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# Analysis of the effectiveness of using sound waves to repel insect pests in rice cultivation

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## Abstract

An Indonesia is an agrarian country with a large amount of agricultural land. Agricultural land in Indonesia is dominated by rice farming. Indonesia is also the largest rice producer in the world. However, there are still many problems experienced by rice farmers. The threat of crop failure is usually caused by natural weather and pest attacks. Pest attacks are a threat to farmers because the presence of pests can bring disease to plants. In addition, pests also damage rice plants by biting the plants so that the plants become damaged. Farmers still rely on the old way to get rid of pests, namely by spraying pesticides. This will have a bad impact on the environment and humans, due to its chemical ingredients. Thus, a new method that is more environmentally friendly must be done, namely by using sound waves to repel animals. The use of sound waves is more effective because it is environmentally friendly, not time consuming. The use of sound waves has the effectiveness to repel insect pests at a frequency of 300 Hz - 500 Hz with a distance of 1 - 9 meters. Of course, this method can be more effective than the old method of spraying pesticides.

**Keywords:** Indonesia, Farmers, Pest, pesticides



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## I. INTRODUCTION

Indonesia is an agrarian country, with the majority of its population working as farmers. Spices have made Indonesia a center of global trade since the 15th century. Selling plantation products is a good way to show that Indonesia is an agriculture-based country. (Krismantoro & Jaya Yogyakarta, 2022) Rice is a commodity that is often grown in Indonesia, making Indonesia one of the largest rice producing countries in the world. Indonesia is the third largest rice producer in the world after China and India, where Indonesia produces 70,600,000 tons of rice per year. (Penelitian et al., 2019).

Improving the quality of agriculture must be done in order to stabilize staple foods. Increasing domestic rice production is very important to avoid the high risk of instability in the price and supply of rice from the world market, in addition to being closely related to poverty alleviation efforts of rural development

funds (Azahari & Hadiutomo, n.d.). However, there are still many problems that farmers often face. On the way, one of the most significant risks for farmers who have been taking on this huge responsibility. Most of the sources of risk are caused by climate change because the basis of agricultural production is through natural processes, in addition to human ability to prevent it still covers the early stages of a process that takes a long time (Wahyudi & Permatasari, 2022). The problem that is often experienced by farmers is pest insects, which is a serious threat to farmers. Many farmers experience losses from crops affected by disease to crop failure. Spread of dwarf disease occurs through plant material and insect vectors. Plant material derived from cuttings of dwarf disease-affected plants will produce seedlings that are also produce seedlings that are also affected by dwarf disease.(BALFAS et al., 2020) .When you hear the name insect, it is always identified with pests in agriculture that are detrimental, such as walang sangit, leafhoppers, grapyak caterpillars and others.(Meilin & Nasamsir, 2016). One of the insect foods is plants, in plants insects usually eat parts of the stem, leaves, fruit, seeds and grains of sarai flour.(Rosniar et al., n.d.). The weevil (Leptocorisa acuta) is a pest that generally damages rice grains in the ripening phase, by sucking grain grains, (Hidayat Amrullah et al., n.d.). This threat must be prevented by proper handling. But there are still many people who cannot handle pests optimally. The method used by farmers usually uses pesticide spraying to eradicate pests. However, this method has the potential to damage the environment, due to the chemicals contained in pesticides. Pest and disease control that they have been using is still mostly using chemical control. The negative effects of using chemical pesticides are they can be toxic to humans and the environment, kill soil organisms, pests will be more resistant and soil structure will be poor.(Sugiarti, 2022). Evidence is increasingly coming about the many victims of pesticides both valuable animals, livestock and humans themselves. Pesticide residues in food and the environment are increasingly frightening humans.(Pertanian Bogor, 2004).

From the problems experienced by farmers, we must innovate how to solve these problems appropriately but also pay attention to environmental sustainability. The use of sound waves is a safe solution in dealing with pests in rice fields. By making a tool that can emit sound waves, it will disturb and even repel insect pests. This method is effective because it has a negative effect on the sustainability of the surrounding environment. The use of sound waves can be used by giving a certain frequency according to the hearing ability of the pest. In this way, farmers do not need to spend money to buy pesticides.

## II. RESEARCH METHOD

The problems that occur among farmers require us to contribute to solving these problems. Therefore, a tool that can repel pests with sound waves was designed. This tool uses sound waves to repel insect pests on rice plants. The use of sound waves is more effective because it does not have a negative impact on the environment. This tool uses DFPlayer mini mp3 arduino as a signal builder, then arduino nano serves to process the signal into waves, the speaker serves as an output to channel sound waves.

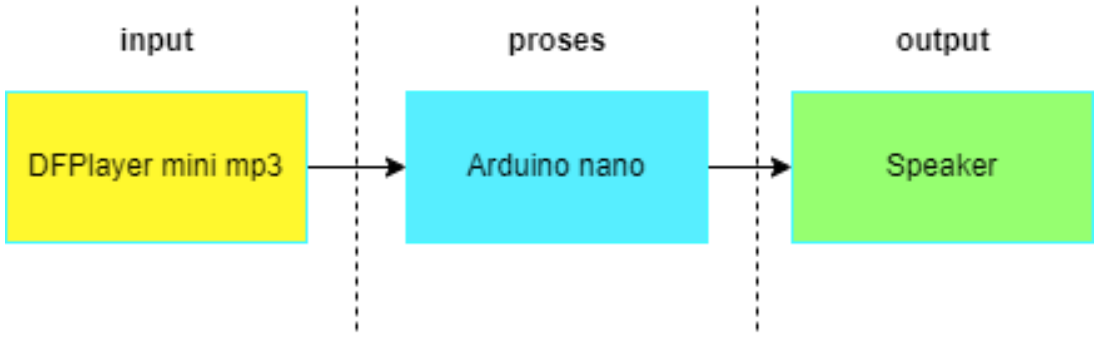


Image 1.1 block diagram

The way this tool works is by emitting sound waves according to a predetermined frequency. This tool uses a 12 v voltage source from the battery which will then be forwarded to the arduino nano. Arduino nano functions as a signal processor and also a 5v voltage source for DFPlayer mini mp3. The input of this tool is DFPlayer mini mp3, this component has a role as a signal generator, after the signal is generated, the next process will be entered into the arduino which functions to process the signal so that it can become a wave,

after being processed by the arduino then the wave will be channeled through the speaker so that waves appear in the form of sound. This sound wave can be adjusted according to the desired frequency.

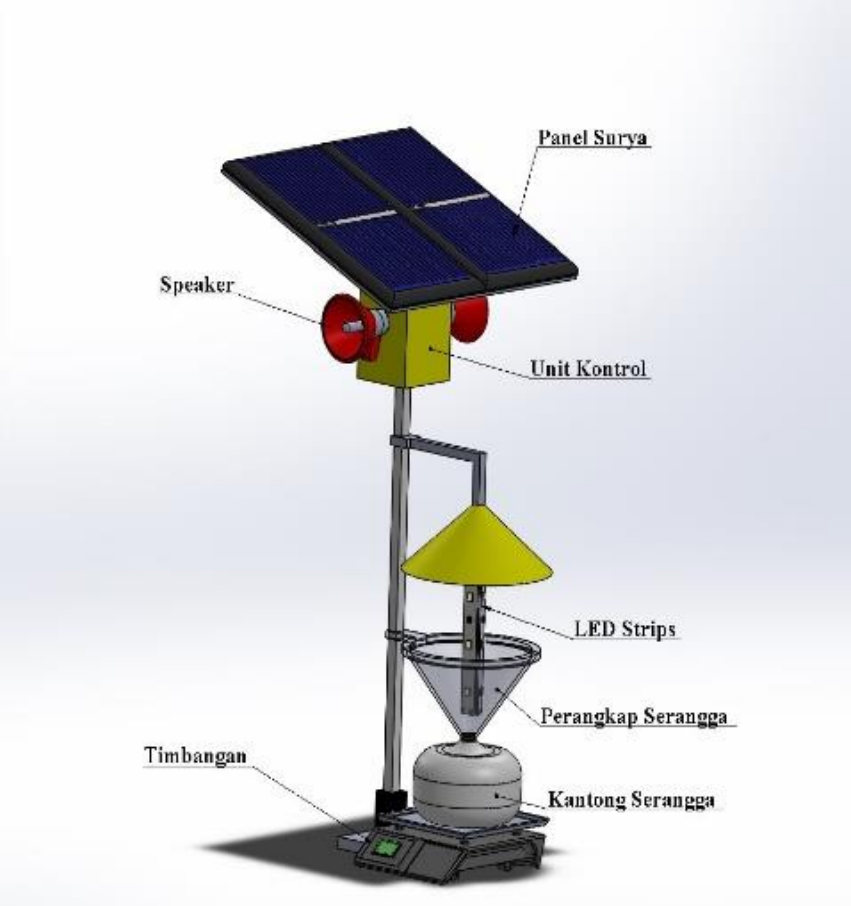


Image 1.2 atmi madi

This tool can operate in the middle of rice fields by using batteries as a source of energy. using this tool is expected to reduce the use of pesticides for the sustainability of a healthy environment.

## III. RESULTS AND DISCUSSION

In this study, we conducted a trial by observing 4 insect pests with a duration of 10 minutes each per trial. The results of the experiment will explain the frequency, distance, and results. In the results section, if there is no response from the insect, it will be given a value of 0, then if there is a response from the insect, it will be given a number 1, and if the insect reacts and flies, it will be given a number 2. In this study using a frequency at 100 Hz to 500 Hz with the first trial of 100 Hz then rising with a frequency increase of 50 Hz. here are the results of this research trial:

Table I. trial results

| frekuensi | jarak | wakang sangit | wereng | ngenget | kupu-kupu |
|---|---|---|---|---|---|
| 100 Hz | 1-4 Meter | 0 | 0 | 1 | 0 |
| | 5-8 Meter | 0 | 0 | 0 | 0 |
| 150 Hz | 1-3 Meter | 1 | 1 | 1 | 0 |
| | 4-6 Meter | 0 | 0 | 0 | 0 |
| | 7-9 Meter | 0 | 0 | 0 | 0 |
| | 10-11 Meter | 0 | 0 | 0 | 0 |
| 200 Hz | 1-3 Meter | 1 | 1 | 1 | 1 |
| | 4-6 Meter | 1 | 1 | 1 | 1 |
| | 7-9 Meter | 0 | 0 | 0 | 0 |
| | 10-12 Meter | 0 | 0 | 0 | 0 |
| | 13-15 Meter | 0 | 0 | 0 | 0 |
| 250 Hz | 1-3 Meter | 1 | 1 | 1 | 1 |
| | 4-6 Meter | 1 | 1 | 1 | 1 |
| | 7-9 Meter | 1 | 1 | 1 | 0 |
| | 10-12 Meter | 0 | 0 | 0 | 0 |
| 300 Hz | 1-3 Meter | 2 | 2 | 2 | 2 |
| | 4-6 Meter | 2 | 2 | 2 | 1 |
| | 7-9 Meter | 1 | 2 | 2 | 1 |
| 350 Hz | 1-3 Meter | 2 | 2 | 2 | 2 |
| | 4-6 Meter | 2 | 2 | 2 | 2 |
| | 7-9 Meter | 2 | 2 | 2 | 2 |
| | 10-11 Meter | 1 | 2 | 2 | 1 |
| 400 Hz | 1-3 Meter | 2 | 2 | 2 | 2 |
| | 4-6 Meter | 2 | 2 | 2 | 2 |
| | 7-9 Meter | 2 | 2 | 2 | 2 |
| | 10-11 Meter | 1 | 2 | 2 | 1 |
| 450 Hz | 1-3 Meter | 2 | 2 | 2 | 2 |
| | 4-6 Meter | 2 | 2 | 2 | 2 |
| | 7-9 Meter | 2 | 2 | 2 | 2 |
| | 10-11 Meter | 2 | 2 | 2 | 2 |
| 500 Hz | 1-3 Meter | 2 | 2 | 2 | 2 |
| | 4-6 Meter | 2 | 2 | 2 | 2 |
| | 7-9 Meter | 2 | 2 | 2 | 2 |
| | 10-13 Meter | 2 | 2 | 2 | 2 |

Then in the test results at each frequency against 4 insect pests namely walang sangit, ngenget, leafhoppers, butterflies get the following results:

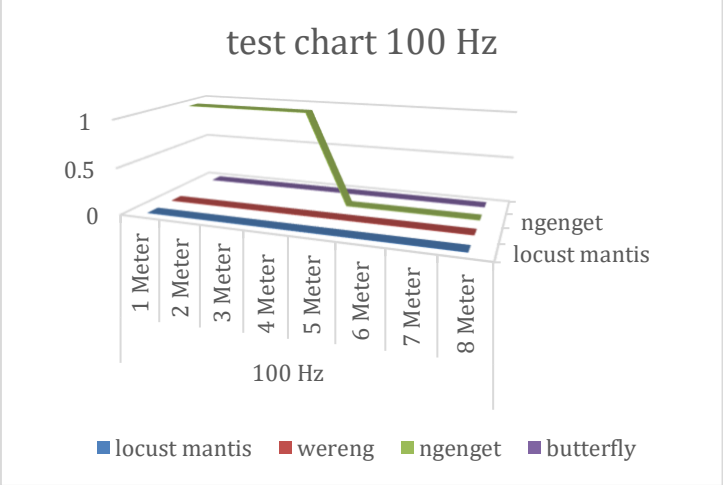


Image 3.1 test chart 100 Hz

Based on the graph above, at a frequency of 100 Hz, the maximum range of sound waves is 8 meters, with the result that there is no response to the insects, leafhoppers, butterflies. While for ngengget insects react at a distance of 1-4 meters.

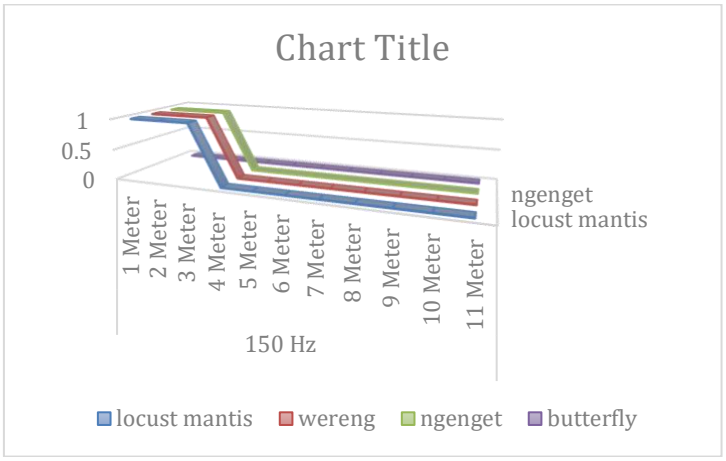


Image 3.2 test chart 150 Hz

Then the next trial with a frequency of 150 Hz. From the results of this trial, the 3 insects showed a response, while the butterfly has not shown a response.

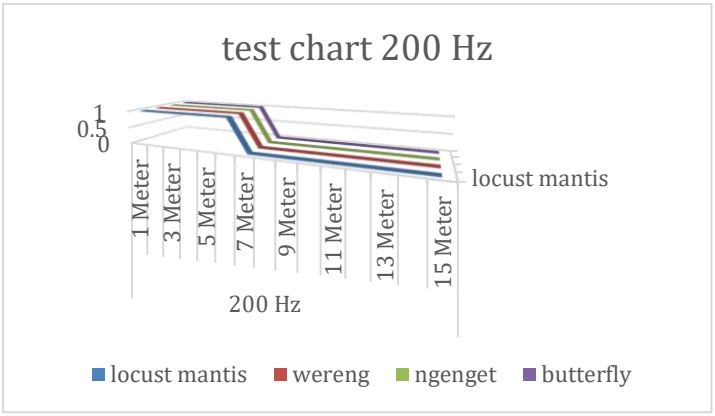


Image 3.3 test charts 200 Hz

Tests were conducted by increasing the frequency to 200 Hz and getting results at a distance of 1-6 meters there was a reaction from the 4 insects.

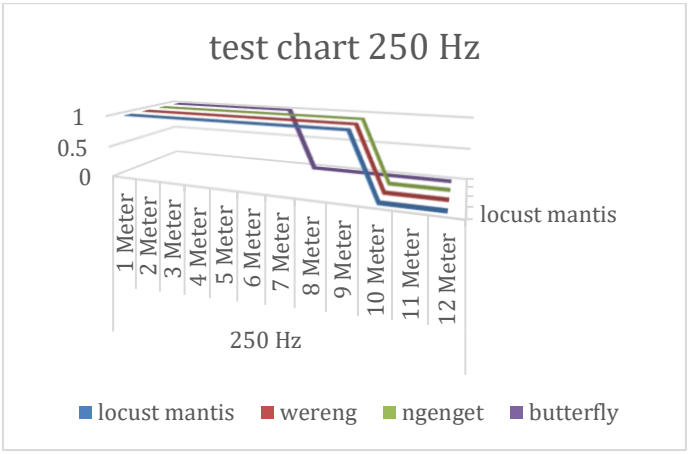


Image 3.4 test chart 250 Hz

In the 4th trial, there was a response from insects with the distance increasing to 1 - 9 meters.

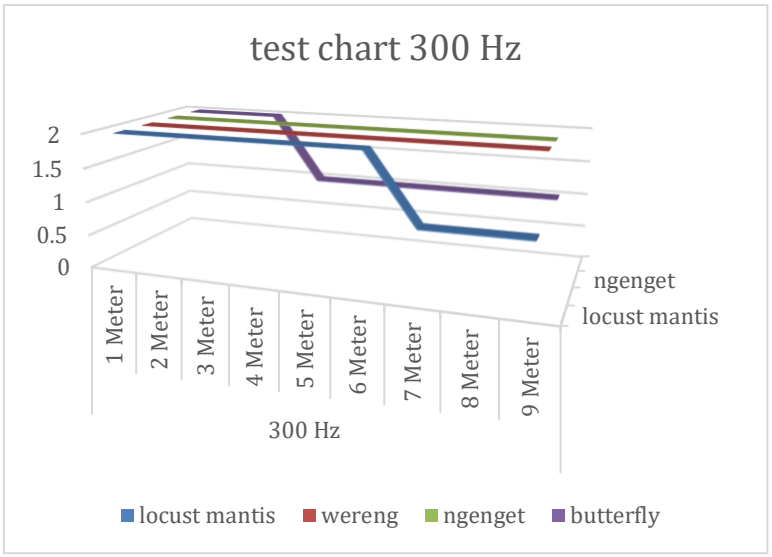


Image 3.5 test chart 300 Hz

In the 5th trial, the frequency was increased to 300 Hz and the maximum range was as far as 9 meters. At a frequency of 300 Hz at a distance of 1-6 meters, the grasshopper insects began to move away and fly away, while the butterflies at a distance of 1-3 flew away and at a distance of 4-9 meters only responded. Then the leafhopper and ngenget insects at a distance of 1-9 meters move away to a place that is not reached by sound waves.

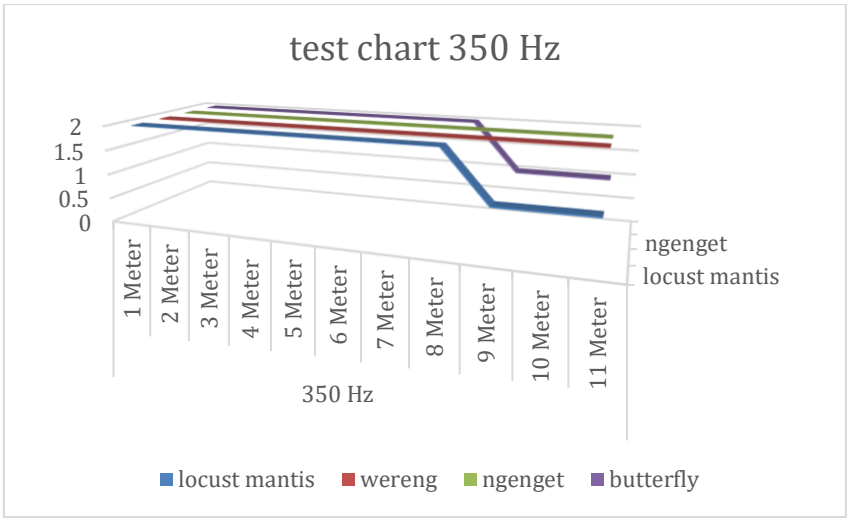


Image 3.6 test chart 350 Hz

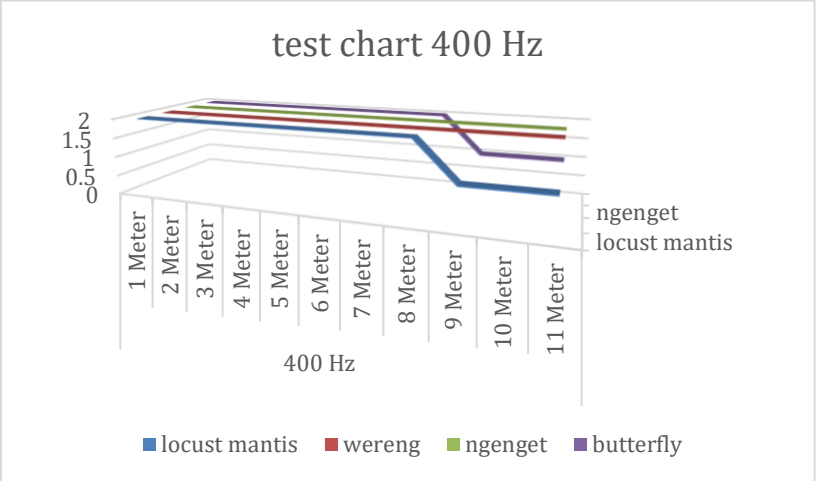


Image 3.7 test chart 400 Hz

At a frequency of 350 Hz - 400 Hz showed the same results, namely the leafhopper and ngenget insects went away to a place that was not reached by sound waves. While the walang sangit and butterfly insects began to move away at a distance of 1-9 meters and only responded at a distance of 10-11 meters.

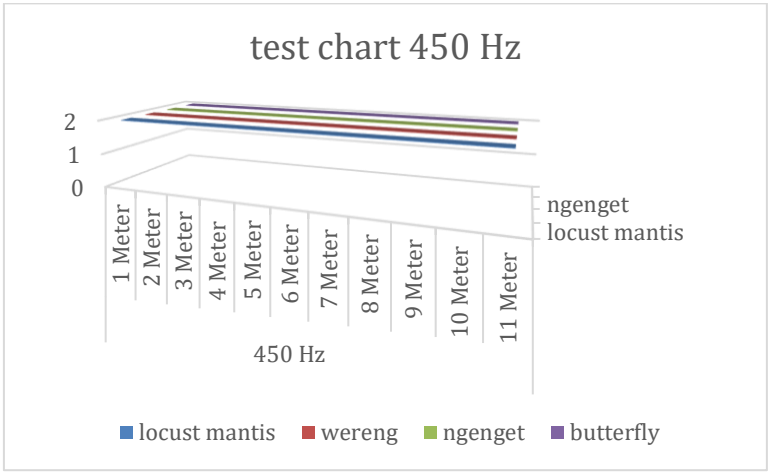


Image 3.8 test chart 450 Hz

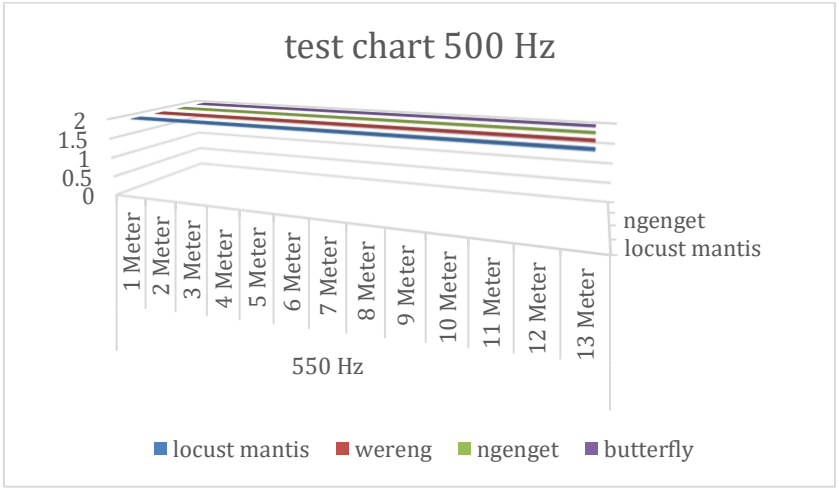


Image 3.9 test chart 500 Hz

In the 450 Hz and 500 Hz frequency experiments showed the same results, namely the four insect pests moved away and flew to a place that was not reached by sound waves.

## IV. CONCLUSION

From the results of trials that have been carried out using a frequency of 100 Hz - 500 Hz with a duration of 10 minutes each and have obtained accurate results. Thus, the use of sound waves to repel insect pests can be more effective than spraying pesticides or other methods. This is evidenced by trials conducted on 4 insect pests, namely grasshoppers, leafhoppers, butterflies. In the trial, the level of effectiveness at a frequency of 300 Hz - 500 Hz pests away from sound waves. The use of sound waves is also safer for the environment because there are no chemicals in it. This tool can also be adjusted to use the frequency, can adjust to the needs. For its use this tool has an effective frequency of 300 Hz - 500 Hz with a distance range of 1 - 9 meters.

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