Proc. Indian Acad. Sci. (Plant. Sci.), Vol. 90, Number 6, December 1981, pp. 541–546.

Initiation of adventitious buds in tuberous roots of *Ipomoea batatas*

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MS received 27 January 1981 ; revised 17 November 1981

Abstract. The anatomical development of adventitious buds in the tuberous roots of *Ipomoea batatas* has been studied. Only the detached tubers regenerate. The bud primordia develop from the procambium-like cells adjoining lateral root scars. Initially, the buds grow away from the surface of the tuber but, later, they turn almost 180° towards the surface of the tuber, before bursting out of the tuber. The growth of the bud is largely contributed by random periclinal divisions of parenchymatous cells of the bud primordium. The basipetally developed vasculature of the bud is connected to the vasculature of the lateral root.

Keywords. *Ipomoea batatas* (L.) Lam. ; adventitious bud ; tuberous roots.

1. Introduction

The occurrence of adventitious buds is very common in dicotyledons (Charlton 1965). The anatomical development of adventitious buds were studied by Murray (1957) and Khan (1973). In case of sweet potato the roots do not regenerate as long as they are intact to the living plant but the detached roots show signs of regeneration. In the present paper we report the anatomical developmental pattern of adventitious buds in *Ipomoea batatas*.

2. Material and methods

The tuberous roots of *Ipomoea batatas* (L.) Lam. were collected from local fields (Boriyavi village, Gujarat) and planted in the pots containing garden soil in horizontal and vertical positions. After 25 days of plantation the regenerated tubers were collected and fixed in FAA. The material was dehydrated through TBA series and embedded in paraffin. The sections were cut at 8-10 μ with Spencer-820 rotary microtome and stained with safranin-fast green combination.

3. Observations

The tubers of sweet potato (*I. batatas*) do not show any sign of regeneration when they are still intact to the root system of a living green plant. But the detached tubers when planted in the soil develop a number of buds within 25 days. In

general, the buds develop on either ends of the tuber and occasionally from its middle part, too. The orientation of the tuber in the soil does not make any change in the development of adventitious buds. The number of buds from each site varies from one to three. All the initiated buds however, survive and grow actively.

3.1. *Development of adventitious buds*

The morphological observations show that the tuber portion at which the bud primordium is to develop, becomes bright red, bulges and then bursts as the developing bud beneath it protrudes out on the tuber surface.

The anatomical observations show that the bud primordium develops in association with lateral root scars (plates IA and plate II). The lightly stained bud primordium is initiated from the procambium like cells present below the tuber surface approximately at 20 layers deep (plate IB). These procambium like cells divide and redivide and form a mass of cells which are vacuolated and these vacuolated cells serve as the early bud primordium (plate IC and plate II 2, 3) which grows downwards. As soon as the bud primordium initiates and grows, the tuber surface at that site bulges out. A gap between the bud primordium and the surrounding parenchymatous cells is communicated by the growing bud primordium throughout its development (plate IF and plate II). Some of the parenchymatous cells of the bud primordium become meristematic and undergo periclinal divisions to the bud surface (plate ID and E, arrows) so as to increase the bulk of the bud primordium.

Once the bud primordium has become massive it changes its direction of growth. The bud primordium takes almost 90° turn in its direction of growth (plate IG and plate II, 4) which is preceded by the longitudinal elongation of parenchymatous cells at the junction of the bud primordium and surrounding the tuber cells (plate IH). The bud in its later stages becomes meristematic and gives rise to prophylls which are still growing on lateral side, i.e., away from the lateral root scar (plate IG). The bud again takes 90° turn before it bursts out of the tuber surface (plate I and plate II 5). Once the bud with leaves has come out of the tuber surface, the gap between the bud and the neighbouring cells is eventually replaced with new cells by lifting the bud completely out of the tuber surface (plate IJ). The matured bud apex is organized with two tunica layers and a mass of corpus beneath it (plate IK).

3.2. *Vasculature of adventitious bud*

The bud vasculature differentiates from the parenchymatous cells of the bud primordium which divides anticlinally to differentiate narrow, elongated procambial cells. These procambial cells later differentiate into complete vasculature of the bud which extends downwards and connects to the lateral root vasculature (plate IL).

4. Discussion

Vegetative propagation by root cuttings gives plants true, in most characteristics, to the parent plant. The tuberous roots of sweet potato do not regenerate as long

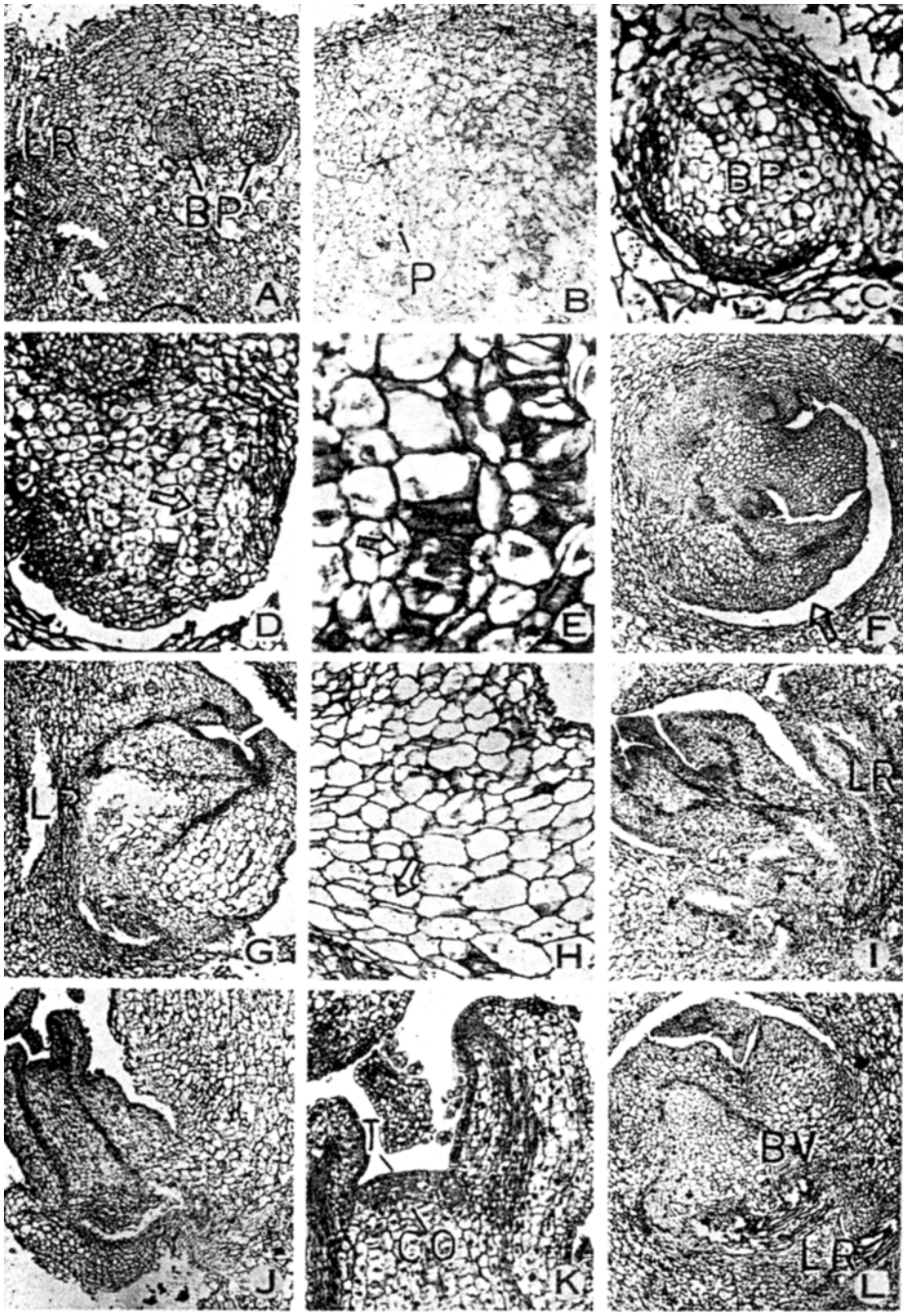

Figure 1. **A.** LS of tuber showing two bud primordia beside lateral root scar × 45, **B.** LS of tuber showing the division of procambium like cells beside lateral root scar. × 55, **C.** LS of tuber showing young bud primordium growing down from the tuber surface. × 110, **D, E.** The bud primordium showing randomly dividing parenchymatous cell (arrows) and advancing bud growth. × 130 (D) and 356 (E), **F.** Budprimordium in communication with gap. ×47, **G.** Bud with prophylls growing on lateral side and away from the lateral root scar. × 31, **H.** Parenchymatous cells showing longitudinal elongation due to the change in direction of bud in its growth (arrow). × 290, **I.** Bud with several leaves bursting out of the tuber surface. × 31, **J.** Bud with leaves lifted completely out of the tuber surface, ×31, **K.** Bud apex organized with two tunica layers and a mass of corpus. × 103, **L.** LS of tuber showing connection between lateral root vasculature and bud vasculature ×31, BP—bud primordium, BV—bud vasculature, Co—Corpus, LR—Lateral root, P—procambium like cells, T—tunica.

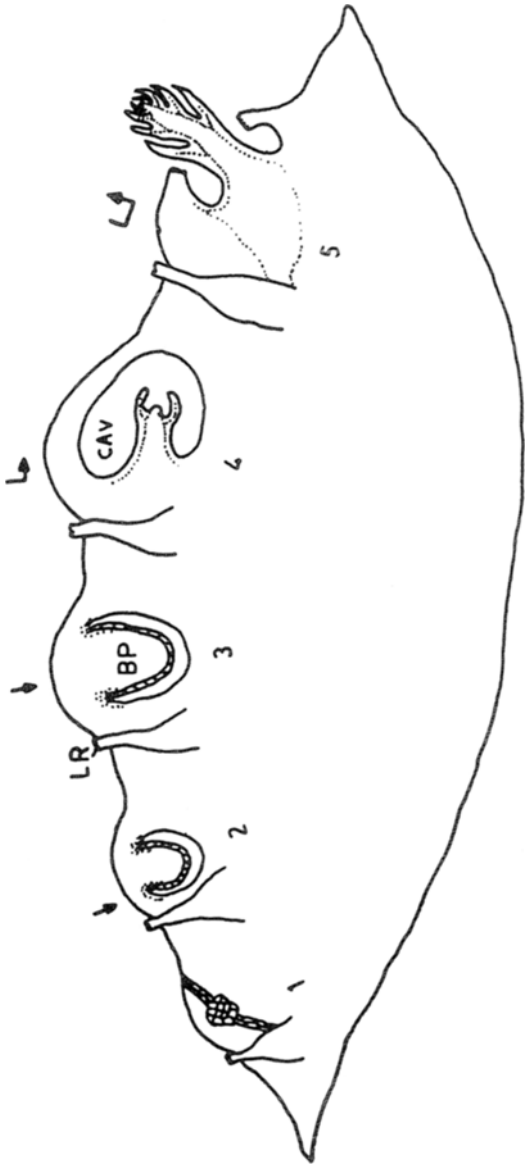

Figure 2. A schematic representation of developmental stages of root-borne bud in *I. batatas*. 1-5. Stages of bud development, arrows—the direction of growth of bud, BP—bud primordium, CAV—cavity between bud primordium and its neighbouring cells, LR—lateral root.

as they remain intact with the plant, but excised tubers do regenerate. It is obvious that the parent shoot system inhibits regenerative potentiality. The tuber stores enough reserve food to support initiation of bud primordia which grow actively.

The occurrence of adventitious buds from secondarily thickened roots is reported in *Linaria* (Charlton 1965), *Midicago sativa* (Murray 1957) and *Taraxacum* (Khan 1973). Since the secondarily-thickened roots can regenerate, it possibly explains that when the root has undergone secondary growth, the tissue matures and can not only store reserve food but also synthesize growth substances so that they acquire a potentiality for regeneration (see Thurman and Street 1960).

The occurrence of buds, beside lateral roots, is reported in *Moringa* (Dore 1955), *Medicago* (Murray 1957), *Linaria* (Charlton 1965) and *Taraxacum* (Khan 1973). Since the origin of the bud in *I. batatas* is associated with lateral root scars, it is assumed that the lateral root scars must be acting as sinks for nutritive materials as well as bud-inducing substances, and possibly these substances shift to the site of malleable meristematic tissues inducing buds. The primordium of the bud is a mass of parenchymatous cells which randomly divide periclinally, and contribute to the primordium. The origin of the bud due to division of procambium like cells, can be said endogenous.

The bud primordium grows downwards, turns 180°, and protrudes beyond the tuber surface. It is common in many plants where the initiation is deep-seated ; and in most endogenous lateral roots. The development of vasculature of the bud is basipetal, connected to the lateral root scar.

Acknowledgement

One of the authors (TKP) is thankful to the Gujarat Government for financial assistance.

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