The Study of Magnetic Field Intensity and Time Variation Affect on the Rice Growth

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Abstract: This paper presents the result of magnetic field intensity and time variation effect to the rice growth. This research focuses on the growth of rice under magnetic field intensity at 40 A/m and 20 A/m. The comparison is done under the condition of magnetic field for the period 8 hours, 16 hours and 24 hours per day and without magnetic field. Research assessment is supported qualitatively by analysis results of the experimental data based on statistic evaluation. The magnetic field effect can be the growth rate of rice, and the physical changing in height of stems and roots. The environment of the experiment such as temperature, light, and relative humidity is controlled in the same condition.

Key words: magnetic field, magnetic intensity, rice growth, mean

1. Introduction

One of the source of the magnetic field and the electric field is the transmission line. Main areas in Thailand are agriculture land and having the transmission line pass through. It may be affected on plant and the other life [1], [2]. Therefore, the study of bio-effect of rice is introduced.

In this paper, the effect of magnetic field intensity at 40 A/m and 20 A/m is focused. The duty ratio of operating period is set up at 8 hours 16 hours and 24 hours/day for a week. The condition of the experiment is shown in table 1.

Table 1: The conditions of the experiment

Group Test	without H	with H (40 A/m)	with H (20 A/m)
group 1 (8hrs)	✓	✓	✓
group 2 (16hrs)	✓	✓	✓
group 3 (24hrs)	✓	✓	✓

2. Theory

2.1 Magnetic Field Intensity (A/m)

The magnetic field intensity can be calculated by equations (1) and (2) [3], [4].

$$dH = \frac{Id\bar{L} \times a_R}{4\pi R^2} \tag{1}$$

dH : Magnetic field intensity (A/m)
dL : The length of a wire (m)
a_R : Unit vector of radius
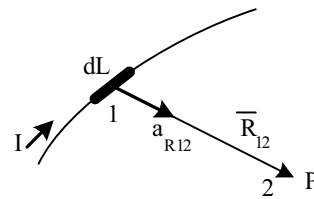R : Radius of operation

Fig. 1. Construction for finding magnetic field intensity by Bio-Savart law

From Fig. 1, magnetic field intensity can be calculated by equation (2).

$$d\bar{H}_2 = \frac{Id\bar{L} \times a_{R12}}{4\pi R_{12}^2} \tag{2}$$

$d\bar{H}_2$: Magnetic field intensity (A/m)

$d\bar{L}$: The length of a wire (m)
a_{R12} : Unit vector of radius
R_{12} : Radius of operation

Two key factors associated with magnetic field intensity are amplitude of current and the distance.

2.2 Theory of statistic

This research is supported qualitatively by analysis results of the experimental data based on statistic evaluation.

Those the statistic evaluations are Mean ($\bar{X}$) and Standard deviation (S). The statistic equations are shown in equations (3) and (4) [5].

2.2.1 Mean ($\overline{X}$);

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n} \qquad (3)$$

$\displaystyle\sum_{i=1}^{n} X_i$: summation value of the test group

n : number of the test group

2.2.2 Standard deviation (S)

$$S = \frac{\sqrt{\sum_{i=1}^{n}(x_i - \overline{x})^2}}{n} \qquad (4)$$

$x_i - \overline{x}$: the difference between value of group

test with mean of test group

n : number of the test group test with mean of test group

n : number of the test group

Two key data for the assessment are the mean and the standard deviation (S.D.) where the low S.D. is preferred.

3 Experimental

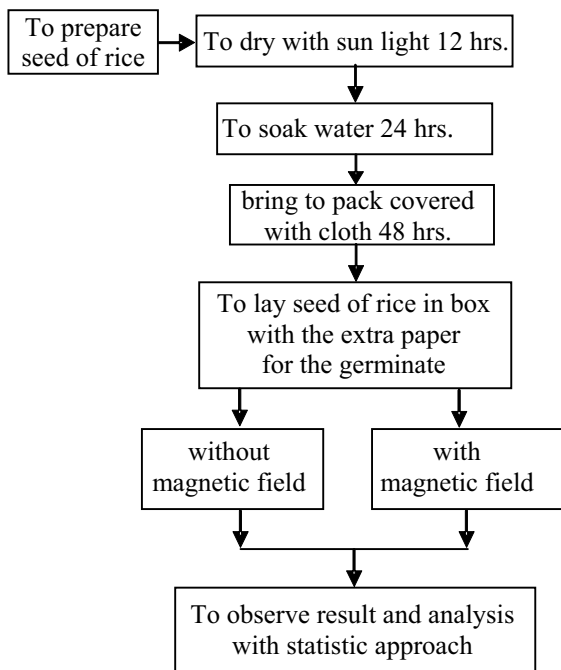**3.1 Experimental Procedure**

Fig. 2. Diagram of the experimental

Fig. 2. shows the diagram of the experiment. The main stage is to prepare the rice seed for testing. The treatment under magnetic field is set with the variation of magnetic field intensity (20A/m and 40 A/m) and the variation of treatment time per day (8 hours, 16 hours and 24 hours per day). Then, the final stage is to compare and analyze the growth rate of stem and root with in 7 day.

3.2 Experimental Setup

In this study effect of magnetic field is done under the continuous magnetic filed with the magnetic field source (AC source, frequency 50 Hz) and a diameter of loop current is 1 m. The magnetic field source and loop current were designed by
- AC source 220V 50Hz
- Transformer 220/10-40Vac
- Variac 0-300 Vac
- the copper wire No. 20 (A.W.G) and area is 0.5174 mm^2, I_{ac} is 8 A.
- the plastic tube for modify loop current, there is a diameter 1 m.

Suphunburi 1, Thai rice, is used in this experiment. Seed of rice is planted in a square plastic box with the special paper for the germinate, the number of seed is laid 10 rows x 10 columns per the group of the test. The experiment is compared with the rice growth under continuous magnetic field and nonmagnetic filed.

The experiment is done for magnetic filed intensity at 40 A/m and 20 A/m. The duty ratios of period is set up at 8 hours, 16 hours and 24 hours per day respectively for a week. Then, growing rice is observed and recorded the physical changing in height of stems and length of roots at the 7th day.

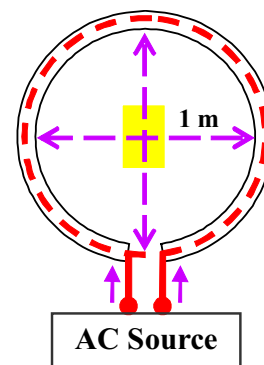The experimental setup are shown in Fig. 3-5

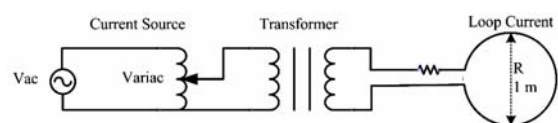

Fig. 3. Layout of loop current

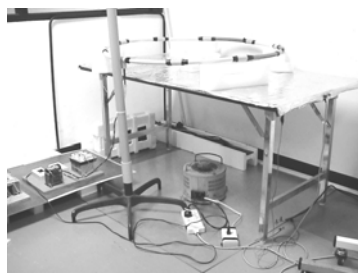Fig. 4. The circuit equivalent of continuous magnetic field

Fig. 5. The experimental setup

4. Experimental results

In this the study, effect of magnetic fields on the rice growth under test of magnetic field intensity 40 A/m and 20 A/m the comparison is done under the condition of magnetic field for the period 8 hours, 16 hours and 24 hours per day for a week then record at the 7th day. The result of experimental analysis bases on statistic evaluation by the mean value and standard deviation. The result is shown in Figs. 6-7 and tables 2-5.
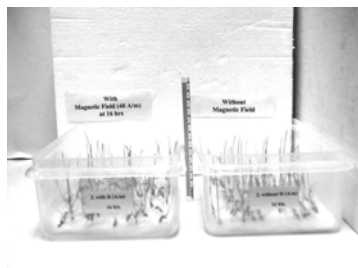

Fig. 6. Comparison of stems sample at various time applying to week shows on the 7th day

Case	With H (A/m)	Without H (A/m)
40 A/m	(a)	(b)
20 A/m	(c)	(d)

Fig. 7. Comparison of roots sample at various time applying to week shows on the 7th day

    (a) root under magnetic field intensity 40 A/m

    (b) root without magnetic field

    (c) root under magnetic field intensity 20 A/m
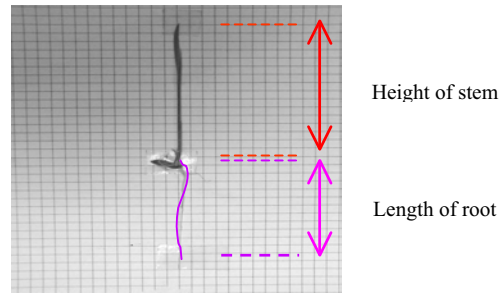
    (d) root without magnetic field

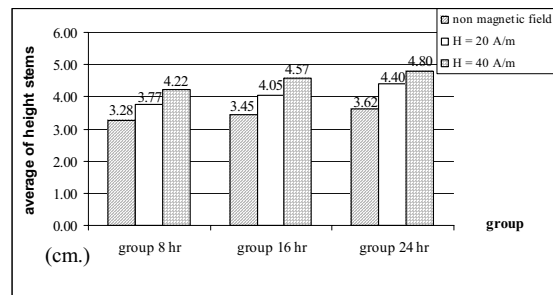Fig. 8. The region of stem and root were record

Fig. 9. Comparison of average height stems at various time applying to week shows on the 7th day
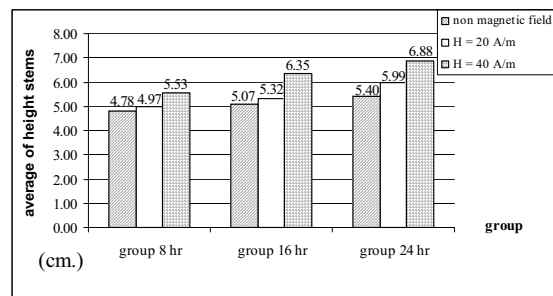

Fig. 10. Comparison of average length roots at various time applying to week shows on the 7th day
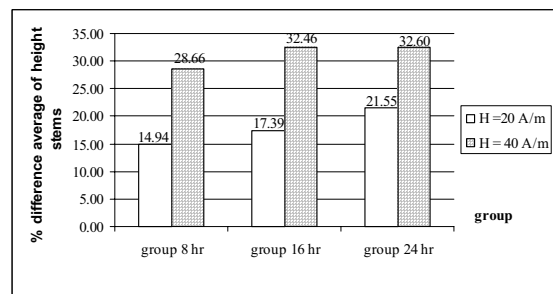

Fig. 11. Comparison of percentage difference average height stems at various time applying to week shows on the 7th day
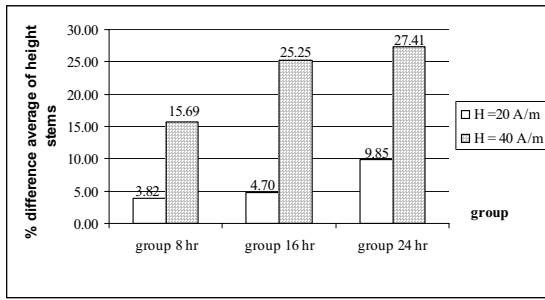
Fig. 12. Comparison of percentage difference average of length roots at various time applying to week shows on the 7th day

Percentage difference can be calculated by equation (5)

$$\% \text{ difference of average} = \left(\frac{data_{with\ H} - data_{without\ H}}{data_{without\ H}} \right) \times 100 \qquad (5)$$

Table 2 Standard deviation of stems and roots

Group	Standard deviation of stems			Standard deviation of roots		
	Without H	With H		Without H	With H	
		20 A/m	40 A/m		20 A/m	40 A/m
8 hrs.	130	1.74	1.56	1.59	1.65	1.44
16 hrs.	1.37	1.32	1.17	1.40	1.43	1.88
24 hrs.	1.68	2.83	1.24	2.19	2.56	2.84

5. Analysis

The temperature, relative humidity are controlled for all the experiment. The comparison between average of stems and average of roots and with the satisficy standard deviation.

Figs. 6 and 7 show the magnetic field effect on the sample of growing rice on the 7th day show that longer applied magnetic field period results a longer stems and roots.

Figs. 9 and 10 show the results of the average height of stems and the average length of roots. The longer applied magnetic field intensities period, the higher of the stem is performed. This is the same as the case of the length of the roots. For example; height of stem is increased from 3.26 cm. to 3.77 and 4.22 cm. for H=20 A/m and 40 A/m respectively at 8 hours per day treatment. Longer period also provide positive in increasing the height of stems as shown in fig. 9.

In general for these operating conditions longer period, high magnetic field intensity result in longer roots and higher stems.

Figs. 11 and 12 show percentage difference average of height stems and length roots. The higher magnetic field intensities and the longer applied magnetic field intensities period, the higher of the stem is performed. This is the same as the case of the length of the roots.

This is a significant advantage about (28.66-14.94 = 13.72 %), (32.46-17.39 = 15.07 %) and (32.60-21.55 = 11.05 %) between treatment without H and 40 A/m and 20 A/m for 3 difference period as compared height of stems in fig. 11.

This is a significant advantage about 11.87%, 20.55% and 17.56% between treatment without H and 40 A/m and 20 A/m for 3 difference period as compared length of roots in fig. 12.

Table. 2 show standard deviation of stems and roots. The standard deviation of all experiment are satisfied.

6. Conclusion

This paper has proposed the study effect of magnetic field on the rice growth under magnetic field intensity at 40 A/m and 20 A/m. The comparison is done under the condition of magnetic field for the period 8 hours, 16 hours and 24 hours. The applied continuous magnetic field can affect the growth rate of rice.

The results of this research can be guide line for rice treatment to increase the rice development.

References

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