

Leaf Replicas Used to Study Stomatal Openings

by James L. Green¹

Common greenhouse plants have over 62,500 openings per square inch of leaf surface (3). This great number of openings exerts a profound influence on the growth of the plant. The stomatal openings in the leaf surface are major ports of exit and entry to the interior of the leaf. It is through these openings that carbon dioxide essential to photosynthesis and plant growth enters the plant. And, through these openings excess water, moved upward from the roots of the plant, is evaporated into the surrounding atmosphere.

The pores are opened and closed by specialized leaf surface cells called guard cells. Certain environmental factors, light, temperature, carbon dioxide, and wind act to increase or decrease the volume of the two guard cells. As the volume of the two guard cells increases, they bend away from each other separating in the middle to form or encompass an opening or pore. As a model of a guard cell, we may take a deflated balloon with masking tape pasted along one side. Upon inflation, the rigid taped wall of the balloon bends inward to accommodate the expansion over the rest of the surface. Likewise, as light intensity increases, the guard cells become more inflated

and the adjacent walls bend inward to form an opening into the interior of the leaf. Also, as temperature increases, the guard cells bend more to form a larger opening.

However, as carbon dioxide in the atmosphere surrounding the stomata increases, the volume or turgidity of the guard cells decreases resulting in a smaller opening. The opening also decreases as wind increases.

The very small stomatal opening can now be measured to study the influence of the environment on the guard cells (1,2). An impression of the leaf can be made without damaging the plant by pouring fluid silicone rubber, "General Electric RTV-11," mixed with the required amount of catalyst, over the leaf surface. After the rubber becomes firm, it is removed and thoroughly dried. The surface of the rubber leaf impression is then coated with clear fingernail polish. When the fingernail polish hardens, it is peeled off the impression. The fingernail polish replica is an exact replica of the leaf surface. This replica is sandwiched between a microscope slide and cover slip for viewing under a microscope. The

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stomatal openings can be seen in detail and accurately measured by viewing them through a microscope magnifying them 1000 times their true size.

This technique was used to study the effect of increasing the carbon dioxide in the carnation plant's atmosphere. Measurement of stomatal openings indicated that increasing the carbon dioxide concentration decreased the stomatal opening. This reduction in stomatal opening size could result in altering the interchange of gases and the loss of moisture by the plants.

Literature Cited

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3. Zucker, Milton. 1963. Experimental morphology of stomata. *Conn. Agr. Exp. Sta. Bull.* 664. 116p.

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