Effect of Acoustic Waves on the Growth and Productivity of Sawi Plants (*Brassica Juncea* L.)

F Arlius¹, R E Putri¹, N S Putri¹, I Putri¹

¹Department of Agricultural Engineering. Andalas University. Padang. Indonesia

Corresponding author’s email address: ferisipado@fateta.unand.ac.id

**Abstract.** Sonic bloom is an audio system that can stimulate the process of plant growth. This technology can help farmers, especially in areas with low water availability and poor soil conditions. Appropriate sonic bloom stimulation can affect plant metabolism at the cellular level and increase the size and number of stomata in each leaf, resulting in a rate of absorption of water and nutrients from the soil. This can be quickly seen in root growth, seed germination, plant growth, and yield. The objective of this research was to determine the effect of sound wave frequency and length of exposure on the quality and productivity of mustard plants. This research was conducted with an experimental method, and used factorial ANOVA with two treatments, namely: 1) Frequency (frequency 4000 Hz and frequency 5000 Hz); 2) Duration of exposure (1 hour/day, 2 hours/day and 3 hours / day). Based on the research that has been done, there is an effect of giving sound wave frequency on plant height growth, number of leaves, leaf length, leaf width and harvest weight of plant. The effect of the growth rate of plants given sound wave frequency treatment is better in plants with a maximum frequency of 5000 Hz and for the best exposure time treatment is in plants with an hour treatment.

**Keywords:** Sonic bloom, Frequency, Growth, Productivity

1. **Introduction**

The sawi plants is a vegetable commodity that has good commercial value, and is suitable for cultivation in Indonesia because it can be seen from a climatological, economic, social and technical point of view which is very supportive, and this vegetable is a type of vegetable favored by all people. The demand for sawi plants always increases along with the increasing population and public awareness of nutritional needs. This sawi plants contains many nutrients that the human body needs, such as protein, fat, carbohydrates, Ca, P, Fe, Vitamin A, Vitamin N and Vitamin C.

According to the West Sumatra Central Statistics Agency [1], overall sawi production in West Sumatra has increased from 2015 to 2017, in 2015 the sawi production was 20.242,30 tons, 22.254,40 tons in 2016, and in 2017 was 25.394 tons. Increasing the yields of sawi plants can be done in various ways, both by intensification of agriculture and agricultural extensification. The development of sawi cultivation is a good prospect to support efforts to increase farmers' income, expand employment opportunities, develop agribusiness, increase state income through reducing imports and increase the growth rate of exports. For fulfill the high consumption of sawi in restaurants and fast-food restaurants, this is the factors needed to increase the productivity of the sawi plants.

The growth of a plant depends on the amount of nutrients it provides, and supporting environmental factors. The low amount of nutrients for plants will result in disrupted plant growth. One way to increase
Plant growth is to take advantage of technological innovations such as providing special treatment with sonic bloom and hydroponic technology to increase agricultural productivity [2].

Sonic bloom technology utilizes high frequency sound waves which function to spur the opening of the stomata combined with nutrition [3]. Sound vibrations can affect the opening of the stomata to be wider, so that it can absorb more water and CO₂ and optimize the photosynthesis process, so that plant growth and productivity can be optimally increased [4].

There have been many applications of sonic blooms in Indonesia to prove its benefits, one of which is [5] examined the provision of Balinese gamelan music to pakcoy plants with different musical nuances, it was found that giving gamelan music gong kebyar with joyful nuances had a positive effect on the growth and productivity of pakcoy. Another research was conducted by [6] on the effect of giving treatment to jazz, Javanese gamelan and heavy metal and the effect of music length of exposure for 1 hour, 2 hours and 3 hours on head lettuce. Based on the research conducted, it can be concluded that giving the type of music treatment can increase the growth of lettuce compared to control plants. The best type of music in this research is Javanese gamelan music and the best length of exposure is 3 hours. This objective is to determine the effect of sound wave frequency and length of exposure on the quality and productivity of sawi plants.

2. Material and Method

This research was conducted with an experimental method, and used two-way ANOVA with two treatments, that is frequency (frequency 4000 Hz and frequency 5000 Hz) and length of exposure (1 hour/day, 2 hours/day and 3 hours/day).

The treatments were given to each type of music as many as 30 plants, and on these 30 plants were divided into three treatments, the length of exposure was 10 plants/repetition. The treatment is given to the plants 6 days after planting, so that at the time of giving the treatment the plant roots are strong. For plants without treatment/control as a comparison, 10 plants/repetition were used. The research was carried out in several stages including:

2.1. Making a Greenhouse

The greenhouse is built with a length of 6 meters, a width of 4 meters and a height of 3 meters. In the greenhouse there are two studios that have active speakers installed for music exposure and LED lights as a substitute for sunlight during music exposure. For the greenhouse design, it can be seen in Figure 1 and Figure 2. The studio here has a function as a test environment and minimizes outside noise, so it is expected that the mustard plant is only affected by a single voice that is speaker sound.

2.2. Irrigation Installation

The irrigation system in this greenhouse uses a drip irrigation system, where water is flowed slowly but continuously. The drip irrigation system utilizes gravitational pressure and pump pressure as an energy source to drain water from tank one to tank two which is at an altitude so that water can be transmitted to plants. Emitter installation as many as 84 emitters and is located on three lines of 3 meters long lateral pipe.

2.3. Preparation of Planting Media

The planting media that used were roasted husks and cocopeat with a ratio of 1:3. The husks and cocopeat that used were stirred until well blended, then put into the pots or containers. Then the planting medium is watered so that when planting the moisture is maintained. Mixing of roasted husk and cocopeat and then put in the pot.
Figure 1. Greenhouse Design

Information:
1. Roof;
2. Tank 1;
3. Tank 2;
4. Water drain pipe;
5. Door 1;
6. Door 2;
7. Drain pipe from the pump;
8. Water discharge pipe to drip irrigation;
9. Music exposure studio;
10. LED light.

Figure 2. Greenhouse Front View Design
2.4. Observations

2.4.1. Temperature
The amount of air temperature and temperature distribution that occurs in the greenhouse must be monitored and controlled to support the optimal growth of sawi plants for a certain production period. Measurement of temperature in the greenhouse using a thermohygrometer was observed every 11:00 a.m.

2.4.2. Humidity
Monitoring the humidity of the greenhouse environment must always be considered so that plant growth can be optimized. Humidity measurements using a thermohygrometer was observed every 11:00 a.m.

2.4.3. Plant Height
Measurement of plant height is done by measuring from the base of the stem to the tip of the highest leaf using a ruler. Measurements was observed every two days.

2.4.4. Number of Leaves
The number of leaves was counted starting from the age of 6 days after planting into the planting medium. Data collection for the number of leaves was observed every two days.

2.4.5. Length and Width of Leaves
The length and width of leaves were measured using millimeter paper and measurements was observed every two days.

2.4.6. Harvest Weight
Harvest weight data was collected only once, only at harvest time, the measurement was observed by sampling using a digital scale.

2.4.7. Energy Analysis Used
Energy analysis observed was the amount of battery energy, electrical energy such as LED lights, water pumps, speakers used at the time of research starting from planting to harvest.

2.5. Data Analysis
The research data were tested by two-way ANOVA. If it shows a real change (P<0.05), then the Duncan test can be performed with a 95% confidence interval to determine whether there is a significant difference in each treatment.

H₀₁ = There is no effect of sound wave frequency on the observed parameters.
H₀₂ = There is no effect on the length of exposure on the observed parameters.
H₀₃ = There is no interaction effect of sound wave frequency and length of exposure on the observed parameters.
H₁₁ = There is an effect of sound wave frequency on the observed parameters.
H₁₂ = There is an effect on the length of exposure on the observed parameters.
H₁₃ = There is an interaction effect of sound wave frequency and length of exposure on the observed parameters.

3. Results and Discussion

3.1. Sound Wave Frequency Analysis
The treatment given in this research was the treatment of sound wave frequency and length of exposure to sawi plants (Brassica juncea L.). The frequency used is a maximum frequency of 4000 Hz in Rock music (Metalica Atlas, Rise!) Which can be seen in Figure 4, and a maximum frequency of 5000 Hz in Minang music (Bareh Solok) which can be seen in Figure 3, as well as a long exposure treatment for 1 hours, 2 hours, and 3 hours per day. According to [7], sound waves at a frequency of 3.5 kHz - 5 kHz are able to stimulate the opening of the stomata so that increasing the rate of photosynthesis which will affect plant growth.

In previous research, the 4000 Hz frequency can be applied to rice plants, and has the widest stomata width compared to plants with a frequency of 10 Hz, 7 kHz and 30 kHz [8]. For giving music with a
frequency of 5000 Hz has a significant effect on plant height, number of leaves and wet weight of pakcoy plants in research on the effect of music and fertilization on the application of sonic bloom technology to the growth of pakcoy (Brassica rapa L.) [9]. In this research, a maximum sound wave frequency of 4000 Hz and a maximum sound wave frequency of 5000 Hz were used to determine the effect on the quality and productivity of sawi plants.

![Figure 3. Minang Music Frequency Graph (Bareh Solok)](image3)

![Figure 4. Heavy Rock Music Frequency Graph (Metalica Atlas, Rise!)](image4)

3.2. Environmental Daily Temperature and Humidity Analysis

The results of observations in the greenhouse which took place at Dangau Inspirasi Kurao, Padang, Kec. Nanggalo, Padang City in July - August 2020 shows daily temperatures ranging from 29.9°C to 34.9°C with temperature data collection at 11.00 a.m. From these measurements, it can be concluded that the greenhouse conditions are relatively ideal for the cultivation of sawi plants. The ideal temperature for sawi plants is 15°C - 21°C at the night and 27°C - 32°C at the day [10]. The temperature distribution at the time of treatment can be seen in Figure 5.

![Figure 5. Temperature (°C)](image5)
The humidity of the air in the greenhouse during the observation ranged from 53% to 70% according to the graph which can be seen in Figure 6, while good humidity for the growth of sawi plants is between 80% - 90%. If it exceeds 90% humidity will adversely affect plant growth [11]. The measurement of air humidity in the greenhouse shows that the environmental conditions are less than ideal for the growth of sawi plants. To help increase humidity, plants are sprayed using a sprinkler that is located on top of the plants, so that they get the ideal humidity.

![Figure 6. Humidity (RH)](image)

### 3.3. Effect of Sound Wave Frequency and Length of exposure to the Quality and Productivity of Sawi Plants

Vibration or sound waves used in plants are a fertilization system through leaves, that is by giving vibrations at a very high frequency (sonar), will stimulate the stomata to remain open and will increase the efficiency of absorption of fertilizers which are useful in the plant growth process [8]. In this research, the frequency and length of exposure were given to sawi plants, and what was observed were leaf length, leaf width, plant height, leaf number, and harvest weight. It can be seen in Figure 7 that the best sawi plant growth for treatment with a maximum frequency of 5000 Hz is a plant with a length of exposure of 1 hour and the lowest growth is plants with a length of exposure of 3 hours.

For plants with a maximum frequency treatment of 4000 Hz that had good growth, they were plants with a length of exposure of 1 hour and those with the lowest growth were those with a treatment duration of 3 hours. From the treatment given, the plants that had the best growth based on the picture were plants with a maximum frequency of 5000 Hz treatment and an hour length of exposure.
3.3.1. Plant Height

Plant height is an indicator that is often used for the observation process or as a parameter used to measure the influence of the environment or the treatment applied [12]. Measuring the height of mustard plants using millimeter paper is measured from the ground to the highest plant height. Measurements were made every two days starting at the sixth day of planting until the age of 40 days, obtained 17 measurement data.

Seen from the treatment of music frequency, the best plant height was in plants with an hour treatment at both a frequency of 5000 Hz and a frequency of 4000 Hz. In the 5000 Hz frequency treatment, an increase in plant height was seen on the 28th day, while in the 4000 Hz treatment it was seen on the 22nd day. with the 3 hours treatment has the lowest height compared to the others, it can be seen in Figure 8. For the 4000 Hz treatment, the height of the control plants and the plants with the 2 hours length of exposure treatment also has almost the same height and the plants with 3 hours treatment also have the lowest height, compared to others, can be seen in Figure 9.
Statistically the effect of sound wave frequency and length of exposure on plant height can be seen in Table 1. Based on the results of the ANOVA test on sound wave frequency treatment, there is no effect of giving sound wave frequency treatment on plant height, where the Sig. value is 0.981 > 0.005. In the long exposure treatment, the ANOVA test results were obtained with the Sig. is 0.000 < 0.005, which means that there is an effect of long exposure treatment on plant height. For the interaction of sound wave frequency and length of exposure, the Sig. 0.002 < 0.005, which can be concluded that there is an interaction effect of sound wave frequency and length of exposure on plant height. This is in accordance with Prasetyo's research (2017) that music stimulation treatment of lettuce plants has a very significant effect on plant height. And in the research of [13], the treatment of classical, pop and hard rock music on curly chilies also affected plant height with the best plant height yield on hard rock music treatment.

Table 1. ANOVA Test for Effect of Sound Wave Frequency and Length of exposure on Plant Height

| Source                        | Type III Sum of Squares | df | Average Squared | F     | Sig. |
|-------------------------------|-------------------------|----|-----------------|-------|------|
| Frequency                     | 0.079                   | 1  | 0.079           | 0.001 | .981 |
| Length of exposure            | 78783.906               | 2  | 39391.953       | 283.384 | .000 |
| Observation                   | 2025473.429             | 16 | 126592.089      | 910.699 | .000 |
| Frequency * Length of exposure| 1800.729                | 2  | 900.365         | 6.477 | .002 |
| Error                         | 138727.435              | 998|                 | 139.005 |      |
| Total                         | 1.671E7                 | 1020|                |       |      |
| Corrected Total               | 2244785.579             | 1019|                |       |      |

Frequency: 4000 Hz (Rock Music, Metallica Atlas, Rise!), 5000 Hz (Music Minang, Bareh Solok).
Length of exposure: 1 hour, 2 hours, 3 hours. Observation Time: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

3.3.2. Number of Leaves

The effect of the frequency of sound waves on the number of leaves of the sawi plants can be seen in Figure 10 and Figure 11. In the treatment with a maximum frequency of 5000 Hz, the highest number of leaves is in accordance with the graph, that is an hour length of exposure treatment, and for the least number of leaves, the length of exposure 3 hours. For the treatment, the length of exposure was 2 hours and the control had almost the same number of leaves. At the maximum frequency treatment of 4000 Hz, the highest number of leaves was also in plants with an hour treatment which was almost close to the number of leaves of control plants and 2 hours treatment. Plants with a 3 hours treatment were also the plants with the least number of leaves.

Figure 10. The effect of the number of leaves toward time in the treatment Frequency 5000 Hz

Figure 11. The effect of the number of leaves toward time in the treatment Frequency 4000 Hz

Statistically, the effect of sound wave frequency and length of exposure on the number of leaves can be seen in Table 2. In the ANOVA test results on sound wave frequency treatment, the Sig. is 0.000 < 0.005, which means that there is an effect of the frequency of the sound waves used on the growth of the number of leaves. In the length of exposure treatment, the ANOVA test results were obtained with the Sig. is 0.000 < 0.005, which means there is a difference in the number of leaves based on the length of exposure. And for the interaction of sound wave frequency and length of exposure, the Sig. is 0.139> 0.005, which can be concluded that there is no interaction effect of sound wave frequency and length of exposure on the number of leaves.

Based on the relevant research from [14] about "Ultrasonic sensing for corn characterization" with the results that corn responds very well to sound waves so that it can grow well with the effect of these sound waves, according to this study where there is an effect of wave frequency treatment. sound and length of exposure to the number of sawi leaves.
Table 2. ANOVA Test for Effect of Music Frequency and Length of exposure on Number of Leaves

| Source                        | Type III Sum of Squares | df | Average Squared | F     | Sig.  |
|-------------------------------|-------------------------|----|-----------------|-------|-------|
| Frequency                     | 20.613                  | 1  | 20.613          | 25.171| .000  |
| Length of exposure            | 264.829                 | 2  | 132.415         | 161.697| .000  |
| Observation                   | 28911.982               | 16 | 1806.999        | 2206.595| .000  |
| Frequency * Length of exposure| 3.237                   | 2  | 1.619           | 1.977 | .139  |
| Error                         | 817.271                 | 998| .819            |       |       |
| Total                         | 182641.000              | 1020|                |       |       |
| Corrected Total               | 30017.932               | 1019|                |       |       |

Frequency: 4000 Hz (Rock Music, Metallica Atlas, Rise!), 5000 Hz (Music Minang, Bareh Solok).
Length of exposure: 1 hour, 2 hours, 3 hours.
Observation Time: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

Based on the statistical analysis, it was found that the difference in length of exposure, so Duncan's test was carried out which can be seen in Table 3. It can be concluded that the plants with an hour length of exposure treatment were the plants with the highest number of leaves, for the 3 hours treatment had the least number of leaves.

Table 3. Duncan's Test Effect of Length of exposure on Number of Leaves

| Length of exposure | N  | Subset       |
|-------------------|----|--------------|
|                   |    | 1 | 2 | 3 |
| 3 hours           | 340| 11.54  |
| 2 hours           | 340| 12.41  |
| 1 Hour            | 340| 12.75  |
| Sig.              | 1.000| 1.000| 1.000 |

3.3.3. Leaf Length

Leaf length measurement is one of the morphological parameters commonly used to determine whether a plant grows well or not. The exposure of various types of sound can trigger the opening of the stomata to become wider, thereby increasing plant length, leaf width and the productivity of sawi plants [12]. It can be seen in Figure 12, the effect of a maximum frequency treatment of 5000 Hz on the leaf length of sawi plants began to appear on day 14. Plants with a treatment duration of 3 hours had the smallest leaf length growth compared to other plants. The plants with the 2 hours exposure treatment and control plants had almost the same leaf length growth according to the graph, while for an hour exposure treatment, the plants with the best leaf length were seen on the 32nd day until harvest.

In the treatment with a maximum frequency of 4000 Hz, the difference in leaf length growth began to be seen on day 8 which can be seen in Figure 13. The best growth in leaf length was in control plants which was seen on day 8 to day 30, while on day 30 until crop harvest with the best leaf length in plants with an length of exposure of 1 hour. For plants with the lowest growth, the plants with the long exposure treatment were 3 hours.
Figure 12. The effect of the leaf length toward time in the treatment Frequency 5000 Hz

Figure 13. The effect of the leaf length toward time in the treatment Frequency 4000 Hz

Statistically, the ANOVA test for the effect of sound wave frequency treatment, length of exposure and the interaction of the effect of sound wave frequency and length of exposure on leaf length, can be seen in Table 4. In the ANOVA test results on sound wave frequency treatment, the Sig. is 0.000<0.005, which means that there is an effect of the frequency of the sound waves on the leaf length. In the length of exposure treatment, the ANOVA test results were obtained with the Sig. is 0.000 <0.005, which means that there is an effect of length of exposure treatment on leaf length. For the interaction of sound wave frequency and length of exposure, the Sig. is 0.000 <0.005, which can be concluded that there is an interaction effect of sound wave frequency and length of exposure on leaf length.

Based on the analysis in this study, there are differences in leaf length to the treatment of sound wave frequency and length of exposure according to [12] which states that exposure to sound with various types of frequencies can trigger stomata openings to become wider, so that increase plant length, leaf width and productivity of sawi plants.
Table 4. ANOVA Test for Effect of Music Frequency and Length of Exposure on Leaf Length

| Source                        | Type III Sum of Squares | df  | Average Squared | F       | Sig.  |
|-------------------------------|-------------------------|-----|-----------------|---------|-------|
| Frequency                     | 6273.706                | 1   | 6273.706        | 108.517 | .000  |
| Length of exposure            | 52626.731               | 2   | 26313.366       | 455.146 | .000  |
| Observation                   | 1024373.180             | 16  | 64023.324       | 1107.421| .000  |
| Frequency * Length of exposure| 1133.204                | 2   | 566.602         | 9.801   | .000  |
| Error                         | 57697.379               | 998 | 57.813          |         |       |
| Total                         | 7104211.589             | 1020| 1020            |         |       |
| Corrected Total               | 1142104.200             | 1019|                 |         |       |

Frequency: 4000 Hz (Rock Music, Metallica Atlas, Rise!), 5000 Hz (Music Minang, Bareh Solok).
Length of exposure: 1 hour, 2 hours, 3 hours.
Observation Time: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

Based on the ANOVA test, there are significant differences in leaf length based on frequency, length of exposure and frequency interaction, therefore further testing is necessary. For further tests, the effect of length of exposure on leaf length can be seen in Table 5. It can be concluded that plants with 1 hour treatment have the best leaf length, and plants with 3 hours treatment are the smallest.

Table 5. Duncan’s Test for The Effect of Length of Exposure on Leaf Length

| Length of exposure | N     | Subset | 1       | 2       | 3       | Sig. |
|--------------------|-------|--------|---------|---------|---------|------|
| 3 hours            | 340   | 1      | 66.87942|         |         |      |
| 2 hours            | 340   | 2      | 78.30199|         |         |      |
| 1 Hour             | 340   | 3      |         | 84.18038|         |      |
| Sig.               |       |        | 1.000   | 1.000   | 1.000   |      |

3.3.4. Leaf Width

The effect of a maximum frequency treatment of 5000 Hz on leaf width can be seen in Figure 14, where the 3 hours length of exposure treatment has the smallest leaf width growth. The best leaf width growth was in plants with a length of exposure of 1 hour, which began to appear on the 30th day until harvest. The effect of treatment with a maximum frequency of 4000 Hz can be seen in Figure 15, there is a difference in leaf width growth in each treatment which begins to be seen on day 10. Plants without treatment or control have the best leaf width growth on day 10 to day 28 compared to other plants, whereas on the 30th day the without treatment plants and the plants with the 1 hour exposure treatment had almost the same leaf width. On the 32nd day until harvest, the best leaf width growth was on plants with an length of exposure of 1 hour. The smallest leaf width at the 4000 Hz frequency treatment is the treatment plant for 3 hours length of exposure.

Figure 14. The effect of the leaf width toward time in the treatment Frequency 5000 Hz
The difference in leaf width in plants with the treatment of 2 hours length of exposure began to be seen on the 12th day. Plants that had the largest leaf width were the control plants and the smallest on the 4000 Hz treatment plants. For the effect of 3 hours length of exposure, control plants also had the largest leaf width which could be seen on day 10. Plants with the smallest leaf width were also on plants with a frequency treatment of 4000 Hz.

Statistically, the effect of sound wave frequency and length of exposure on leaf width can be seen in Table 6. In the ANOVA test results on sound wave frequency treatment, the Sig. is 0.000<0.005, which means that there is an effect of the frequency of sound waves on the growth of leaf width. In the length of exposure treatment, the ANOVA test results were obtained with the Sig. is 0.000<0.005, which means that there is an effect of length of exposure treatment on leaf width growth. For the interaction of sound wave frequency and length of exposure, the Sig. is 0.076> 0.005, which can be concluded that there is no interaction effect of sound wave frequency and length of exposure on leaf width.

| Source                        | Type III Sum of Squares | df | Average Squared | F    | Sig.  |
|-------------------------------|-------------------------|----|-----------------|------|-------|
| Frequency                     | 2876.869                | 1  | 2876.869        | 123.661 | .000  |
| Length of exposure            | 23848.785               | 2  | 11924.393       | 512.566 | .000  |
| Observation                   | 452694.457              | 16 | 28293.404       | 1216.183 | .000  |
| Frequency * Length of exposure| 120.371                 | 2  | 60.185          | 2.587 | .076  |
| Error                         | 23217.567               | 998| 23.264         |      |       |
| Total                         | 2758163.673             | 1020|                |      |       |
| Corrected Total               | 502758.049              | 1019|                |      |       |

Frequency: 4000 Hz (Rock Music, Metallica Atlas, Rise!), 5000 Hz (Music Minang, Bareh Solok). Length of exposure: 1 hour, 2 hours, 3 hours. Observation Time: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17.

Based on the ANOVA test, there is a significant difference in leaf width based on the frequency and length of exposure, so that further testing is necessary. For Duncan’s test the effect of length of exposure on leaf width can be seen in Table 7. It can be concluded that plants with 1 hour treatment have the best leaf width and plants with 3 hours treatment have the smallest leaf width.

This research is in suitable with previous research, that is in [15] about the effect of the sonic bloom single tone amplitude on the germination of cherry tomato seeds (Lycopersicum cerasiforme Mill.) as a design source for learning biology, stating that decibel variations significantly affect the growth of cherry tomato sprout leaves.
Table 7. Duncan's Test The Effect of Length of Exposure on Leaf Width

| Length of exposure | N  | Subset 1 | Subset 2 | Subset 3 |
|--------------------|----|----------|----------|----------|
| 3 hours            | 340| 40.79    |          |          |
| 2 hours            | 340|          | 47.70    |          |
| 1 Hour             | 340|          |          | 52.58    |
| Sig.               |    | 1.000    | 1.000    | 1.000    |

3.3.5. Harvest Weigh

Harvest weight is an indicator that can be used in observing the development of a plant. In previous research, sound stimulation provided a significant increase in harvest, both increase in mass and plant size. This increase can be caused by sound which can trigger stomata openings and will increase plant weight and plant productivity [12]. In Figure 16, it can be seen that the average harvest weight of several plants with treatment and without treatment (control). The harvest weight obtained had a significant difference, in the 1 hour exposure time treatment, the harvest weight obtained with the 5000 Hz frequency treatment was better than the 4000 Hz frequency treatment and control. Where the harvest weight of 5000 Hz treatment is 102.1 grams, while for 4000 Hz treatment it is 90.9 grams and 83.2 grams without treatment.

Figure 16. Effect of Harvest Mass on Treatment

The exposure time of 2 hours obtained the harvest weight of the 5000 Hz treatment frequency of 72.6 grams and 4000 Hz treatment frequency of 58.20 grams, while plants without treatment were 83.2 grams. In the 2 hours and 3 hours treatment, the largest harvest weight was in control plants. According to [16], exposure to music has an effect on the harvest weight, exposure to music can increase cell growth in the leaf primordia and shoot apical meristem so that the plant's wet weight increases, this happens in plants with 1 hour treatment. In the 2 hours and 3 hours treatment, the harvest weight was lower than the control. The music treatment with a frequency of 5000 Hz is able to increase the absorption of nutrients and CO2 through the stomata, so that maximizing the photosynthesis process. The application of sonic bloom technology triggers the opening of the stomata wider, so that the absorption of nutrients through the leaves is better and absorption of nutrients through roots (Pujiwati, 2017). According to [17], the lower the sound frequency given will slow down plant growth, leaf area, root length, wet weight and dry weight. According to this treatment, the harvest weight with the 5000 Hz treatment was better than the 4000 Hz frequency.

4. Conclusion

Based on the results and discussion in this study, it can be concluded that there is an effect of giving sound wave frequency on the growth of plant height, number of leaves, leaf length, leaf width and harvest weight of sawi plants (Brassica juncea L.); Based on the analysis of the observation parameters, plant height, number of leaves, leaf length, leaf width and harvest weight, the growth rate of sawi plants with the best sound wave frequency treatment is the maximum frequency treatment of 5000 Hz with
Minang music (Bareh Solok); Based on the analysis of the observation parameters, plant height, number of leaves, leaf length, leaf width and harvest weight, the best length of exposure treatment for the growth of sawi plants is 1 hour; The best treatment interaction for sound wave frequency and length of exposure is the treatment with a maximum frequency of 5000 Hz and a length of exposure for 1 hour. This is based on the analysis of the observation parameters of leaf length, leaf width, leaf number, and harvest mass. For plant height, the best treatment was with maximum frequency treatment of 4000 Hz and length of exposure for 1 hour.

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