Topic Number

Effects of Air, N_2, and CO_2 Plasma Irradiation to Seeds of Radish Sprouts, Potato and Soybean

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We compare growth enhancement effects of air, N_2, or CO_2 plasma irradiation to seeds of radish sprouts, potato and soybean. Air and CO_2 plasma irradiation in a short duration of 3 min lead to growth enhancement of plants in a long term for radish sprouts and potato. The maximum average length is 1.42 and 1.14 times as long as that of control for radish sprouts and potato, whereas the length is nearly the same as that of control for soybean. N_2 plasma irradiation shows no effects indicating reactive oxygen species are key species for the plant growth enhancement.

1. Introduction

In recent years, a novel trend of plasma applications towards biomedical and agricultural areas has spread wide, because plasma can offer extracellular control of cell division, cell growth, and apoptosis.[1-6] Our previous study shows, for instance, that compared with non-treated seeds, air nonthermal plasma irradiated seeds lead to a 11-percent shorter harvest time, a 56-percent increase in total seed weight, and a 39-percent increase in the number of seeds harvested from the grown plants.[5] In this study, we investigated effects of plasma irradiation to seeds of radish sprouts, potato and soybean using air, N_2, or CO_2 plasmas.

2. Experimental

Experiments were carried out with a scalable DBD device described in elsewhere.[5] The discharge voltage and current were 9.2 kV and 0.2 A. Seeds of radish sprouts (*R. sativus*), potato (*S. tuberosum*) and soybean (*G. max*) were employed for plasma irradiation. 10 seeds for each species were arranged at 3 mm below the electrodes in chamber filled with air, N_2, or CO_2. After 3 min plasma irradiation, the seeds were cultivated using a water tray for radish sprout and soybean, and using soil for potato. The length of their stem was measured 7 days for beans and 30 days for potato and soybean after the onset of cultivation.

3. Results and discussion

Table 1 shows average length of plants 7 days cultivation for Radish and soybean, and 30 days for Potato after 3 min plasma irradiation in dry air, N_2 and CO_2. The length was normalized by that of control.. Radish sprouts has the maximum average length 1.42 times and 1.24 times longer than that of control for Air and CO_2, whereas that for N_2 is nearly the same as that of control. CO_2 plasma irradiation to soybean brings about slight inactivation. Average length of Radish and Potato were significantly greater by Tukey test, $P<0.1$ with air plasma irradiation than that control. These results clearly show that each species has its own unique response to plasma irradiation. Because N_2 plasma irradiation shows no effects, reactive oxygen species are key species for the plant growth enhancement.

	Ambient gas species		
Plants	**Air**	**N_2**	**CO_2**
Radish	142%*	98%	124%*
Potato	114%*	106%	108%
Soybean	96%	102%	84%

Table 1. Average length of plants 7 days cultivation for Radish and soybean, and 30 days for Potato after 3 min plasma irradiation in dry air, N_2 and CO_2. The length was normalized by that of control. N=10, * : $P<0.1$.

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5. References

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