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# Effect of 2.4 GHz WiFi Frequency Electromagnetic Wave Radiation on Green Bean's Growth

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**Abstract:** In this research, access points are placed near the green bean's seed to identify the effect of 2.4 GHz electromagnetic waves to green bean's growth. There are 3 groups of green bean's seed, one is positioned near one access point, another is positioned near two access points, and the last is positioned near 3 access points. For the control treatment, another sample group is placed in area without WiFi access, with 30cm distance and 6 x 24 hours times elapsed. The result shows that samples with 63 mV/m electric field strength that comes from 3 WiFi access points could grow till 8.6 cm, the samples with two access points with its electric field strength 63V/m could grow until 8.8 cm, and samples with one Wi-Fi access point with electric field strength of 0.792 mV/m could grow until 9 cm. As for the controlling samples, it could grow until 9.5 cm. From the result, we can conclude that samples will grow slower when they are affected by the electromagnetic wave radiation. We assumed that the radiation of 2.4 GHz electromagnetic waves disturb the performance of the green bean's growth.

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## INTRODUCTION

Wi-Fi (Wireless Fidelity) is a technology that uses radio waves to provide network connectivity. A WiFi connection is established using wireless adapter to create hotspot - areas in the vicinity of the wireless routers that are connected to the network. This allows users or other devices to access internet services (Fajariyah and Aviana, 2014; Yuwono and Trenggamayunahla, 2016).

Once configured, Wi-Fi provides wireless connectivity to devices by emitting frequencies between 2.4GHz – 2.5GHz. The use of Wi-Fi as media access wireless networks is increasing along with the development of Wi-Fi technology as well as devices that support it. The function of the access point is to send and receive data, and to convert radio frequency (RF) signals into digital signals which is routed through a cable or WLAN devices that will be reconverted into radio frequency signals (William et al., 2006; Effendi et al., 2007; Harmeil at al., 20111).

When electromagnetic waves crashed into material, the wave would be weaker. Most of the signal energy was absorbed and converted into other energy forms while others passed propagates. When the electromagnetic waves hit a non-living object, some of the energy will be transformed into heat by the object. But if it hits living objects such as humans or plants, it may not only affect the objects' heat but also something else.

Green beans are used as our testing subject because it is one of the plants that could grow very fast and have many benefit to human lives. It is very nutritious, and is used to make porridge and stuffing for many foods We found that the more the electromagnetic waves come from more access points, the less the bean could grow (Ruengwaree et al., 2005; Yuwono et al., 2015a, Yuwono et al., 2015b).

Based on the above, this research will discuss about the effect of electromagnetic wave radiation coming from access points to green bean's seed. This research used up to three access points.

### Preparation of Test Object, the Radiation, Electromagnetic Waves Barrier and Measuring Tool

Tools and materials which are used in this research are Wi-Fi Router, Field Strength Meter, and the test objects.

Wi-Fi Router acts as the Radiation Source. We used TP-Link TL-WR841HP, TP-Link TD8817, and TP-Link TL WR741ND in this research.

Field strength meter acts as measurement tool of the electromagnetic field emitted by the access point. In this case, we used field strength meter application installed in our smartphone.

Test objects are green beans. In this research, each seed has a weight of about 0.05 mg – 0.8 mg. There are four sample groups according to the number of access points (0 – 3 access points). Each sample groups consisted 10 beans.

### Testing the Objects

The sample groups are placed 0.3 m from Wi-Fi router and are tested for 6x24 hours alternately.

After the first sample group is placed close to 0 access points, the next group will be put close to 1 access point. Following the second group is the third group which is close to 2 access points and the fourth group which is close to 3 access points.

Fig 1. Testing the Object

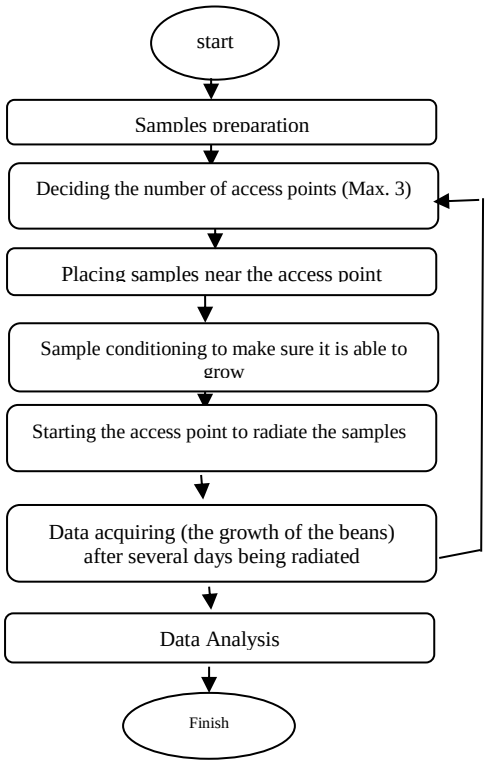


Fig 2. Research Flowchart

**Measurement of Electromagnetic Fields Emitted by Access Points**

Access Point A has -52 dBm power level. To count the field strength coming from one access point (A), the equation below is used.

$$P_{(A)} = 1W \cdot 10^{(P/10)} / 1000 = 10^{((P-30)/10)}$$
$$= 6.3 \,.\, 10^{-9}\ W$$

$$T = \frac{6.3 \,.10^{-9}}{(30 \,.\, 10^{-2})^2} = 7 \,.\, 10^{-8}\ W/m^2$$

$$E = \frac{\sqrt{30 \,.\, 6.3 \,.10^{-9}}}{0{,}3}$$

$$E = 7.93 \,.\, 10^{-4}\ \frac{V}{m} = 0.792\ mV/m$$

The second access point, Access Point B, has -14 dBm power level. To count the field strength coming from two access points (AB), the equation below is used.

$$P_{(B)} = 1W \cdot 10^{(P/10)} / 1000 = 10^{((P-30)/10)}$$
$$= 3{,}98 \,.\, 10^{-5}\ W$$

$$P_{(AB)} = \sqrt{P_A^2 + P_B^2}$$
$$= \sqrt{(7 \,.\, 10^{-8})^2 + (3.98 \,.10^{-5})^2}$$
$$= 3.98 \,.10^{-5} W$$

$$T = \frac{3.98 \,.10^{-5}}{(30 \,.\, 10^{-2})^2} = 7 \,.10^{-8}\ W/m^2$$

$$E = \frac{\sqrt{30 \,.\, 3.98 \,.10^{-5}}}{0{,}3} = 6.3 \,.10^{-2}\ \frac{V}{m}$$
$$= 63\ mV/m$$

The third access point, Access Point C has -38 dBm power level. To count the field strength coming from three access point (ABC), the equations below are used.

$$P_{(C)} = 1W \cdot 10^{(P/10)} / 1000 = 10^{((P-30)/10)}$$
$$= 1.58 \,.\, 10^{-7}\ W$$
$$P_{(ABC)} = \sqrt{P_{AB}^2 + P_C^2}$$

$$= \sqrt{(3.98 \,.\, 10^{-5})^2 + (1.58 \,.10^{-7})^2}$$
$$= 3.98 \,.10^{-5} W$$
$$T = \frac{3.98 \,.10^{-5}}{(30 \,.\, 10^{-2})^2} = 7 \,.10^{-8}\ W/m^2$$

$$E = \frac{\sqrt{30 \,.\, 3.98 \,.10^{-5}}}{0{,}3} = 6.3 \,.10^{-2}\ \frac{V}{m}$$
$$= 63\ mV/m$$

These calculations show that the field strength from two and three access points are similar. It is because the power level of the third access is too low.

**RESULTS**

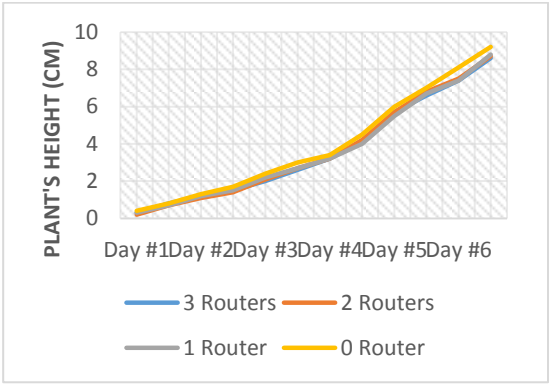


Fig 3. Plant A's Growth Measurement

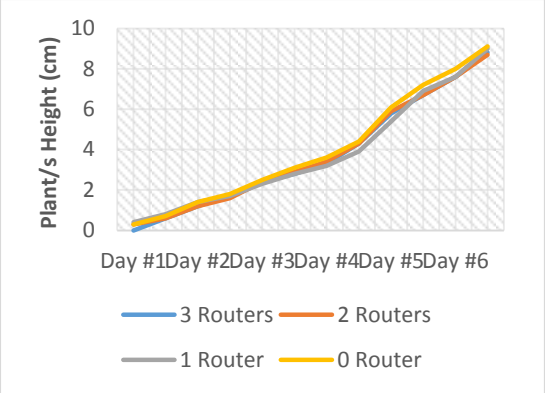


Fig 4. Plant B's Growth Measurement

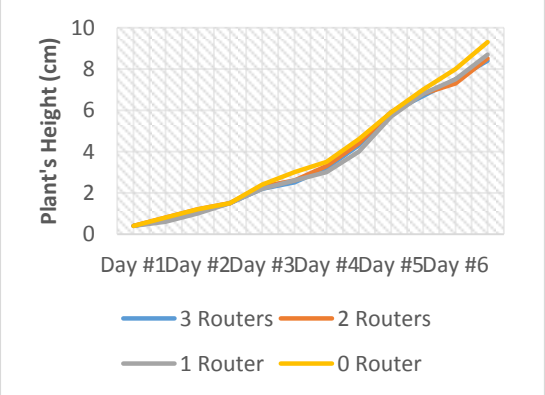


Fig 5. Plant C's Growth Measurement

These results show that from Plant A to Plant J, every plant sample that is given more Wi-Fi radiation grows slower than the other samples which are given less radiation. Plant A for example, in the same duration, the one given 3 radiation sources could grow until 8.6 cm, the one given 2 radiation sources could grow until 8.7 cm, the one given 1 radiation source was able to grow until 8.8 cm, and the one which has no radiation source close to it could grow until 9.2 cm. This growth pattern applies to Plant A to Plant J.

From all of the research results, the sample with 3 sources of radiations could grow until 8.8 cm (Plant B), the sample with 2 sources of radiation could grow until 8.8 cm (Plant H and Plant I), the sample with one source of radiation could grow until 9 cm (Plant B), and the sample without additional source of radiation could grow until 9.3 cm (Plant C).

## CONCLUSIONS

Electromagnetic wave radiation from the access point affects the growth of the green beans. The more radiation that green bean took, the slower its growth became. Result shows that samples with 63 mV/m electric field strength coming from 3 Wi-Fi access points could grow till 8.6 cm, the samples with 2 access points with electric field strength of 63V/m could grow until 8.8 cm, and samples with one Wi-Fi access point with electric field strength of 0.792 mV/m could grow until 9 cm. As for the controlling sample that grows without additional access point as the radiation source, it could grow until 9.5 cm.

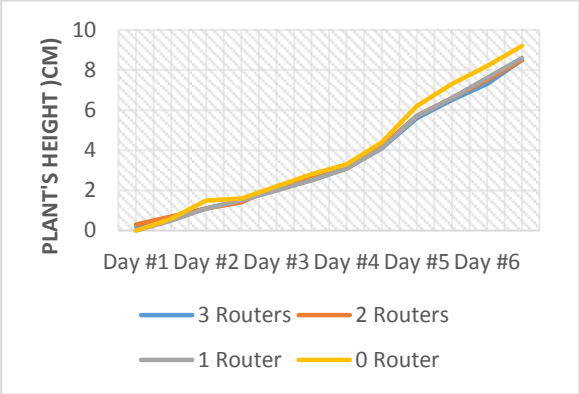


Fig 6. Plant D's Growth Measurement

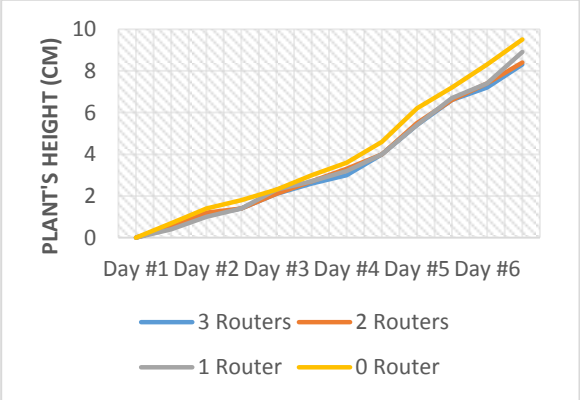


Fig 7. Plant E's Growth Measurement

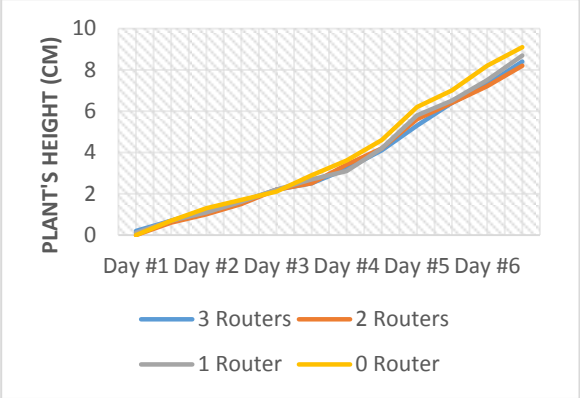


Fig 8. Plant F's Growth Measurement

From the result we can conclude that samples will grow slower when they are affected by the electromagnetic wave radiation. We assumed that the radiation of 2.4 GHz electromagnetic waves disturb the performance of the green bean to grow. There could be many ways on how electromagnetic field affects living creatures other than plants. One of them is that the energy that comes out from the access point could increase the heat of the water temperature inside the body albeit it is very low. and this research still needs to be expanded.

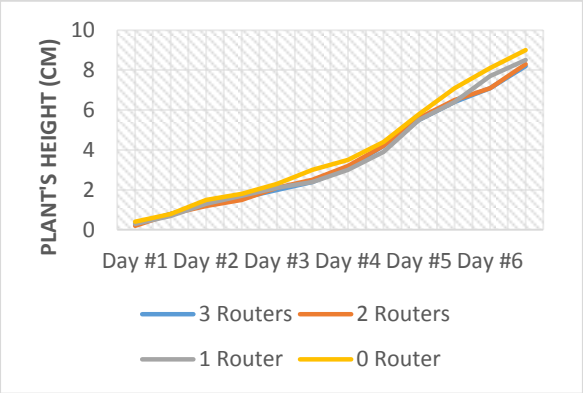


Fig 9. Plant G's Growth Measurement

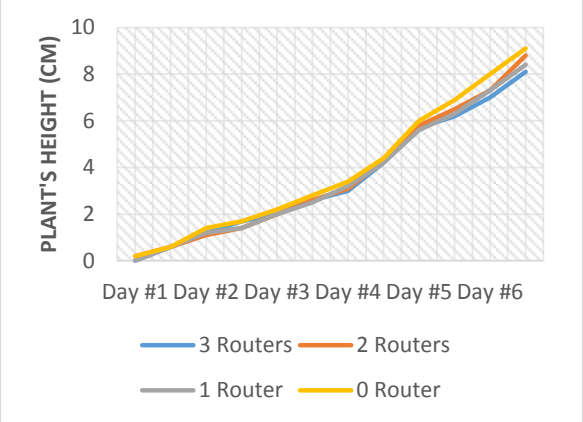


Fig 10. Plant H's Growth Measurement

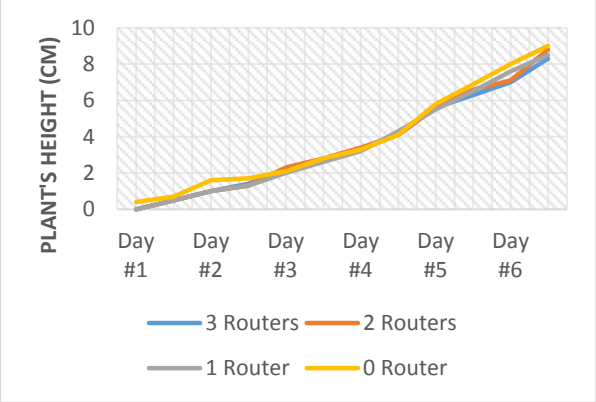


Fig 11. Plant I's Growth Measurement

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**REFERENCE**

Yuwono, R., Trenggamayunahla, I. (2016). Effect of Wi-Fi Wave Frequency 2.4 GHz to Water Content, Fat and Protein of Chicken Egg Based on Electromagnetic Waves Barrier. Journal of basic and applied Research 2(4): 508-511

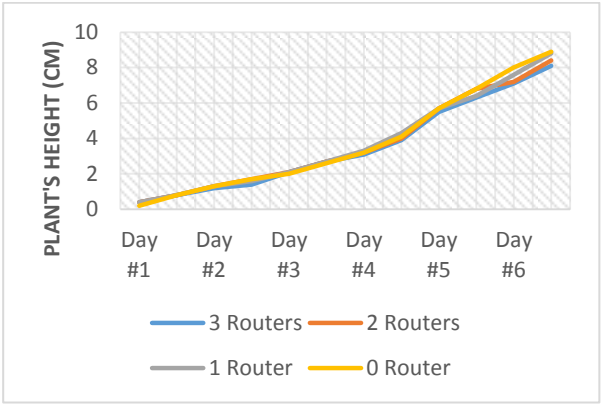


Fig 12. Plant J's Growth Measurement

Fajariyah, Aviana. (2014). Radiation Effect of Radio Waves Wi-Fi On Protein content of Chicken Egg Race. Journal Brawijaya University

Jr, William H. Hayt. dan Buck, John A. (2006). Electromagnetic. 7th edition. Translation: water content (gram)time (day)fat (gram)time (day) protein (gram time (day)

Irzam Harmeil, S.T. Jakarta: Publisher Erlangga Soeparno. (2011). Nutrition and Nutrition Meat. Gadjah Mada University Press. Yogyakarta.

Effendi, Rustam., Slamet Syamsudin, Wilson Sinambela and Sunarto. (2007). Applied electromagnetic field. Publisher: Erland Jakarta.

Yuwono, Rudy.,Syakura,R.,Yudaningtyas, E., Purnomowati, E.B. (2015). Optimized Performance Result for 2.4 GHz and 2.45GHz Circularly Polarized Microstrip Antenna. Advanced Science Letters, Vol.21, No. 10,ISSN :1936-6612,pp. 3007-3008, October.

Ruengwaree, A., Yuwono, R., Kompa, G. (2005).A Noble Rugby-ball Antenna for PulseRadiation. In: The European Conference on Wireless Technology. IEEE Conference Publications, 455 – 458.

Yuwono, Rudy., Syakura, R.,Kurniawan, D.F,(2015) Design of the Circularly Polarized Microstrip Antenna as Radio Frequency Identification Tag for 2.4 GHz of Frequency. Advanced Science Letters, 21(1), 12-14,January

Yuwono, Rudy, Mujahadin, I, Mustofa, A, Aisah.(2015) Rectifier Using UFO Microstrip Antenna as Electromagnetic Energy Harvester. Advanced Science Letters,21(11),3439-3443, November