Development and Contraction of Contractile Roots in *Crocus sativus*

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Abstract

The contractile roots of *Crocus sativus* are formed from meristematization of parenchyma cells at the base of terminal, lateral buds and corm. When the contractile roots are 1-1.5 cm long, cortex cells are changed and grow horizontally and then collapse. In the end of this process, the contractile parenchymal cells grow more horizontally and cell walls remain, which causes the root to shrink. In the contraction process the central cylinder cells and vessels remain intact.

INTRODUCTION

In *Crocus sativus* L., in addition to ordinary fibrous roots, different kinds of contractile roots are formed. They called fibrous, corm, terminal and lateral buds contractile roots (Khalesi et al., 2003). In the other plants contractile roots are also observed (Halevy, 1986; Iziro, 1984; Puetz, 1999). Corm figure and size, soil depth, type and accumulation, temperature, light, amount of N_2 and CO_2 and hormones affect growth and contraction of contractile roots (Chio-Sang, 1996; Negbi, 1999). Root contraction in the monocotyledons is a result of horizontally growth of cortex cells, accumulated water and minerals, their collapse and change of the direction of cellulose microfibriles (Fahan, 1990; Puetz, 1995; Sterling, 1972,).

MATERIALS AND METHODS

Cultivation

Corms of cultivated saffron were cultured in sand or clay, or a mixture of them, in 5-cm depth.

Preparation of Samples for Light Microscope

Morphologic studies were carried out by light microscope. The segments of fibrous and contractile roots, in different steps of growth, were fixed by FAA (Formaldehyde, Ethanol, Acetic Acid 1:2:17). The samples from contractile roots were included the root tip, the without contraction region of root, the swelling region and contraction region. They were then sectioned on a microtome and stain either with Heamatoxylin, Methyl-pyronin green (Jensen, 1962) or Flouroglucin-HCl (Harborn, 1962). They were studied under a light microscope. In addition, some of non-stained sections were studied under phase-contrast light microscope.

RESULTS

Comparison of Longitudinal Section of Contractile Root and Fibrous Root

In the contractile roots, the cap, calyptra and meristem are vaster than fibrous roots. The numbers of cortical layers are more than fibrous roots. Contractile roots are swollen and greater. In the contractile roots the elongation region is longer than fibrous roots and the cell differentiation is slower (Figure 1 A, B, C). One or two red colored layers of sub-epidermal cells are Flouroglucin-HCl-positive, which shows they become lignified. The cortex parenchyma is Flouroglucin-HCl-negative which evident its cells have cellulosic walls.

Structural Changes of Contractile Roots in the Different Stages

When the contractile roots are 1-1.5 cm long, the cells of root specially the cortex cells are changed to produce the contractile region in the base of the roots. The cortex cells grow horizontally and their cell walls become shrank. When water enters, they become swollen and then collapse. In the end of this process, the contractile parenchymal cells grow more horizontally and their cell walls remain and it causes the root to shrink. These changes gradually continue to a point near the root tip (figure 2, A and B).

Central Cylinder Changes

In the contraction process, the central cylinder cells and vessels remain intact. These cell walls are longitudinal pressed altogether and get wrinkled. These changes cause root to become shorter and corm to attract into depth of the soil.

DISCUSSION

Contractile roots of *C. sativus*, like contractile roots in the other plants, cause the corm to attract into depth of the soil and accumulate water and minerals (Puetz, 1992, 1993). Fibrous and corm contractile roots provide water and minerals for mother corm and buds contractile roots for daughter corms. Morphological study of contractile roots, in different steps of their growth shows that the contractile parenchyma is a main reason for root contraction. The cortex aerenchyma pressed by growing the contractile parenchyma more than other root tissues. The main characteristic of contractile roots is change of growth direction of cortex parenchyma.

Collapsing of outer and middle cortical cells, lateral development of inner cortical cells and unchanged epidermal cells caused contraction. Wrinkled longitudinal cell wall of inner cortical cells and stele and decrease of longitudinal growth of these cells move corms deeper in the soil. The success obtained this experience about contractile roots can be used to examine the formation and growth of procreative buds and pigments rate.

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Figures

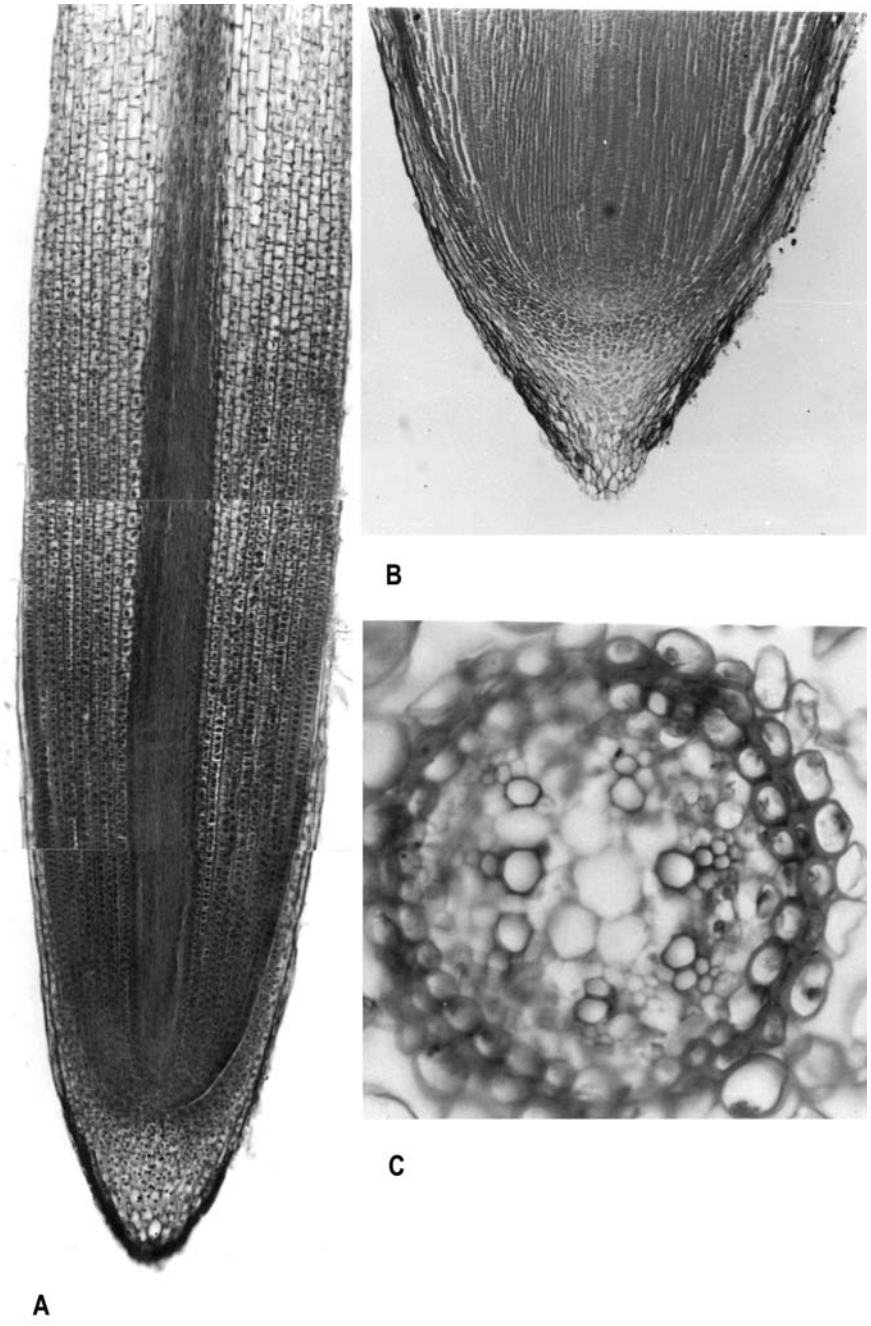

Fig 1. A. Longitudinal section of fibrous roots, staining with methyl-pyronin green. Magnification × 330. B. Longitudinal section of apex lateral bud contractile root, staining with pyronin methyl green. Magnification × 50. C. Central cylinder of fibrous contractile root.

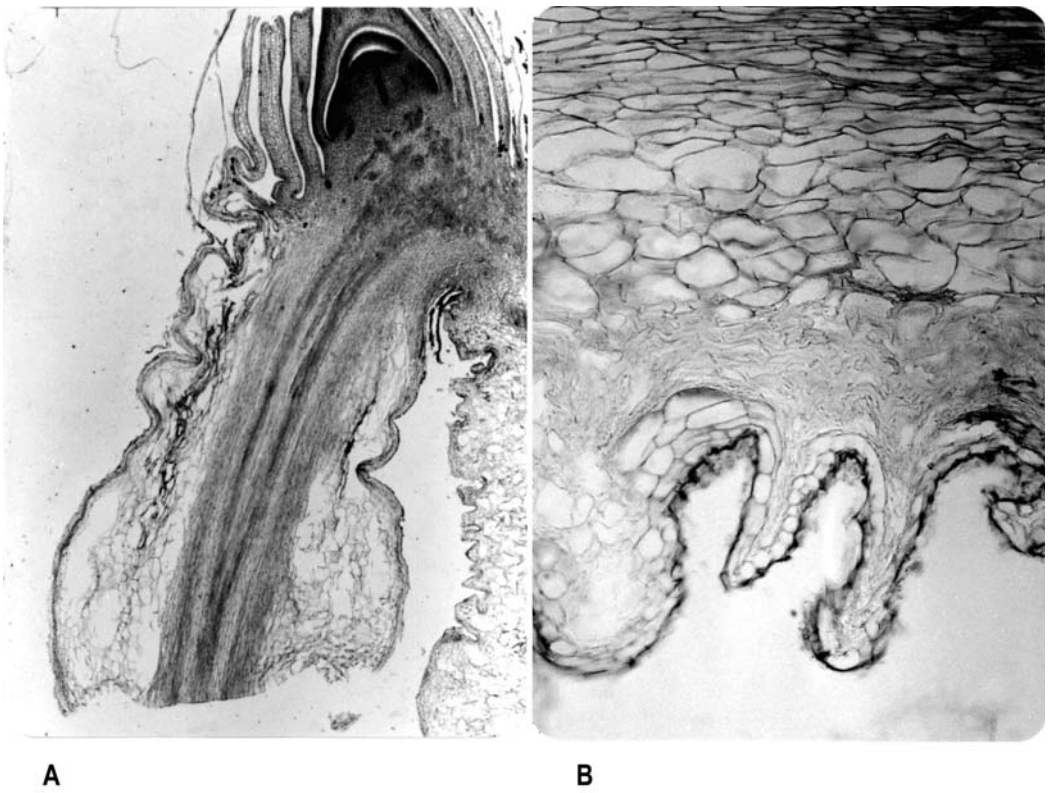

Fig 2. A. Longitudinal section of contractile root in relation with lateral bud and mother corm, staining with hematoxylin. Magnification × 132. B. Longitudinal section of contractile root in old age stage, staining with hematoxylin. Magnification × 500.