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トマトの水耕栽培における病原菌不活化用コロナプラズマシステムの開発
Development of Corona Plasma System for Inactivation of Pathogen in Hydroponic Cultivation Medium of Tomato

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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 low workload and high crop efficiency. However, the recirculation system has a disadvantage that is the increase in the density of plant pathogenic bacteria, which is responsible for infection. Therefore, the way for decreasing the density of plant pathogenic bacteria in culture solution is desired [1].

In this study, a system using discharge plasma under solution was developed, and the performance of the developed system was evaluated. The performance of the system on the sterilization effect is evaluated by a standard plate count for background microflora and *Ralstonia solanacearum*, which is a plant pathogenic bacterium, in the nutrient solution.

Experimental Setup

Figure 1 shows a schematic of the discharge plasma system using the plasma reactor. The system consists of two treatment tanks, a 100 L cultivation tank and a cultivation bed, where 100 L of nutrient solution is circulated by water lifting pumps with a water flow rate of 18 L/min. The active species produced by the plasma that remain undissolved in 1st treatment tank are injected into the 2nd treatment tank for the efficient use. The discharge reactor consisted of a wire electrode that was placed in a circular insulating cylinder, and a grounded electrode on cylinder outside. Atmospheric air gas was injected into the cylinder using a gas pump and released through holes. Holes of the cylinder were 0.5 mm in a diameter and 2.0 mm separation one another.

Results

The number of bacteria in the nutrient solution is obtained using a colony-counting method with a plate count agar. The sample is collected at the cultivation tank after stirring. Figure 2 shows the diurnal variation of standard plate count for background microflora in the solution. The standard plate count is reduced from 3.9 $\times 10^4$ to 2.4$\times 10^2$ CFU/mL in 2 days of treatment, and the bacteria is not detected after 8 days of treatment. The results show that the infection risk of the plant is significantly reduced by the continuous system operation. The ozone produced by plasma mainly contributes to the inactivation of bacteria.

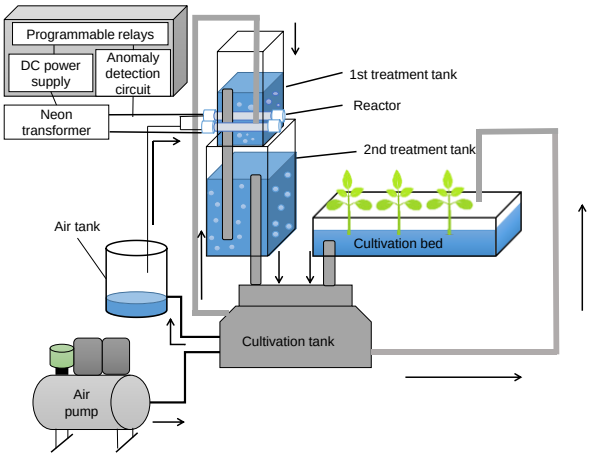

Fig. 1. Schematics of the nutrient solution treatment system using plasma in the recirculation system of hydroponics.

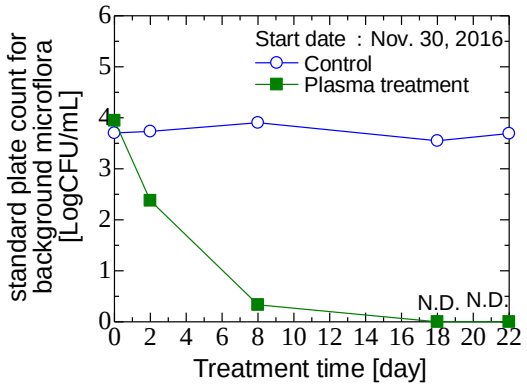

Fig. 2. Diurnal variation of standard plate count for background microflora

References

[1] K.Mizukai,K.Satoh,IEEJ Trans.FM.Vol.126, 2006