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Traumatic Gum Duct Formation in *Sterculia urens* ROXB. in Response to Injury

By

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With 4 Figures

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Summary

SETIA R. C. 1984. Traumatic gum duct formation in *Sterculia urens* ROXB. in response to injury. — Phyton (Austria) (2): 253—255, with 4 figures (1 plate). — English with German summary.

The gum ducts normally occur in the pith and cortex of young stem of *Sterculia urens*. Time course experiments involving mechanical injury to both young and old stems indicate that gum ducts are also formed in the xylem within 30—40 minutes. These ducts, called as traumatic ducts, are formed as a result of breakdown of xylem cells. A traumatic duct shows an irregular lumen without any distinct epithetial cells. Histochemical test reveals that the nature of the gum produced in these ducts is similar to that in the normal ducts.

Zusammenfassung

SETIA R. C. 1984. Bildung von Wundgummikanälen in *Sterculia urens* ROXB. nach Verletzung. — Phyton (Austria) 24 (2): 253—255, mit 4 Abbildungen (1 Tafel). — Englisch mit deutscher Zusammenfassung.

In jungen Sprossen von *Sterculia urens* kommen Gummikanäle normalerweise im Mark und in der Rinde vor. Versuche ergaben, daß nach Verletzung junger wie alter Stämme innerhalb 30—40 Minuten auch im Xylem Gummikanäle gebildet werden. Diese „traumatic ducts" genannten Kanäle entstehen durch Zusammenbruch von Xylemzellen. Derartige Kanäle zeigen ein unregelmäßiges Lumen ohne jede epithelartige Zellen. Die histochemische

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Untersuchung (Anfärbung mit Rhutheniumrot, vom Editor erg.) zeigt, daß sich der in den Wundgummikanälen gebildete Gummi von dem normalen nicht unterscheidet. Editor transl.

1. Introduction

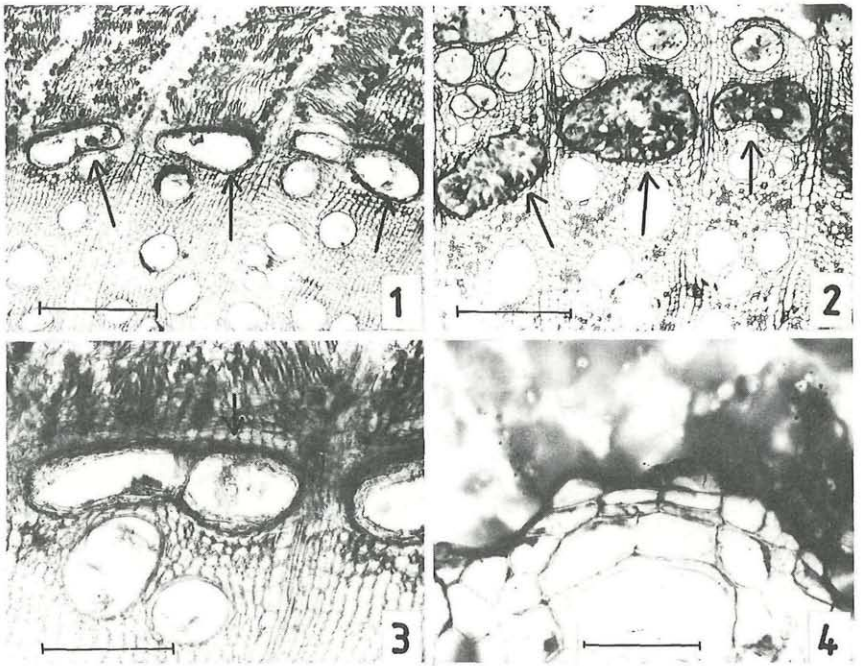
Sterculia urens is the source of karaya gum which is an important raw material in the textile cosmetic, food, pharmaceutical and other industries. Gum karaya is collected as exudate from the natural wounds or from the cuts made artificially (tapping) on the stem and the branches of *Sterculia urens* (Anonymus 1973). Purkayastha (1959) observed the formation of ducts in the xylem or wood in response to injury which exude gum profusely. He called these ducts as 'traumatic' ducts. However, in the young stem of *Sterculia urens* gum ducts are present in the cortex and pith but absent in the xylem (Shah & Setia 1976). It seems that in xylem the gum ducts originate in response to injury. How these ducts are formed and what type of histological changes take place during their development is not known. In the present investigation experiments were carried out to study the effect of mechanical injury on traumatic duct formation and to study the histological changes during their development.

2. Materials and Methods

For experiment on young branches, the stem tips of *Sterculia urens* Roxb. were cut transversely and were left exposed to environment. Two centimeter long pieces of the stem behind the cut end were fixed in Carnoy's fluid (Sass 1958) at 5, 10, 20, 30 and 40 minutes interval after exposure. For control, a 2 cm long piece of stem was immediately fixed after cutting the tip. For experiments on old stem or tree trunk, incisions were made through the bark deep upto wood with hammer and chisel. Square blocks of bark with some wood were fixed at 5, 10, 20, 30 and 40 min after incisions. A block was fixed immediately after incision which served as control. Transverse and longitudinal sections of the fixed materials were cut on a sliding microtome and stained with safranin and fast green. Gum in the tissue was localized with ruthenium red stain (Jacobs 1959).

3. Observations and Discussion

When the young stem is cut transversely gum exudation is seen even with naked eye on the cut surface from the ducts present in pith and cortex. However, after 30 min exposure gum is also seen exuding in the xylem region near the cambium on the cut surface. Likewise on the tree trunk where the incisions were made deep upto the wood, no exudation occurs initially but after 30 min profuse exudation of gum was seen in the xylem region.



Figures 1—4. *Sterculia urens*. Formation of truamatic ducts as a result of injury. All transverse sections stained with ruthenium red. Fig. 1. Arrows indicate the presence of traumatic ducts in the xylem near the cambium. Index bar = 500 μm. Fig. 2. Traumatic ducts in the xylem near the cambium. Index bar = 500 μm. Fig. 3. Arrow indicates cambial zone. Index bar = 330 μm. Fig. 4. Cells lining the duct lumen do not show the presence of gum. Index bar = 100 μm.

Observations on the transverse and longitudinal sections from the material showing gum exudation indicate the presence of small ducts in the xylem near the cambium (Fig. 1). Such ducts have been referred to as traumatic ducts because of their origin as a result of injury or wound. Similar ducts are also developed in the xylem parenchyma in the plant material fixed at 40 min interval after incision (Fig. 2).

The traumatic gum ducts form a circular band parallel to the cambium zone (Fig. 1). A traumatic gum duct has irregular lumen with no definite epithelical cell layer (Fig. 3) unlike a normal duct which is oval to round in shape and has definite epithelial layer (Shah & Setia 1976). The cambial zone is prominent and consists of 8—9 cell layers (Fig. 3). As this zone is structurally uniform irrespective of the absence or presence of the ducts nearby, it is concluded that the traumatic gum ducts develop from the young and mature xylem cells. The parenchyma cells lining the duct lumen show degradation and appear irregular (Fig. 4). These cells do not show the presence of gum. Because of the absence of definite epithelial cell layer, thus, it appears that the duct presumably develop lysigenously. The nature of gum in the traumatic ducts and in the normal ducts in cortex and pith of young stem is similar as indicated by histochemical test. In both the cases the intensity of colour reaction with ruthemium red is same.

It is well known that gum originates in plants as a result of physiological or pathological disturbances, or injury or a normal metabolic activity (Setia & Shah 1979). In the present case injury induces the development of traumatic gum ducts. Because due to injury the plant tissue is exposed to external environment, it is possible that microorganisms find their way into the plant and bring about pathological breakdown of cells to form gum. Thus these traumatic ducts form the major source of gum exudation during tapping of trees on large scales.

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