In Vitro Formation of Tuberous Roots in Sweet Potato*

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サツマイモにおける *in vitro* 塊根形成：中谷　誠（農業研究センター）
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For the improvement of sweet potato (*Ipomoea batatas*), it is important to know the physiological mechanism of the formation of tuberous roots. In potato, the *in vitro* tuberization system gives informations for knowing the physiological mechanism of tuberization[3]. In sweet potato, however, the tissue culture system of root for the formation of tuberous root has not been established except for some occasional formation of tuberous root *in vitro*[2]. In sweet potato, it is said that the production of tuberous root under hydroponic culture is impossible. This is due to the same reason for the difficulty in formation of tuberous root *in vitro*. Recently some investigators succeeded in sweet potato production under a hydroponic culture system[1,7]. The present study demonstrates successful *in vitro* formation of tuberous roots of sweet potato through improving culture conditions.

Materials and Methods

Sprouts from tuberous roots of the cultivar Beniazuma were cut into single node segments. After sterilization, they were incubated on a medium containing 3% sucrose and 0.2% gellan gum at 28°C in the dark for a week. The roots from these segments were cut to about 2 cm in length and transferred into a liquid medium containing a half concentration of Murashige and Skoog's salts[4] (1/2 MS), 5% sucrose and 0.2% casamino acid. They were incubated at 25°C in the dark with shaking. After 4–5 weeks, roots with a length above 15 cm were transferred into a culture system as shown in Fig. 1. The cut-end of a root was inserted into 14 m*l* of medium solidified by 0.2% gellan gum in a 10 m*l* Erlenmeyer flask and the root tip was dipped into 50 m*l* of liquid medium in a 300 m*l* bottle. The basic medium both for the solid and liquid medium consisted of 1/2 MS, 6% sucrose and 0.2% casamino acid. Indole acetic acid (IAA) and/or jasmonic acid (JA) was added to the solid medium. Benzyladenine (BA) and/or abscisic acid (ABA) was added to the liquid medium. They were placed at 25°C in the dark. Four replications were prepared for a treatment.

After 6 or 7 months culture, the maximum root diameter was measured. The thickest parts of the roots were fixed by FAA and prepared as cross sections. They were stained with safranine and fast green FCF and observed by light microscope.

Results and Discussion

In the present study the experiments were repeated three times. In every experiment, the roots with maximum diameter of more than 2 mm were observed after 6 or 7 months in culture. Fig. 1 shows examples. Only the root part that was exposed to air was swelled. Their skin color was red, the native color of this cultivar.

Table 1 shows the effects of growth regulators on the root development. Although the effects of growth regulators added to the medium were not so apparent throughout the experiments, the highest frequency of tuberous root formation and the thickest diameter of the root was observed in the treatment of JA 10^{-5} M in solid and BA 10^{-6} M in liquid medium. The vagueness of effect of growth regulators may be derived partly from the variation in physiological conditions of roots used as the materials.

Fig. 2 shows cross sections of the thickest part of swelled roots. The increase in stele

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Fig. 1. Examples of swelled root (left) and non swelled one (right) after the 7 months culture.

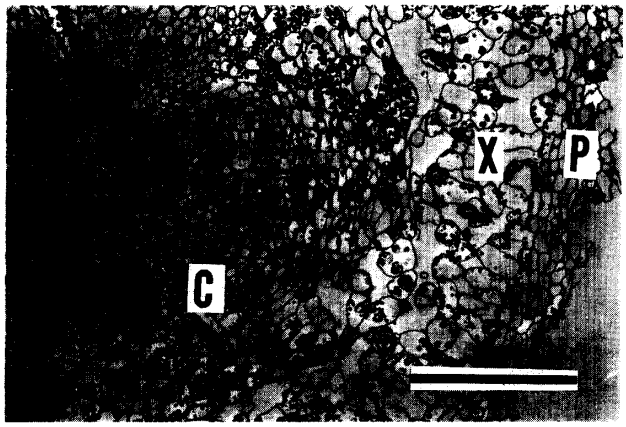

Fig. 2. An example of cross section of swelled root *in vitro*.
P : periderm, X : cortex, C : primary cambium. Bar in the figure shows 1 mm.

Table 1. Effects of growth regulators on number of thick roots (>2mmϕ) and maximum root diameter after the 7 months culture of sweet potato root *in vitro*.

Solid medium	Liquid medium	Number of thick roots (>2mmϕ)	Maximum root diameter (mm)
Hormone free	Hormone free	1	2.1
JA 10^{-5}M	Hormone free	1	2.6
JA 10^{-5}M	BA 10^{-6}M	3	5.0
JA 10^{-5}M+IAA 10^{-8}M	Hormone free	1	2.2
JA 10^{-5}M+IAA 10^{-8}M	BA 10^{-6}M	1	2.3
JA 10^{-5}M+IAA 10^{-8}M	BA 10^{-6}M+ABA 10^{-7}M	1	3.2

diameter was observed. The primary cambium and periderm were differentiated. These features are identical with those of tuberous root[6]. It was concluded, therefore, that the swelled roots in the present study were tuberous roots. When the root was dipped throughout in a similar medium, the *in vitro* application of JA[5] and/or BA did not induce thickening of stele but a swelling of cortex cells. Thus, it is thought that the formation of tuberous root in the present study largely depends on the physical condition of this culture system. Especially the improvement of oxygen supply for root by exposure to air seems effective as well as in the case of hydroponic culture[1,7].

Further improvement is still needed as a tool for physiological studies of tuberous root formation and as a propagation method in sweet potato. However, they are topics of future study.

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