

# A Paraquat-Inducible Protein B-like (pqiB) Gene From *Chromobacterium Violaceum* Confers Tolerance to Paraquat in Transgenic Tobacco

Lais Santos Freire

Universidade Estadual de Santa Cruz

Jamilly Azevedo Leal Sena

Universidade Estadual de Santa Cruz

Marcio Gilberto Costa

Universidade Estadual de Santa Cruz

Fatima Alvim (✉ [alvim@uesc.br](mailto:alvim@uesc.br))

Universidade Estadual de Santa Cruz <https://orcid.org/0000-0001-8867-4998>

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## Research Article

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## Abstract

Paraquat (1,1'-dimethyl-4,4'-bipyridinium dichloride) is a contact non-selective herbicide, widely used in agriculture in several countries. Proteins induced by paraquat have been the subject of great interest because of the possibility of conferring herbicide resistance when introduced into crops. In this work, we analyzed a paraquat-inducible protein B-like ( *cvpqIB* ) gene, isolated from *Chromobacterium violaceum*, in conferring tolerance to paraquat in transgenic tobacco. A DNA fragment containing the *pqiB* coding sequence was isolated from the *C. violaceum* ATCC12472 genome, inserted into the pCAMBIA1390 vector, under the control of the cauliflower mosaic virus (CaMV) 35S promoter, and used in *Agrobacterium* -mediated transformation of *Nicotiana tabacum* cv. Havana. Analysis of the regenerants revealed the incorporation of *cvpqIB* into the tobacco genome and its transmission in a Mendelian fashion to the progeny of transgenic plants. Sensitivity assays using tobacco leaves demonstrated that the transgenic plants were tolerant to concentrations up to 50  $\mu\text{M}$  paraquat, whereas the wild-type (WT) plants exhibited intolerance to concentrations higher than 1  $\mu\text{M}$  of the herbicide. Paraquat-treated leaves of the transgenic plants also exhibited significantly reduced electrolyte leakage and their chlorophyll content was not impacted as observed in the WT plants. Besides, in contrast to the WT, negligible amounts of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) were detected in paraquat-treated seedlings of the transgenic plants, as revealed by 3,3'-diaminobenzidine (DAB) staining. Collectively, these results indicate that the *cvpqIB* gene is functional in plants and may be further used in the genetic engineering of crop plants aiming paraquat tolerance.

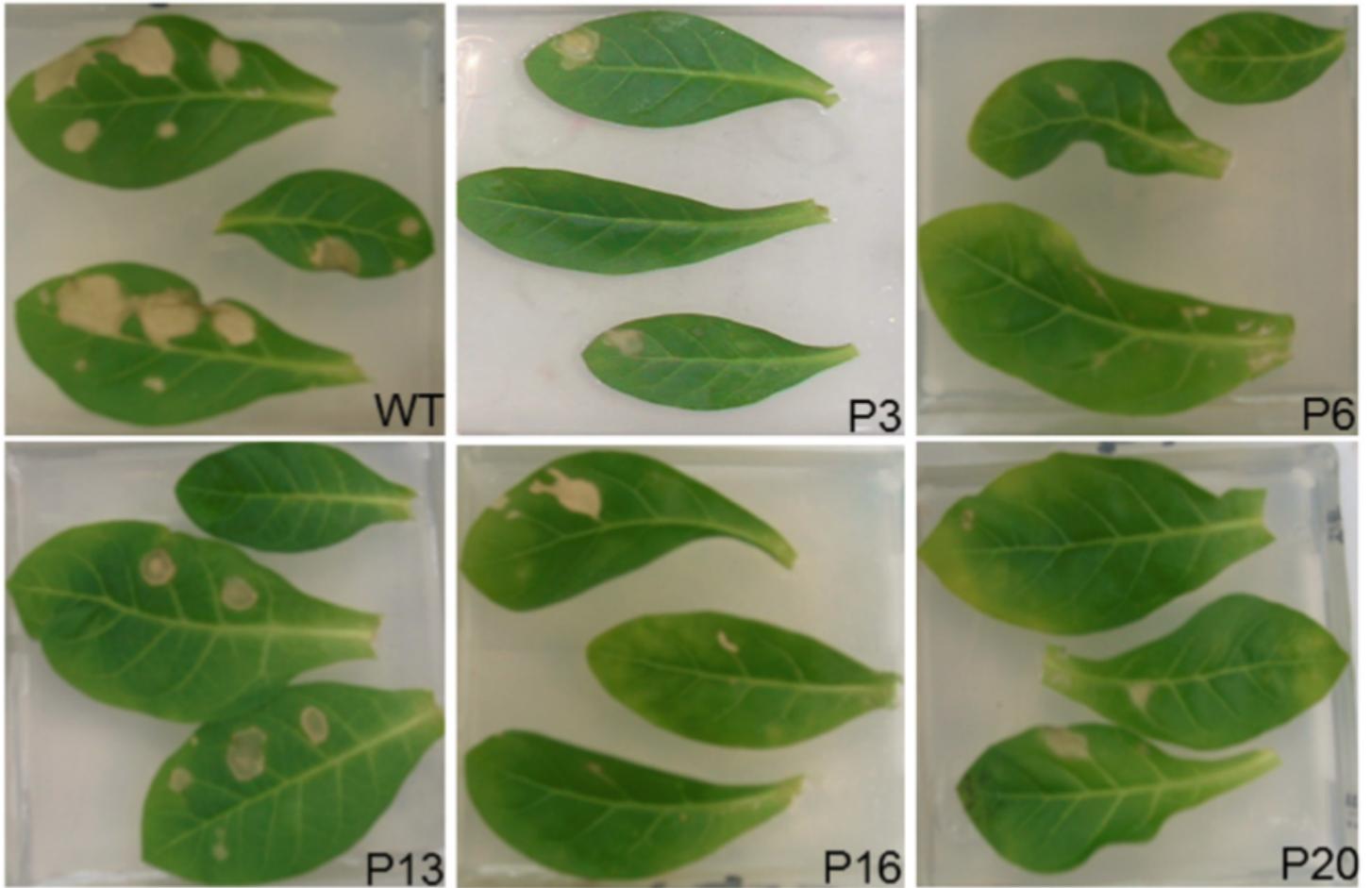
## Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the latest manuscript can be downloaded and [accessed as a PDF](#).

## Table

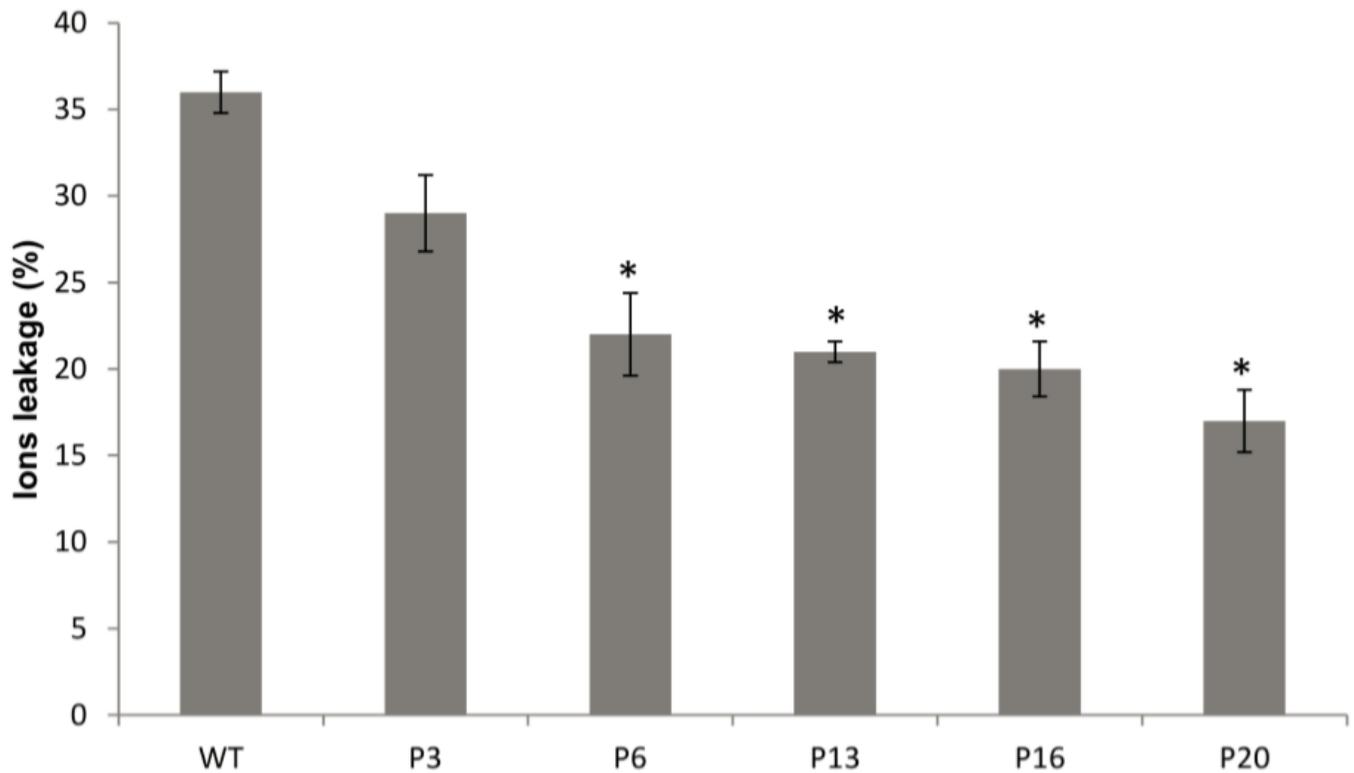
Table 1 not available with this version

## Figures



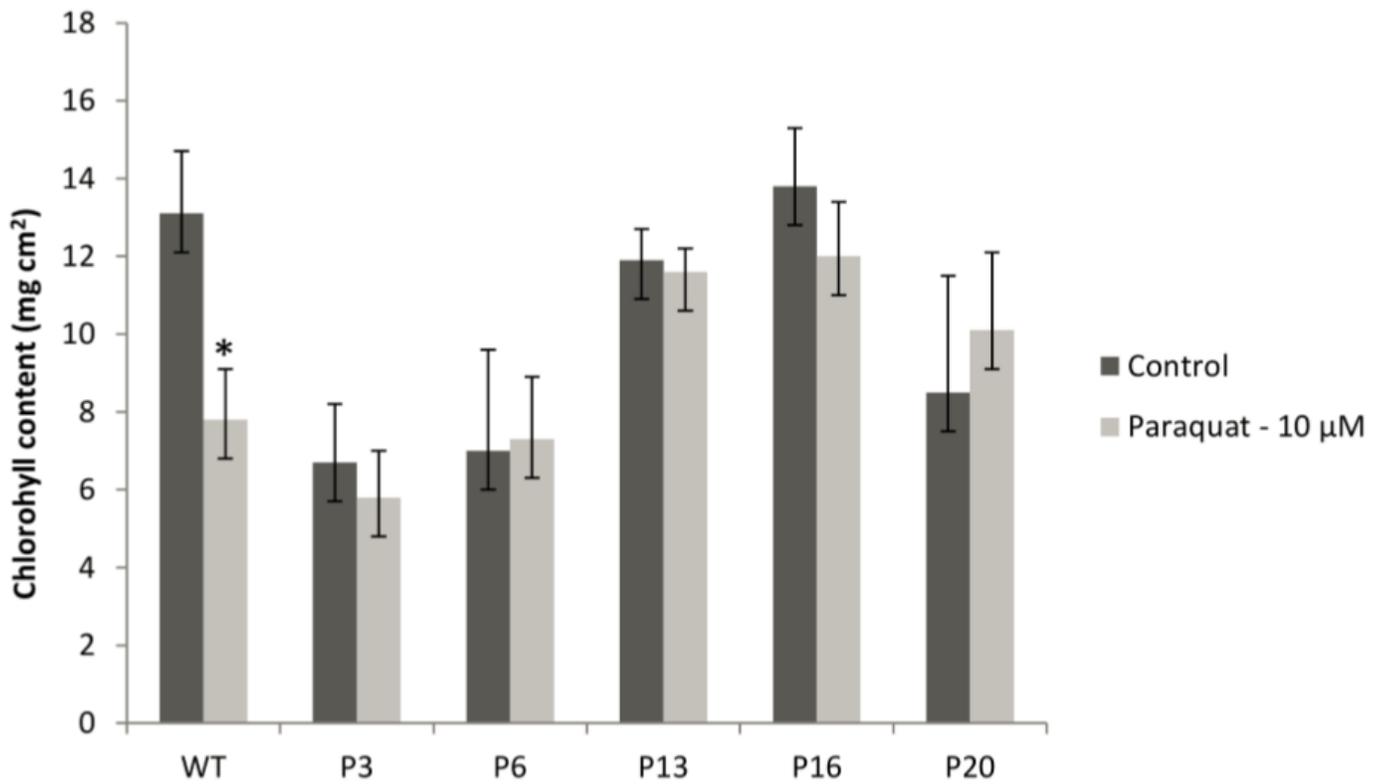
**Figure 1**

Sensitivity of tobacco plants to different concentrations of paraquat. Three leaves, representative of WT and transgenic lines (P3 – P20), were induced with drops containing 0, 1 and 10 (left side of the leaves, from the base to the apex) and 20, 50 and 100 (right side of the leaves, from the base to the apex)  $\mu\text{M}$  paraquat (refer to Material and methods section and ESM Fig. S2 for details). Symptoms were recorded 48h after the treatments. WT: wild-type; P3-P20: transgenic lines. Pictures were taken 5 days after the treatments, with three leaf replicates for each plant line tested.



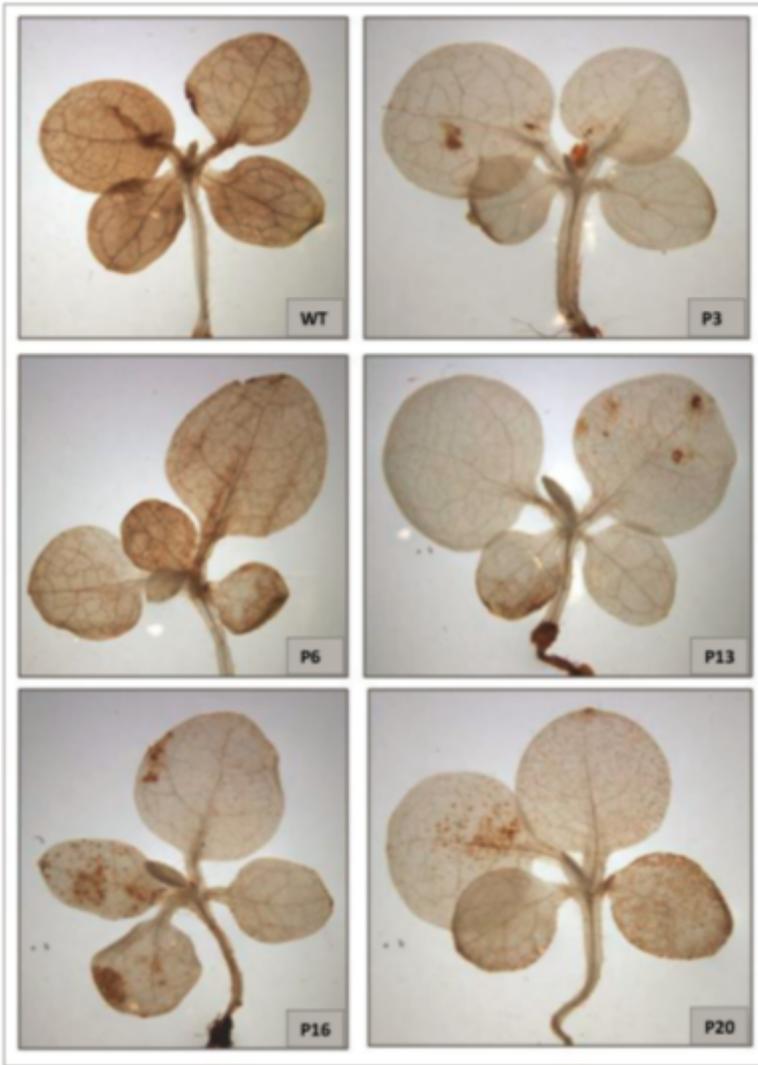
**Figure 2**

Ion leakage in tobacco leaves treated with paraquat. Leaves of WT and transgenic plants were treated with 10  $\mu$ M paraquat and ion leakage was recorded 24 h after the treatment. Data are means  $\pm$  standard deviation of three biological replicates. \*Significant differences according to t-test at the  $p \leq 0.01$  significance level. WT: wild-type; P3-P20: transgenic lines.



**Figure 3**

Chlorophyll content of tobacco leaves treated with paraquat. Leaves of WT and transgenic plants were treated with 10 μM paraquat and the chlorophyll content was recorded 24 h after treatment. Data are means ± standard deviation of three biological replicates. \*Significant differences according to t-test at the  $p \leq 0.05$  significance level. WT: wild-type; P3-P20: transgenic lines.



**Figure 4**

Detection of H<sub>2</sub>O<sub>2</sub> in tobacco seedlings treated with paraquat. Seedlings of WT and transgenic plants were treated with 10  $\mu$ M paraquat and the H<sub>2</sub>O<sub>2</sub> production, as revealed by reddish-brown stain, was detected by DAB staining, 4 h after the treatments. Results are representative of experiments performed in six biological replicates. WT: wild-type; P3-P20: transgenic lines.