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Impacts of Lightening on Agriculture and Its Remediation

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Abstract

Lightening is one of the naturally occurring devastating disaster causing dreadful effects in all sectors. Considering the frequency of occurrence and impact, Kerala declared lightening as a state disaster. Lightening causes death fatalities as well losses in agriculture sector. Lightening causes pull up of palm trees and premature fruit drop or deflation in other crops. The main challenge posed by lighting injury is to diagnosis the problem correctly. At the same time lightening benefits soil by adding atmospheric nitrogen. Earth Networks contributes to national, state and municipal efforts to minimize lightning injuries and damage by deploying and operating total lightning detection networks. Other than this, farmers need to take precautionary actions based on bulletins published by concerned authority.

Introduction

Lightning has been recognized as one of the most powerful and devastating disaster that mankind has encountered throughout history (Shearman and Ojala, 1999). Lightning is announced as a state natural disaster of Kerala. Lightning strikes had been reported in Kerala along with abundant rain and thunderstorm both in South-west and North-east monsoon period. Kerala reported highest incidence of lightning strike claiming many lives and lost in various structures including agriculture. Western Ghats region of Kerala with its cumulonimbus clouds is more prone to lightening especially during north east monsoons from October to December. The most affected areas in Kerala are Idukki, Wayanad and adjoining midland.

Kerala is a region with high density of vegetation. In Kerala, thunderstorms normally occur from October 15th to June 1st (Malayalam months Tulum to mid Edavam). Lightning activity is more in the afternoon than in the forenoon hours. In our atmosphere, three types of discharges take place: one within a thundercloud (intra-cloud), the second from one cloud to another (inter-cloud) and the third, from cloud to ground (CG). The last type takes a toll on our life and property and so is of concern to us. In India, every year 1,755 animals' deaths are due to lightning strike. According to Ronald, death rate in animal due to lightning strike is six times than that of human death. In India, 70 percent of human deaths are related to agriculture labours, farmers and livestock caretakers. Risk is more to farm community due to more outdoor exposure. Most of the lightening strokes in India happened during March-April.

Damage to Tall Trees

In Kerala, homes are generally surrounded by tall trees and trees act as good conductor of lightening energy. Because of the height difference, lightning conductor installed on

the building in not being able to protect the tree, ultimately the trees died out of lighting shock. This is a normal calamity found with tall tress like palms, mango tree, jack fruit tree etc. during lightening (Das *et al.*, 2007)

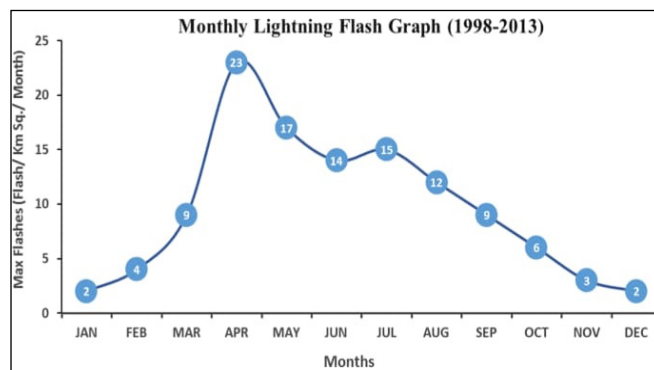


Figure 1: Periodic trend analysis of lightening on month wise (1998-2013)

Damage to Crops

The common damage from lightning in crops includes wilting, yellowing, collapse, necrosis and premature fruit drop. The main challenge posed by lighting injury is to diagnosis the problem correctly. The lightning injury can be confused with other diseases such as root rots, girdling, herbicide injury, vascular wilt, heart rots, and severe drought injury. This situation demands an expert subject matter specialist to analysis and confirms the situation.

Damage to Coconut

Coconut is the most important plantation crop in Kerala commonly known as 'Kalpavrisa' occupying highest area in production among plantation crop. A matured coconut tree is having a height of 30 m and its make coconut very susceptible to lightning stroke. The very common symptom of lightning stroke in coconut is stem bleeding, oozing of liquid from entire trunk. But this symptom usually gets confused with symptoms of stem bleeding disease and root wilt.

Damage to Banana

The same scenario is seen in all most all crops in Kerala. Banana, the other major crop in Kerala. Lightning strikes on banana cause yellowing of leaves and as progress it turns to wilting. The lightning strokes in banana resemble Panama wilt disease. Upon closer inspection, however, other unusual signs or symptoms become manifest, suggesting that the plant must have been exposed to unusually high temperatures or pressures. The same scenario is observed in mostly all crops in Kerala (tuber crops, plantation crops and cereals). In short, lightning stroke symptoms manifest in crops

as yellowing, necrosis, wilting, oozing of liquid from stems and in acute condition it causes fell down of crops.

General Views

Here given is the brief review of indications of lightning injury to crops. The rapid wilting and browning of leaves, fruits and stems is a common occurrence. As compared to disease and pest infection, symptoms develop rapidly and they appear in days rather than weeks and the symptoms onset coincides with recent thunderstorms. Mostly circular area of field gets affected due to lightning. Other common symptoms include is premature mass dropping of green fruit, burns or strange scars on plants or organs and roots may be blackened or cooked. For crops such as sugar beets, potatoes or sweet potatoes, underground tubers or roots are cooked due to lightning shock. Tall-standing, erect plants are ready pathways for lightning energy.



Figure 2: Lightning injury in maize field

The most severe damage to plants by lightning is caused by the extreme heat and shock waves generated by the current.

Heat

The energy in lightning current produces temperatures greater than 50,000 degrees Fahrenheit in millionths of a second. The heat turns plant fluids into steam and burns plant cells and tissues leading to a wilting appearance.

Shock Waves

The tremendous heat energy is produced in millionths of a second, which is far too quick for the air to expand gradually. The pressure produced by this intense heat is on the order of 10 to 100 times normal sea-level pressure. This high-pressure region rapidly expands outward causing compression of the surrounding air. This region of compression propagates outward as a shock wave. The pressure can cause the pith of a plant stem to explode out through holes in the

stem, it can cause immediate drop of all fruits (ripe or not), and it can split a tree trunk.

Lightening Helps to Fertilize the Soil

A nitrogen molecule in the air consists of two atoms which are held together very tightly. The plants are unable to absorb the diatomic molecules directly for the metabolic use. In lightening, there is enough electrical energy to separate the diatomic nitrogen molecule in the air. Once the atoms are separated, they can fall to earth with rain water and combine with minerals in the soil to form nitrates, a type of fertilizer. The nitrogen-containing nitrates in the soil are absorbed by the plants. So, in addition to provide a spectacular light show and scaring effects, lightning also helps fertilize the soil (Tinmaker and Chate, 2013).

Remediation

Earth Networks contributes to national, state and municipal efforts to minimize lightning deaths, injuries and damage throughout by deploying and operating total lightning detection networks and supporting stakeholders with much needed data and analytics. Earth Networks patented lightning sensors should be located in most areas in state. Proper contribution from top atmospheric scientists studying thunderstorm dynamics in early forecasting is needed. As of now, Indian Institute of tropical meteorology Pune has installed 48 lightening sensors throughout the India which can pin point lightening activity in real time and the institute also has developed a mobile app for alert for impending lightening activity over the area. But the success of alert system in farming community depends on the mode of communication because the perception level is very poor in rural area especially agriculture community. Indian Meteorological Department is about to launch end to end prediction system in predicting lightening aiming both for rural and urban areas. The possible damage from lightning strike on crops is tremendous if it's near to power transmission line. So, we need to plan our agricultural firm accordingly. Installing lightening arresters and wire fence grounding can be

considering one of ways to alter intensity of lightening stroke. Hire professionally trained personnel to design and install effective lightening protection system around valuable farms. A small investment can protect farm, property and equipment from lightening devastation.

When there is thick black colored clouds are seen farmers and agriculture labors should move to safe place like home or indoor place. In open field, farmers should not take shelter under trees while lightening because trees are good conductors of electricity. Agriculture wet fields are good conductors of electricity during rain. So, working in agriculture field should be avoided during rainy season as well as thick cloud time. Avoid touching metal pipes or farm objects in the field while lightening as they are good conductors of electricity. Agriculture works like ploughing, sowing should not be done on thick cloudy days, even without rain lightning strike can occur. Agriculture markets and intense agriculture zone mainly of plantation should be adopted with safety lightning rods with safety measures. We should not tie animals to tall trees. Need to keep animals away from water bodies, solar panels and water towers as these things will increase the risk of lightening stroke. Need to avoid contact with farm equipment and tractors as they can make farmer life in a risk.

Conclusion

In agriculture sector, lightening can have serious impact. So, we need to think of a technical standard to protect agriculture from lightening shock. There are works at rudimentary stage about the before said. So, considering the losses, here is the time to expand research and make it available to the farmers in an affordable way.

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