Why Plants Grow Vertically Upwards?

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Abstract

Certain events are so common that it skips the scientific enquiry as to why it is so? The natural growth of trees is directed vertically upwards. For such directional growth, a directional dominating force in the growing-front is essential. It is also seen that the direction can be changed responding to the direction of centrifugal force if the pot with the tree is kept on a spinning disc. Obviously, when the magnitude of centrifugal force is high, the natural directional force in the vertical direction becomes significant. Electric field influences plant growth, generally leading to increased germination rates, and accelerated growth depending on factors like the field strength, duration, and polarity of the field. This article has discussed the possible nature of forces that grow plants vertically upward direction.

Key wards: *growth direction of trees, field forces in plant growth, electric field of earth, field effect on plant growth.*

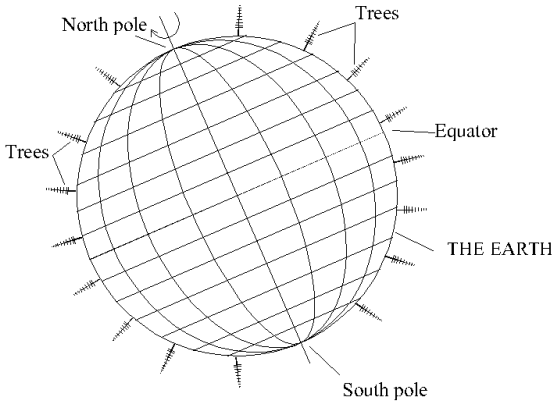
Introduction

Plants like animals require food for survival. The plants require sunlight for synthesis of their food and many physiological processes. Plants kept inside a room facing a window are seen to bend towards the window to get more sunlight. From this phenomenon, one might say that the plants grow upward because the mean position of the sun is vertically upward. When a plant grows upward the mass of the plant increases and the center of gravity of the plant shifts upward. In the growth process the plant is doing work against gravity. Obviously, some vertically upward force stronger than gravity is in action and we need to understand the same.

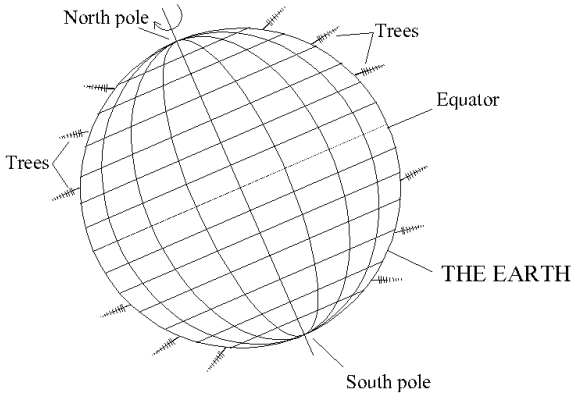
Discussion

Only in the equatorial zone, the sun's mean position is vertical. However, in higher latitudes (polar regions) the sunlight is always oblique and the mean position of the sun is also inclined to the vertical. If the above hypothesis is correct, then all trees in higher latitudes would have been tilted towards the Equator (Fig.1). In fact, this does not happen. Obviously, there is a stronger vertically upward field force acting on the growing-front of the trees which promotes the growth of trees in vertically upward direction against gravity. On surveying the various fields (potential gradients) present near the surface of the Earth, we notice the presence of three distinct types of fields. They are: (1) the gravity field, (2) the positive electric field on average 100 volts/meter and 3) the negative thermal field (6^{o}C/km). Beside the above fields; there may be some

less-known fields. Let us examine how the growth of trees respond to the thermal and the electric fields.



(a) Tree growth in vertical direction



(b) Tree growth (if) inclined towards equator

Fig.1 GROWTH DIRECTION OF TREES

We are aware as to how the growing front advances in solidification of ice and metal. The nature of microstructure formed during solidification is a complex function of the solidification rate, temperature gradient, chemical composition and several material characteristics such as phase equilibrium reactions, nucleation and growth kinetics of the phases and crystallographic constraints [1]. During the solidification of ice, metals, and ceramics, various microstructures can form, including dendritic (tree type microstructure), cellular, and equiaxed. Metals often exhibit dendritic structures, which are branching crystal formations [2]. The growing front at the solid liquid interface gives rise to formation of several microstructural phases responding to both thermal and electric fields. For example, the solidification of cast iron composition at normal cooling rates (thermal gradient in sand castings) develops dendritic structure. The shape of the tree structure is a function of the concentration gradient of the solute atoms and the degree of thermal gradient. Additionally, electric and magnetic fields do produce prominent effects on the directional growth of the dendrite phase. The growth processes

of trees and solidification of metals have some similarity. The ordering of atoms in both, are organized by the local interactions (electric charge forces and thermal charge forces). Any external charge field has the scope to directionally drift the ions and the ionic clusters present in the proximity of the growing front to directionally orient the microstructure of solid in the direction of the field. Since these ions and the clusters are yet to be attached to the growing solid, they respond to the external fields in setting their position in the solidification front.

We may now examine the growth process of trees. Permanently embryonic tissue involved in cell division at the apices of roots and stems are known as apical meristem. These meristems usually consist of small, densely packed cytoplasmic cells which get established during embryo development and divide, producing the primary plant body of root and soot that form the dynamic regions of growth. Below the apical meristems, tissue differentiation begins. The protoderm gives rise to the epidermal system, the procambium to the primary vascular system and the ground meristem to the pith and cortex. The root apical meristem is covered by a **root cap which is responsible for perceiving gravitational changes** [3]. The shoot apices vary greatly in size and shape. The shape of the Cycas revoluta may be elongated, conical, dome-shaped, flat, or even slightly concave. Apices increase in size during the development of a single plant, however, the surrounding cells are also mitotically active which give rise to plants with multicellular apical meristems. **The outer layer of cells (tunica) is the growing front which exhibits a growth in a direction opposite to the gravity field** [4]**.** The phenomenon of directional growth of plant organs in response to gravity is termed as gravitropism or geotropism. It is difficult to justify preferences in the existing gravitational interaction for the root cap and the tunica. However, the new interpretation of gravity from mass-space interaction has scope of explaining the above phenomena [5]. Further, the cause of electric charge interaction can also be understood from the new mass-space interaction [6]. However, the strength of mass-space interaction between matters in neutral state and that in charge state differ by many orders of magnitude due to the nature of densities of mass and space. Both mass and charge interactions being fundamentally caused by mass-space interaction, the net force can be determined from the algebraic sum of gravitational interaction and charge interaction. The net force can be directly evaluated from mass-space interaction of matter in a charged state having variation in mass-space composition [6].

In the present concept the surface of the earth is composed of neutral matter with zero absolute charge. But in the new concept charge appears in matter when there is a difference between the mass-space ratio of the matter and that of its surrounding matter. Thus, charge is a relative property and charge neutrality appears in matters at equal charge potentials state [6]. Hence, the zero-charge potential of the surface of the

earth refers to a definite absolute charge potential which is the same everywhere on the surface of the earth. The absolute potential of the surface of the earth is taken as reference zero for the relative charge potential scale to measure the charge potential of different levels of atmosphere, as well as to measure the potential of artificially produced charged bodies. The interior of the earth is positively charged with respect to the zero charge of the surface [8]. By appropriately increasing the absolute value of the reference zero charge potential, the interior of the earth remains positively charged while the crust becomes negatively charged.

The matter of the surface of the earth has a definite mass-space ratio that corresponds to zero relative charge potential. The mass rich matter with mass-space ratio higher than that of the surface-matter of the earth are positively charged and the space rich matter with mass-space ratio lower than that of the matter on the surface of the earth are negatively charged [6]. Due to the effect of electric charge, the negatively charged matter experiences an increased pull towards the center of the earth and positively charged matter experiences a decreased pull towards the center of the earth as compared to gravitational interaction of neutral matter. In germination of seeds the primary plant body of root senses stronger gravity and makes its way into the soil (positive gravitropism) and the primary plant body of soot senses weaker gravity where it is pushed up by the internal charge interaction and external charge field forces (negative gravitropism). The plant body being a good conductor of electricity, the electric charge potential of all parts of the plant remains nearly at earth's electric potential. The electric potential of the lower atmosphere has a positive electric field in vertically upward direction. With reference to the charge potential of the surface of the earth the electric potential of the atmosphere is positive. Alternatively, the ground potential or the potential of any parts of the tree becomes negative with respect to the potential of the atmosphere. Thus, the plant as a whole, particularly the growing top of the tree experiences the electrical field force. The downward movement of root and upward movement of soot is understandable from the new concept of gravity and the effect of existing positive electric fields in the atmosphere.

When the soot enters into the atmosphere having a positive charge potential gradient of 100v/m it experiences upward force from the electric field. The growing front remains always at a lower charge potential due to charge conduction from the surface of the earth. The negatively charged growing soot experiences a vertically upward force from the positive charge field of the atmosphere. This promotes the growth of a plant in a vertically upward direction. The growing front of the root being relatively more charge-negative experiences stronger gravity which makes it advance downward. This hypothesis is in full agreement with experimental results. Exposure to an electric field influence plant growth, generally leading to increased germination rates, and sometimes

accelerated growth and development. The effects of an electric field on plant growth depends on factors like the field strength, duration, and polarity of the field [7].

It is well known that the surface of the Earth is negatively charged with respect to the atmosphere above. If an electric conductor is raised from ground level, then positive charges from the atmosphere are attracted towards the conductor and they are seen to crowd around the top of the conductor which ensures the positive nature of the field in the atmosphere. A tree is a natural good ionic conductor. Thus, when the tree top attracts the positively charged particles including the ions of carbon dioxide from the atmosphere towards the growing front, the growing front is thus pulled by the positive ions causing directional growth of the plant. The negative ions from the ground are also attracted towards the top of the tree. The field assisted motion of ions and the ionic clusters towards the growing fronts promotes the directional growth of the plants.

Conclusion

The effect of the impressed charge field on germination and growth rate has been noticed experimentally. It is also known that there exists a positive electric field of 100v/m in the lower atmosphere. Therefore, the natural growth of trees in vertically upward direction is well justified from the nature of electric fields present at the lower atmosphere of the earth.

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