Growth and productions of crossing between brown rice accessions and submergence rice variety of Inpara 5

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Abstract. This study was aimed to determine the growth and production of brown rice accessions which were tolerant to submergence stress. The study was conducted in Greenhouse, Faculty of Agriculture, Sriwijaya University, Indralaya, Ogan Ilir. This study used Randomized Block Design and Top cross method of a breeding program. The results indicated that Inpara 5 varieties showed better results on plant height, number of tillers, panicle number, 1000 grain weight and yield potential per plant. The accession of fragrant Brown Rice has better results in panicle length and the number of grains per panicle. The accession of Early/Genjah Brown Rice has better results in flowering age and harvesting time compared to Inpara 5 varieties and fragrant brown rice. The success of breeding between Fragrant Brown Rice and Inpara 5 was higher compare to Early Brown Rice and Inpara 5.

Keyword: Brown rice accessions, Inpara 5, submergence stress

1. Introduction

The development of a farming system in the swamp area has several barriers that might influence rice production such as flooding and drought stress which can not be predicted [1]. Submergence is abiotic stress which can influence the growth and yield of paddy [2]. This condition always influences the growth of paddy, especially during vegetative growth. Usually, farmers always do agronomy adaptation by delaying planting time or transplanting for more than one. Using superior variety is one method that is easy and not expensive done by farmers [1].

Badan Litbang Pertanian has produced two superior varieties that are tolerant of submergence stress ie. Inpara 4 [Swarna-Sub1] and Inpara 5 [IR64-Sub1] [2]. Gene which is tolerant of submergence stress is in chromosome number 9 in rice and has been identified as a molecular marker of the sub-1 gene. This Gene was found in FR13A which was one of rice variety from India.

Brown rice is one of paddy variety that has a brown color and contributes some nutrition which is a benefit for human health [3][4]. Brown rice was rarely cultivated in Indonesia [5]. So to grow brown rice in the swamp area, the breeding technique to find brown rice that is capable to grow in submergence condition especially during the rainy season is a must.

The purpose of this study is to know the growth, production, and crossing between two types of brown rice with Inpara 5 which has a sub-1 gene to find the variety or accessions which are capable to live in submergence stress.

2. Materials and methods

The seedling was prepared for 20 days before transferring to the media. Plant maintenance was conducting by fertilizing and controlling the pest. Fertilization was conducted three times by using Urea, SP36, and KCl while pest control was conducted by using pesticides.
Castration and emasculation were conducted before pollination. The crossing was conducted by using a vacuum pump which was done in the morning or the afternoon. After fertilization, all flowers that have been pollinated were closed by using glissine bag. All grains were dried to get the moisture content of 13 percent. The parameters being observed included the number of tillers, plant height, flowering age, harvesting time, number of panicles, panicles length, number of grain per panicle, number of seed from crossing and percentage of success of the crossing.

3. Result and Discussion

| Variables being observed | F-value | CD [%] |
|--------------------------|---------|--------|
| Plant Height [cm]        | 6.14\textsuperscript{m} | 4.08   |
| Number of Tillers        | 24.8\textsuperscript{**} | 6.45   |
| Flowering Time           | 951.6\textsuperscript{**} | 0.75   |
| Harvesting Times         | 511.1\textsuperscript{**} | 0.75   |
| Number of Panicles       | 18.4\textsuperscript{**} | 6.75   |
| Lenght of Panicles [cm]  | 13.7\textsuperscript{*} | 2.32   |
| Number of Seed per Panicles | 12.5 \textsuperscript{*} | 13.7   |
| Weight of 1000 Seeds [g] | 4.75\textsuperscript{m} | 1.42   |

F-table 5%: 6.94
F-table 1%: 18

Note: \textsuperscript{m}: not significant different, \textsuperscript{*}: significant different, \textsuperscript{**}: highly significant different

3.1. Plant Height

![Figure 1. Characteristics of plant height](image-url)
3.2. **Number of tillers**

![Bar chart showing the number of tillers for three rice accessions: Fragrant Brown Rice, Early Brown Rice, and Inpara 5.](chart)

**Figure 2.** Number of tillers of three rice accession

3.3. **Flowering Time**

![Bar chart showing the flowering time for three rice accessions: Fragrant Brown Rice, Early Brown Rice, and Inpara 5.](chart)

**Figure 3.** Flowering time of three rice accession

3.4. **Harvesting Times**

![Bar chart showing the harvesting times for three rice accessions: Fragrant Brown Rice, Early Brown Rice, and Inpara 5.](chart)

**Figure 4.** Harvesting times of three rice accession
3.5. Number of Panicles

Figure 5. Number of panicles of three rice accession

3.6. Length of Panicles

Figure 6. Length of panicles of three rice accession

3.7. Number of Seed per Panicles

Figure 7. Number of seed per panicles of three rice accession
3.8. Weight of 1000 Seeds

![Graph showing weight of 1000 seeds for different rice accessions](image)

**Figure 8.** Weight of 1000 seeds of three rice accession

3.9. Crossing Results

| [♂] x [♀]                  | Number of Flower being Crossed | Number of Seeds | Percentage of Crossing Result [%] |
|----------------------------|--------------------------------|-----------------|----------------------------------|
| Fragrant Brown Rice X Inpara 5 | 560                            | 278             | 49.6                             |
| Early/Genjah Brown Rice X Inpara 5 | 320                           | 114             | 35.6                             |
| Total Number               | 880                            | 392             | 44.5                             |

The results indicated that the plant height of Inpara 5 was higher compared to the two types of brown rice. The different plant height is caused by the genetic factor in cultivar [6],[7]. The number of tillers of Inpara 5 was much higher compared to the two types of brown rice being observed. This was happened because of genetic factors at different varieties [8]. Time of flowering of Inpara 5 was not significantly different while fragrant brown rice has a long period of flowering time. This difference was caused by a different characteristic of the plant being observed [9]. Different characters were caused by genetic factors that make different time of flowering. The harvesting time of brown rice was much longer which was >134 days while Genjah brown rice has the average age of 120 days [5]. The harvesting time of Inpara 5 was 125 days. This situation made the sub-optimal condition which caused the potential genetic of the plant would not be observed [10].

The number of panicles depended on the number of productive tillers. The more productive tillers which were produced, the higher the number of panicles might be produced [11]. He also stated that the number of productive panicles was indicated by the number of tillers which grew before primordia occurred. Lenght of panicles showed that brown rice has 27.5 cm, fragrant brown rice has 22.6 cm while Inpara 5 has 24.5 cm. This situation also found by Ikwani dan Makarim [12] which stated that Inpara 5 has a length of panicles of 24.4 cm.

The weight of 1000 seeds was correlated to shape and grain size [8]. Fragrant brown rice and Inpara 5 have the same shape that is slim and long. Potential production of Inpara 5 was 37.7 g/plan while fragrant brown rice was 32.1 g/plan and Genjah brown rice was 14 g/plan. Low production occurred since a lot of pest attraction i.e stink bugs and planthopper. There was a different time of
flowering among accessions. Condition of the environment did not support the breeding techniques so the anthesis was not optimal which results in only about 50 percent all breeding techniques were successful.

4. Conclusion
Inpara 5 showed better growth performance compare to brown rice. Only 50 percent of the successful breeding program due to bad weather conditions.

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