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Electrical Stimulation and Effects on Plant Growth in Hydroponics

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Abstract: In this study, the investigation of the effect of electric current on the growth of the plants is accomplished. Soilless agricultural techniques like hydroponics have gained a lot of importance over the years. Hydroponics is a technique to grow the plant without using the soil. This technique ensures the plant gets all nutrients needed from the water solution. There are many types of hydroponics technique. This study observes the leaf growth by applying to the plants an electric current of magnitude micro ampere. The experiment shows that electric current affects the growth of the plant but the difference is not big. And definitely in the electric current above a certain magnitude, the plant does not grow.

Key words: Electric current, plant growth, hydroponics, technique, plant, soil

INTRODUCTION

Now a days, soilless culture is widespread more than before because of the limited space of cultivation including higher labor costs. Therefore, soilless culture is one of the solutions to the problem. Hydroponics is part of the systems classified as soilless culture. In these systems, the medium contributes in a variable rate to the growing of the crops which can be composed by substances of different origins and characteristics (i.e., organic, inorganic and inert) (Gilsanz, 2007). In general, hydroponics allows high quality crops with an efficient use of water and fertilizer (Asumadu *et al*., 1996).

There are many types of hydroponics technique such as deep water culture, aeroponic system, drip system, ebb and flow (food and drink) system. NFT (Nutrient Film Technique) and wick system (Fourside, 2009). Deep Water Culture (DWC) is one of the hydroponic system techniques that prepare the nutrient in water solution in to the plant (Saaid *et al*., 2013). This technique will ensure the root of plant will absorb the nutrient in water solution to grow wisely (Gupta, 2004). By using this technique, there are several environmental factors that should be considered such as oxygenation, salinity, pH and conductivity of nutrient solution, light intensity temperature, photoperiod and air humidity (Corwin and Lesch, 2005). There are two variables must be considered when growing the plant in nutrient solution which is Electrical Conductivity (EC) and potential of hydrogen ion (pH) (Jones, 1997).

This study investigates the effects of the electric current on the plant growth. Especially a lettuce in hydroponics is considered as a subject which is rich in essential amino acids such as vitamin A and B, iron, calcium, hitosin and lysine. Therefore, it is good for women and also it can make you feel good if you take when you are depressed or stressed. For exploring something helpful to the growth of the plant factory with LED systems, the electric current is investigated and the results are summarized.

MATERIALS AND METHODS

Electronic stimulation in hydroponics: Hydroponics is cultivation without using soil and to grow plants in culture medium made in water and nutrients. It has the advantages that can produce clean vegetables or crops which are not contaminated and can observe the status and appearance of root growth directly. And it can be grown easily in the house and serves to decorate the house.

When plants grow in soil, it is difficult to know what nutrients are required for the plants growth and what the effect is. Because there are already nutrients in soil, it is not easy to identify how the supplied nutrients affect. But hydroponics is able to observe exactly what happens in plants growth. And it is also more efficient to apply the electric current to hydroponics which accelerates the plants growth in hydroponics not in soil cultivation because water is more conductive than soil.

RESULTS AND DISCUSSION

Test period is 26 days (May 19, 2014~June 13, 2014) and the measurement is accomplished 2~3 times a week. Test subject is a romaine lettuce and seedlings germinated in the same day are transplanted for the test. Figure 1 shows that water tanks are for 0, 10, 20, 33.3 μA from the

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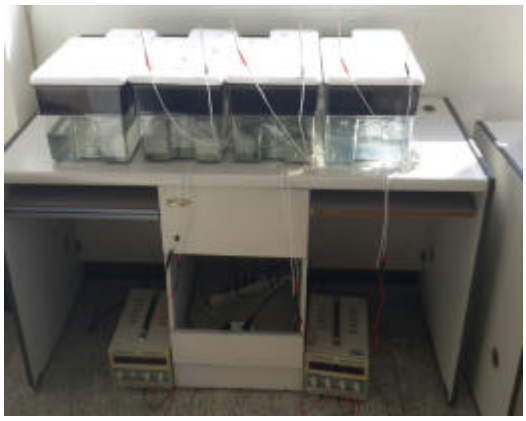

Fig. 1: Water tanks

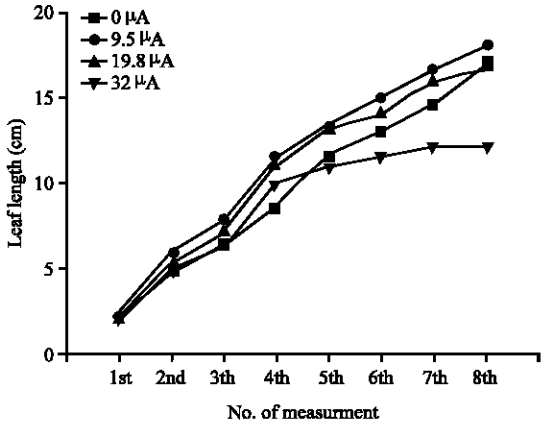

Fig. 2: Leaf length measurement

Table 1: Electric current

Electric current (µA)	Voltage (V)	Resistance (kΩ)
0	0	0.0
10	5	502.0
20	5	244.4
33.3	5	149.0

Table 2: Test conditions

Test period	May 19, 2014~June 13, 2014
Water: culture medium	100: 1
Water temperature	20~22°C

Table 3: Leaf length measurement data (cm)

Set	0	10 µA	20 µA	33.3 µA
Real	0	9.5 µA	19.8 µA	32 µA
Electric current				
1st	0.0	0.0	0.0	0.0
2nd	3.5	5.0	4.2	3.8
3rd	5.4	7.4	6.4	5.5
4th	8.4	12.0	11.2	10.0
5th	12.2	14.2	14.0	11.2
6th	13.9	16.3	15.1	12.0
7th	15.9	18.3	17.5	12.7
8th	18.5	20.0	18.5	12.7

left side. The tested electric currents are 0, 10, 20 and 33.3 µA in Table 1 and all other conditions are the same as shown in Table 2.

Applying a constant voltage to the plant, the test shows the difference in the growth rate depending on the intensity of the electric current. Leave sizes show the similar growth without a significant difference until 5 cm. After 5 cm, the difference shows up in growth according to the magnitude of the applied electric current as shown in Fig. 2-6. Until a certain magnitude of electric current, the growth of the applied electric current case is faster than the growth without the electric current. However, in the case of greater electric current than the certain magnitude, the lettuce is dying and slower in growth (Table 3).

The growth rate is shown in Fig. 7 and it shows the similar growth rate of the lettuce leaves until 4 or 5 days

Fig. 3: Growth (without electric current)

Fig. 4: Growth (9.5 µA)

since, germination. But after 10 days, a higher growth rate appears in the applied electric current case which is better than the not applied case. And then suddenly all growth rates decrease and shows a similar growth rate with no electric current case but in the 9.5 µA case, the reduction of the growth rate is slowly going. At the final

Fig. 5: Growth (19.8 μA)

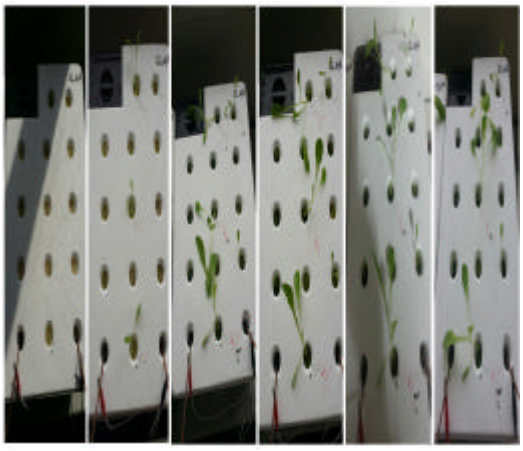

Fig. 6: Growth (32 μA)

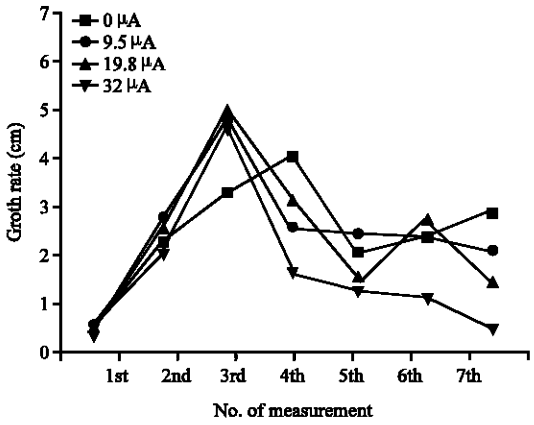

Fig. 7: Growth rate

measurement, the growth rate of the no electric current case is highest among them and in the 32 μA case, the lettuce does not grow.

CONCLUSION

In this study, the effect of electric current on the growth of the plants is investigated. The growth rate of lettuce is better in the electric current applied case than no electric current case during certain days and the effect of electric current in the plant growth is confirmed. In the beginning, the electric current applied case is better than no electric current case but after certain days, the growth rate is reduced abruptly and the result shows no difference with zero electric current case in the plant growth. Especially, in the 32 μA case, the lettuce stops growing and all died. Definitely, in the greater magnitude of electric current case than 32 μA, the plant growth stops. With this result for more effective cultivation, LED light will be considered for the next study.

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