# 04aE14P

## 水中気泡内放電を用いた植物の育成改善
## Improvement of Growth Rate of Plants by Discharge inside Bubble in Water

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Discharges in water are one of the promising candidates to reduce the infection risk of plants in hydroponics because the discharges produce chemical active species such as atomic oxygen (O), ozone ($O_3$) and hydroxyl radical (OH), which work to inactivate the sundry germs [1]. In addition, the discharges also produce nitric acids which are working as fertilizer [2]. In this study, the effect of the discharge irradiation to the water on bacteria activity and growth rate of the plants were evaluated. In the experiments, *Fragaria* × *ananassa*, *Spainacia oleracea* and *Raphanus sativus var. sativus* plants were cultivated in pots filled with artificial soil, which included the use of chicken droppings as a fertilizer [3]. The water was recycled once per day from a drainage water pool added to the bed-soil in the pots. A magnetic compression type pulsed power generator was used to produce underwater discharge with 250 pps in repetition rate. The plasma irradiation times were set in range from 15 to 30 minutes per day over 28 days of cultivation.

**Figure 1** shows the dried weights of cropped *Spainacia oleracea* at 28 days after cultivation for various discharge irradiation times. The error bars show the standard deviations of the data. The dried weight of the plant without the plasma irradiation was an average weight of 0.036 g. The dried weight increased to 0.170 and 0.209 g as a result of 15 and 30 minutes of discharge irradiation, respectively. These values correspond to 4.7 and 5.8 times incremental increases in comparison to that of the control group. The statistical significance was confirmed by t-test with an accuracy of $P < 0.01$. These results indicate that the nitric acids are produced with the discharges and are absorbed by the roots as a fertilizer [3, 4]. An increment of relative chlorophyll content of the leaves by the water discharge was also confirmed based on chlorophyll gauge analysis [3]. **Figure 2** shows the time history of the bacteria count in the drainage water of cultivated *Raphanus sativus var. sativus* at different discharge irradiation times. The bacteria count was found to increase from 3.5 to 4.5 Log-CFU at 28 days of cultivation without discharge irradiation. However, the bacteria count in the drainage water after 28 days of cultivation shows approximately the same value at day 0 of cultivation under the discharge irradiation condition. The bacteria count decreases by 2 Log-CFU with the application of plasma irradiation into the drainage water.

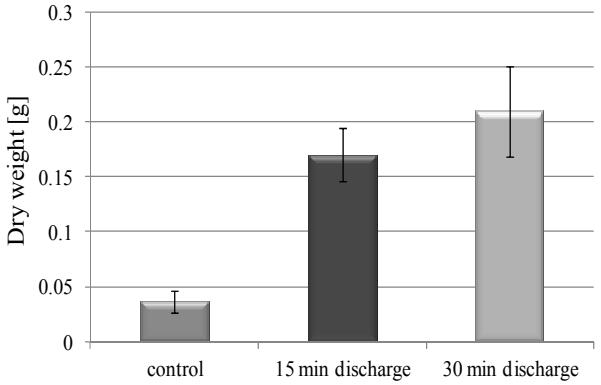


Fig. 1. Dry weight of *Spainacia oleracea* at harvesting time.

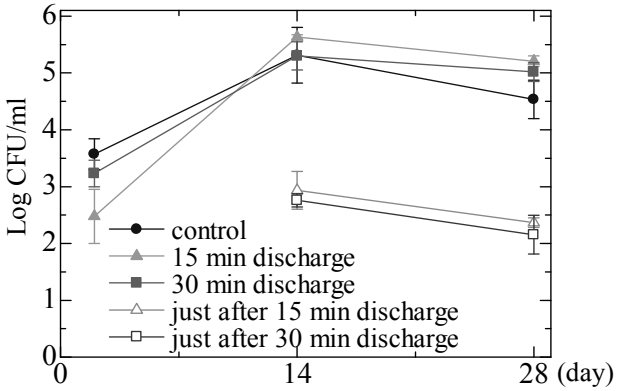


Fig. 2. Bacteria count in aerobic plate counting agar in cultivation of *Raphanus sativus var. sativus*.

**References**

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