

水中気泡内放電を用いた水耕栽培用溶液中の植物生育阻害物質の分解 Decomposition of allelochemicals in hydroponic nutrient solution using discharge inside bubble

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Introduction

Recently, a recirculation system of hydroponics culture systems has been widely used for cultivating many kinds of plant because of their low workload and high crop efficiency. However, the recirculation system has a disadvantage that the organic compounds contained in the secretions excreted from the roots of the plant accumulates in the cultivation nutrient solution. The organic compounds suppress growth rate of plants. Therefore, it is important to keep the organic compounds dissolved in water low by water treatment methods.

In this study, 2,4-dichlorobenzonic acid (DCBA), an allelochemicals of cucumber plants, in hydroponic nutrient solution using discharge inside bubble is investigated.

Experimental Setup

DCBA solution is prepared by dissolving DCBA in 20 L distilled water. The concentration is fixed at 20 μ M. Air gas is injected into water through a vertically positioned glass tube, into which high voltage wire electrode is placed to generate plasmas at low applied voltage. A magnetic pulse compression circuit is used to generate high voltage pulses. DCBA solution is treated by the discharges during 24 hours. The concentration of DCBA and chloride ion is determined using a high performance liquid chromatography and an ion chromatography, respectively. The four experimental groups are prepared for indoor cultivation of cucumbers. In the experimental groups, a distilled water mixed a fertilizer (control), DCBA solution without discharge treatment (DCBA), DCBA solution after discharge treatment (discharge) and DCBA solution with pH adjustor after discharge treatment (discharge pH adjusted) are used as the nutrient solution. The pH of the water after the discharge treatment is adjusted to 5.7 using a pH adjustor.

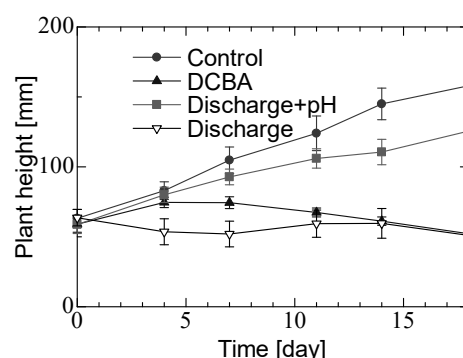


Fig.1. Diurnal variation of plant height for four experimental groups

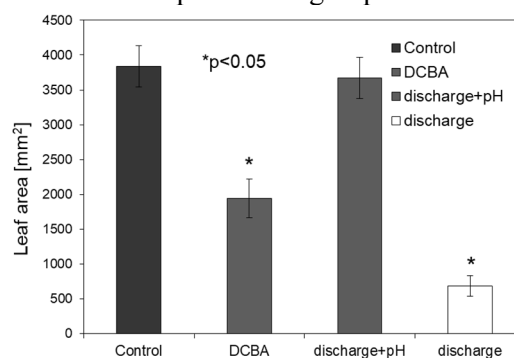


Fig.2. Leaf area for four experimental groups

Results

Figure 1 shows diurnal variation of plant height for four experimental groups. The plant height of control and discharge treatment with pH adjustment increases with increasing cultivation time and have same value. The growth of almost plants is suppressed by the DCBA without discharge treatment (DCBA group). The plant height is decreases with discharge treatment group. Figure 2 shows leaf area for four experimental groups. Leaf area shows a similar trend to the diurnal variation of plant height. These results show that the plants cultivated using the treated water by discharge treatment with pH adjustment grow healthily.