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The Effect of Ornamental Plants on Reducing the Intensity of Electromagnetic Wave Radiation

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Abstract

Entering the digital era, the culture of human life is increasingly inseparable from the use of electromagnetic waves which are very useful in supporting human life, but in the other side, it also has negative impacts in the form of radiation that threatens human health. Only few people realize that ornamental plants have many benefits other than as a decoration inside or outside the room. Several types of ornamental plants have the ability to absorb electromagnetic radiation emitted by electronic equipment. In this simple physics research, measurements were made to compare the absorption of several types of ornamental plants to electromagnetic wave radiation, those are karet kebo, betel, succulent, ivy plant, and snake plant. The research results show that snake plant's ability to absorb electromagnetic wave radiation is the greatest than others. Research conducted on ivy shows that the absorption of ornamental plants to electromagnetic wave radiation is influenced by the distance of the plant to the radiation source, where the closer the distance between the ornamental plants to the source of electromagnetic wave radiation is, the greater the absorption of radiation occurs, resulting in a decrease in the intensity of electromagnetic radiation also getting bigger. The trend of changes in the absorption of electromagnetic wave radiation shows a decrease in each increase in distance according to the exponential graph.

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INTRODUCTION

Entering the digital era, people's lifestyles are increasingly inseparable from the use of equipment that utilizes electromagnetic waves, both at home, in the office, and in public places. The National Radiological Protection Board (NPRB) UK, UK revealed the effects of electromagnetic wave radiation on cell phones. The effects caused by repeated radiation irradiation include physiological effects that cause disturbances to the organs of the human body, as well as psychological effects or psychological effects, such as the emergence of a sense of stress and discomfort (Swamardika, 2009).

The beginning of 2020 became a new chapter in human life with the COVID-19 pandemic. To prevent the spread of the disease caused by the SARS Cov-2 virus, the Indonesian government urges the public not to travel to limit activities outside the home. Work and school are also done from home, known as work from home (WFH) and school from home (SFH). To reduce boredom with activities and routines that can only be done at home, many people run to new hobbies. There are several popular hobbies during the pandemic released by the University of Indonesia (UI), including cycling and gardening, especially ornamental plants. This research was conducted using a radar inventory, a tool for scanning social conversations in the digital world to observe people's activities on Twitter social media (Widiarini, 2021). Besides being useful for decorating and beautifying a room, ornamental plants also have the benefit of providing tranquility, scent the room, repel mosquitoes, increase endurance, and reduce the intensity of electromagnetic wave radiation.

Electromagnetic waves are waves that do not need a medium to propagate. Electromagnetic wave energy propagates in the form of transverse waves with several accompanying characters, such as wavelength, frequency, and speed. The spectrum of electromagnetic wave radiation is presented in Figure 1.

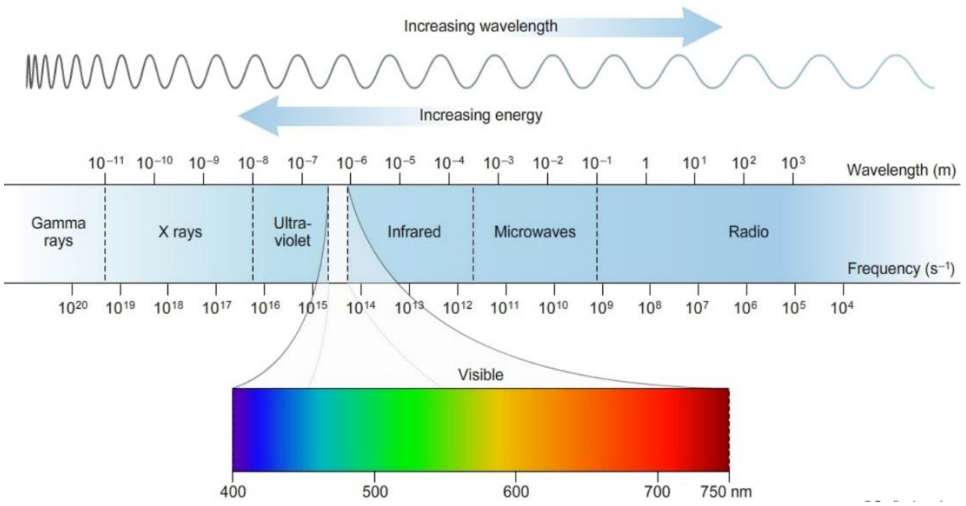


Figure 1. Electromagnetic Wave Spectrum (classnotes.org.in)

Radiation is the emission and multiplication of energy in the form of waves, rays or particles. There are 3 main types of radiation, namely non-ionizing radiation, ionizing radiation, and neutrons. Non-ionizing radiation is the release of energy from the low-energy region of the electromagnetic spectrum. Non-ionizing radiation includes visible light, radio waves, microwaves, infrared (heat), and UV rays. Visible light, radio waves, and microwaves are some examples of radiation that are often encountered in everyday life.

Sources of electromagnetic wave radiation can be found in everyday life. For example, electrical oscillations produce radio and television waves, sunlight which produces a spectrum of light from infrared, visible light to ultraviolet, infrared lamps, mercury lamps that produce ultra violet, and the shooting of electrons in a vacuum tube on metal chips that produce X-rays or commonly known as as an x-ray.

According to Thandung (2014), laptop electronic devices emit electromagnetic radiation which has the potential to cause health complaints of hypersensitivity reactions (electrical sensitivity), namely health complaints due to the influence of electromagnetic field radiation in the form of physiological disturbances. This complaint is characterized by a set of neurological symptoms and sensitivity to electromagnetic fields. Symptoms that are often found in the form of headaches, dizziness, chronic fatigue syndrome, difficulty sleeping (insomnia). Other symptoms that can be found include palpitations (tachycardia), nausea for no apparent reason, face burning (facial flushing), pain in the muscles, ringing in the ears (tinnitus), muscle

spasms, confusion, psychiatric disorders in the form of depression and difficulty in concentrating.

Sendari (2019) stated that there are several ways can be done to reduce the impact of electromagnetic wave radiation, and one simple way that can be done to minimize exposure to electromagnetic radiation is by placing plants that can absorb or eliminate these electromagnetic waves indoors. As Sendari stated that some plants are known to have the ability to minimize exposure to electromagnetic radiation as shown in the Table 1.

Table 1. The Benefits of some Ornamental Plants (Sendari, 2019)

Plant	Description
Cactus	Cactus plant is effective in absorbing radioactive waves. It can be used to absorb radiation generated by computers and cell phones. This plant is easy to care for, does not require much water, and can grow well in a warm place with lots of light
Snake plant	Snake plant or snake plant is very effective in absorbing electromagnetic wave radiation. Snake plant plants can be placed near computers or other sources of radiation to keep the room healthy
Succulent	Succulent plants have a strong ability to purify the air. Succulents are also believed to be effective at absorbing EMF radiation. The small size of the succulent makes it practical to be placed on a table right next to a computer or other radiation source as a multifunctional decoration. In their care, succulents require little light and water
Betel	This betel leaf plant that has a beautiful but simple accent has a strong ability to absorb electromagnetic wave radiation. This is because betel leaf has hydroxyl and superoxide scavenging properties, which can be used to remove radioactive components in the air
Aloe Vera	Aloe vera has long been used for medicine. This plant also has the ability to absorb high levels of radiation. To take advantage of this, this plant can be placed near the source of electromagnetic wave radiation
Asparagus Fern	The Asparagus fern is able to protect against non-ionizing radiation with its dense root layer and smooth leaves. This plant always packs water in its roots. Water molecules produce hydrogen bonds that can be broken by electromagnetic radiation which dissipates as heat
Ivy Plant	Ivy plants are able to pump water through their stems and store it in their waxy leaves. This helps the ivy to protect itself from electromagnetic radiation
Lily Paris	Paris lilies are one of the best houseplants for reducing indoor air pollution. Paris lilies ward off electromagnetic radiation, especially when producing beautiful flowers
Karet Kebo	This plant can absorb harmful radiation and is the most effective plant when kept next to electronic equipment. In addition, karet kebo also helps purify the air so that it is much healthier
Sun flower	Sunflower is one of the best plants in the world to absorb radiation. In the years following the Chernobyl incident, millions of sunflowers were deliberately planted to help absorb radiation leaks

This simple research was carried out with the aim of analyzing the effect of ornamental plants on electromagnetic wave radiation and analyzing the use of ornamental plants to reduce electromagnetic wave radiation.

METHODS

This simple research was conducted by testing the ability of several types of ornamental plants to reduce electromagnetic wave radiation generated by electrical equipment commonly used in everyday life. The tools and materials needed in this simple research include laptop device as a source of electromagnetic wave radiation, an electromagnetic wave radiation detector, and ornamental plants that absorb electromagnetic wave radiation. In this study, several plants were used, including karet kebo, red betel ivory, snake plant, several types of succulents, and ivy plant.

This study was conducted to compare the difference between the radiation intensity of the electromagnetic wave radiation source, before and after placing ornamental plants around it. There are 2 variation of data which carried out in the research. The first one was variation of the plant types with the same distances to the source of electromagnetic wave radiation. This variation was carried out to find out which plants have the ability to absorb radiation intensity stronger than the others. The second one was variation the distance between a plant to the source of electromagnetic wave radiation. After knowing the ability of plants to absorb the intensity of electromagnetic wave radiation, it is necessary to do research on the distance to the source of electromagnetic waves that is most suitable for placing plants so that these plants

work optimally. Therefore, it is necessary to measure the intensity of electromagnetic wave radiation by varying the distance between the plants and the source of the electromagnetic waves. This research was conducted on one of the plants with the assumption that these properties apply to all types of plants absorbing electromagnetic wave radiation.

The first research was conducted in several types of plants with the same distance. The steps taken in this simple research are as follows:

a. Preparing the necessary tools and materials.
b. Measuring the radiation intensity of electrical equipment without any treatment (in this study a laptop device was used as a source of electromagnetic wave radiation).
c. Placing radiation-absorbing plants near the laptop device in a distance of 5 cm, then measuring the intensity of the radiation again.
d. Repeat steps b and c for three times of data collection.
e. Repeat steps b, c, and d for different plant species.

In the same way, the second research was conducted to analyze the effect of plant distance on decreasing the intensity of electromagnetic radiation. This research was conducted on ivy plant by varying the distance of the plant from the radiation source, namely 0 cm, 5 cm, 10 cm, and 15 cm. Research results are recorded in tables and presented in graphs.

RESULTS AND DISCUSSION

a. Variation of the Plant Types with the Same Distances to the Source of Electromagnetic Wave Radiation

This simple research was conducted to examine the ability of some ornamental plants to absorb electromagnetic wave radiation by comparing several types of plants that are easily found in everyday life. The results showed that the absorption rate of electromagnetic wave radiation was different for each type of plant.

Measurements of the radiation intensity around the laptop before and after the placement of the radiation-absorbing plants showed the results as shown in Table 2. Plants are placed at a distance of 5 cm from the source of electromagnetic waves. Because the value of the radiation intensity was unstable, the measurements for each plant were carried out 3 times, then the results were averaged. The difference in radiation intensity is the difference between the radiation intensity before and after placing plants around the laptop device. The percentage reduction in radiation intensity here is a comparison between the radiation intensity after and before the radiation-absorbing plants were placed. This percentage shows the ability of plants to absorb electromagnetic wave radiation, where the greater the percentage the better the ability of plants to absorb electromagnetic wave radiation.

Table 2. Percentage of Decrease in Radiation Intensity by Some Ornamental Plants

No	Plants	Radiation Intensity			Reduction of radiation intensity	
		Before	After	Difference	Percentage	Average
1	Karet Kebo	658	447	211	32%	25%
		647	560	87	13%	
2	Betel	650	460	190	29%	30%
		660	525	135	20%	
		667	425	242	36%	
3	Succulent 1	684	452	232	34%	20%
		685	480	205	30%	
		645	509	136	21%	
4	Succulent 2	667	602	65	10%	10%
		751	640	111	15%	
		729	660	69	9%	
5	Succulent 3	700	650	50	7%	27%
		741	576	165	22%	
		768	521	247	32%	
6	Ivy Plant	762	564	198	26%	28%
		787	571	216	27%	
		728	572	156	21%	
7	Snake plant	783	505	278	36%	33%
		760	472	288	38%	
		773	558	215	28%	
		793	521	272	34%	

The table 2 shows that for the same distance, that is, when plants are placed at a distance of 5 cm with an electronic device as a source of electromagnetic waves, the maximum radiation absorption capacity is shown by snake plant plant. Snake plant can absorb radiation emitted by electronic and communication devices because it has chemical elements that can counteract the radiation emission (Syamsia, 2017). Snake plant leaf extract contains saponins, flavonoids, steroids and triterpenoids which were shown to be positive (Komala, 2012). Morphologically, the leaves of snake plant or *Sansevieria Trifasciata* are composed of several layers, namely the cuticle (top and bottom), epidermis (top and bottom) and mesophyll tissue. Snake plant have mesophyll tissue consisting of parenchyma tissue with the same structure and not in the form of palisade tissue or spongy tissue (Megia et al., 2015).

Utilization of snake plant to absorb electromagnetic wave radiation can be done by placing the plant near a device that produces electromagnetic wave radiation. Basically, snake plant is a plant that is rich in benefits. Some of the other benefits of the snake plant are that it is the best natural air purifier, removes indoor and outdoor air pollution, supplies abundant oxygen, including anti-cancer plants, absorbs carbon dioxide at night, absorbs odors, acts as an antiseptic, as a natural hair tonic, helps treat hemorrhoids, help cure headaches, and help reduce the risk of diabetes (Maulana, 2021).

Considering the ability of this plant which is quite effective in absorbing electromagnetic wave radiation, as well as other benefits possessed by snake plant, it is better to optimize the use of this snake plant. Snake plant can reduce electromagnetic wave radiation caused by computers, televisions, and cell phones, so this plant is good if placed next to a computer or television. This is considering that the impact of electromagnetic waves on human health is so great. Especially in modern times like today, humans cannot avoid exposure to electromagnetic wave radiation. For example, the use of mobile phones (devices) which have been shown to have a negative impact on the human brain such as changes in the initial shape of pyramidal cells in the hippocampus in the form of a triangular shape to become irregular or other shapes and a reduction in the number of cells by more than 10% of the normal number which can cause deficits in working memory. and behavior change (Putra, 2020). Electromagnetic radiation in the form of non-ionizing will cause negative effects if the body is

exposed to a Specific Absorption Rate (SAR) > 4 watts/kg. When calling the immediate effect is a headache due to an increase in blood pressure, and for a longer time it can cause brain cancer (Prasetia, 2020). In addition, exposure to cellphone electromagnetic waves can cause an increase in the production of Reactive Oxygen Species (ROS) such as Malondialdehyde (MDA) and a decrease in antioxidant activity such as catalase, Superoxide Dismutase (SOD) and Gluthatione Peroxidase (GSH) which can cause a decrease in sperm motility in the male reproductive system. (Sudirman, 2020).

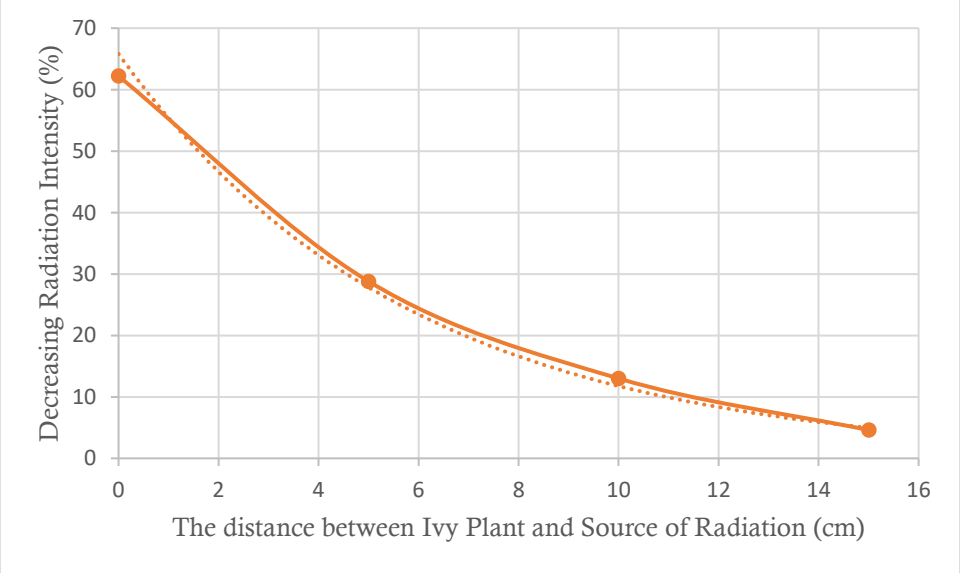
In addition to the snake plant, this research also shows that another plant that has a great ability to absorb electromagnetic wave radiation is the betel plant. The betel plant used in this research is the red ivory betel plant. Based on the shape, leaf color, taste and aroma, several types of betel are known, including worm betel, Javanese betel, ivory betel, banda betel, and clove betel (Widiyastuti et al., 2013). With its beautiful color and ability to absorb electromagnetic radiation, it is a good choice for growing this plant. Unlike the snake plant, this ivory betel plant actually grows well in humid and cold places.

The ivory betel plant (*Epipremnum Aureum*) as an ornamental plant has benefits as an anti-pollutant plant that is effective in reducing indoor air pollution (Putrianingsih & Dewi, 2017). One of them by placing the plant in the room. This poison-sucking plant will utilize the toxic gas for metabolic processes in cells. Plant parts that absorb toxins are leaves and roots (Situmorang, 2017). Betel Gading plant also has the ability as an absorbent of heavy metal lead (Pb) in the air (Sari, 2015). Aprilliani (2020) revealed that the ivory betel plant also has many other benefits, including processing toxins into fresh oxygen supply, helping to overcome respiratory problems, regulating air circulation in the room, helping neutralize the room from fishy odors, can help eliminate the smell of cigarette smoke, and calms the psychological state.

b. Variation the Distance Between a Plant to the Source of Electromagnetic Wave Radiation

The second research showed that the distance from the plant to the radiation source affects the decrease in the intensity of this radiation. Graph 1 shows the decreasing trend of radiation intensity with respect to the distance between the plant and the radiation source on the Ivy plant. The selection of ivy plants in this experiment was to represent all the plants present in the first experiment, which showed that they were effective at reducing electromagnetic radiation.

This experiment was carried out by varying the distance between the plant to the source of electromagnetic wave radiation. The first experiment was carried out at a distance of 0 cm, the second at a distance of 5 cm, the third at a distance of 10 cm, and the last experiment was carried out at a distance of 15 cm. Radiation intensity measurements at each distance were carried out 5 times. The average measurement results for each plant distance are shown in Graph 1.



Graph 1. Trend of Decreasing Radiation Intensity on Distance from Plant to Radiation Source

Mulyani (2016) stated that the position and distance of the placement of Sansevieria sp. (snake plant) effect on reducing the level of electromagnetic radiation. Graph 1 shows that the greatest decrease in radiation intensity in this research occurs for a plant distance of 0 cm from the source of electromagnetic waves. The decrease in radiation intensity decreases as the distance between plants

and the radiation source increases. This downward trend satisfies the exponential equation.

The selection of ivy plants in this second experiment was carried out with the consideration that ivy plants have a smaller size so they are easy to move compared to Snake plant even though their ability to absorb electromagnetic wave radiation is lower than that of Snake plant. Ivy is one of the best radiation absorbers and can absorb up to 90% of benzene in the air within 24 hours. The results of this research also show that ivy has a fairly good ability to reduce the intensity of electromagnetic wave radiation.

As previously explained, that selection of ivy plants to represent all plants on the first experiment. The results of the experiments show that all plants have a good ability to absorb electromagnetic wave radiation. Treatment of ivy, by changing the distance of the plant to the radiation source which affects the ability of the plant to absorb electromagnetic wave radiation. In general, it can be seen that the percentage decrease in radiation intensity decreases with the increase in the distance between the radiation-absorbing plants and the radiation source. This means that to maximize the function of these ornamental plants in the absorption of electromagnetic wave radiation is to place them as close to the radiation source as possible.

The ability of some ornamental plants in absorbing electromagnetic wave radiation show that it is necessary to place this kind of plants near the sources of electromagnetic wave radiation. For example, it can be placed near the computers or laptops, wifi, televisions, microwaves, cell phones, and other frequently used equipment.

CONCLUSION

Based on the results of this simple research, it can be concluded that several types of ornamental plants besides functioning to beautify indoor or outdoor also has function to absorb the electromagnetic wave radiation which is quite harmful to human health. Among the plants tested, snake plant is the best plant in absorbing electromagnetic wave radiation. This is shown by the measurement results of a decrease in radiation intensity with a value of 33%, the largest compared to other plants. Dampening electromagnetic waves naturally is done by placing ornamental plants near the source of electromagnetic waves. The ability to absorb electromagnetic wave radiation in ornamental plants is influenced by the distance of the plant to the radiation source. The closer the plant to the radiation source, the greater the ability to absorb electromagnetic wave radiation.

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