Response of Ornamental Plants to Music

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Sound through the use of the components of rhythm, melody, harmony and colour, generates beauty of expression and emotion in a meaningful form. Sound is like a wave generating music by instruments or human voices. Plants respond to incentives, which is one of their living beings' characteristics and are thought to be as sensitive as people while testing out new treatments. In addition to accelerating growth, music has a clear impact on the concentration of several metabolites, such as chlorophyll, carbohydrates, protein, etc. Plants appreciate music and respond to various musical genres and wavelengths. It has been reported that conversing with humans can help plants grow and develop more effectively. However, little research has been done in this area where the impact of various types of sound on plants are being tracked and evaluated. A harmonious and coherent synthesis of different vibrations and frequencies is what makes music. The mood and health of a plant and its flowers are said to be negatively impacted by loud and discordant noises. Soft, rhythmic music is better for a plant's growth and blooming, which might affect a plant's general health and growth rate. On the other side, some reports claim that heavy metal music can be particularly harmful to a delicate plant, even when played at low intensity.

History

Sir Jagdish Chandra Bose, an Indian plant physiologist, was one of the forerunners in the research of how environment and music affect plants. He came to the conclusion that, like people, plants respond to the environment around them and are sensitive to light, cold, heat and noise. Both of his publications "Response in the Living and Non-Living" (1902) and "The Nervous Mechanism of Plants" (1926) provide documentation of this. Joel Sternheimer (1943) created a model melody for tomato chalcone synthase followed by Sonic Bloom method by Dan Carlson in 1960. According to an Idian Scientist Dr. T. C. Singh (1962), balsam plants are 20% taller with 72% more biomass when exposed to music. Additionally, he discovered that petunias and marigolds bloomed two weeks faster than expected due to musical vibrations from Bharatnatyam. According to him as the plants have the ability to elicit a variety of emotions in humans and other fauna, music also has favourable impacts on plant growth. Varied forms of music have different effects on plants. They may experience stunted growth when exposed to certain types of music, while they may grow tall when exposed to others. This may vary based on the type of plant species as well.

Scientists have demonstrated that music can have an impact through mechanoreceptor (ability to recognise and classify sound waves) on plants which can further be exploited by flower growers for enhanced growth and yield. Aesthetics has also noted numerous changes in the physiological and biochemical characteristics of plants, such as an increase in growth, metabolism, the number of stomata, increased transpiration and photosynthesis. In 1973 Dorothy Retallack, (Francis student) undertook in-depth research on the impact of music on plants and came to the conclusion through her book, "The Sound of Music and Plants" that playing nonstop rock music could damage plants.

Mechanoreceptor in plants

The pressure when sound wave transfers causes medium to vibrate The plants might pick up this vibration, which causes quick movement of protoplasm in their cells, as a result of which plant's system becomes more active producing more nutrients and making plants vigorous and stronger. When xylem cells perceive vibrational sound, transpiration and re hydration takes place. Moreover, due to strain development in xylem vessels, transpiration also causes cavitation in form of gas bubbles. The release of an audible sound is said to occur when transpiration is reduced, but an ultrasonic emission is said to occur when transpiration is increased. This is because gas bubbles attached to vessels can indeed produce sound in plants.

Additionally, as the diameter of the xylem vessel diminishes, sound vibration is produced. Nevertheless, there is no discernible change. Plants exposed to sound vibration experience modifications in transcription and translation. Plants exposed to sound affect the level of transcripts associated to defence and redox homeostasis that are mechano-stimulus response signalling related. However, the precise organs or proteins involved in hearing are still unknown.

Influence of music on plant growth

1. Gene activation: A certain gene is triggered by a particular sound frequency, resulting in an increase in plant cell proliferation.

2. Effect on stomata: Sound frequency technology causes leaf stomata to open, allowing plants to absorb more dew and fertiliser by spraying.

3. Impact on cell organelles: By accelerating the movement of cytoplasm inside the cell, some frequencies cause resonance in the cell organelles of live organisms, which promotes cell growth.

4. Plant hormone: Gibberellic acid, a plant hormone, reacts to sound to stimulate shoot elongation or seed germination.

5. Movement of protoplasm: The noises cause the leaves to vibrate and accelerate this movement, which promotes the synthesis of food and nutrients and promotes the growth of healthy plants.

Plant reactions induced by artificial sound treatments

1. Improvement of seed germination and plant growth: Sound promotes plant growth by modifying plant growth hormones including gibberellins and Indole-3-acetic acid (IAA).

2. Induction of the plant defence response to pathogens: By stimulating the plant defence hormone like salicylic acid (SA) and jasmonic acid (JA), sound pre-treatment increases plant immunity against upcoming pathogen attack.

3. Increasing resistance to abiotic stress: Sound therapy increases resistance to drought by altering the cell wall's supplyy and flexibility, which impacts plants' capacity to absorb more water.

4. Delaying ripening: Sound therapy prevents tomato fruit from maturing by inhibiting the manufacture of ethylene and the expression of genes associated to signalling, ethylene production may be postponed.

5. Increased ability to synthesise organic compounds: Sound therapy increases the expression of genes involved in photosynthesis, including those that code for fructose 1,6-bisphosphate aldose and rubisco small subunit, which may lead to CO_2 fixation.

The germination of seeds, the lengthening of roots, the height of plants, and other biological indices of plants can all be positively impacted by specific frequencies and intensities. Plants grow when exposed to music with a frequency range of 115 to 250 Hz. Plants produce ultrasonic acoustic emissions (UAE) between 20 and 300 kHz as well as audio acoustic emissions between 10 and 240 Hz. When roots are exposed to unidirectional 220 Hz sound and they subsequently develop in the direction of the vibration source, this provides evidence for the existence of plant mechanosensory capacities. Dan Carlson asserts that a mixture of frequencies between 3000-5000 kHz can help plants open their stomata more quickly.

Different musical genres have varying affects which may be beneficial or detrimental. When exposed to music, plants develop more quickly with higher metabolites, which can be utilised as a component to obtain a higher and quality yield. Both humans and animals are affected by noise pollution caused by continuous music playing. The intensity of sound decreases with increasing area because the pressure level is inversely related to distance. Regarding frequency and exposure times, there is still a lot of ambiguity and contradiction surrounding this technology, which could result in stunted plant growth.

Applying music to decorative plants

In chrysanthemum callus, the activity of superoxide dismutase (SOD) enhanced with increasing sound intensity (100 dB) and frequency (800 Hz), while it declined below that range. When sound waves of a certain intensity (100 dB) and frequency (1000 Hz) stimulated *Dendrobium candidum*, SOD, catalase activity (CAT), peroxidase activity (POD), ascorbate peroxidase activity (APX) and malondialdehyde (MDA) content of leaves, stems and roots, increases in various ways under stress and on average more than the control group.

According to Vidya Chivukula and Ramaswamy (2014), rose plants that were exposed to vedic chants for 60 minutes in the morning for a period of 62 days grew more quickly than plants exposed to other genres of music in terms of plant height and the number of flowers with the largest diameter. On playing Indian music, meditation music and noise for marigold plants, it was found that although thre were identical growth patterns in initial growth phase, but in late phase marigold plants treated with mild Indian music and meditation music depicted superior plant growth and flowering than noise treatment.

When ornamental plants like *Tagetes erecta, Catharanthus roseus* and *Dendranthema grandiflorum* were subjected to 3 hours per day of gentle music for a month, the number of leaves, flowers and early flower buds enhanced with higher concentrations of carbohydrate, protein and phenol compared to the control. When exposed to sound waves for a month at a frequency of 1000 Hz at 110 dB intensity for an hour a day, *Salvia splendens* cv. Vista's biochemical content and activities, such as protein content, catalase activity (CAT), peroxidase activity (POD), and malondialdehyde (MDA) content, were at their highest. Additionally, in comparison to the control, stem length, root length, shoot weight, and shoot dry weight all displayed an ascending trend with an increase in intensity to 110 dB in 1000 Hz frequency.

Conclusion

In addition of having the ability to elicit a variety of emotions in both humans and other animals, music also has some favourable impacts on plant growth. Varied forms of music have different effects on plants. They may experience stunted growth when exposed to certain types of music, while they may grow well when exposed to others. This may vary based on the type of plant species as well. Scientists have demonstrated that music can have a favourable impact on plant growth which can be exploited by farmers and flower businessman.

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