

BRIEF COMMUNICATION

Effect of Ultraviolet Light on Stomatal Movement

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During our experiments with the stomata of *Begonia semperflorens* we observed that the open stomata close in the course of a few minutes after irradiation with ultraviolet light. It is known that the stomata of plants are very sensitive to different factors, such as light, water content, concentration of carbon dioxide, etc. (STÁLFELT 1956, HEATH 1959, KETELLAPPER 1959, to mention only a few comprehensive reports). Visible light produces opening of the stomata, the red and blue parts of the spectrum being most effective. It was therefore surprising that we were able to demonstrate stomatal closing after irradiation of the whole leaves or their sections with ultraviolet light.

The stomata of the leaves of *Begonia semperflorens* (fig. 1) are present mostly on the lower surface of the leaf, with a frequency of approximately 50 stomata per 1 mm². The stomata are arranged in groups of 2–6 and are situated about 10 μ higher than the surface of the epidermal cells. When the adjacent cells lose their turgor, the stomata drop to the epidermal level. The mean length of stomatal opening is 31 μ , the width during full opening is about 9 μ . Under normal conditions of temperature, light and moisture, the plant opens its stomata at about noon. After trying different modes of preparation, we observed that the best way to get a leaf with open stomata early in the morning, was to place a detached leaf in a beaker of water on the evening before the experiment. In the morning nearly all stomata are wide open and ready for experiment. From the marginal parts of the leaf several sections with dimensions of 50 $\times$ 10 mm are prepared and placed under a cover glass in water. The number of opened and closed stomata is then determined. Before irradiation the sections are carefully dried with filter paper and placed on a drop of water.

As a source of ultraviolet light the Philips tube TUV 15 was used at a distance of 63 cm. This tube mostly gives a resonance line 2537 Å. The intensity of the light was measured kindly by Dr. Věchet (Microbiological Inst., Academy of Sciences) with a Latarjets UV dosimeter and compared in our laboratory with inactivation of T2 phage. A mean value of intensity 31.6 μ W . cm.⁻² at a distance of 100 cm was found.

During our first irradiation experiments we used an unnecessary high dose (5·10⁶ erg. cm.⁻² and more). Later, we found that very rapid closing of the stomata takes place after a dose of 6900 erg. cm.⁻². In fig. 2 the reaction of the stomata after a dose of 13,800 erg. cm.⁻² is demonstrated. The dose was administered for one minute. After irradiation the percentage of closed stomata steeply rises, and after 20 minutes some kind of equilibrium is attained. After higher doses an almost complete closure of the stomata may be observed. During this time, the control sections were kept in the dark and their stomatal posture did not change considerably.

The experiments performed up to now do not show a marked dose-effect relationship. It seems more probable that after a certain threshold dose (approximately 10,000 erg. cm.⁻²)

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changes in the posture of the stomatal apparatus usually occur very rapidly. This would point to a mechanism where excitability plays a certain role.

Experiments regarding the photoreactibility of this phenomenon have not yet met with success.

It is interesting that in preliminary experiments, closing of previously opened stomata was found also after irradiation with cobalt source (with a dose of 150 r) and after irradiation with alpha rays from polonium (with a dose of $3.7 \cdot 10^6 \alpha \cdot \text{cm}^{-2}$).



Fig. 1. A group of stomata of *Begonia semperflorens*.

The closing of the stomata is probably due to the changes of turgor in the guard and/or adjacent cells. It seems that the stomata of *Begonia semperflorens* would be an interesting object for the study of different radiobiological problems. Further experiments along these lines will be reported later.

References

- HEATH, O. V.: Light and Carbon Dioxide in Stomatal Movements. — In: W. RUHLAND ed. Handb. der Pflanzenphysiologie XVII, Teil 1 : 415, 1959.
 KETTELAPPER, H. J.: The Mechanism of Stomatal Movements. — Amer. J. Bot. 46 : 225, 1959.
 STALFELT, M. G.: Die stomatäre Transpiration und die Physiologie der Spaltöffnungen. — In: W. RUHLAND ed.: Handb. der Pflanzenphysiologie III : 351, 1956.

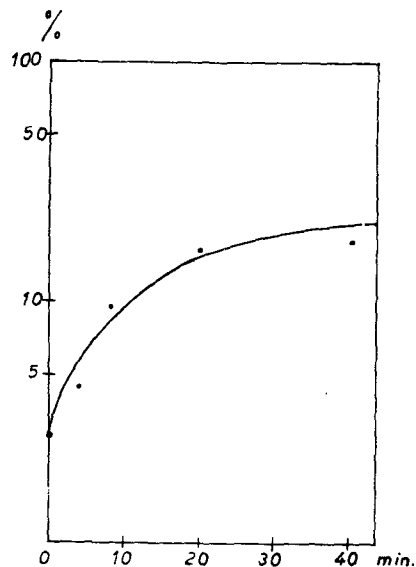


Fig. 2. Percentage of closed stomata after UV-irradiation (dose 13, 800 erg. cm^{-2}).

F. Herčík, Biofyzikální ústav ČSAV, Brno: Vliv ultrafialového záření na pohyby průduchů. — Biol. Plant. 6 : 70 — 72, 1964.

Byl pozorován uzávěr průduchů u *Begonia semperflorens* během několika minut po ozáření UV.

Ф. Герчик, Биофизический институт ЧСАН, Брно: Влияние ультрафиолетового облучения на движение устьиц. — Biol. Plant. 6 : 70 — 72, 1964.

Наблюдалось закрывание устьиц вида *Begonia semperflorens* в течение нескольких минут после ультрафиолетового облучения.

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