ABSTRACT

Modern agriculture and the food industry face serious challenges, such as the growing demand for food and crop losses caused by environmental stress and diseases. This doctoral thesis explores the use of cold plasma (CP) and plasma-activated water (PAW) as eco-friendly and sustainable alternatives to traditional agrochemicals (fertilisers and pesticides). The research is divided into two parts, focusing on improving plant growth and development and fighting post-harvest diseases.

The first part investigates the effects of PAW generated by transient spark (TS) discharge on three selected maize (*Zea mays* L.) hybrids, focusing on their growth, development, and antioxidant capacity. PAW was applied using three methods and their effectiveness was compared: priming during imbibition, short-term cultivation in paper rolls and foliar spraying of grown plants. We also evaluated longer-term effects of PAW priming in pot experiment. We analysed growth parameters (length, fresh weight, dry weight), root development (lignification), photosynthetic pigments, non-enzymatic antioxidants and activity of antioxidant enzymes.

The second part evaluates the antifungal efficacy of CP and PAW against *Penicillium digitatum*, a major post-harvest pathogen of citrus fruits. This section analysed the physicochemical properties of PAW, including pH, conductivity, and the content of reactive oxygen and nitrogen species. Both direct CP treatment and indirect treatment of spores in PAW were tested, as well as the effects of low pH. Additionally, the effectiveness of PAW in disinfecting infected citrus surfaces was examined, and two different plasma reactor configurations were compared.

Key words: cold plasma, plasma-activated water, reactive oxygen and nitrogen species, transient spark discharge, *Zea mays* L., antioxidants, *Penicillium digitatum*