9th Asia-Pacific Conference on Plasma Physics, 21-26 Sep, 2025 at Fukuoka

Function of high-voltage stimulation on fruiting body formation of *Basidiomycota*

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The demand for cultivated edible mushrooms such as *Lentinula edodes* (Shiitake) is increasing as both healthy and functional foods. The high-voltage application to the cultivation-bed of *Basidiomycota* i.e. mushroom is known as an electrical stimulus for promotion of fruiting body formation [1]. The function of the electrical stimulus is basically worked as the trigger the growth mode change from vegetative to reproductive of mushroom hypha i.e. mycelium [2]. Repetitively operated compact pulsed power generators with a moderate peak power were developed for the applications in several stages of agriculture and food processing. We tried to clarify the function of the electrical stimulus through the three approaches; 1) evaluation of fruiting body formation of *L. edodes* after application of the pulse high-voltage using originally designed compact Marx generator [3], 2) evaluation of amount of hypha in the cultivation log after applying high-voltage to the bed-log using qPCR analysis, and 3) observation of the primordium formation on the potato dextrose agar (PDA) medium in petri dishes using *Coprinopsis cinerea*. In here, the effects of electric stimuli on fruiting body promotion are discussed.

In the experiments, Mori 290 strain (Mori Sangyo Co., Ltd.) was used as materials. The main harvest season of Mori 290 is spring. *Quercus serrata* (Konara oak) logs were used for cultivation with 0.9 m in length and 0.1 m in diameter. After a two-year incubation as mycelial growing period, high-voltage pulses were applied at different timings for promotion of fruit body formation. A Marx generator of four stages of 0.22 μF capacitors was used to produce high-voltage pulses shown as **Figure 1**. The pulse width was approximately 200 μs, with an output voltage of 50 kV and a current of 10 A. The 16 logs were used and the pulse high-voltage was applied five times.

Figure 2 shows changes in the harvested weight per log and the total yield over a four-year period. The high-voltage pulses were applied two weeks prior to the regular harvest timing. As Mori 290 is a originally spring-fruiting strain, the autumn yield without stimulation was much less compared to that in spring. However, electrical stimulation enabled harvests even in autumn, leading to an overall increase in total yield. The harvest over four years with the stimulation showed a 208% increase compared to that in control. **Figure 3** shows the Yield of fruits body per 16-logs for various timing of electrical stimuli after first flash (same timing, two weeks later, and four weeks later). The yields were evaluated as the total fruit body harvested from 16 logs. The increase in yield due to electrical stimulation was 48%, 232%, and 238% respectively. This result indicates that the electrical stimulation can induce fruit body formation even at out of the original harvest season.

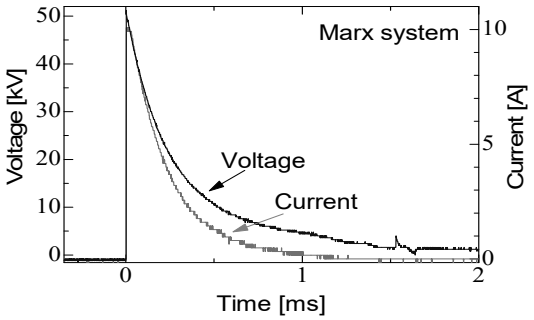

Fig. 1 Waveforms of applied voltage and discharge current of the bed-log.

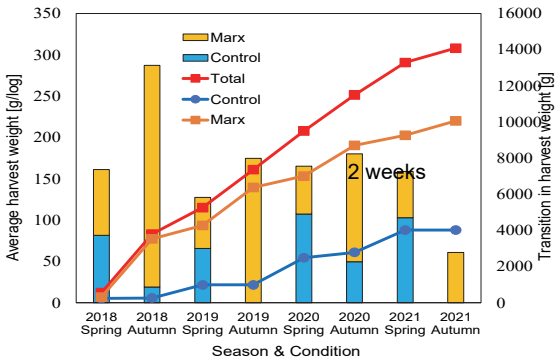

Fig. 2 Yield of fruits body per a log and total harvested weight for each cultivation period.

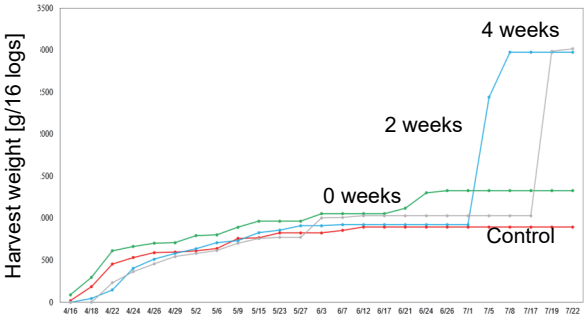

Fig. 3 Yield of fruits body per 16-logs for various timing of electrical stimuli after first flash.

Acknowledge This work was supported by a Grant-in-Aid for Scientific Research (S) (Grant No. 19H05611) and for Scientific Research (A) (Grant No. 24H00301).

References

[1] K. Takaki, *et. al*, Rev. Modern Plasma Phys. **5,** 12-1-112 (2021)
[2] K. Takaki, *et. al*, Microorganisms, **1**, 58-72 (2014)
[3] K. Takahashi, *et. al,* Materials, **11**, 2471-1-12 (2018).