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Destruction Of Weeds Using HV Pulsed Discharges

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***Abstract*—In Mongolia, there are big lands for products in agriculture. Recently, problems of pollution of air and water due to chemicals used in agriculture and gardening or golf courses have been recognized. Residual chemicals in agricultural products have also been a sensitive problem, In order to improve these problems, high voltage discharges have been studied for control of weeds. Weeds can be removed by disrupting the cells. Pulsed spark discharges to weeds also destroy bacteria around their roots since high electric field appears around the roots. Finally, we found that small weeds 4~5cm hight and 1~2mm stem diameter, could be destroyed by one shot discharge with its electrical energy about 140mJ and large weeds could also be destroyed using a pulsed voltage about 15kV with discharge energy of 2J.**

Since the spark discharges take place from the electrode to the neatest or highest weed, the discharge can selectively destroy weeds which grow faster. The use of pulsed voltage can restrict the electrical energy of the discharge below the incendiary level. Also, pulsed spark discharges to weeds destroy bacteria around their roots since high electric field appears around the roots. At the same time nitrogen is fixed due to discharges between the roots and soil.

Keywords—pollution, weed, high voltage, discharge energy, pulsed voltage, bacteria, electric field

1. Introduction

Recently in a farm or golf course pesticide use for information on how to get rid of weeds and crushed as the cause of environmental pollution or soil contamination. In addition, agricultural production for water pollution is a serious problem in the human body by seriously. On the other hand, using the high voltage pulse discharge is very useful in weed removal method as compared with that these chemicals are harmful for the environment and the human body, In this place, one of the issues on the replaceable as one of the main methods can be chosen. These high-voltage pulse discharges in agriculture, attempts to take advantage of that while I've been trying a lot of long, his scope of application has recently been greatly widened. High voltage pulse discharge, not get rid of the weeds and microorganisms that inhabit the crops, pest, also used in the removal of benefits. From this perspective, the pulse high-voltage discharge using the default attribute of the weed have pest removal, antiseptic, nitrogen fixation, etc. can get the benefits of nutritional effects.

2. Experimental Apparatus and Procedure

In this experiments, we used following each different electrodes of 3 types system, niddle, knife edge plate and niddle plus knife edge plate type electrode systems.

Fig. 1 shows schematic diagram of knife edge plate electrode system. In this electrode system, C of condenser was charged from dc high voltage source and discharge into the electrode by controller. In this case, the discharge energy appears from $w= 1/2\ cv^2$. and it's value is decided by dc charge voltage and condenser capacity. discharged pulse rising time is about 50 ns and when does happen discharge from the electrode to weed, it's voltage decreases with exponential decay. In this experiment, the frequency of pulse voltage is used 60Hz and capacity of condenser is changed from 2700pF to 18000pF.

In this Fig.1, the plant pot is consist of insulated box on 45cm lengthX30cm width and 14cm high and filled with soil. And this knife edge plate dimension is consisit of 120mmX50mm and 1.0mm thickness.

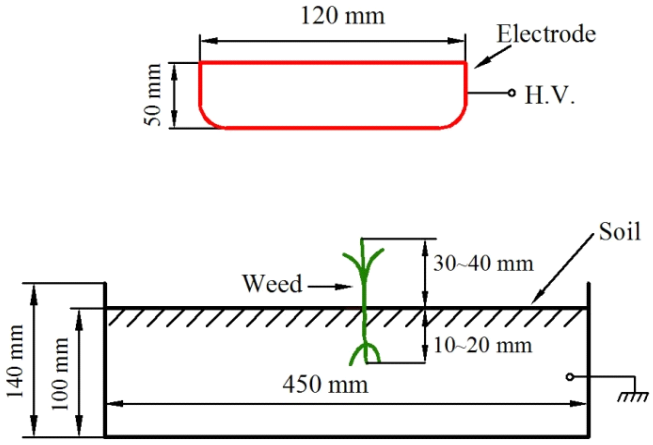


Fig.1 Schematic diagram of knife electrode system

Fig.2, shows schematic diagram of needle electrode system. In fig.2, when the weed is discharged by needle electrode for 1 second, we checked survivability of yeast cell on plant's root around into the soil. Beforehand, 15g of the soil with an aseptic condition put into 4cc of the yeast cell suspension and to approved high voltage into plant the soil with weed.

In this niddle type, the niddle dimension is consist of 60mm length, 0.8mm diameter. and 0.05mm radius of curvature on front edge.

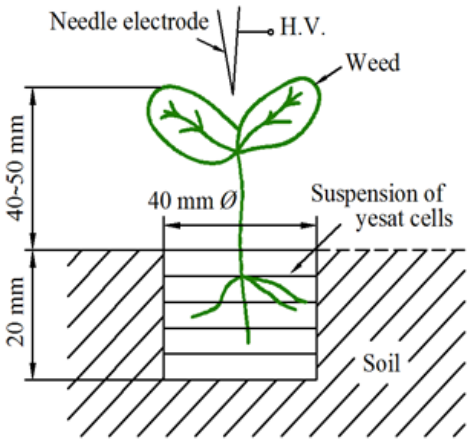


Fig.2 Schematic diagram of needle electrode system

Fig.3 shows schematic diagram of knife and needle electrode system. In this fig.3, we used 2 types of electrode. The one is needle electrode(60mm length and 0.8mm diameter) and the other is knife edge electrode(120mm length X50mm width and 1.0mm thickness)

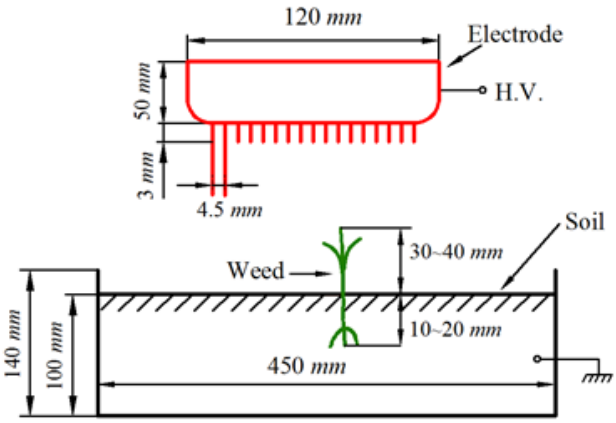


Fig.3 Schematic diagram of knife and needle electrode system

3. Experimental Result

Fig.4 shows the various sample shape for 3days after the pulse spark discharge. The sample(a) shows Papilionacea without the discharge and sample(b) with discharged energy of 70mJ. And sample(c) shows slightly withered papilionacea with discharged energy of 140mJ. and sample(d) appears effectively withered with discharged energy of 400mJ. These results indicate that the minimum energy to wither the weeds is between 70 and 140mJ

(a) Papilionacea without the discharge

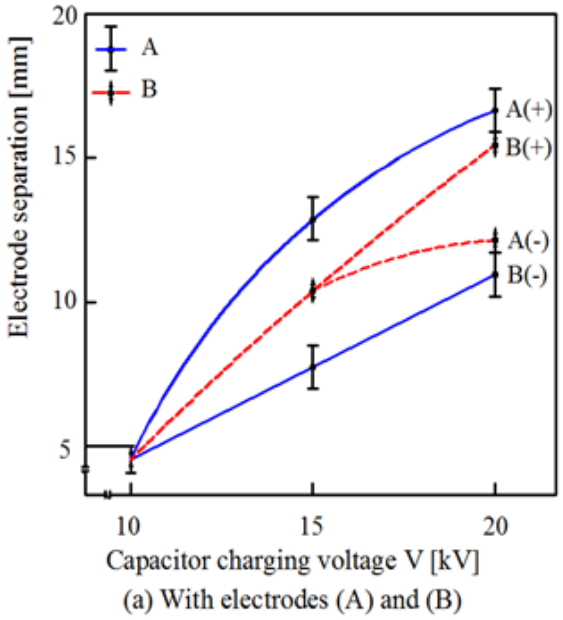
(b) Papilionacea with the discharge(70mJ)

(c) Papilionacea with the discharge (140 mJ)

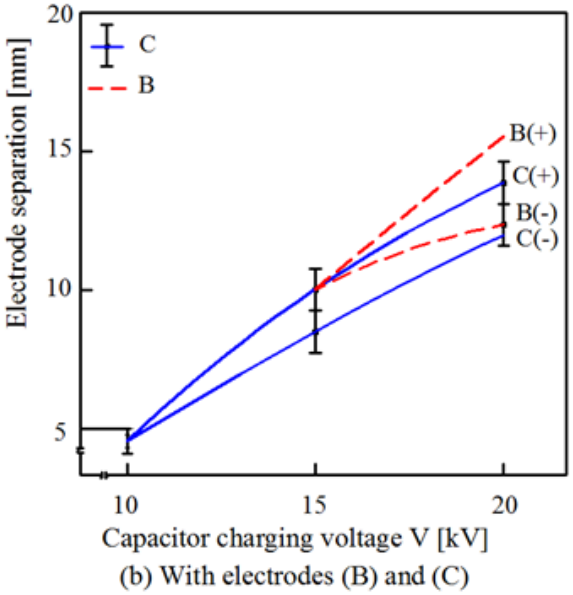
(d) Papilionacea with the discharge(400mJ)

Fig.4. Various sample shape for 3days after the spark discharge

In fig.5, When starting pulse discharge, the relationship between the electrode to the sample and the distance to the weeds was checked. When the capacitor was C=3600pF, the beginning voltage fixed, then the electrode moved and adjusted to small range of the gap distance until the spark discharge. occurred. Thus, the gap between the discharge electrodes and the weeds varies from 0 to 30 mm. At 15 kV and 20 kV, the electrodes (A) have the largest distance between the electrodes, and the following sequence (B), and (c). Moreover, the distance between electrodes at 15kV(-) pole and 20 kV (-) pole is less than (+) poles in relation to electrode. In fig.3, a normal indicates maxmum value or minimum value for electrode's gap distance in measurement range. In case of using the electrode (B), (c), average value of electrode distance on the (+)(-) 15kV and (+)(-)20kV distributed to (+)(-) 0.5mm range. The result showed to happen the pulsed spark discharge on the weeds selectively.



(a) With electrodes (A) and (B)



(b) With electrodes (B) and (C)

Fig.5 electrode separation against the capacitor charging voltage for spark discharge

4. Conclusion

In a way to remove weeds from the green fields of Mongolia, they did not use chemicals to remove weeds. Of course, there was a lot of difficulties in this experiment, and we tested a small discharge experiment, but we could see the factors that damaged the weed in the experiment.

(1)It was understood that it was possible to effectively remove the weeds using pulsed spark discharge. It was thought to be possible to remove with 3 times discharge(discharge energy is 140mJ) about 10cm hight and 3 mm in diameter.of weeds.

(2)When starting a pulsed spark discharge, the spacing between the weeds and the electrodes is determined by pulse voltage. If the weeds are higher than the other plants in the range of different plants, it is possible to selectively remove the weeds by means of a discharge. In the case of a + 15 kV application using theniddle and knife edge plates electrode (C), the variation range was 2 mm at 2 cm gap distance

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