

专论与综述

树木树液上升机理研究进展

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摘要 水分在植物体内的运输一直是很多植物生理生态学家所关注的一个重要问题。介绍了内聚力学说的基本假设和其存在争议, 总结了近年来这一研究领域的几个热点问题, 主要包括: (1) 木质部栓塞及其恢复机理; (2) 木质部压力探针和压力室法测定的木质部张力值不一致的现象及其可能原因; (3) 补偿压学说; (4) 不同界面层张力以及输水管道的毛细作用力、薄壁细胞膨压和木质部渗透压、逆向蒸腾等在树木汁液上升中的贡献; (5) 最近发现的存在于木质部导管伴胞和韧皮部薄壁细胞等质膜中的水孔蛋白在植物水分运输中的调控作用等。这些方面在解释树木的树液上升中都起着重要的作用。

关键词 [树液上升](#); [内聚力学说](#); [木质部张力](#); [渗透压](#); [水孔蛋白](#)

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Research progresses of the mechanism of the sap flow in trees

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Abstract Water transportation in plants has been an important issue in plant ecophysiology. The most popular theory of the mechanism about sap flow in trees is cohesion-tension (CT) theory. However, it is difficult to explain how negative pressure of several MPa can exist and the continuity of water can maintain in those vulnerable vessels. Moreover, the existence of embolism is also a challenge to the traditional CT theory. The tension measured by xylem pressure probe was far lower than the value predicted by the CT theory since the 1990s. Therefore, in this field, many researchers have carried out further and more comprehensive studies. In our review paper, the hypothesis of the CT theory and its scientific controversies were introduced. Several hot topics in this field were summarized, which included: (1) xylem embolism and its refilling mechanism; (2) discord values of xylem tensions between two methods measured by xylem pressure probe and pressure chamber and the possible reasons; (3) compensating pressure theory put forward by Cannon; (4) inter-surface tensions, capillary forces in water transportation, turgor pressure in parenchyma cells, xylem osmotic pressure, as well as reverse transpiration in sap flows; (5) Aquaporins in the cytoplasm membrane of the parenchyma cell in phloem and the companion cells of vessels in xylem. These topics play important roles in the explanation of water transportation mechanism in plants and lead the research in this field to a molecular level.

Key words [Aquaporin](#) [sap flow](#); [cohesion-tension theory](#) [osmotic pressure](#) [xylem tension](#)

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