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Plant Response to music sound frequencies

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Abstract

Music is all around us marking every event of our life. Rishis of yore have recognized the linkage of musical sound with emotions and intrinsic nature of living things. Sonorous music, more than entertainment, has played instrumental role in healing and harmonizing the body and mind. The developments of modern scientific era have added a new thinking in the field of music. The therapeutic and applied aspects of music have shown remarkable impact on all the three aspects of human personality- physical, mental and emotional and also on animals and insects. In addition, there is a handful of information available regarding the positive effect of sound energy on plant growth.

Many scientists experimented on music sound and plant response. For music therapy in plants, it has been found that classical music is preferred than loud music. The positive or negative effect of sound on plants also depends on frequency, intensity, exposure time and type of sound used. Reports are also there with enhanced growth of plants by the use of 'Green Music'. Classical music and the vibration of sound waves are thought to help plants grow by stimulating their production of proteins. With an understanding of waves, sound and pressure, we look at plant response to music from a scientific standpoint. Music is an expression of joy of Nature having an intimate relationship with every vibrations of Nature.

1. INTRODUCTION:

Music is all around us in various forms of sounds in natural world like rumbling clouds, singing birds, undulating rivers ,waves of ocean and murmuring springs. It is essential in every walk of life in every corner of world. Melodious sound is voice of eternal soul. The cosmic existence of sound, its expression in rhythmic order of the origin and vivid manifestation of nature and its spiritual expansion in consciousness are present in Vedas as Nada-Brahma. Indian classical music was developed by Rishis of yore. They have recognized the linkage of music with emotions and intrinsic nature of living things. The development of scientific thinking in modern era has added

new dimensions to the studies and applications of music sound especially ranging from agricultural production and music therapy to social improvement. In today's noisy, trouble stricken and stressful world, the melody of music serves as a 'Divine Boon'. It generates a feeling of satisfaction and joy and inspires creativity. Experiments aimed at therapeutic and other applications of music have shown remarkable effects of it on human beings, animals and insects. Thus, music plays an instrumental role in healing and harmonizing the mind, body and spirit. These possibilities are also there in the botanical world too. Although not much research has been done in sound and music, a handful of research papers have been found to have positive results on the effects of sound energy on plant growth. In daily life, it has been observed that plants acknowledge and respond to music. It is because that plants are living organisms and they respond to stimuli. Plants are as sensitive as humans and sound is known to affect the growth of plants and plants respond to music the same as humans do. Rhythmic dance of leaves of China legume grass to harmonious music, production of bigger fruits and vegetables etc. (Hou and Mooneyham, 1999) are some examples of plant responses to music.

Experiments done on plants:

Numerous studies have attempted to modify plant growth using music, some of which have concluded that it does indeed act as a stimulant. Sir J.C.Bose,an Indian scientist made a number of pioneering discoveries in plant physiology and viewed that the music sound does wonder for plant growth. Dr. James Smith of London University in agreement with Dr.Bose opines that plants do have some kind of sentiments and are also equipped with sensors to receive other sentiments.

In Book 'The Sound of Music and Plants' by DorothyRetallac in 1973 which documented some of her early experiments with plants and music. She exposed different groups of plants to different levels and types of music for different time period. She discovered that plants reacted positively to soothing music while rock music had a harmful effect on growth.

Dr.T.C.Singh, Head of Botany Dept. at Annamalli University conducted research with Indian music and plants with amazing results. According to him, rice harvest was 25-60% than average and about 50% higher for peanut and tobacco. He found violin to be one of the most life enhancing instrument of all. Dr. Singh also experimented on a vast number of species such as common asters, petunias, cosmos and white spider lilies along with economic plants as onions, sesame, radish, sweet potatoes and banana with playing dozen 'ragas' on flute, violin, harmonium and veena and had proved that harmonic sound waves affect plant growth, flowering, fruiting and seed yield. Daisies, marigolds and petunias showed flowering earlier a fortnight than controls with 'dancing' the BharatNatyam because of rhythm of the 'footwork' transmitted through the earth. His method of musical stimulation has even increased chromosome count of certain species of water plants and nicotine content of tobacco leaves.

Ultra sound has been shown to have the greatest effect on plants especially on seed germination(Timonin,1966; Halstead and Vicario,1969; Hageseth,1974;Weinberg and Burton,1981; Miyoshi and Mii,1988; Hideyuki *et al.*,1991; Creath and Schwart,2004; Joshua Leeds,2004; Maulic and Darshi, 2011). Dr.K.N.Bhagwati, former head of Plant Pathology at Assam University has been associated with plantation of Orchids in India Carbon Limited (ICL) campus for last 12 years. He found that music is essential for the growth and flowering and reported an orchid with 52 flowers in 2009. Nuran Ekici *et al.*(2007) reported positive effect on root growth and mitotic division in onion root tip. Many

farmers connected radio with loudspeakers to their fields to increase the resistance against germs and pests. Insects find music stressful and it could be used to control unwanted pests. Morale et. al. (2010) studied that exposure to classical music decreased the life span of male Drosophila. Music appeared to affect the normal aging process rather than show overt toxicity and suggested that it could be used in insect management programme. Jiang Shi Ren *et al.* (2011) have increased the growth, yield and nutritive value of edible fungi by mixed combination of classical music and cricket voice. They also reported enhanced metabolism and growth by use of 'Green Music' consisting of classical music base along with some natural sounds as those of birds, insects, water and wind i.e. like music in a field. 'Green music' also increased Chinese cabbage yields and decreased aphid damage (QinYu Chuan *et al.*2001).

Many Indian agricultural scientists and botanists have also reported positive effects of music on plant growth. The experiment of Dr. Arthur Luca of Wisconsin has used music to produce bigger flowers indirectly increasing the scope and market value of music in Western world where flower farming is a hot business.

Plant response to music-A scientific perspective:

The ability to sense and respond to physical stimuli is of key importance to all living things. A number of stimuli like sunlight, temperature and various chemical stimuli are considered as physical-mechanical stimuli. A plant cell may perceive stimuli by snow, ice, wind rainfall, touch, sound and hydration within the cell. This sensitivity accounts for the perception of mechanical stimuli like gravitropic, thigmotropic, growth strains, turgor pressure, and xylem pressure potential and sound. The sound is an acoustic energy in form of wave audible to the human ear falling in the range of 20-2000Hz. Sound above this range is ultrasound and below this is called as infrasound. The sound waves created in music also create vibrations. These vibrations respond human beings by turning up the bass on an instrument while these vibrations stimulate growth in plants. Sound is defined as 'Mechanical Energy' in form of pressure variances in an elastic medium. These pressure variances propagate as waves from a vibrating source (Blair School of Music). The sound is our perception of these waves through ears. Playing music for the plants can alter their growth or produce other effects. This is the result of vibrating air molecules caused by sound. Plants respond differently depending on sound's frequency. So, the waves of music that human can perceive are the frequencies that do not harm the plants but in some cases might actually promote the growth of the plants. It is evidenced by K. Creath *et al.* (2004) in Hibiscus esculentus seeds with faster germination when exposed to musical sound. Seeds exposed to noise did not germinate as fast as those to music. Joshua Leeds (2004) measured biological effects of music, noise and healing energy on seed germination in Okra seeds and concluded that musical and healing sounds had a statistically significant effect on the number of seeds sprouted as compared to the noise. Loud music adds to noise pollution creating the effects very similar to eutrophication. Loud noise can be an environmental stressor to plants. They shrivel and die if exposed to heavy metal or rock music.

Plants interact with their outside world through epidermal cells for gaseous exchange. Some scientists have a thought that plants can perceive outside world on cellular level (Plant Perception (Physiology). Every disturbance whether sound, light, gravity (a physical disturbance in natural air) is on a microscopic level. Sound is also a form of physical wave that have a potential to affect plant cells. Xiaujuan *et al.*(2003) opined that each cell is blasted with waves

of sound, light and so on, the amount of RNA created alters leading to greater growth. They observed significant increase in levels of RNA in Chrysanthemum.

V.Doorne Yannick dealt with the role played by sounds and music in living organisms and more precisely in agriculture. According to him, certain sound frequencies and even some kind of music can influence plant growth in different ways.

Certain sound frequencies could activate certain genes in cells affecting the growth and expression of cells. Sound exists as a wave that propagates pressure variations stimulating movement of molecules like diffusion or stirring processes liquids or air. Sound frequencies resonate with the object. Resonant mechanism may be found in plants .So, stomata can vibrate and stimulate their openings enhancing the exchange of carbon di oxide and oxygen with their environment. It is even through resonance with the stomatal cavities that foliar nutrients and water uptake can be enhanced effectively. This technique is named as 'Sonic Bloom'. It helps plants growing in a very effective and musical way. Scientific research of Weinberger et al. (1973) proved it in many ways.

Certain sound frequencies create microbubbles in cell liquid that resonate with the sound. These bubbles collapse causing pressure that may damage cell wall or the cell contents. These oscillations of microbubbles help in translocation of cell cytoplasm, molecules and proteins. Dr. T.C.Singh also stated that' protoplasm' in trees rests in an unstable state like a liquid filled in a pit. The waves of music vibrate and activate it. The consistent flow of sonic waves emanated from a soft and slow music generates a massaging of the particles of protoplasm and energise them.

According to Sternheimer (1993), when amino acid bring by its t-RNA, it emits a signal. This signal is a wave of certain frequency and certain wavelength. He named it as' scale resonance'. These frequencies are musical to amino acids and stimulate the corresponding protein biosynthesis. By way of scale resonance, author experimented on tomato plants in glasshouses to observe the phenotypic responses of epigenetic regulation of protein with sound frequencies and reported amazing results. Near ultrasound (1.4 KHZ, 0.095Kdb) was reported to increase metabolism in Chrysanthemum roots characterized by increase in amylase activity, soluble sugar and protein (Yi *et al.*2003). The treatment of Chrysanthemum callus with 1.4 KHZ sound increases Indole Acetic Acid(IAA) while decreasing scisic Acid(ABA) levels(Wang *et al.*2004).

The effect of sound on plants apparently depends on frequency, intensity and exposure time. In 2001, Chinese researchers found that low frequency sounds does not damage cell structure but instead activates enzymes, cell membrane fluidity and promotes DNA replication and cell cycling. A report from 'New Scientist'(2007) suggest that exposure of plants to certain types of sound wave frequencies can result in 'sound sensitive' genes being activated and plant growth improving. Mi-Jeong of National Institute of Agricultural Biotechnology in Suwon, South Korea and colleagues (2007) claim to have identified two genes in Rice that respond to sound waves. They also say that promoters of one of the sound-sensitive genes could be attached to other genes to make them respond to sound too. They also discovered that sounds at certain frequencies (125HZ and 250HZ) speed up genetic activity within rice plants.

Strong pressure of musical wave may harm plant growth. Strong winds can stunt growth on hills. Similar is the case with under water flora that has to face strong ocean currents. Similar reduced growth occurs with the musical waves also. Wind blown plants generate a hormone

'Ethylene' that slows growth resulting in shorter and fatter stems and might be the same hormone releases in plants when exposed to musical sounds. That is why plants became sick when music is played for more than four hours a day.

2. CONCLUSION:

For music therapy on plants, it has been found that plants responded well to classical music better than they did to no music at all and poorly to rock and roll music. The 'Ragas' in Indian classical music is believed to have worked wonders for plant growth. The destructive effect of noise and high and low frequency sounds are just opposite to the creative effects of sound present in the harmony of swars and the sonorous music. Audio-visual studio of Shanti Kunj, Hardwar, (S.R. Sharma) is developing music records for therapeutic use in different diseases and those useful for healthy vegetation and agricultural applications.

The collective waves of musical sound eliminate the evil elements from the environment and the whole atmosphere became purified eliminating the diseases with healthier vegetation, enhanced agricultural growth and trees with bigger and tastier fruits. It is the reason that many professional greenhouses play classical music to stimulate the plant growth. Great scientist Albert Einstein had taken the moral support of playing violin to gain mental peace in state of gloom. Great Mathmatician, Pythagorus theorized that music diminished and even eradicated negative energy and emotions. Fascinated by the magic of classical music, Mahatma Gandhi has said," Music can calm and cool the distress of soul. It purifies our soul by absolving it of impurities."Latest report of Health Watch (2012) states that Fortis Hospital of Noida,U.P. has introduced the 'Music Therapy' as a supportive therapy in the hospital and planning to launch 'Musical Pills'(music CD) so as to treat particular disease with particular type of music(CD). Now, it is proven fact that a certain kind of music i.e. classical music definitely has healing powers and harmonizes the mind, body and spirit. As music has an intimate relationship with humane emotions, it must also be associated with the sentiments of plants and trees.

Music is not a field of knowledge and art, it is a stream of power too. It could control many activities of Nature- The 'Jada' (non-living) and 'Chetan' (living) components. It acts as a motivating force in boosting chetan component of Nature. Music is a feeling of joy of Nature and is closely related with every vibration of Nature including human, animals and plants. Plants are more aware of their surroundings than we think probably much more so than us.

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