

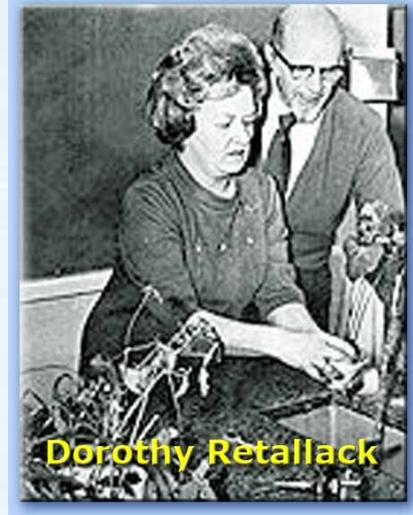
# The Effect of Sound and Music On Plants

# Questions

How long do they like music played?  
Do plants like one kind of music over  
another?

Do plants like loud or soft volume?  
Do they like pure tones better than  
overtones?

## Dorothy L. Retallack



- One of the well-known researches in this field
- Conducted scientific experiments on effects of music on plants in 1973
- Colorado Woman's College in Denver using the school's three Biotronic Control Chambers
- Author of "The Sound of Music and Plants"

## Dorothy Retallack

Using three separate laboratories containing the same species of plants, Retallack began her experiment. Piping in different types of music to each facility, she recorded the daily growth of each plant. The results were quite surprising.

# Duration of Tones

1. Steady Tone for 8 hours

2. Intermittent tone for 3 hours

3. Silence

1. Died within 2 weeks

2. Grew 2X healthy – abundantly, green and tall—more so than the 3<sup>rd</sup> chamber

3. No change

# MUZAK Corp.

Similar results were obtained from experiments performed by the Muzak Corporation in the early 1940s to determine the effect of "background music" on factory workers.

# Research by the MUZAK Corp.

## Music Played

1. Continuously

Workers were:

More fatigued & less productive

2. Several hours at a time scattered throughout the day

More productive, alert & attentive than when no music was played

# Type of Music

1. Rock 'n Roll

1. Grew Sickly & small  
1/2 stunted &  
1/2 small leaves

Stems were bent  
away from the radio

2. Soothing music

2. Large and healthy

# Results on the 16<sup>th</sup> Day

1. Rock Music

2. Soothing Music

1. Last stages of dying

2. Much alive, beautiful leaves. Plant grew abundantly.

# Country Vs. Jazz

1. Country & Western

2. Silent

3. Jazz of Louis  
Armstrong

1. No Reaction

2. No Reaction

3. Plants “liked” the  
jazz she played  
them

# Rock Vs Steel Drum Music

1. Percussive Rock  
Music of Jimi  
Hendrix, Vanilla  
Fudge and Led  
Zepplin

2. A song with steel  
drums

1. Plants turned away  
from the music.  
When the plants  
were rotated 180°  
they turned away  
again.

2. Plants leaned just  
slightly away from  
the speaker but not  
as extremely as #1

# Rock vs. Modern Classical

1. Rock

1. Leaned 30-70 degrees away from the speaker

2. Modern dischordant classical music of negative composers like Arnold Schonberg & Anton Webern

2. Leaned 10-15 degrees away

# Indian vs Bach Music

1. North Indian classical music with sitar and tabla

1. Plants leaned toward the speakers the most

2. Bach organ music

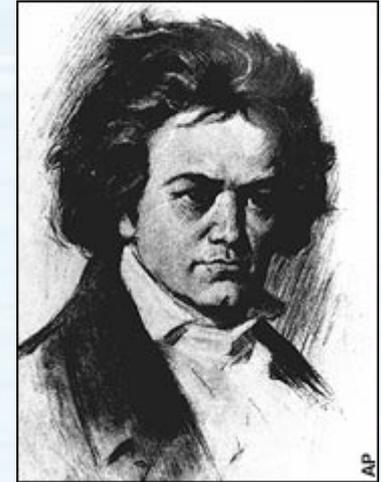
2. Leaned toward speakers somewhat

3. Silence

3. No effect

# Beethoven can help crops grow more quickly

Plants are known to respond to light, wind, and soil nutrients.



South Korean scientists, who played classical pieces including Beethoven's Moonlight Sonata in rice fields, found that plant genes also respond to music.

[http://www.karensaltus.com/audio/beethoven\\_moonlight\\_so.mp3](http://www.karensaltus.com/audio/beethoven_moonlight_so.mp3)

# Beethoven helps crops grow quicker

Mi-Jeong Jeong of the National Institute of Agricultural Biotechnology in Suwon, South Korea, and colleagues began their research by playing 14 different classical pieces to rice plants.

They monitored gene expression in the plants - the process by which their DNA code is translated into instructions for biological processes such as growth.

# Beethoven helps crops grow quicker

Sounds at specific frequencies

- 125Hz and 250Hz -

made genes *rbcS* and *Ald* more active, whereas sound waves at 50HZ made them less active.

As both genes are known to respond to light, they repeated the experiments in the dark and concluded the sound was causing the effect.

# Beethoven helps crops grow quicker

The researchers say their discovery could in future enable farmers to switch specific plant genes on and off - potentially making crops flower at certain times or grow more quickly.

# Auditory Stimulation

The Pennsylvania State University's Research Center states that

- plant seeds respond to sound at decibels of 92 or higher.
- Additionally, 70 decibels of softly playing music positively affects a gene in plants responsible for its reaction to light, which in turn affects the plant's ability to thrive.

# Decibel (Loudness) Comparison Chart

Whisper Quiet Library at 6'	30dB
Normal conversation at 3'	60-65dB
Telephone dial tone	80dB
City Traffic (inside car)	85dB

## Decibel (Loudness) Comparison Chart

Train whistle at 500', Truck Traffic	90dB
Jackhammer at 50'	95dB
Subway train at 200'	95dB
Hand Drill	98dB
Power mower at 3'	107dB

Level at which  
sustained exposure  
may result in  
hearing loss

90-95dB

# Perceptions of Increases in Decibel Level

Imperceptible Change	1dB
Barely Perceptible Change	3dB
Clearly Noticeable Change	5dB
About Twice as Loud	10dB
About Four Times as Loud	20dB

# Pure tones vs Overtones

What do plants like better pure tones or overtones?

Pure Tone, def.

A fundamental tone without any overtones represented by a sine wave. A tuning fork generates a nearly pure tone.



In 1950 Professor Julian Huxley, (the biologist grandson, of Thomas Henry Huxley), and brother of novelist Aldous Huxley....was visiting Dr. T.C. Singh who was head of the Department of Botany, at Annamalai University, which is south of the "Tamil-speaking" city of Madras. He found his host studying through a microscope, the live "streaming of protoplasm", in the cells of "Hydrilla Verticillata", an aquatic plant of Asian origin, with transparent leaves.

# Streaming of Protoplasm

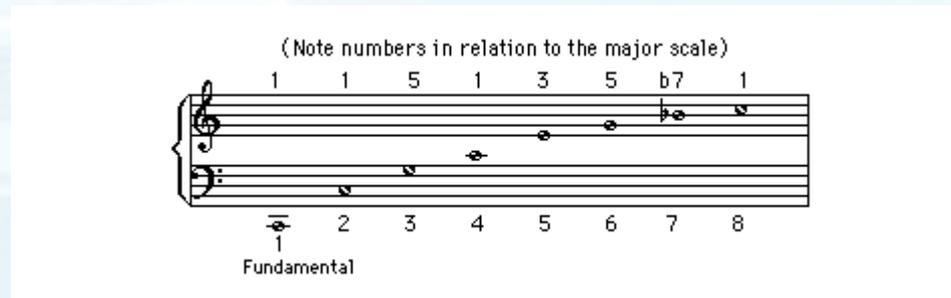
- Singh placed an electrically operated tuning fork, six feet from a Hydrilla. He microscopically observed that the fork's note, (broadcast for half an hour just before 6 am), caused the protoplasm to stream.....at a speed normally attained, only much later in the day.
- When the strings of a violin were stroked at a certain pitch, the protoplasm streaming of a Hydrilla was again observed to be accelerated.

# Overtones

- Overtones of a note, also called the harmonic series, are naturally heard when the fundamental note is played.
- As the overtone notes get higher in pitch above the fundamental note, they get lesser in volume.
- The first 8 notes are the most important.
- The notes above the 16th notes vanishes completely from being heard.

# The Harmonic Series

- The Fundamental tone is repeated each octave.
- The number of Overtones doubles within each successive octave.
- The first 8 pitches of the Overtone Series, expressed in scale tone numbers of the major scale are :



# Overtones and the Indian Sitar

The East Indian sitar is known for its rich use of overtones.

A sitar can have 21, 22, or 23 strings, among them six or seven played strings which run over the frets:

Three of these (or four on a *Kharaj-pancham* sitar), called the *chikaari*, simply provide a drone: the rest are used to play the melody, though the first string (*baajtaar*) is most used.

The strings that are not played, the 14, 15, or 16 strings, vibrate in sympathetic resonance and thus are referred to as sympathetic strings.

# East Indian Ragas

Dr. T.C. Singh played the South Indian tune, "Maya-Malava-Ganla-Raga" to Mimosas.....

- After two weeks the number of "stomata" per unit area, in the experimental plants, was 66 percent higher.
- The epidermal walls were thicker, the palisade cells were longer, and broader, than in "control" plants.....sometimes by as much as 50 percent

## East Indian Ragas

From 1960 to 1963, studies were conducted, where the "Charukesi Raga" was piped via a loud speaker, on a gramophone to six varieties of early, medium, and late "paddy rice", growing in the fields of seven villages.

- They got harvests ranging consistently, from 25% to 60% higher, than the regional average.
- He also was able to musically provoke peanuts, and chewing tobacco, into producing nearly 50% more than normal.

# Why are Plants affected by Music?

Dr. Singh explained that the fundamental metabolic process of plants e.g. transpiration, carbon assimilation under excitation of musical sound or rhythm were

- accelerated with an increase of over 200%
- Synthesize greater quantities of food
- Leading to greater yields

# Pure tones vs Overtones

Which are better?



## J.S. Bach Increases Wheat Yields

Canadian Engineer and Farmer Eugene Canby, of Wainfleet, Ontario, broadcast the violin sonatas of Johann Sebastian Bach to a test plot of wheat and produced a crop 66% greater than average and with larger and heavier seeds.

# J.S. Bach Increases Wheat Yields

Since the wheat growing in those areas of the plot where the soil was inferior did just as well as those growing in the richest earth, Canby concluded that Bach's musical genius was as good as or better than nutrients.

# Listening Test

Imagine you're a plant and have to listen to music that your housekeeper likes to play all day. Take out a piece of paper and number it 1 to 5. I'll reveal the names of the pieces after this 5 minute test.

Turn up the sound. The test will take five minutes. Sit back, relax and listen. You might learn more about the difference between positive and negative music that you ever suspected.

Which pieces do you like?

<http://www.dovesong.com/MP3/PosNeg.mp3>

# Listening Test

The selections on the test are from these works:

1. Claire de Lune by Claude Debussy
2. Moses and Aron, by Arnold Schönberg (Opera)
3. Mass in G, by Franz Schubert
4. Lulu, by Alban Berg (Opera)
5. Ave Maria, by Franz Schubert (from the Fantasia movie)
6. Downward Spiral, by Nine Inch Nails (Contemporary rock)

# Bibliography

<http://www.musicforyourplants.com/>

<http://www.telegraph.co.uk/earth/earthnews/3305158/Beethoven-can-help-crops-grow-more-quickly.html>

[http://www.ehow.com/info\\_12023224\\_loud-music-affect-plants.html#ixzz29yEr4V5o](http://www.ehow.com/info_12023224_loud-music-affect-plants.html#ixzz29yEr4V5o)

Thompkins, Peter and Bird, Christopher. *The Secret Life of Plants*. New York, NY.: Harper and Row, Publishers Inc., 1973. (Chapter 10 only)

Piston, Walter *Harmony*. New York, NY: W.W. Norton & Co., 1987.