SUPPLEMENT ISSUE

ARTICLE

THE EFFECT OF SOUND AND MUSIC ON SOME PHYSIOLOGICAL AND BIOCHEMICAL TRAITS, LEAF NUTRIENT CONCENTRATION AND GRAIN YIELD OF COWPEA

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ABSTRACT

The present study was conducted to examine the effect of music on the growth and yield of Kamran cultivar of in the summer of 2013 in District 7 of Tehran. This study was conducted in pot in a completely randomized design with six music treatments (Nature, classic, traditional, techno, noise, and control) in four replications. The results of this study showed that playing different types of music has significant impact on all studied traits. As a result of playing classical music compared to control treatment (non-music), traits such as grain yield in single plant (33%), stomatal conductance (21%), relative water content of leaf (21 percent), chlorophyll (47 percent), leaf area of single plant (30%), plant height (38%), sub-branch (52 percent), gibberellin hormone (81 percent), nitrogen (44%), and calcium (21%) increased. However, some traits reduced by playing classical music compared to control (non-music), that rate of their reduction for these traits was respectively: proline (13%), abscisic acid hormone (8%), and auxin hormone (2%). Generally, it can be said that as result of playing classical music, plant found better growth conditions, but playing traditional and techno music, and noise had negative impact on growth of cowpea plant, indicating that the plant as human reacts negatively to sad, unquiet, and stress creating music. It should be noted that the objective observations showed that plants against playing techno music found greater distance from sources of noise and even the arrangement of leaves (the angle of the leaves on the petiole and main stem was more open) was different than other treatments. The results of this study showed that classical music treatment improved cowpea yield and its growth through increased stomatal conductance, chlorophyll content, relative water content, and content of gibberellin hormone. Thus, according to the results of the current study, classical music treatment could be used in order to improve the growth and yield of cowpea.

KEY WORDS
sound,chlorophyll, stomatal conductance, plant hormones

Published: 10 September 2016

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INTRODUCTION

The use of music and sound in improving health is not dream or fiction. Beneficial and harmful effects of music have been recognized by ancient Greeks and Romans and scholars such as Pythagoras, Democritus, and Aristotle [1]. In addition to entertainment, music play very useful role in healing and harmonizing the mind, body and spirit of man. One characteristic of living creatures is giving response to stimuli. Plants are complex multicellular organisms that as human are sensitive to assess various effects and testing new treatments and give response to it [2, 3, 4]. Initially, it was believed that there is no perception and memory in plants, but it has been determined that sound has impact on growth of plants and plants as human react to music. Results of various studies indicate that music is effective in various phenomena of germination, growth and development of plants and physiological phenomena such as photosynthesis and flowering time and plant yield [5, 6]. Melodious sounds compared to untreated samples have higher impact on number of germination of seeds, and sound vibrations directly affect the biological living systems [7].

Some studies have been recently conducted in which music is used for growth, yield and quality in plants like tomatoes [8, 9], vegetables [10], and barley [11] that this branch of science is called " biological and phonological " science in which plants are exposed to sound waves or music so that high quality product to be produced, while this science is in its infancy. Some researchers have played different styles of music like rock and roll, jazz, classical or light music for plants and they have achieved to different results. However, a number of other researchers have used different sound frequencies and sound pressure level to treat plants [12].

Cowpea is a plant belonging to fabaceae species, leguminous family, and it is considered annual plant [13]. This plant is regarded often as plant with high adaptability to high temperatures and drought in comparison with other species [14]. Cowpea grains are an important source of dietary protein in developing countries of Asia and Africa, and its foliage has high nutritional values than hay. Its green pods are used and its grains are sold canned .

This plant has nutritional value that applying useful and effective methods in its planting increases its quality and its optimal production. It is clear that many factors contribute to the improvement and control of plant growth and yield. According to what was said, music could be considered one of these enumerated factors. Therefore, in this study, we are trying to determine the effects of sound and music on some traits, including biochemical and physiological traits, leaf nutrient concentration and cowpea grain yield.

Literature Review of study

The effect of music on pants growth

Great number of studies conducted within the area of agricultural science refer to the role and vital impact of music on the growth of yield of plants. For example, Measures & Weinberger (1969) at the University of Ottawa conducted study on spring and winter wheat and placed these plants at the exposure of various frequencies in germination periods or growth period and both periods sometimes. They observed significant increase in stimulation of plant growth under 5 kHz sound compared to controls (no sound). In 1973, the book titled as "Sound of Music and Plants" was written by Dorosi. Retallack based on experiments on the effects of the plants and music. He obtained the best results from classical music (songs of J.S.Bech, Haydn, Beethoven, Abrahams, Schubert and other composers of the 18th and 19th century in Europe) and traditional music North Indian by Sitar and Tabla. He also found that inharmonious music of the twentieth century composers including Arnold, Shenberg, and Anten.Van. Vebren caused plants to dry, but not as much as rock music [15].

The effect of music on plant height

A number of researchers conducted a study on the effect of music on bean plant height and recorded plant height in the period of 32 days. First, difference in height of plants that violin music was played and then plants that traffic sound was played for them was maximum. Difference in height of control group was minimum. This means that music definitely played a role in better growth of plant. Therefore, the growth of plants received no external sound was slower. Results for traffic sound and violin music compared to control group were slightly better. Thus, it can be concluded that plants may be unable to distinguish different types of sounds, harmonious or inharmonious, but sound definitely affects the plants [16].

The effect of music on growth and germination in grains

Researchers have found that high-frequency sounds increases grain germination rate of Alyssum plant, while it seems that random sounds have opposite effect [17]. Research has shown steady and loud music sound (classical) with frequencies 200 and 2000 Hz on red bean grains and green beans increased their germination by 60% to 100% compared to control group. However, the effect of music on the germination of corn was reverse and germination rate in corn dropped by 40% compared to control group. This difference can indicate that the effect of music on plants depends of species [18]. Plants are sensitive to sounds and radio waves. Sound wave can accelerate plant growth and the effect of sound wave stimulating on the growth and development of plants is clear. Music, sound and healing energy have a significant impact on germination of grains [19].

The effect of sound waves on plant physiological activities

Each plant type requires a particular sequence of musical notes to stimulate growth. Playing real music sound stimulates the protein structure of the plant [20]. Optimal growth occurs when plant is exposed to special waves that their wavelengths are at the size of moderate sizes of plant large leaves [21]. It has been found that playing appropriate music stimulates construction of suitable proteins in plant [22]. Sound waves can alter the cell cycle [23]. Sound waves vibrate the plant leaves and accelerate the movement of protoplasm in the cells [24]. According to reports, leaf transpiration rate and exit of water from leaves are affected by sound waves affect, influencing plant growth [6].

Using laser Doppler vibrometer system, Martens & Michelsen (1981) examined vibration of four plant species in the sound field. All leaves operated in the form of linear mechanical systems when they are sound production was directed at SPL 100 dB at the reference pressure of 20 µPa. Leave vibration rate varied at frequencies between 0.5-5 KHz and 3×10^{-4} m s-1, while vibration rate of air particles at 100 dB was 0.005 m s^{-1} SPL. As a result, vibration rate of leaf was 3-1 times smaller than the air particles. This means that only one part of sound waves energy reaching to leaf cause vibration in leaf and other part of it releases to leaf surrounding as if leaf has not moved. Sound waves might be absorbed by leaf tissue and converted into heat [25].

MATERIALS AND METHODS

Characteristics of the experimental project

To examine the effect of music on the growth and yield of cowpea, Kamran cultivar, an experiment was conducted in the summer of 2013 in District 7 of Tehran. This study was conducted in pot in a completely randomized design with six music treatments (Nature, classic, traditional, techno, noise, and control) in four replications. Music was considered as a factor in this experiment. Twenty and four pots (at the size of 40 cm in height and 50 cm in diameter) were placed in six groups (each containing 4 pots) and they were named under tags of nature, classic, traditional, techno, noise, and control. Four pots in each group were integrated and sticking together, and all groups were same in terms of environmental conditions and they were exposed to external sound (music). Each group of pods had a source of music playing and a sound player.

Planting operation

In early June 2013, they were cultured with high density (30 grains per pot) at depth of 3 to 4 cm. Then, the grains were covered with a mixture of sand and gravel. The first irrigation was performed immediately after planting to provide favorable conditions for seedling growth and increase the germination rate. Music treatment was looped on music playing source in the form of 8 hours of continuous music. Then, it was

replicated for 8 hours in the form of playing music for one hour and silence for one hour by music playing device for 8 hours.

Six treatments included: a) the nature group received nature sounds like the sound of birds, waterfalls, etc. b) classical music group received songs of musicians including Beethoven, Mozart c) traditional group received songs of traditional Iranian music devices such as saline, Knoll, etc. d) techno group e) noise g) control (no music). Since the planting of grains, music was played every day from 9 am to 5 pm for 8 hours, intermittently.

Plant maintenance operation

The first irrigation was performed immediately after planting to provide favorable conditions for seedling and increase the rate of germination. To regulate density, at the time of thinning (2-3 weeks after planting or 2 to 4 leaf stage), the number of seedlings in each plot reduced to 6 by removing the poor seedlings. In this stage, combating with weeds, pests and diseases took place.

Measuring traits at the time of flowering

In the mid-flowering, traits such as chlorophyll (SPAD value), stomatal conductance, and relative water content (RWC), and leaf area were measured.

Measurement of chlorophyll

In order to measured chlorophyll value, hand chlorophyll meter device of SPAD (CM 200 model) was used. Chlorophyll meter shows the relative concentration of leaf chlorophyll based on amount of light absorbed. This measurement was conducted on each pot included 6 plants that three of them were non-destructive and three of them were destructive. Among destructive plants in each pot during the 9-11 hours, the highest leaves of these three plants were determined by chlorophyll meter devices through three readings.

Relative water content

Relative water content of leaf (RWC) is calculated using Turner formula as follows:

100 × (dry weight saturated weight) / (dry weight of leaf – fresh weight of leaf) = RWC

3.4.3. Stomatal conductance

To measure Stomatal conductance, LEAF PROMETER - SC-1, Decagon device was used. This measurement was conducted from upper leaves of three plants determined in each pot during 9-11 hours. [26]

Leaf area (LA)

To measure leaf area index, LAI LEAF AREA METER scanning device ci202 model was used. We conducted this measurement by scanning all leaves of three destructive plants in each pot.

Measurement of physiological and biochemical traits

Nitrogen measurement

Nitrogen of plant was measured through Kjeldahl device. After obtaining plant sample, total amount of nitrogen of plant was calculated by the following formula:

Plant nitrogen content = (read number of blank titration – read number of plant sample) × 0.491

Calcium measurement by atomic absorption spectrophotometry

After clouding in the acetylene-air flame, plant extract is evaporated and calcium compounds are converted to atoms. These atoms in based state absorb radiation from hallow cathode related to itself. The beam of calcium atoms in 422.77 nm wavelength was measured by atomic absorption spectrometry.

Measurement of leaves Proline

To measure Proline, [27] method was used. Proline concentration is determined in milligrams per gram of fresh leaf tissue. Unit is determined in milligram per gram of fresh weight according to the following formula:

$$\text{micromle proline in gram of leaf fresh weight} = \left[\frac{\mu g\text{proline}}{\text{ml}} \times \frac{\text{mlToloen}}{\frac{115}{5}(\mu g/\mu mol)}\right] \div \frac{\text{grsample}}{5}$$

Measurement of hormones

Measurement of plant hormones such as gibberellins, auxin and ABA was conducted after solutions preparation and plant samples, using HPLC analysis by observing its analysis conditions.

Harvesting operation

After physiological maturity and drying of pods, the crop was harvested in the first week of November 2013.

Measurement of traits in the final harvesting time

Traits at the time of the final harvest

At the end of the growing season, 3 non-destructive plants were harvested in each pot and their height, number of sub-branches, number of pods per plant, number of grains per pod and grain weight were

calculated. The plant height was firstly measured. Then, number of pods was counted. Then, grains were separated from pods and counted. Grains were placed in sun so that sun to dry them. After, two days, their weight was measured that this weight is fact grain yield of three plants in each pot that through dividing it to number of grains, mean weight of grain was calculated.

Data analysis

Data analysis was performed using MSTAT-C software, comparison of means was performed using Duncan method, and graphs were outlined using Excel software.

RESULTS

Grain yield in single plant of cowpea

Investigations conducted in this regard showed that the effect of playing different types music on yield of cowpea grain was significant at the 1% level (Table 4-1).

Comparing means showed that the highest grain yield (with mean of 47.5 g) was obtained in the plant treated by playing classic music, and the lowest yield (with mean of 28.25 g) was obtained in the plant treated by traditional music. Techno music, nature sound, and noise showed no significant difference compared to control group (Table 4-2).

In the present study, the classic music treatment increased all components of grain yield (number of pods, number of grains per pod and grain weight) in cowpea. Ultimately, this treatment resulted in a 33% increase in grain yield.

Table 4.1- Variance analysis results of cowpea yield and its components under the effect of music treatments

Source of changes	df	Number of pods in plant	Number of grains in pod	Grain weight percentage	Grain yield
Treatment	5	18/67*	1/62ns	24/64**	152/47**
error	18	5/79	0/92	3/80	14/79
Coefficient of changes (%)	-	12/72	11/88	8/01	10/35

Ns, *, **are respectively non-significant, significant at the level of 5 and 1 percent probability level

Table 4-2- Results of comparing the mean yield and components of cowpea yield under music treatments

Treatment	Number of pod in plant	Number of grain in pod	Weight of grain (g)	Grain yield in single plant (g)
Control	20/00ab	7/70a	23/07bc	35/50b
nature	20/25ab	7/25a	24/94b	37/25b
Classic	21/75a	7/75a	28/83a	47/50a
Traditional	15/72c	8/24a	21/64c	28/25c
Techno	18/00abc	8/77a	24/46bc	38/00b
Noise	17/75bc	8/84a	23/16bc	36/25b

In each column, the means with at least one shared letter had no statistically significant difference at the 5% level based on Duncan test

Stomatal conductance of cowpea

The investigations showed that the effect of treatment (playing various music) on cowpea leaf stomatal conductance was significant at the 5% level (Table 4.3). According to the results of comparing the means, the highest stomatal conductance (with an mean of 155.58 micromoles per second) was obtained from treatment of playing classical music and lowest value (with mean of 108.45 micromoles per second) was obtained from treatment of playing nature (Table 4-4). It is noteworthy that plant stomatal conductance increased by 21 percent after playing classic music.

Relative water content

Analysis of variance showed that the effect of music on the distribution of cowpea relative water content was significant at the 1% level (Table 4.3). The results of comparing the means presented in Table 4-4 showed that the highest relative water content with mean of 92.17% was obtained from treatment of playing classical music that showed no significant difference with treatment of nature, noise, and techno music. Additionally, the lowest relative water content with mean of 75.68% was obtained from treatment of playing

traditional music that this treatment had no significant difference with non-playing the music (table 4-4). However, in general, playing classical music compared to control treatment (non-music) increased relative water content by 21 percent.

Chlorophyll of cowpea leaf

The effect of treatment (playing various music) on chlorophyll value of cowpea leaf was significant at the probability level of 1% (Table 4-3). As result of playing classic music, chlorophyll content of leaf increased significantly so that it showed significant difference with control group with mean of 36.27 milligram per gram of fresh weight and the lowest content of chlorophyll was obtained from treatment of playing traditional music (Table 4-4).

Leaf area of cowpea

Based on the results variance analysis reported in Table 4.3, the effect of playing different types of music on cowpea leaf area was significant at the probability level of 1%. The highest leaf area with mean of 837.31 cm was obtained from plant treated by playing classic music, while the lowest value with mean of 553.38 cm was obtained from plant treated by playing traditional music (Table 4-4).

Cowpea plant height

Investigations conducted on the effect of playing all types of music on cowpea plant height showed its significance at 1% probability level (Table 4-3) so that by playing music height of plant increased. Results of mean comparisons showed that the highest plant height with the mean of 48.75 cm was obtained by playing classic music, and the lowest height was obtained from control treatment with mean of 35.14 cm (Table 4-4), reflecting the positive impact of music on plant growth.

Number of sub-branches in cowpea

As shown in Table 3-4, the effect of different types of music on number of cowpea sub-branches was significant at the probability level of 1%. As result of playing music, the number of sub-branch increased. Results of comparing means showed that the highest number of sub-branches was obtained by playing classic music that was different significantly from treatment of playing techno music and the lowest number of branch with mean of 5.5 branches was obtained from treatment of lack of playing music (Table 4-4-).

Table 4-3- variance analysis results of some cowpea traits under music treatments

Source of changes	df	Stomatal conductance	Relative water content	Chlorophyll	Leaf area	Plant height	Sub-branch
Treatment	5	938/39*	237/94**	164/48**	42690/88**	94/32**	4/63**
error	18	314/65	27/73	12/75	7246/51	13/02	0/33
Coefficient of changes (%)	-	13/38	6/16	12/48	12/10	8/47	7/96

Table 4-4- Results of comparing the mean of some cowpea traits under music treatments

Treatment	Stomatal conductance (Micromole per second)	Relative water content (percent)	Chlorophyll (device number)	Leaf area (cm)	Plant height (cm)	Sub-branch
Control	127/88ab	76/00b	24/62c	642/66cd	35/15d	5/50c
Nature	108/45b	90/13a	31/85ab	714/35abc	46/20ab	6/67b
Classic	155/58a	92/17a	36/27a	837/31a	48/75a	8/40a
Traditional	135/33ab	75/68b	17/95d	553/38d	39/30cd	7/17b
Techno	130/28ab	91/45a	30/72ab	676/01bcd	43/45abc	8/25a
Noise	137/78a	86/16a	29/15b	794/86ab	42/70bc	7/52ab

Cowpea leaf proline

The results reported on the impact of the effect of playing various types of music on content of proline indicate its significance at 1% probability level (Table 4-5) so that playing music that was stressful increased proline. As shown in Table 6-4, the highest value of proline content with mean of 10.11 milligrams per gram of fresh weight was obtained from treatment of playing techno music, while the lowest content with mean of 5.95 milligrams per gram of fresh weight was obtained from nature music. This suggests the stressing effect of techno music inducing the plant for synthesis of osmolytes such as proline.

The amount of the gibberellin hormone in cowpea plant

The results of this study indicated the effect playing different types of music on amount of gibberellin hormone is significant at probability level of 1% (Table 4-5) so that as result of playing classic music, compared to other treatments, gibberellin acid hormone increased. The results of the means comparisons state that the highest rate of gibberellin with mean of 2.22 milligram per gram of fresh weight was obtained from treatment of playing classic music. In addition, the lowest rate of gibberellin with mean of 1.07 milligram per gram of fresh weight was obtained from treatment of playing noise sound that it has no significant difference with treatment of lack of playing music (control) (Table 4-6).

Auxin hormone of cowpea plant

Investigations (Table 4.5) showed that the effect of music on the auxin hormone in cowpea plants parts was significant at the 1% level of probability. Results of the comparison of the means presented in Table 4.5 indicates it, since the highest rate of auxin hormone with mean of 1.8 milligram per gram of the fresh weight was obtained from treatment of playing techno music that had significant difference with control group. The lowest rate of it with mean of 0.98 milligram per gram of fresh weight was obtained from treatment of playing classic music that had no significant difference with control group and playing noise sound group.

Abscisic acid hormone in cowpea plant

The results of this study showed that the effects of playing different types of music on abscisic acid hormone level was significant in cowpea leaves at probability level of 1% (Table 4-5) .According to results reported in Table 4-6, the highest abscisic acid hormone content with mean of 1.56 milligram per gram of fresh weight was obtained from techno music that had significant difference with control group. In addition, the lowest rate of it with mean of 0.83 milligram per gram of fresh weight was obtained from treatment of non-music that had no significant difference with playing music.

Table 4-5- Results of variance analysis of bio-chemical traits of cowpea under the effect of music treatments

Source of changes	Df	Proline	Gibberellin	Auxin	Abscisic acid
Treatment	5	8/53**	0/67**	0/37**	0/31**
error	18	0/27	0/030	0/0028	0/0023
Coefficient of changes (%)	-	6/82	11/64	4/43	4/26

Table 4-6- Results of mean comparison of bio-chemical traits of cowpea under the effect of music treatments

treatment	Proline (milligram per fresh weight gram)	Gibberellin (milligram per fresh weight gram)	Auxin (milligram per fresh weight gram)	Abscisic acid (milligram per fresh weight gram)
Control	7/48c	1/22d	1/00d	0/83d
Nature	5/95e	1/64b	1/25b	1/06c
Classic	6/60de	2/22a	0/98d	0/90d
Traditional	7/28cd	1/31cd	1/15c	1/37b
techno	10/11a	1/57bc	1/80a	1/56a
Noise	8/33b	1/07d	1/06d	1/06c

Nitrogen content in cowpea leaf

The results of the analysis of variance of the data related to this trait indicated that the effect of the playing different types of music on nitrogen element in cowpea leaves beans was significant at 1% level of probability (Table 4-7). Based on the investigations conducted, considering the results of comparison of mean shown in Table 4-8 the highest nitrogen content in the cowpea leaves with the mean of 3.28% of the dry weight was obtained from treatment of playing classic music that had significant difference with control treatment. In addition, the lowest nitrogen content in the cowpea leaves with the mean of 2.27% of the dry weight was

obtained from treatment of non-music that had no significant difference with treatment of playing techno music.

Calcium content in cowpea leaf

Based on the results reported in Table 4-7, the effect of the playing different types of music on calcium element in cowpea leaves beans was significant at 1% level of probability. In addition, results represented in Table 4-8 suggested that the highest calcium content in the cowpea leaves with the mean of 23.42 milligrams per dry weight gram was obtained from treatment of playing nature music that had no significant difference with treatment of playing classic music. In addition, the lowest nitrogen content in the cowpea leaves with the mean of 15.97 milligrams per dry weight gram was obtained from treatment of noise sound that had no significant difference with treatment of playing techno music.

Table 4-7- Results of variance analysis of concentration of nutrients of cowpea leaves under the effect of music treatments

Source of changes	Df	Nitrogen	Calcium
Treatment	5	0/74**	35/62**
Treatment	18	0/17	7/69
Coefficient of changes (%)	-	15/55	14/42

Table 4-8- Results of comparing the mean of concentration of nutrients of cowpea leaves under the effect of music treatments

Treatment	Nitrogen (dry weight percentage)	Calcium (milligram per dry weight gram)
Control	2/27c	18/11bc
Nature	2/71abc	23/42a
Classic	3/28a	21/92ab
Traditional	3/07ab	19/49abc
techno	2/20c	16/43c
Noise	2/51bc	15/97c

CONCLUSION

The results revealed that the effect of playing different types of music on all traits was significant. The results of means comparing suggested that among all types of music, playing classical music had significant impact on some traits. In general, it can be said that as result of playing classical music and even sounds of nature in some cases plant had better growth conditions, while treatment of playing traditional and techno music, and noise had a negative impact on cowpea plant growth. This result suggests that the plant, as human, reacts negatively to insecure, unquiet, or stress-causing sounds. It should be noted that the objective observations indicated that plant found greater distance from sound production source in playing the techno music and even the arrangement od leaves (leaves angle on the petiole and the stem was more open) was different compared to other treatments and results of other similar studies have been mentioned in this regard.

Grain yield

In this study, as result of playing classical music compared to control treatment (non-music), grain yield in single plant (33 percent) increased.

Investigating the effect of music on cluster bean growth, Vanol & Vaidya (2014) reported that instrumental classic music compared to the melodious sounds of rhythmic rock music had positive effect on the growth of plants. Both instrumental classic music and rhythmic rock music showed better results compared to control. This was also true on negative effects of traffic noise. Higher frequency (2000-1500) showed better results than lower frequency (100-50) and in the case of plant growth plants that were close (25cm) to sound source showed more positive effect than the plants that were distant from the sound source (55 cm).

Stomatal conductance

In this study, as result of playing classical music compared to control treatment (non-music), stomatal conductance in plant studied in this research (21 percent) increased.

At the same token, India University professors played obscure parts of the violin for plants at certain times and sometimes they used its setting clutches as sound source. After several years of experience in the area of sound effects, these results were obtained: Music causes that plant release its oxygen 60% to 100% more

than its conventional level and as the value of oxygen released is exactly consistent with amount of carbon absorbed from carbonic gas in the air, it indicates the increased stomatal conductance as result of playing the music.

Relative water content of leaf

As result of playing classical music compared to control treatment (non-music), Relative water content of cowpea leaf (21 percent) increased.

Sound waves vibrated the plant leaves and accelerated the protoplasm movement in the cell [24]. According to reports, the rate of transpiration and water loss from the leaves are affected by the sound waves, which in turn affects plant growth [6].

Additionally, water absorption is also improved leading to an increase in the relative water content. Kai Xun et al showed that 400 Hz and 106 dB sound stimulation has the best effect on the rate of grain germination, seedling height, the relative increase in fresh weight, ability to split the root, root activity, and plasma membrane permeability [28]

Chlorophyll

The results show that the amount of chlorophyll in plants exposed to classical music compared with control group has been increased by 47%. In this regard, many studies show that plants exposed to louder music, plant height, leaf area, and plant weight had higher chlorophyll content. Additionally, these traits were higher in plants that classical music compared to plants heavy metal music and control groups [18]. Various elements of music had positive effects on the mitotic divisions and growth in leaf cells of onion that this positive impact of music on chlorophyll content in the leaves of onions has been reported in the current study [29].

Single plant leaf area

Due to playing classical music, leaf area of single plant studied in the research increased by 30 percent compared to control (non-music). The results of some studies have shown that the plants exposed to the louder music, plant height, leaf area, plant weight, and chlorophyll content were higher. In addition, these traits in plants that played classical music was played for them were greater than plants heavy metal music and the control groups [18].

Plant height

Due to playing classical music, height of cowpea pant studied in the research increased by 38 percent compared to control (non-music).

In investigating the effect of six types of music with different frequencies on cowpea growth reported that the best treatment to improve the effects of growth and plant height included 400 Hz sound waves, cuckoo singing and the sound of crickets, followed by other treatments . Acoustic sound with cuckoo and cricket sound could increase the height and dry weight of this plant at the stage of seedling. They stated that various sound waves with different frequencies has significant improving effects on seedling stage growth of the cowpea, but their effects varied.

Number of sub-branches

The results showed that sub-branches of plants exposed to classical music playing compared with treatments of control group increased by 52%. It noteworthy that in one study the growth and type of plant species, bean and henna, under sounds of different frequencies were studied. The results of the studies showed that the optimal growth of these plants occurs when the wavelength of the sound was in accordance with the size of the leaves. It should be noted that in the case of bean, growth with random noise was less than the growth of pure sound. This significant difference between the growth in henna plant when exposed to random noise and pure sound was not seen, but the general result showed that as result of playing the music, the number of sub-branches and vegetative organ increased in both plants [22].

Proline

Some plant traits, such as proline decreased by 13% through playing classical music compared to control (non-music) group, but stressful music such as techno music has reverse effect, so that considering the current study, playing stressful music photos increased proline.

Evidence suggests that some genes may be stimulated by sound to move, so the amount of duplication might be increased that increased proline content could be justified by it [30].

Gibberellin

As result of playing classical music compared to control treatment (non-music), stomatal conductance in plant studied in this research increased by 81%.

India University professors played obscure parts of the violin for plants at certain times and sometimes they used its setting clutches as sound source. After several years of experience in the area of sound effects, it was found that music causes that plant to release its oxygen 60% to 100% more than its conventional level and as the value of oxygen released is exactly consistent with amount of carbon absorbed from carbonic gas

in the air. As a result, plant growth greatly and gives more flowers or fruits, controlled as result of gibberellin synthesis in plant.

Auxin

Auxin hormone was increased by 2% compared to control group (non-music) by playing classical music. On the other hand, the highest content of auxin with mean of 8.1 mg per gram of fresh weight was obtained from treatment of playing techno music that had significant difference with control group.
In order to study the effects of sound on callus Chrysanthemum growth by measuring the activity of SOD, soluble proteins content, oxidase activity of indole-3-acetic acid (IAA), and calcium absorption, Liu et al., (2002) used a sound stimulation generator (SSG). In their results, they stated that auxin hormone content reduced as result of sound frequency increase.

Abscisic acid

Abscisic acid hormone was also reduced by 8% compared to control group (non-music) by playing classic music, while the highest content of abscisic acid with mean of 1.56 milligram per gram of fresh weight was obtained by playing techno music that had significant difference with control group. Abscisic acid known as stressful hormone and its concentration increases at the stressful conditions. Therefore, its concentration is low when conditions are favorable for plant growth.
Inducing effect of sound wave on dynamical change of Indole-3-acetic acid (IAA) and abscisic acid (ABA) in the laboratory during the differentiation of mature callus of chrysanthemum showed that in the group treated with sound frequency (SF) 1.4 dB and SPL 95 kHz, IAA content was significantly higher ($p < 0.05$) and ABA content was lower than the control group. As a result, activation of IAA and ABA inhibition for development and differentiation of mature callus are desirable. Sound waves increased capacity of IAA metabolism and prevented ABA metabolism in mature callus. Thus, higher content of IAA / ABA in treated callus showed that specific gene expression system is associated with internal hormone, which is regulated by certain signals generated by sound waves stimulation [31]

Nitrogen

Nitrogen content was increased by 44% compared to control group (non-music) by playing classical music. Sound waves stimulation increased root activity, total length, and number of roots [32] .Dan Carlson invented sonic bloom that contains a unique blend of sound and spray spraying seaweed and he indicated that the frequency of 3 to 5 kHz makes the opening of the orifice and increasing absorption of nutrients contained in the atmosphere, including nitrogen and moisture in the morning dew [33].

Calcium

The results of this study showed that playing classical music enhances the calcium content of the plant by 21 percent compared to control (non-music) group. In this regard, Liu et al., (2002) used a sound stimulation generator in order to investigate the effects of sound field effects on callus Chrysanthemum growth by measuring the activity of SOD, soluble protein, acid oxidase activity, indole-3-acetic (IAA), and absorption of calcium. They reported that as result of increasing sound frequency, activity of superoxide dismutase (SOD), soluble proteins and calcium absorption increased in callus.
As seen, the present study investigated the effect of sound and music on some physiological and biological traits, leaf nutrient concentration, and grain yield of cowpea. We hope that findings of the current study to have significant impact in the adoption and application of innovative solutions in farming practices, especially acquiring the necessary knowledge on breeding the plants and increasing the quality of their growth stages.

CONFLICT OF INTEREST
None

ACKNOWLEDGEMENTS
None

FINANCIAL DISCLOSURE
None

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