Anatomical structure of stem in the above- and underground portions of *Rosa rugosa* suckers

INTERNATIONAL JOURNAL OF HORTICULTURAL SCIENCE
AGROINFORM Publishing House, Hungary

Fouda, R.

University of Horticulture and Food, Budapest, Hungary and Mansoura University, Egypt
H–1091 Budapest, Üllői u. 93

Key words: Rosa rugosa, suckers, anatomy, juvenility, etiolation, rooting

Summary: Comparitive histological studies were made on the underground and the aboveground stem parts of Rosa rugosa taken from one year old suckers. The underground stem parts were characterized with thicker primary cortex, phloem and pith, weaker phloem fibers, wider cambial zone, medullary rays, xylem and phloem rays as compared with the aboveground stem parts. The most marked differences in the underground stem parts were in the wide cambial zone and in the development of some adventitious roots.

Introduction

Rosa rugosa is a popular hardy ornamental shrub in Hungary. It has the inclination to develop suckers from the underground part of the bush, and these suckers are also used in the propagation. *(Nagy* and *Schmidt,* 1989).

The physiological state of such plants plays an important role in the adventitious root formation. There are spectacular morphological differences between the underground and aboveground stem of the suckers. The underground parts resemble roots: They are practically spineless, have small and flat buds, the bark is of brownish colour and fleshy consistency. The above-ground stem parts, on the other hand, are similar to the "normal" shoots developing in any part of the crown. They are thickly covered by small prickly spines, and are grayish green tomentose on their surface The bark is hard (not fleshy), with clearly visible ovate buds *(Schmidt,* 1992 and 1998). There are also constant changes in their ability for adventitious root formation. Hardwood cuttings propagated under greenhouse conditions (Schmidt, et al., 1994) or from leafy stem cuttings treated with IBA at different concentrations *(Fouda,* 1994), rooted poorly. The under-ground stem parts of their suckers, however, have the tendency to form adventitious roots even on the intact plant *(Schmidt* and *Tóth,* 1996: *Krüssmann,* 1989, *Mac-Cártraigh,* 1997) *Schmidt* (1982) studied this phenomenon on *Tilia tomentosa* and supposed that both etiolation and juvenility factor played role.

The aim of the present studies was to study the histological differences between the aboveground and underground parts of suckers and to clear which of these features are most responsible for the increased rooting ability.

Materials and methods

One year old suckers of *Rosa rugosa* were collected from the Garden of University of Horticulture and Food, Budapest, Hungary. For histological studies their 1–2 cm long stem portions were taken from cca 1 cm under and 1 cm above the soil surface (10–10 samples each). The samples were killed and fixed in 70 % ethanol. The sections were prepared by hand and stained in safranin and light-green. The histological measurements were carried out under a Visopane microscope at 50-fold and 125-fold magnifications.

Results and discussion

The most important histological differences in the underground and the aboveground stem parts are shown in Table I and illustrated in *Figs 1–4* as follows:

The thickness of the stem (total radius), surface tissue, xylem tissue and diameter of pith in the underground stem parts shows a small increase. The underground stem part is also characterized by thicker phloem, wider cambial zone, phloem and xylem rays as compared to the aboveground stem parts.

Striking differences were found in the cambial zone. In the underground stem, it became almost one and half times as wider than that in the aboveground stem part. Also, the phloem fiber bands in the underground stem part are relatively weaker and more divided: by more numerous and wider gaps between them *(Fig. 2).* These anatomical features especially wider cambial zone, gaps between the phloem fibers, wider xylem and phloem rays are important for

Table 1 Distribution of the tissues (µm) in both under and above-ground stem parts of Rosa rugosa

Characters	under ground stem part(2)		above ground stem part(3)	
	%	µm	%	µm
stem diameter	100	2541.9	100	2116.8
surface tissue thickness	5.7	144.5	5.4	114.0
cortex I. (collenchyma thickness)	1.6	41.2	3.0	63.2
cortex II. (no. of cell layers)	–	3	–	4
cortex III. (parenchyma thickness)	6.6	167	9.9	210.0
cortex IV. (no. of cell layers)	–	9.0	–	12.0
total cortex thickness	8.2	208.2	12.9	273.2
phloem fiber thickness	1.5	38.6	3.0	64.2
no. of cell layers	–	5.0	–	8.0
no. of gaps between phloem fiber bands	–	35.0	–	30.0
gaps width	–	134.0	–	80.0
phloem thickness	4.8	122.0	3.2	67.0
cambial zone thickness	2.7	69.6	1.7	35.6
xylem thickness	17.7	449.0	21.9	462.8
phloem rays width	–	28.4	–	18.4
xylem rays width	–	13.8	–	10.0
pith diameter	59.4	1510	51.9	1100

adventitious root formation. *Fahn* (1977) reported that the adventitious roots of some *Rosa* species originated from cambial zone especially from the interfascicular regions. He added that the easy rooting of plants is usually associated with broad vascular rays, while plants having narrow rays root with difficulty.

One of the characteristics of the underground stem of certain species of *Rosacae* is that a special phellogen is formed. This protective tissue is called polyderm *(Fahn,*

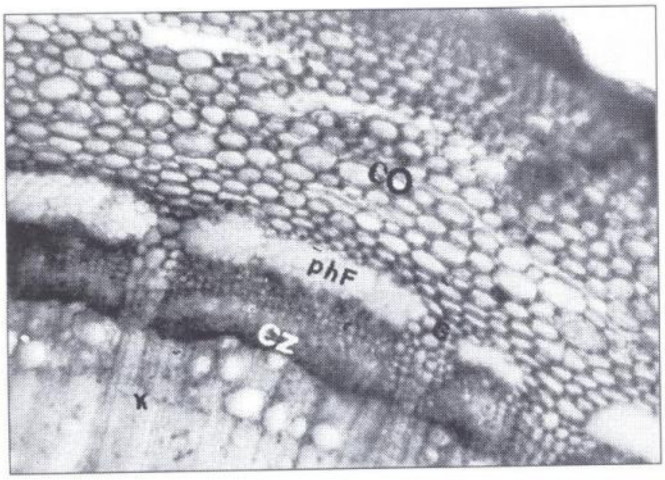

Fig. 1 Cross section through the above ground stem part of *Rosa rugosa* sucker (obj10x oc. 4x). co = cortex; ph = phloem; phr = phloem fiber; cz = cambial zone, x = xylem g= gap between phloem fibers.

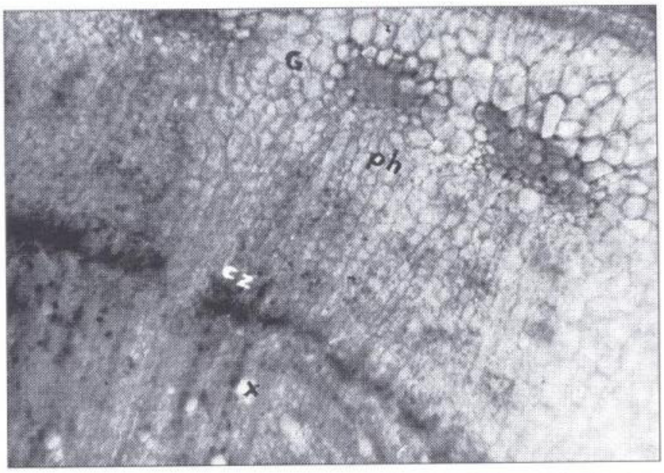

Fig. 2 Cross section through the under-ground stem (sucker) part of and xylem rays *Rosa rugosa* showing weak fibers,and a wide cambial zone, phloem (obj. 20 x oc.4x). (Abbreviations as on fig. 1.).

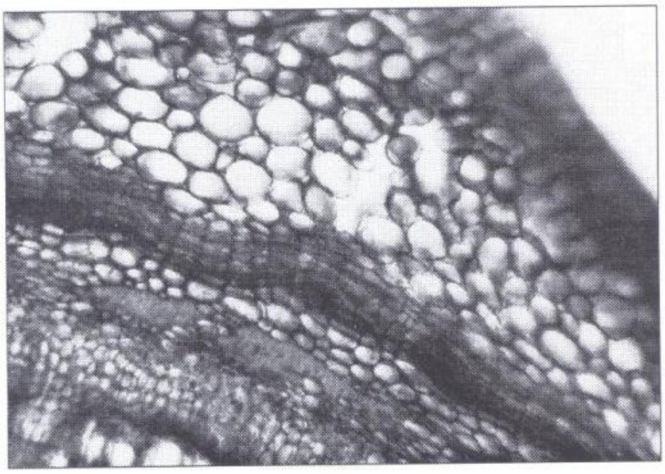

Fig. 3 Cross section through the underground stem part of *Rosa rugosa* showing the phellogen as a special protecting tissue, originating from the innermost layer of primary cortex. (obj. 20 x oc.4x)

Fig. 4 Cross section thtrough the undergroud stem part of Rosa rugosa showing an adventitious root developed at the node (obj10x oc. 4x) (Abbreviations as on fig. 1., and: v= vascular transition; rp= root primordioum, mlg= median leaf gap.).

1977). In *Rosa rugosa*, the polyderm is initiated from the innermost layers of the cortex and started to differentiate into cork cells *(Fig. 3)*. As shown in *(Fig. 4)* some roots have developed from underground stem parts at the nodes. These nodal rootes were associated with parenchymatic leaf gaps.

The adventitious roots associated with nodes in intact plants may be a consequence of the distinctive anatomical and physiological features of nodes, which are usually regions of locally high auxin concentration *(Bruck* and *Paolillo,* 1984a). Nodes are often sites where xylem differentiation is initiated *(Bruck* and *Paolillo* 1984b). Also, the greatest regions of cambial activation are always associated with traces from young leaves which are probably exporters of auxin *(White* and *Lovell,* 1984).

According to *Schmidt* (1982), the wide cambial zone and the medullary rays (and the presence of preformed root primordia) can be considered as the" root-forming regions" of the stem. The better they are developed, the higher is the rooting potential.

References

Bruck, D.K. and **Paolillo, D. J. Jr. (1984A):** Anatomy of nodes vs.internodes. In Coleus: the nodal cambium. Am. J. Bot. 71, 142–150.

Bruck, D.K. and **Paolillo, D. J. Jr. (1984B):** Anatomy of nodes vs. internodes. In Coleus: the longitudinal course of xylem differentiation. Am. J. of Bot. 71, 151–157.

Fahn, A. 1997. Plant anatomy. 2and Pergamon Press, oxford, New York and Paris, pp. 404.

Fouda, R. 1994: Relationship between the anatomical structure of stem and adventitious root formation in some genera of Rosaceae family. Dissertation for obtaining the degree of Candidate of Agriculture Sciences, Budapest, Academy of Sciences.

Fouda, R. 1997: Anatomical structure of stem in the above- and underground portions of Rosa spinosissima L. suckers. Publ. Univ. Horticulturae Industriaeque Alimentariae Vol. LV. 84–89.

Fouda, R. A., Schmidt G. 1994: Rooting ability of Rosa hybrid cv. Red succes: Morphological and anatomical study and the effect of IBA. Horticultural Science (Kertészeti Tudomány) 26 (l):62–65.

Krüssmann, G. 1989: Manual of Cultivated Broad-leaved Trees and Shrubs.Timber Press, Or., USA, 616.

Mac-Cártraigh, D. 1997: Die Vehrmehrung von Rosa rugosa. In: Krüssmann, G. 1997: Die Baumschule, Paul Parey, Berlin-Stuttgart, 467.

Nagy B., Schmidt G. 1989: Kertészeti dendrológia. Kertészeti és Élelmiszeripari Egyetem, Budapest, 140, 251.

Schmidt, G. 1992: Rügyatlasz. Excit Bt., Budapest, 116-117.

Schmidt, G. 1998: Rügyhatározó. Mezõgazda Kiadó, Budapest, 1106–107.

Schmidt, G., Tóth I. 1996: Díszfaiskola. Mezőgazda Kiadó, Budapest 601-602.

Schmidt, G.,Kovács,I.-Pál, J., Pálfi, P. and **Kovács, J. (1994):** Propagation of unusual woody plants by hardwood cuttings on bottom heat. Kertészeti és Élelmiszeripari Egyetem Közleményei 54:115–119.

White, J. and **Lovell, P.H. (1984):** The anatomy of root initiation in cuttings of Griselina littoralis and Griselina lucida. Annals of Bot. 54, 7–20.