The effects of electroculture on shoot proliferation of garlic
(*Allium sativum* L.)

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Abstract. The Philippines is an archipelago that always experiences yearly devastating typhoons which hinders continuous agricultural crop production. Using an old horticulture technique called electroculture, supplied electric voltage can stimulate plant growth, improve crop quality, and increase crop yields as long as the contributing factors are present – dormancy and essential nutrients. Using garlic (*Allium sativum* L.), three set-ups were prepared: control, 6 V, and 12 V electrocuted systems. Then, the effects of the supplied voltage in terms of plant height were visualized. The reaction of the garlic (*A. sativum* L.) to the application of voltage gave unfavorable results – the average height is relatively higher for the controlled system having 78.2 cm compared to the 6 V and 12 V set-ups of 55.7 cm and 57.1 cm, respectively. However, from the data of the 12th, 17th, 18th, 19th, 20th, 21st, 25th, and 26th day of the experimental period, the electricity applied somehow assisted the plant’s growth. Drying and decrease in height were also visible during the 29th day of the experiment. Further experimentation and optimization can be done to substantiate the results of this present study.

1. Introduction

The Philippines is a tropical country where farming is the staple source of food with principal crops growing such as rice (*Oryza sativa*), corn (*Zea mays*), coconut (*Cocos nucifera*), banana (*Musa*), pineapple (*Ananas comosus*), coffee (*Coffea*), and mango (*Mangifera indica*) [1,2]. As one of the major exporters of agricultural products, the rate of production of each crop must be continuous. However, the country always experiences yearly devastating typhoons and natural calamities that hinders ceaseless production [3].

In order to compensate for this loss, electroculture, an overlooked planting method, can be a promising technique to use. Electroculture is a method of applying electric currents to a plant to assist its seed germination process [4]. The earliest experiments on the subject recorded appear to be those of Dr. Maimbray of Edinburgh in 1746 where he electrified two myrtle plants which in turn gave a positive result [5]. Based on the observations of Palafox (2013) [6], plants that grew beside power lines are healthy. In this context they concluded that the plants utilize the electric current produced by the power lines to speed up its growing process. They also considered the contribution of thunderstorm to the plant’s germination and growth process, hence, gave a favorable result. Though, some
researchers have found out that applying electrical current to a plant decreases its growth rate [7,8] while others stated that electric current application does not affect the plant’s growth [9]. Previous experiments on electroculture use root crops and monocotyledon seed and showed satisfactory results.

Yet, the influence of electricity to garlic (Allium sativum L.) plant, which is considered to be a monocotyledon bulb, has never been studied. Garlic (A. sativum L.) is an important dry season crop that usually takes about seven to nine months for it to be ready for harvest [10] and the Philippines need about 46,000 metric tons to meet the local garlic (A. sativum L.) demand [11].

Thus, this study aims to determine the effects of applying varying electrical voltages (6 V and 12 V) for 30 days on shoot proliferation of garlic (A. sativum L.). The influence of electricity will only be based on the observable changes in the height of the garlic (A. sativum L.) shoots. The results may lead to an early emergence, a sign of higher produce yields, or a prolonged germination process that will hinder continual harvest. Nevertheless, these collections of data can contribute to the understanding of the electroculture technology in relation to garlic (A. sativum L.) and other crop farming. It can potentially alleviate the Philippines’ dependence on importation and uplift the agricultural sector in terms of crop production.

2. Materials and methods

The garlic (Allium sativum L.) cloves bought in a local nursery was planted in plastic pots (5.4 in. x 7 in.) with loam soil in an upright position, 2 inches deep from the surface then covered with compost. Watering schedule was set every two days at 12:00:00 PM with 200 mL of water to maintain the dampness of the soil. Also, exposure to sunlight was maintained. A measuring stick was installed until outgrowths are visible.

Electrocution was performed with 6 V and 12 V from a nail buried 1 inch beside where the garlic (A. sativum L.) clove was planted attached to battery sources via alligator wire clip. The electricity applied was scheduled same time twice a day (morning and evening) for 5 minutes. A total of three set-ups were prepared – set-up A for the control, set-ups B and C with 6 V and 12 V applied, respectively. Only the favorable conditions for planting garlic (A. sativum L.) were maintained. All measurements performed in this study were carried out in three replicate runs and the mean values were reported.

3. Results and discussion

Figure 1 shows a month-long progress measurement of the garlic (Allium sativum L.) plant’s average height, expressed in centimetres(cm), for the controlled and electrocuted systems. The average weather conditions recorded during this specific experimental period were as follows: temperature of 27°C, 0.79% relative humidity, and atmospheric pressure of 1,009.50 mbar.

Figure 1. Garlic (Allium sativum L.) shoot’s height daily progress
– Control (○), 6 V (△), and 12 V (△△).
As shown in figure 1, the garlic (A. sativum L.) plant’s average height in the controlled system is relatively higher with value of 78.20 cm compared to the two electrocuted systems – 6 V and 12 V set-ups having only 55.70 cm and 57.10 cm, respectively. However, the tallest outgrowth first became visible under 6 V having a value of 8.10 cm. Based on the gathered data, application of electricity gave an unfavorable result. Uneven sprouting occurred during the period of the application of electricity. A continuous growth was visible until the 29th day where the outgrowth drying occurred for 6 V and 12 V electrocuted set-ups. These results are comparable to the study conducted by Murr (1964) [7] where leaf tip damage was evident from grain sorghum (Sorghum bicolor), orchard grass (Dactylis glomerata), yellow bush and wax beans (Phaseolus vulgaris), and corn (Z. mays). These phenomena were caused by the damages gained by the important cells for metabolism.

Nonetheless, looking at figure 2, based on the daily change in height of garlic (A. sativum L.) plant, data on the 12th, 17th, 18th, 19th, 20th, 21st, 25th, and 26th day of the experimentation somehow exhibited enhancement in the garlic (A. sativum L.) plant’s shoot proliferation.

![Figure 2. Garlic (Allium sativum L.) shoot’s daily change in height – control (−), 6 V (−−), and 12 V (−−−).](image)

As theorized by Dudgeon (1915), in the presence of electrical liberation, essential nutrients of the soil tend to be more soluble for easy assimilation, the formation of starch and sugar was increased, and all processes were accelerated, thus, an increase activity in the plant [12]. Somehow, the effects of adopting electroculture farming techniques will help to increase the yield unless the planted crop did not undergo dormancy period. According to a study conducted by Woldeyes (2016), three months of dormancy period must be maintained for the crop in order for it to adjust to its environment [13]. In this case, simultaneous application of electricity was performed during this period for visualizing the effects of an accelerating parameter to the plant’s growth.

Nutrients, another essential factor for the plant’s growth must be present in the soil. As reported by Goldsworthy (2006), cells only respond to artificial current if there are calcium ions available in the environment [14]. Calcium ions act as an accelerator together with the supplied electric current in a process of channel opening. Once a plant sensed a change in voltage, calcium channels (voltage gated) flip open to let calcium ions enter. Also, these ions follow electrical stimulation. The connection of the two parameters to plant growth is the main reason why sometimes, electroculture experiments are not successful.

Another source of disparity is the type of plant used for this experiment. Early experiments utilized plants of different classification that falls under root crops – carrots (Daucus carota), potato (Solanum tuberosum), and radish (Raphanus raphanistrum); and grains – mostly barley (Hordeum vulgare), corn (Z. mays), and wheat (Triticum). Almost all root crops that were subjected to electroculture are all dicotyledon and all grains are monocotyledon. However, garlic (A. sativum L.) is considered to be a crop that grows underground having a monocotyledon type of seed. The feasibility of this study to use garlic (A. sativum L.) for electroculture planting gave disapproving results. It seems that garlic (A.
*Allium sativum* L.) plant's properties, together with the applied electricity inhibit the metabolic capacity of the plant.

### 4. Conclusions

The success of electroculture technique depends mainly on the following parameters: dormancy and essential nutrients. Dormancy is a period wherein a crop adjusts to the environment’s condition in order for it to survive drastic changes. On the other hand, essential nutrients are needed for the plant’s metabolic processes. Comparison between the controlled system vis-à-vis electrocuted systems – 6 V and 12 V set-ups, showed that the electricity supplied inhibits the maximum growth of the garlic (*Allium sativum* L.) plant within a month of experimental period with values of 78.20 cm, 55.70 cm, and 57.10 cm, respectively. During the 29th day of electrocution process, garlic (*A. sativum* L.) experienced dryness and decrease in height for electrocuted systems–6 V and 12 V set-ups because of the damage received by the important cells for metabolism and growth. Still, based on the data of the 12th, 17th, 19th, 20th, 21st, 25th, and 26th day of the experimental period, the electricity applied somehow assisted the plant’s growth. The electrocution process would be successful if there were calcium ions present in the soil based on the records and observations of past researches.

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