

# **Effect of High Voltage on Texture, Color, and Growth of Aloe Vera Leaves**

## **ABSTRACT**

With the growth in transmission lines all over the world an evident observation comes in front regarding the effect of high voltage on the plants. High-voltage transmission lines are used to transmit electric power over long distances. High voltage may have positive or negative effects on plants and other living beings. The objective of this study is to investigate the effect of high voltage on aloe vera plants with respect to changes in texture, colour, and growth of leaves after exposure to high voltage for different durations. Aloe Vera plant is chosen due to its various properties and uses in dermatology. The leaves of Aloe Vera contain a soothing thick sap that is valuable for healing and curing of wounds and diseases. Images of exposed as well as unexposed aloe vera leaves were taken and analysed over a period of ten days. Other control variables like temperature, humidity, sun light were maintained almost the same for all observations.

*Keywords: Aloe Vera, effect of high voltage, Tesla coil.*

## **1. INTRODUCTION**

Revolutionary and ever growing field of electrical engineering have enhanced the high voltage transmissions in day to day life. Since last few decades high voltage transmission is becoming a vital part of our life. The high voltage has much effect on living organisms as well as human beings. Plants are also multicellular, complex organisms like human beings and some studies have reported the effect of high voltage on them as well [1]. The growth and development of the plant can be affected by mechanical stimulations like wind, vibrations, and touch. This process is called thigmomorphogenesis [2]. In plants, there are various natural and artificial impacts along with large variation of potential. These days, huge amount of information regarding electrical effects in plants is available. Plants play a significant role in the living world as main producers of food and oxygen; therefore it would be advantageous to investigate their relations with today's increased exposure to high voltage electrical fields. Ksoy et al. [3] in 2010 investigated the growth of allium cepa bulbs in pots for three days on treatment area on which 380 KV high voltage power lines were passing. Ten bulbs were set up for each treatment area. Triticum baeticum boiss. subsp. baeticum seeds were collected at same distance from power lines on planted field. Ten seeds from each area were germinated in petri dishes for three days in laboratory. The treatment groups were compared with the control group for mitotic index and chromosome aberrations. Data obtained from this revealed that the electromagnetic fields from high voltage power lines improved the mitotic index and chromosome aberrations. Maziah et al. [4] investigated that electromagnetic field could be used as a tool to promote mustard growth by means of photosynthesis once the right EMF strength is exposed. The effects of

electromagnetic fields at high voltage transmission line on biochemical and antioxidant system changes in mustard leaf (*brassica chinensis*) were investigated under field condition. Mustard leaves were exposed to EMF from power lines at various distances. The effects of EMF on leaf mustard planted at different distances from the power line showed that the leaf mustard planted within 20 m from the power line had considerably higher protein, soluble protein, soluble nitrogen, and chlorophyll contents due to the higher EMF strength which decreased with increasing distance from the line. Higher EMF strength closer to the 275 KV power line resulted in higher peroxidase enzymatic activity, and chlorophyll content. Thus the new and energetic area of scientific research is the studies associated to the high voltage effects. In India, high voltage exposure is very common as shown in Fig. 1.



**Fig. 1 Plants under high voltage agricultural fields in roop nagar area of Jammu**

Agricultural science takes interest not only in the general and valued crop-forming factors, but also in those which are inexpensive and generally underestimated, though more pro-ecological ones which include ionizing, laser, ultraviolet radiation, electric, and magnetic fields [5]. The objective of this paper is to investigate the effect of high voltage on texture, colour as well as on the growth of the Aloe Vera plants. The Aloe Vera has been chosen because of its numerous applications. The Aloe Vera and its characteristics are described in Section 2. The methodology is presented in Section 3 and results and discussions in Section 4 along with the conclusions in Section 5.

## **2. ALOE VERA**

Aloe Vera is a perennial liliaceous plant which has juicy green leaves attached at the stem in a whorled pattern [6]. It is a hardy, perennial, tropical, drought-resistant, succulent plant and has been used for a variety of medicinal purposes. Aloe Vera is a stem less or very short-stemmed plant growing upto 60– 90 cm in height. The stem has dormant root buds that develop to form new roots. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on the upper and lower stem surfaces [7]. Mature plants can be grown as tall as four feet with average height around 30 inches. Each plant has an average of 15 leaves usually and weighs up to 2-3 kg when fully matured. The Aloe Vera plant can be harvested following every 6 to 8 weeks by removing 3-4 leaves per plant [8]. The peripheral bundle sheath cells of Aloe Vera produces extremely bitter, yellow latex, which is commonly known as aloe juice or sap [9]. Aloe Vera has also been used for medicinal purposes in several countries like India, Mexico, Greece, Egypt, China and Japan [10]. Fig. 2 shows a Aloe Vera tree grown in a house.



**Fig. 2 Aloe Vera**

Aloe Vera has extensive applications in Ayurveda for its anti-burn effect. It also acts as a tonic, antiseptic, antibiotic, anti-diarrheal, anti-fungal, anti-viral, and also a good hair conditioner [11]. In Ayurveda, which is also the traditional medicine of India, Aloe Vera has manifold uses such as it is used as a laxative, in haemorrhoid remedy, and as a uterine stimulant. It is also use to treat eczema or psoriasis [12]. Recently, Aloe Vera has been used to treat canker sores [13]. The most important part of Aloe Vera is Aloe gel. Aloe Vera gel is 99% water. It has a pH of 4.5 and is a common ingredient in many non-prescription skin salves. The gel also consists of the bulk of the leaf substance, which serves as the water storage space organ for the plant. In addition to this, the Aloe gel consist of polysaccharide, glucomannan, etc. [14].

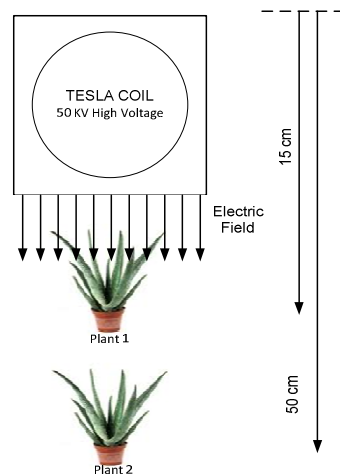
### **3. METHODOLOGY**

The experiment was carried out on Aloe Vera plants to study the effect of high voltage on the leaves with respect to texture, colour, and growth. In this research, the photograph of Aloe Vera leaf before high voltage exposure was taken and it was studied. After that the Aloe Vera plant was exposed to high voltage. The Tesla coil shown Fig. 3 was used to produce high voltage of order 50 KV.



**Fig. 3 Tesla coil**

102 Tesla coil is an electrical resonant transformer which is used to produce high voltage low  
 103 current, high frequency alternating current electricity. It is essentially a high frequency air  
 104 core transformer. Tesla coil can produce comparatively higher voltages than other artificial  
 105 sources of high-voltage discharges or electrostatic machines. The voltage across the Tesla  
 106 coil was 50 kV. After that two Aloe Vera plants were taken and were kept at a distance  
 107 of 15 cm and 50 cm respectively from the Tesla coil respectively. Three leaves from each  
 108 Aloe Vera plant was taken to study the effect of high voltage on it. On each of the leaves two  
 109 surface electrodes were attached at a distance of 6.5 cm in between them. The high voltage  
 110 experimental setup can be explained in the Fig. 4.



111  
 112 **Fig. 4 Block diagram of the experiment**  
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114 Then these Plants were kept in Faraday cage along with the Tesla coil to study the effect of  
 115 high voltage. Faraday cage is a metallic enclosure that prevents the entry or escape of high  
 116 voltages or electromagnetic field. It is an enclosure formed by conducting materials which  
 117 blocks external effect of high voltages. For best performance, the cage should be directly  
 118 connected to an earth ground. A heavy duty Faraday cage can shield against direct lightning  
 119 strikes.  
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121  
 122  
 123 **Fig. 5 Faraday's cage**

124 The exposed Aloe Vera leaf was kept under natural environmental condition for ten days i.e.  
 125 the control variables like temperature, humidity, sun light were maintained almost same for  
 126 all observations. The plant was watered every day. The Aloe Vera leaf was observed with

127 respect to change in physical properties like texture, colour and growth. The texture and  
128 colour was observed by taking images of the Aloe Vera leaf and the growth was recorded by  
129 a thick thread measured from the base of the leaf just above the root to the tip of the leaf.  
130 The setup to record the growth of the Aloe Vera leaf is shown in Fig. 6.  
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Fig. 6 Setup to record growth of Aloe Vera leaves

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#### 136 4. RESULTS AND DISCUSSIONS

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138 Investigations were carried out using both normal Aloe Vera leaves and high voltage  
139 exposed Aloe Vera leaves for the determination of the change in texture, colour, and growth.  
140 Two different Aloe Vera plants were taken to study the effect of high voltages on them.  
141 Three leaves from each plant were selected to study the change in the texture, colour, and  
142 growth. The third leaf from each plant was unexposed to high voltage radiations by wrapping  
143 it with the thin aluminum foil. The texture of the leaf was hard and the colour was natural  
144 green. The length of the leaf of Plant 1 was measured and was found to be 30 cm on the 1<sup>st</sup>  
145 day without exposure. Similarly, the length of the leaf of Plant 2 was measured with and  
146 without exposure and it was found to be 30.5 cm on 1<sup>st</sup> day with and without exposure to  
147 high voltage. The analysis of the images shows that the texture of the Aloe Vera leaf does  
148 not have any noticeable effect but the colour of the Aloe Vera leaf was slightly faded to  
149 yellow green from natural green and the length of the Aloe Vera leaf which was at a distance  
150 of 50 cm got shirked at the tip by 1 cm while the Aloe Vera leaves which were unexposed to  
151 high voltage did not showed any change in it. Table I shows texture, colour, growth, and  
152 damage of Aloe Vera leaves exposed to high voltages. Here D0 corresponds to leaves  
153 before exposure to high voltages.

154

#### 155 5. CONCLUSIONS

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157 The experiments were conducted to study the effect of high voltage on Aloe Vera leaves,  
158 which is an important plant because of its useful properties and uses in dermatology. The  
159 analysis of the results showed that high voltage has a definite adverse effect on the Aloe  
160 Vera leaves and growth. It was also observed that with passage of time, the recovery  
161 process of the plant tries to minimize the damage. If the level of the exposure is very high,  
162 the damage is irreversible. Some colour changes were also observed in the unexposed  
163 leaves. This may be due to the wrapping of the leaves, which stops the sun light in the  
164 wrapped portion of the leaves. This type of damage is easily recovered within 2-3 days.  
165 Further, the results may not be same for other plants as the voltage bearing capacity may be  
166 a function of the shape, size, and constituents of the leaves as well.  
167

168 **Table I. Texture, colour, and growth of Aloe Vera leaves before and after exposure to**  
169 **high voltages.**  
170

DAY	PARAMETER	PLANT 1 L1	PLANT 1 L2	PLANT 1 L3 (UNEXPOSED)	PLANT 2 L1	PLANT 2 L2	PLANT 2 L3 (UNEXPOSED)
D0	TEXTURE	HARD	HARD	HARD	HARD	HARD	HARD
	COLOUR	GREEN	GREEN	GREEN	GREEN	GREEN	GREEN
	LENGTH	30 CM	31 CM	28 CM	29 CM	30.5 CM	28.5 CM
	DAMAGE	NIL	NIL	NIL	NIL	NIL	NIL
D1	TEXTURE	HARD	HARD	HARD	HARD	HARD	HARD
	COLOUR	GREEN	GREEN	GREEN	GREEN	GREEN	GREEN
	GROWTH	29CM	31 CM	28 CM	28 CM	30.5 CM	28.5 CM
	DAMAGE	LIGHT BLACK SPOTS	NIL	NIL	ONE BIG AND ONE SMALL BLACK SPOT	TIP OF LEAF STARTED SHRINKING	NIL
D3	TEXTURE	HARD	HARD	HARD	HARD	HARD	HARD
	COLOUR	YELLOW GREEN	GREEN	GREEN	YELLOW GREEN	GREEN	GREEN
	GROWTH	29 CM	31 CM	28 CM	28 CM	30 CM	28.5 CM
	DAMAGE	DARK BLACK SPOTS	NIL	NIL	PROMINENT BLACK SPOTS	NIL	NIL
D5	TEXTURE	HARD	HARD	HARD	HARD	HARD	HARD
	COLOUR	YELLOW GREEN	YELLOW GREEN (STARTED FADING)	GREEN	YELLOW GREEN	YELLOW GREEN	YELLOW GREEN
	GROWTH	28 CM	31 CM	28 CM	29 CM	30 CM	28.5 CM
	DAMAGE	DARK BLACK SPOTS	VERY SMALL BLACK SPOTS	NIL	DARK BLACK SPOTS	TIP OF THE LEAF SHRINKED FURTHER	NIL
D7	TEXTURE	HARD	HARD	HARD	HARD	HARD	HARD
	COLOUR	YELLOW (FADED)	YELLOW	STARTED TO FADE YELLOW.		YELLOW	YELLOW
	GROWTH	15 CM	31 CM	28 CM	29 CM	30 CM	28.5 CM
	DAMAGE	TOTALLY DAMAGED AND LEAF FALLEN OFF	SMALL BLACK SPOTS	NIL	NIL		



**Fig. 7 Images of Aloe Vera leaves taken on 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> day.**

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