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Influence of Alpha Rays on Stomatal Movements

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Abstract: The stomata closure in *Begonia semperflorens* by alpha - rays was studied. Complete closure of the stomata was used as indication of the reaction. The minimal doses with significant results was $2{\cdot}2 \cdot 10^6$ $\alpha \cdot cm^{-2}$, the maximum at the dose of approx. $9 \cdot 10^6$ $\alpha \cdot cm^{-2}$ was found.

Stomata of *Begonia semperflorens* leaves close after low doses of ultraviolet rays (HERČÍK 1963a 1964, in press). In preliminary experiments it was observed that irradiation with alpha rays of polonium causes closure of stomata within approximately one hour after irradiation (HERČÍK 1964). A series of irradiation experiments with a polonium source were performed to determine more precisely the dose-effect dependency. Polonium was deposited on copper beads of about 0·1 mm in diameter. The beads were placed in a lucite tube of 33.5 mm outer diameter provided with a window of 1.3 mg. cm^{-2} thickness on one side of the tube. The tube was placed on a 1.5 mm. high lucite ring; this ring separated the window from the surface of the irradiated leaf. The source was calibrated by means of the already described autoradiographic method (HERČÍK 1963b).

During the irradiation experiments the intensity of the source was $1.1 \cdot 10^6 \alpha \cdot cm^{-1}$ min.$^{-1}$. The depth of the irradiated guard cells is approximately 14μ. Taking into account the stopping power of the tube window and of the air layer between the source and the surface of the guard cells, it is to be expected that the entire depth of the guard cell is penetrated by α-rays.

For the irradiation experiments one plant of *Begonia semperflorens* LAMM et OTTO (hybr. hort. Carmen) was used. Young leaves, about 2—3 cm. long, were cut off 16 hours prior to the experiment and placed in water. After this time interval, 90—95% of the stomata were fully open. Before the experiment, cuts from the leaves were prepared, which had dimensions of about 8×15 mm. In the middle of the narrow part of the cut a 1 mm. long indentation was made which served as a starting point for always observing the same cells by moving the microscope stage in the lateral direction.

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The complete closure of the guard cells was used as indicator of the stomata's reaction to irradiation. These stomata were counted as "closed". When the gap between the guard cells let any light pass through, the cells were counted as "open". The difference $\triangle P = P_t - P_0$, where P_t is the percentage of closed stomata for the time t after irradiation, P_0 the percentage of closed stomata before irradiation, indicates the degree of radiation injury.

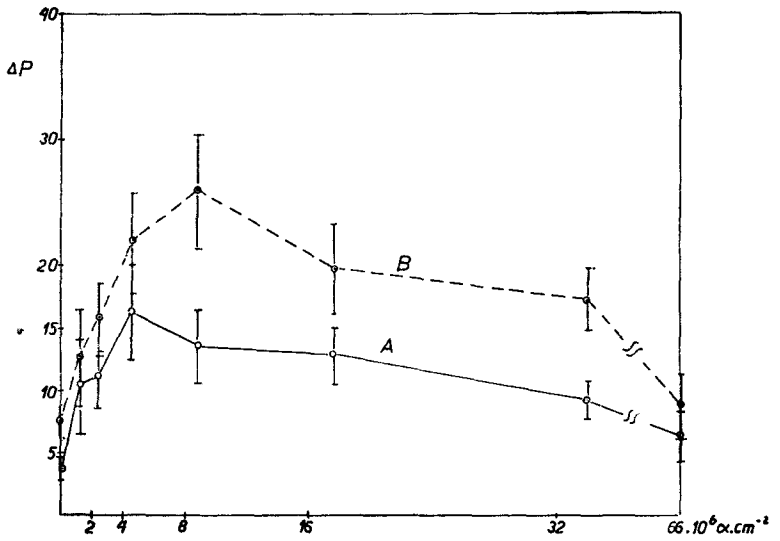

Fig. 1. Effect of alpha rays on the closing of stomata of *Begonia semperflorens*. A — curve: $\triangle$ P 40 minutes after irradiation, B — curve: $\triangle$ P 120 minutes after irradiation.

The results of irradiation (A — curve: $\triangle$ P 40 minutes after irradiation, B — curve: $\triangle$ P 120 minutes after irradiation) are demonstrated in fig. 1. It is to be seen that there is a steep rise in $\triangle$ P already after a small dose of irradiation. A maximum is attained at the dose of approximately $9 \cdot 10^6 \alpha \cdot \cdot cm^{-2}$. At higher doses the $\triangle$ P decreases a little, which signifies that more stomata remain open.

The minimum dose which causes significant closing of the stomata 120 minutes following irradiation is $2{\cdot}2 \cdot 10^6 \alpha \cdot cm.^{-2}$, i.e. $2{\cdot}2 \cdot 10^{-2} \alpha \cdot \mu^{-2}$ ($\triangle$ P for control is $7{\cdot}4 \pm 1{\cdot}3$; $\triangle$ P for cells irradiated with a dose of $2{\cdot}2 \cdot 10^6 \alpha \cdot \cdot cm^{-2}$ is $15{\cdot}6 \pm 2{\cdot}8$). The area of both guard cells is about 750 μ^2. The minimal dose for the area of guard cells is then $750 \times 2{\cdot}2 \cdot 10^{-2} = 17$ alpha particles. This is a very small dose if the closing of the guard cells is caused only through the radiant energy absorbed in them. The guard cells are encircled by five accessory cells and surrounded by epidermal cells. Both the accessory cells and the epidermal cells are free of chloroplasts. Although the influence of the adjacent cells cannot be excluded, it seems that the decisive site for the closing reaction are the guard cells themselves. At higher doses, closing of the stomata is less intensive and there is a tendency of the stomata to remain

open. This may be due to a injury of the closing mechanism in the guard cells. Further studies in this direction are going on.

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Byl sledován uzávěr průduchů po aplikaci α-záření u *Begonia semperflorens* LAMM et OTTO. Indikátorem reakce byly úplně uzavřené průduchy. Numerické hodnocení bylo prováděno po 40 a 120 minutách po ozáření. Minimální dávka s průkazným výsledkem byla $2{,}2 \cdot 10^6\ \alpha \cdot cm^{-2}$, maximální $9 \cdot 10^6\ \alpha \cdot cm^{-2}$.

Ф. ГЕРЧИК, Биофизический институт ЧСАН, Брно **Влияние α-излучения на движения устьиц.** Biol. Plant. 6:315—317, 1964.

Изучалось закрывание устьиц после применения α-излучения у *Begonia semperflorens* LAMM et ОТТО. Индикатором реакции являлись полностью закрытые устьицы Нумерическая оценка давалась 40 и 120 мин. спустя после облучения. Минимальная доза с достоверным результатом составляла $2{,}2 \cdot 10^6\alpha \cdot см^{-2}$, максимальная $9 \cdot 10^{-2} \cdot \cdot см^{-2}$.