Original Research Paper | Vol. 04 Issue 10 Oct - 2021 | Manuscript ID: #0504

EFFECT OF PRE-GERMINATION SEEDLING DEPTH ON GROWTH RATES OF RICE

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ABSTRACT

The current practice of farmers is using seed blower to broadcast the rice seeds on the rice field and the depth of planting pre-germination seedling has a meaningful effect on the growth of rice seed. Therefore, the objective of this study was to determine the effect of pre-germination seedling depth on the growth rate. The study was conducted in Ladang 10, Universiti Putra Malaysia. The rice variety used was MARDI Siraj 297. The rice seeds were exposed to 5 treatments of depth in the soil; T1: 0 cm, T2: 1 cm, T3: 2 cm, T4: 3 cm, T5: 4 cm with five replication arranged in Completely Randomized Design (CRD). The data of growth rate was recorded 14 days after planting. The study showed that the rice seeds exposed at 0 cm treatment were significantly different in the percentage of growth of 95.6% compared to other treatments. The seed germination was reduced as the planting depth increased and it is represented in the equation percentage of Growth = -15.36 planting depth + 91.92 (R^2 = 0.9681). Therefore, seed broadcasting using a seed blower to the soil in saturated conditions can result in the pre-germination seeds sinking and dying. Eventually, planting pre-germinated rice seeds at a depth of one (1) cm or more will reduce the number of plants per m^2 and affect grain yield.

KEYWORDS

Seedling depth, seed germination, seedling growth, food security, rice cultivation.

INTRODUCTION

Paddy is the third most important crop in Malaysia after oil palm and rubber were the first and second, respectively. Mainly paddy is growing in the 10 granary areas in Peninsular Malaysia, covering about 300,446 ha. The total paddy production in Peninsular Malaysia as of 2018 was 3,064,822 metric tonnes, and the growing area was 524,220 hectares per year (Department of Agriculture, 2018).The direct seeding method is the most popular method of cultivation among farmers in Malaysia. According to Kumar and Ladha (2011), the total rice cultivated area in Malaysia is 0.67 million ha which is more than 95% is direct seeding. Because of a minimal input demand and low price cost in adopting the direct seeding method in flooded rice (Farooq et al., 2011).

Crop stand establishment becomes a critical factor affecting subsequent growth, development and yield in rice. Crop establishment and yield are influenced by the rate, uniformity, and percentage of seedlings that emerge (Farooq et al.,2011). One of the most important parameters influencing seedling emergence, stand establishment, and crop production is sowing depth (Zuo*et al.,* 2017). The depth of pre-germination seedlings was affecting the paddy growth rates. The current practice of farmers using a seed blower in the direct seeding method affected the fall of the seeds to the ground at different levels of depths. Seedling emergence, crop stand, establishment, yield characteristic, and seed quality significantly impact planting depth (Alam et al., 2015). In rice, the establishment of the crop stand becomes a significant component impacting subsequent growth, development, and production.

The objective of this research was to determine the effect of pre-germination seedling depth on growth rate of rice. Thus, the present research could provide a reference for guiding rice cultivation management for the maximization of yield.

MATERIALS AND METHODS

Experimental site and treatments

Field experiments were carried out at the Ladang UPM 10, University Putra Malaysia. The experiment was laid out in a Complete Randomized Design (CRD) with five treatments and five replications. The treatments are seedling depth at five levels is 0cm, 1cm, 2cm, 3cm and 4cm. 50 pre-germination seeds have been used for each replication. The seeds used were MARDI Siraj 297. Pre-germination seeds are provided by soaking the rice seeds for 24 hours and then draining with cover for 24 hours.

In this study, a container with size 33cm (length) x 23cm (width) x 9cm (height) and soil in were used. The soil was filled into the container up to the container level, and the water was added until it reached saturation level. Pre-germination seeds are placed at a single point with one seed per hole on the surface level for treatment depth at 0 cm. While, for treatment depths at 1cm, 2cm, 3cm and 4cm, pre-germination seeds are planted according to respective depths. The planting distance between seeds is 3.5cm x 3.5cm.Established seedlings were pulled from the soil from the 5th day after planting (5 DAP) until the day after planting (14 DAP). The number of seedlings was counted, and the establishment percentage was calculated based on the seed sown.

Data collection

The number of pre-germination seed growth readings according to replication is taken from the 5th day after planting (5 DAP) until the day after planting (14 DAP).

Statistical Analysis

Statistical analysis of the data was performed using Analysis of Variance (ANOVA), and the significance of variation between means was tested using the Least Significant Difference (LSD) test at $P \leq 0.05$ using SAS University Edition.

Result and Discussion

The Effect of Depth of Seedling on Growth Rate in Field

The variation of seedling depths showed an effective impact on the growth as well as productivity of the rice crop. There was a significant difference ($p > 0.05$) in the growth rate as the different depth of seedling was applied in all trays in the 14 days. The LSD mean comparison also showed a significant difference in the growth rate between treatment 0 cm with other treatments. However, there was no significant difference between

treatment 1 cm, 2 cm, 3 cmand4 cm (Figure 1). Table 1 shows that the percentage growth of rice seedlings MARDI Siraj 297 variety was decreased with increasing the level of seedling depth. The highest growth rate of 95.6% at the 0 cm level of seedling depth. However, the number of growths at depths of 1cm, 2cm, 3cm and 4cm were recorded at 71.2%, 64.0%, 41.6% and 33.6%, respectively and in line with the explanation by Chauhan and Jonson (2011). Accordingly, the germination rate of seeds placed on the soil surface was 92%. With increasing seedling depth, emergence declined exponentially at 1cm, 19% emergence was detected, and at 8cm, no emergence was seen.

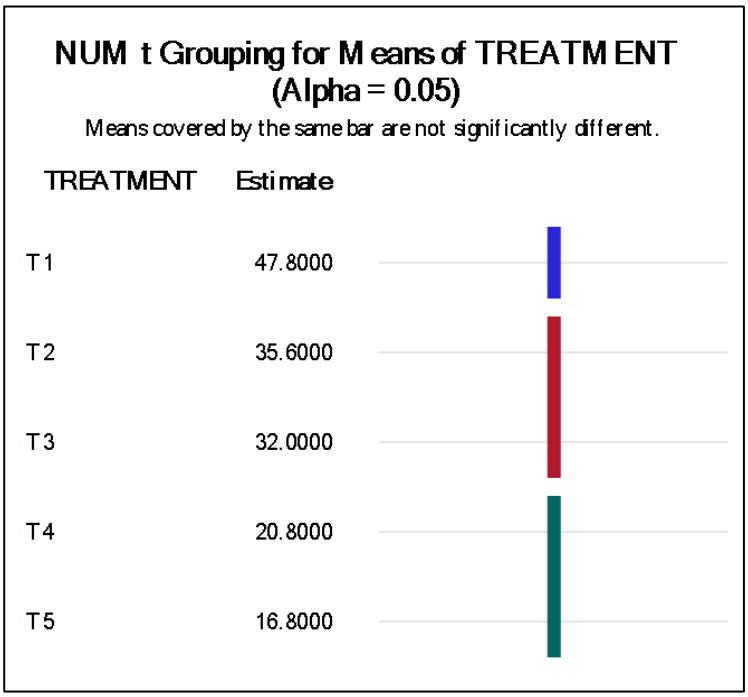

FIGURE1. LSD Means Comparison between Treatment.

TABLE 1. The Percentage of Growth by the Seedling Depth (Means with the same letter are not significantly different at $p<0.05$**.**

Seedling Depth	No. of Growth (%)
0 cm	95.6a
1 cm	71.2b
2 cm	64.0b
3 cm	41.6c
4 cm	33.6c

According to Soham et al. (2016), oxygen deficiency occurs only when the seed is buried deep in the submerged soil. If the rice seeds are embedded into the ground, this phenomenon will become more serious. As a result, pelleting treatments with calcium peroxide significantly increased seed germination and improved seedling growth, as recommended by Mei et al. (2017). They are very effective in improving seedling emergence and growth in wet soils, where calcium peroxide releases oxygen molecules when it interacts with water ($2CaO_2 + H_2O \rightarrow 2Ca(OH)_2 + O^2$). Thus, even in anaerobic soil, oxygen is made available for seedling

development. Therefore, it is best to avoid sowing rice seeds that can result in pre-germination seeds embedded in the wet soil to achieve a higher number of plants per m^2.

Correlation between The Depth of Seedling and The Growth of Plant

Trend analysis shows an inverse correlation (r = -0.9681) at the pre-germination seedling depth level, MARDI Siraj 297 variety, with the percentage of seedlings growing. This relationship shows that the more profound the pre-germination seeds are planted into the soil, the less percent of the seedlings will grow. These two factors can be shown through linear regression equations: Y = -15.36X + 91.92, where Y is the percentage of seedlings growing and X is the planting depth (Figure 2).As a result, using a seed blower on higher clay content and saturated soil condition will affect the pre-germination seed embedded and dead as direct seeding. When using seed blowers to direct seed, make sure the pre-germination seeds are on the soil's surface and do not sink in the ground. If this happens, farmers should dry the water from the rice field as soon as possible after planting to ensure that oxygen can reach the soil cavity and help seedling development.

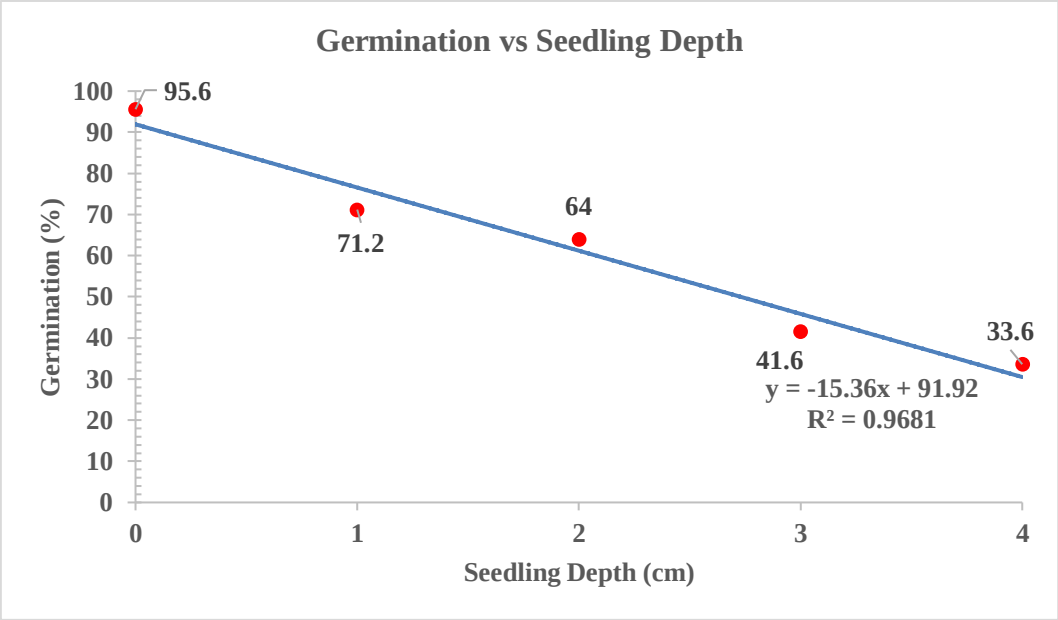

FIGURE2. Relationship between Seedling Depth with Percentage of Seedling Growing.

CONCLUSION

The depth of seedlings had a significant impact on the growth of MARDI Siraj 297 varieties. Planting pre-germination seeds as deep as one (1) cm or more profound may reduce the number of plants per m^2.

ACKNOWLEDGEMENTS

The authors would like to express sincere gratitude to all staff of the Crop Science Department, Faculty of Agriculture, University Putra Malaysia, for providing the materials and facilities needed for this study.

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