Short Communication

ANATOMICAL EVIDENCE FOR THE EXISTENCE OF ROOTS ON POTATO TUBERS AND STOLONS[1]

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Abstract

Roots on potato tubers and stolons displayed the normal root anatomy which consisted of a central vascular cylinder surrounded by endodermis with Casparian strips, the cortex and epidermis. Tuber roots appear to initiate from the parenchyma cells adjacent to the vascular tissue. Shoot tips were similar to normal apical meristems. These observations support our research demonstrating the growth of functional roots from potato tubers and stolons.

Introduction

There are numerous reports on the anatomy of tubers, stolons and roots in *Solanum tuberosum* L (1, 2, 3, 4, 5, 7, 8, 9). Information is sparse concerning the presence and function of roots on different plant parts. In a recent study the existence of functional roots on potato tubers and stolons was documented (6). To our knowledge there are no other reports indicating the presence of tuber roots. This investigation was undertaken to provide anatomical evidence in support of the previous study (6) for the existence of roots on tubers and stolons.

Materials and Methods

Russet Burbank tubers and roots were obtained from field experiments conducted at the University of Wisconsin Hancock Experiment Station. Plants were carefully removed manually from the field, washed and transported in a moist medium to the laboratory for further study. Within 3-4 hours after removal from the soil, samples of adventitious roots (Fig. 1A) and shoots were fixed in formalin-aceto-alcohol (FAA), dehydrated in a series of normal butyl alcohol solutions and infiltrated with paraplast. Sections were cut (10 μm thick) using a rotary microtome and attached to glass slides. The slides were stained with safranin crystal violet and light green SF yellowish.

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KEY WORDS: Tuber roots, stolon roots, root anatomy.

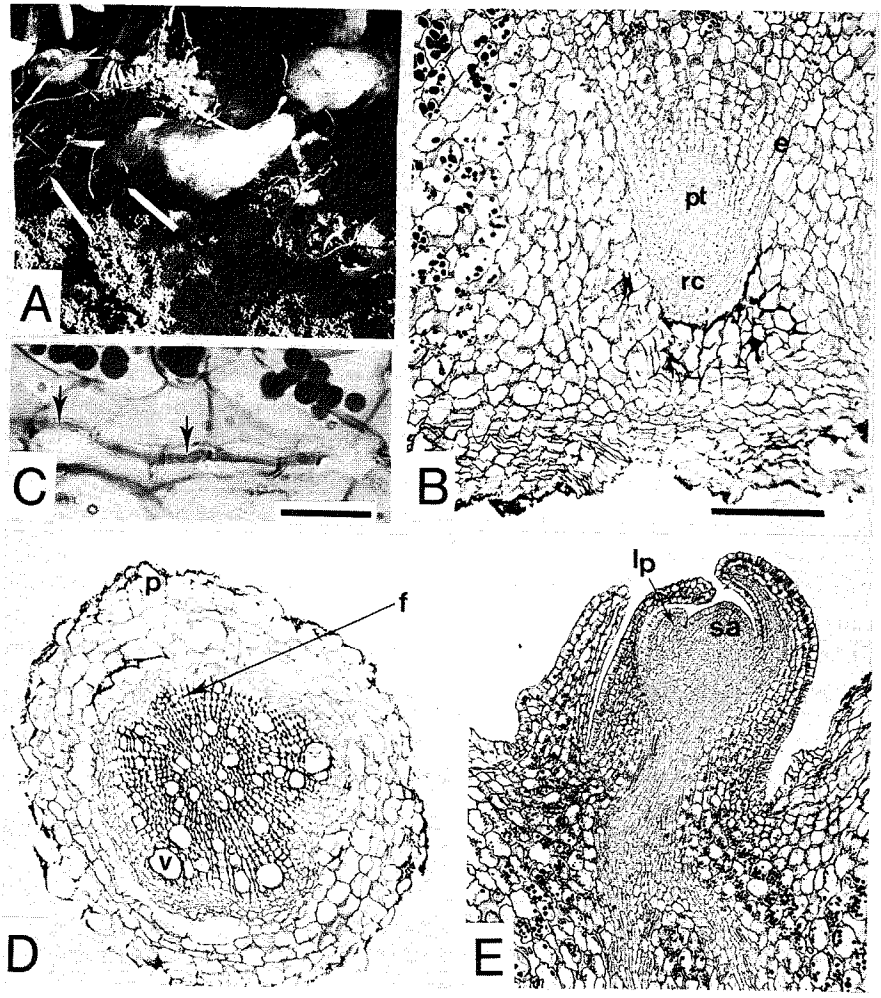

FIG. 1. Anatomy of roots and shoot meristem on potato tubers. Line in B represents 250 μm and line in C represents 20 μm. Magnification for B, D, and E are the same. A. Roots on tubers and stolons (arrows). B. Longitudinal section of root primordium differentiating within tuber. C. Longitudinal section of root initiated from a tuber showing Casparian strips in endodermis (arrows). D. Transverse section of tuber root showing secondary growth. E. Longitudinal section of shoot tip differentiating from tuber; e = epidermis; f = fibers; lp = leaf primordium; p = periderm; pt = procambial tissue; rc = root cap; sa = shoot apex; v = xylem vessels.

Results and Discussions

Roots initially appeared as primordia within the tuber (Fig. 1B) and subsequently grew through the cortex and periderm to the exterior. These roots were initiated from parenchyma cells adjacent to the vascular tissue.

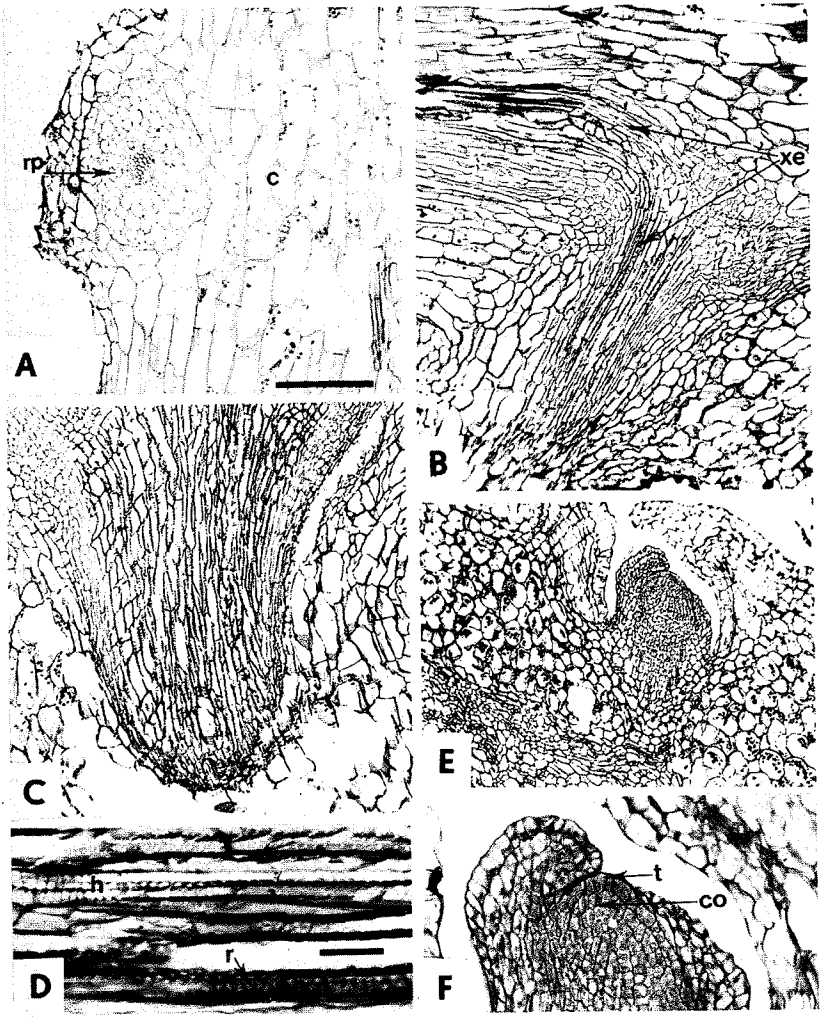

FIG. 2. Anatomy of roots and shoot meristem on potato stolons. Line in A represents 250 μm and the magnification for B, C, and E is the same. Line in D represents 50 μm and magnification of F is the same. A. Transverse section of root primordium showing tetrarch xylem strands. B. Longitudinal section of stolon with differentiating root. C. Longitudinal section of stolon with advanced differentiation of the root. D. Longitudinal section of xylem showing helical thickenings and reticulate pits. E. Longitudinal section of stolon showing differentiating shoot tip. F. Enlargement of E showing tunica and corpus in apical meristem. c = cortex; co = corpus; h = helical thickenings; r = reticulate thickenings; rp = root primordium; t = tunica; xe = xylem elements.

This is expected since adventitious roots are known to differentiate from parenchyma cells (4). The root tips consisted of the root cap, quiescent center, epidermis, cortex and procambial tissue (Fig. 1B). As the roots continued to elongate, the cells, about 450 μm from the meristem, enlarged

and became differentiated. Helical and pitted reticulate xylem elements were prominent in the vascular tissue. An endodermis surrounding the vascular cylinder had conspicuous Casparian strips (Fig. 1C arrows). The epidermal cells adjacent to the cortex were small (Fig. 1B). The roots had undergone secondary growth as phloem and xylem were differentiating from the cambium (Fig. 1D). The xylem consisted of different sized vessels, xylem parenchyma and fibers (Fig. 1D). Externally a periderm was differentiating.

In the stolon, also, root primordia differentiated from parenchyma cells (Fig. 2A). In more mature stolons the roots were advanced through the cortex and epidermis to the exterior. A cambium had formed and helical and pitted reticulate thickenings in the xylem were conspicuous (Fig. 2C, D). Casparian strips in the endodermis of the stolon roots were prominent.

The shoot apices from tubers had an apical meristem (Fig. 1E). Leaf primordia surrounding the meristem and a procambium were differentiating (Fig. 1E). The shoot apices in the stolon were similar to the apices on the tuber with a tunica and 2-3 layered corpus (Fig. 2E, F).

The anatomy of the adventitious roots from tubers and stolons was similar to roots originating from other parts of the plant. An earlier report indicated these roots to be functional (6) and from anatomical evidence this appears valid.

Acknowledgment

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