

# Foliar application of kaolin clay reduces oxidative stress, improve photosynthetic efficiency and chlorophyll content in the leaves of peer trees during summer stress



Ines Mihaljević<sup>1</sup>, Marija Viljevac Vuletić, Dominik Vuković<sup>1</sup>, Vesna Tomaš<sup>1</sup>

<sup>1</sup>Agricultural institute Osijek, Južno predgrađe 17, HR-31000 Osijek, Croatia ([ines.mihaljevic@poljin.hr](mailto:ines.mihaljevic@poljin.hr).)

## Introduction

Extreme summer conditions, such as high temperatures and excessive solar irradiance, are major factors limiting growth and productivity of many fruit trees, including pear trees. Kaolin is a natural clay and its spray application provides a uniform thin layer coating protector on the plant. It has been proposed as a promising strategy for the alleviation of adverse abiotic stresses. In a field experiment, kaolin particle film application on pear leaves was examined during summer conditions with the aim to evaluate the benefits of kaolin against stressful summer conditions. The objective of this study was to assess the influence of kaolin on leaf physiology and plant vitality of investigated pear cultivars.

## Material and methods

The experiment was performed at the Agricultural institute Osijek, on experimental orchard Tovljač; Two pear cultivars were included in experiment: Abate Fetel and Conference (planting distance: 3,2 x 0,8m; rootstock: MA). Fifteen trees per cultivar were selected and sprayed six times during vegetation with kaolin clay (Surround, 3.5%) to uniformly coat leaves of the entire canopy, while fifteen control trees were sprayed with water only. The measurements of photosynthetic efficiency (OJIP test) were performed on warm, sunny day (2 p.m.), on 5th and 6th fully developed leaf. The same leaf samples were collected and used for further analysis of chlorophyll and carotenoid content, malondialdehyde (MDA), hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), phenols and enzymatic antioxidative activity, between kaolin sprayed and water sprayed (control) trees.



Figure 1. Application of kaolin clay on pear trees, in experimental orchard Tovljač, Agricultural institute Osijek

## Conclusions

Kaolin clay application improved photosynthetic efficiency, chlorophyll content and alleviated membrane damage in stressed pear leaves of both cultivars. Antioxidant contents such as phenols, PPO, and GPOD enzyme activities were reduced by kaolin applications, indicating that under kaolin treatment, pear trees were more stable and produced less reactive oxygen species (ROS), which reduces the need to increase these enzymes. Lower H<sub>2</sub>O<sub>2</sub> levels and lipid peroxidation (MDA content) in kaolin treated leaves indicated less oxidative damage in leaves of both cultivars. Our results reveal that kaolin application can alleviate the harmful effects of summer stress on pear trees, which may be also useful in the production of other fruit trees affected by climate change, as summer stress mitigation strategy.

## Results

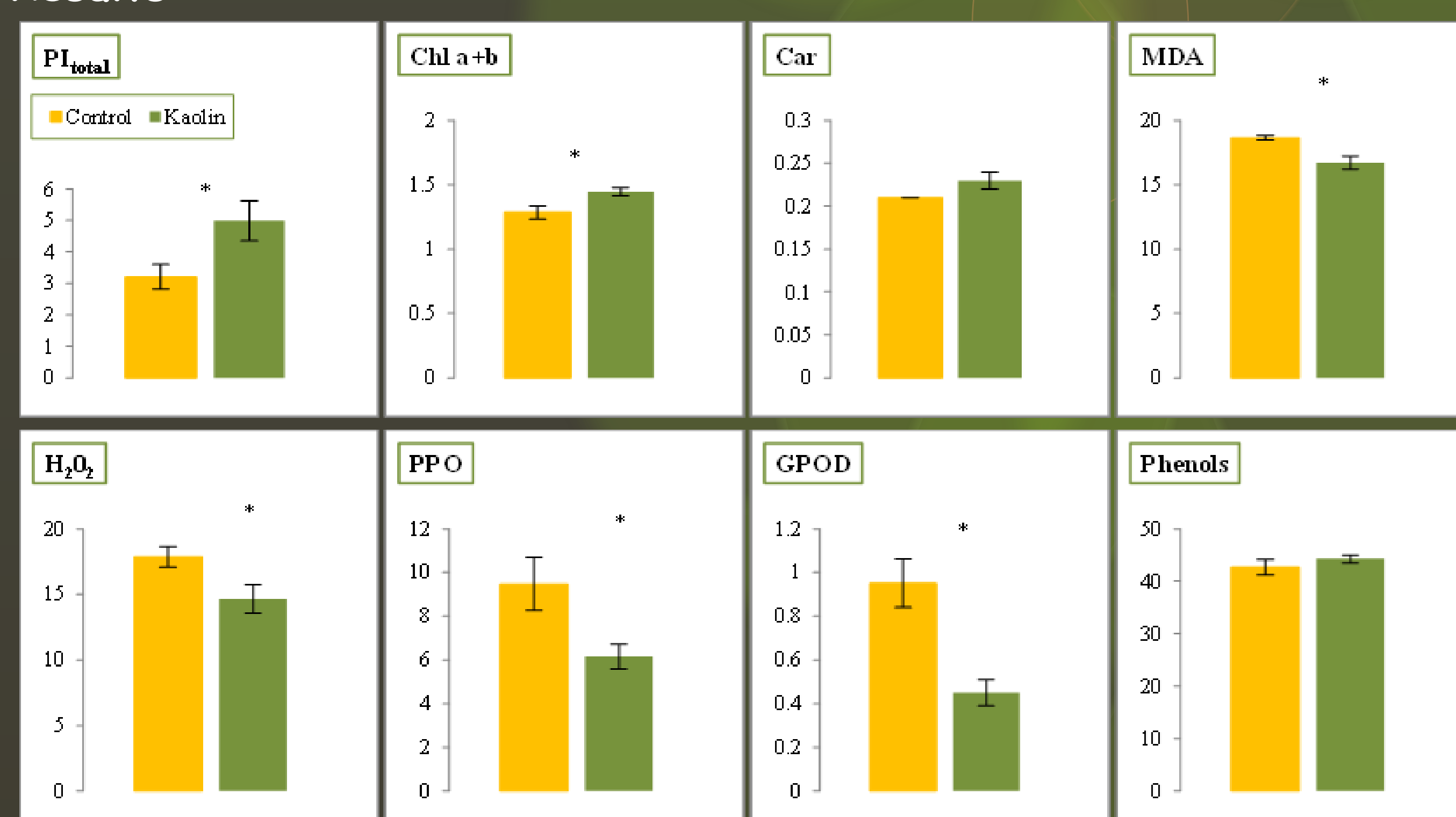


Figure 2. The mean values ( $\pm$  SE) of the performance index of overall photochemistry (PI<sub>total</sub>, relative units); total chlorophyll content (Chl a+b, mg/gFW); carotenoid content (Car, mg/gFW); malondialdehyde content (MDA, nmol/gFW); hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>,  $\mu$ mol/g FW); polyphenol oxidase activity (PPO, nkatal/mg<sub>proteins</sub>); guaiacol peroxidase activity (GPOD, nkatal/mg<sub>proteins</sub>); phenols (mg<sub>GAE</sub>/gFW) in control and kaolin sprayed leaves of Abate Fetel cultivar. Asterix (\*) represents significant differences.

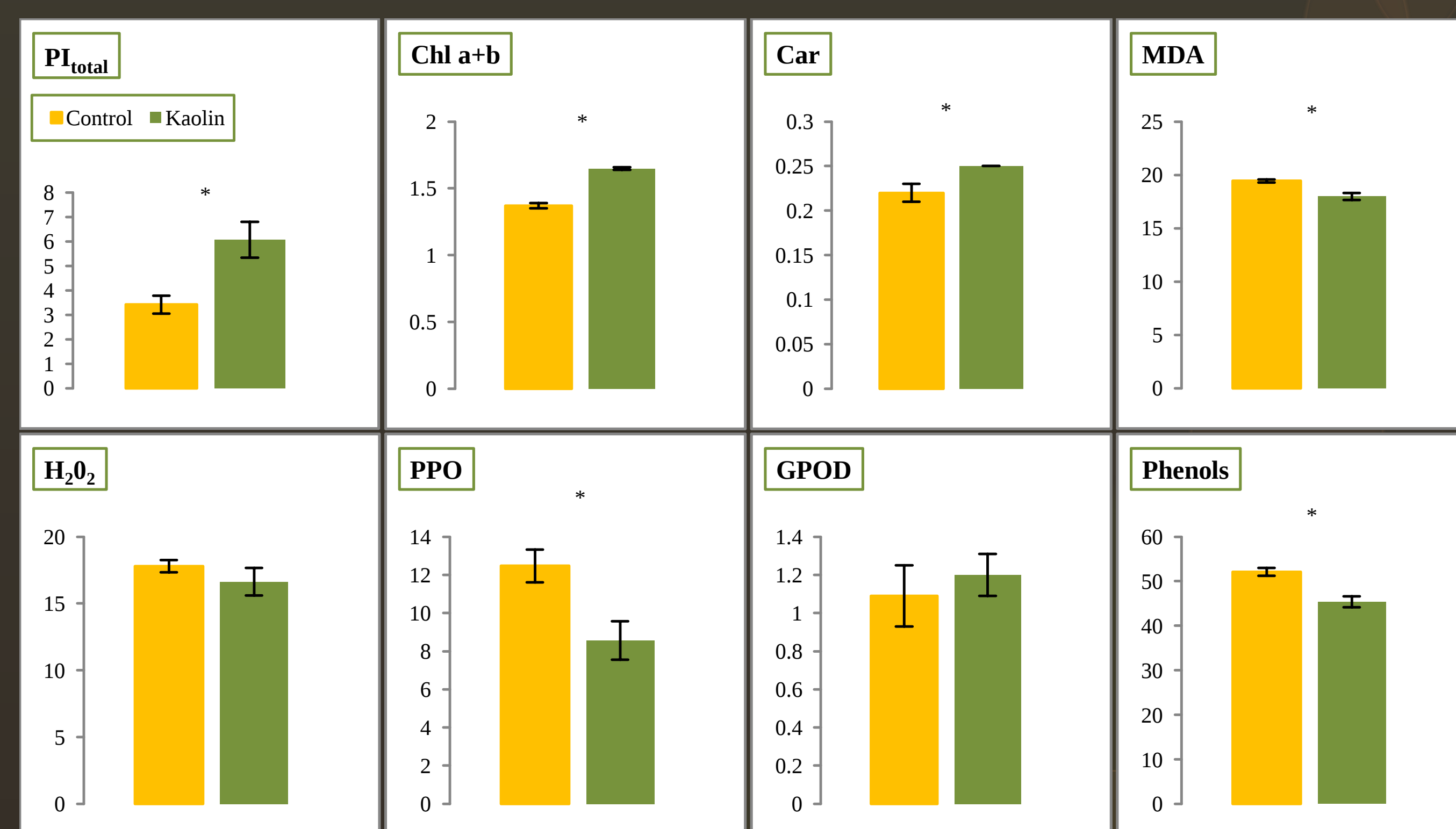


Figure 3. The mean values ( $\pm$  SE) of the performance index of overall photochemistry (PI<sub>total</sub>, relative units); total chlorophyll content (Chl a+b, mg/gFW); carotenoid content (Car, mg/gFW); malondialdehyde content (MDA, nmol/gFW); hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>,  $\mu$ mol/g FW); polyphenol oxidase activity (PPO, nkatal/mg<sub>proteins</sub>); guaiacol peroxidase activity (GPOD, nkatal/mg<sub>proteins</sub>); phenols (mg<sub>GAE</sub>/gFW) in control and kaolin sprayed leaves of Conference cultivar. Asterix (\*) represents significant differences.