Adaptation of new superior varieties of rice to seawater intruded land in Mootilango Village, Duhiadaa District, Pohuwato Regency, Gorontalo Province

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Abstract. Seawater intrusion of paddy fields is one of the limiting factors in increasing the productivity of rice fields in Duhiadaa District. This study aims to see the adaptability of several new superior varieties of rice in seawater intrusive paddy fields in Mootilango village, Duhiadaa district. The method used in this study was a randomized block design with several treatments, namely V1 = Banyuasin variety, V2 = Inpari 34, V3 = Mekonga, V4 = Inpari 30 which was repeated three times and analyzed using the SAS program (one way ANOVA), if showed significantly different results then continued with Duncan's continued test at the 5% real level. The data show that the treatment of Banyuasin and Inpari 30 varieties is able to adapt well to seawater intrusive land. This was indicated by the higher number of productive tillers and the number of filled grains, as well as the high weight of a thousand grain compared to the treatment of Inpari 34 and Mekonga varieties.

1. Introduction
The agricultural sector for Gorontalo Province is a sector that drives the economy. This can be seen from the contribution of the agriculture, forestry and fisheries sectors which contributed around 38.7 percent of gross regional domestic product or 37.7 trillion in 2018. This value has increased compared to the previous year which reached 34.5 trillion or contributed 38.01 percent. If look more deeply, it is known that the food crop sub-sector is the main contributor to the agricultural sector with a contribution of 74.5 percent or far above the contribution of other subsectors such as horticulture and plantations which contributed 9.0 and 8.8 percent [1].

Pohuwato Regency is one of the center of food crop agriculture in Gorontalo Province, this can be seen from the land use data where ± 70 percent is agricultural and plantation land [2]. Agricultural land consists of irrigated rice fields, rainfed rice fields, fields, moor and dry land. As a food center, Pohuwato district must be able to meet the food needs of the people of Gorontalo Province. Rice productivity in irrigated and rainfed lowlands is 5.3 tons/ha or slightly lower than the national average productivity of 5.7 tons/ha [3]. One of the obstacles to increase rice productivity in Pohuwato regency is the geographical location on the shoreline, making it vulnerable to seawater intrusion. Rice fields close to the shoreline are very often affected by seawater intrusion, and make it unproductive.

The rice fields in Mootilango Village, Duhiadaa District is one of the areas affected by seawater intrusion. The rice fields located not far from the ponds use tidal irrigation for the Water User Farmers Association (P3A), where when there is a high tide, seawater is intruded into the rice fields. This has an impact on low rice production in the area. Growth inhibition in these lands increases in high tide
conditions and the dry season, and is accompanied by low solubility of essential nutrients resulting in nutrient deficiency [4].

Seawater intrusion can make rice fields unproductive because it contains salt content which can make plants suffocate with saline, soil pH becomes acidic, oxygen content in water is greatly reduced so that plants cannot photosynthesize properly. The effect of salinity causes the plant's metabolic processes to be disturbed, and the results in a reduced number of assimilates produced by plants [5]. The growth and yield of rice plants can be affected by high salt levels through two mechanisms. First, osmotic pressure due to high salt content in the soil causes rice plants to experience physiological stress such as pressure caused by drought [6]. This causes the rate of photosynthesis decrease so that plant growth slowly. Decreased water absorption due to differences in osmotic pressure between roots and groundwater solutions, and inhibition of nutrient absorption [7]. Second, sodium (Na\(^+\)) in excess concentrations can be toxic to plant cells, especially in the cytoplasm, so that the physiological processes of plants in the cytoplasm can be disrupted [8].

Several studies have resulted in technological innovations to reduce the impact of salinity stress. One of them is the use of high yielding rice varieties that can withstand saline stress. The technology component that plays a significant role in increase the production and quality of agricultural commodities is the new high yielding varieties (VUB) [9]. The dominant factors causing the low productivity of food crops are: low application of cultivation technology in the field; The level of soil fertility continues to decline and the exploration of plant genetic potential is not optimal [10]. Optimization of suboptimal land with VUB rice cultivation is both a challenge and an opportunity, through adaptive technology innovation, sub-optimal land can become productive land for rice cultivation [11]. So that studies are needed to ensure the effectiveness of these superior variety seeds in a specific area. This study was carried out to determine the adaptability of the new superior varieties of rice on land that was intruded by seawater based on the variety of growth and yields achieved by each variety.

2. Research methods
The assessment was carried out in July - October 2019 in Mootilango Village, Duhiadaa District, Pohuwato Regency, Gorontalo. The research location is a paddy field adjacent to a fishpond, when the tide goes into the irrigation channel. At the study site, seawater enters the rice fields 4 times and soaks the land for ± 10 hours. The productivity of paddy fields in this location is quite low, where the average productivity is 2-3 tons/ha, below the average in Pohuwato Regency of 5.3 tons / ha.

This study used a randomized block design (RBD) with 4 treatment varieties consisting of V1 = Banyuasin variety, V2 = Mekonga, V3 = Inpari 34, V4 = Inpari 30 and repeated 3 times. The research stages consisted of land cultivation, seed treatment with Agrimeth biological fertilizer, nursery, planting with 2: 1 legowo spacing, fertilization according to the recommendations of PUTS, weeding, pest and disease control and harvesting. The observation variable are vegetative, generative, and production growth.

The analysis was carried out on the quantitative data observations of the vegetative and generative growth component variables using oneway anova. If there is a significant difference between treatments, a further test is carried out with the Duncan test at the 5% level using the SAS software.

3. Results and discussion
3.1. Plant growth
New superior varieties (VUB) of rice are selected rice genotypes so that they have advantages and the ability to adapt to certain stress conditions such as land with salinity stress. VUB that has been tested in this study shows a fairly good adaptability. The varieties are Banyuasin, Inpari 34, Inpari 30, and as a comparison variety, the varieties that are often used by farmers are Mekongga. Based on the description of these varieties, Banyuasin and Inpari 34 have resistance to salinity stress, while Inpari 30 is resistant to immersion [12].
The growth performance of rice VUB at the research location shown in table 1. The adaptability of plants to a certain environment can be seen through several indicators including plant height and number of productive tillers which are presented in table 1. The results of the analysis of variance show that there is a variation in plant height at each VUB studied. The different genetic traits of each VUB result in different plant heights. Inpari 34 has the highest plant height (116 cm) but it is not significantly different from Inpari 30 (115 cm), and it is significantly different from Mekonga (110 cm), the lowest is shown by Banyuasin variety (130 cm). The genetic factors of each VUB greatly affect plant height growth. According to [13], reflecting on genetic and environmental influences during plant development can change the stability of the characteristics of a rice variety. However, plant height has a negative correlation with the yield obtained. Vegetative growth of the tested varieties is still good and on average quite adaptive to the environment being tested. Plant height is determined by the rate of extension of stems and leaves, where the magnitude of the elongation speed is caused by the high or low water potential in the leaves or the turgidity pressure in the leaves [14]. High plant growth does not guarantee the results obtained [15]. In line with the opinion of Blum 1998 in [16] who stated that plant height has a negative correlation with yield.

Genetic and environmental factors that were tested greatly affected the number of productive tillers, where each variety had its advantages. Copy stress can be indicated by a reduction in the number of tillers. This is in line with the opinion of [17] that plants experiencing salt poisoning can be recognized by the reduced number of tillers formed. The results of the analysis of variety showed that the highest number of productive tillers was in the Banyuasin variety (26) which was not significantly different from Inpari 30 (24), significantly different from Inpari 34 (23), and the lowest was in the Mekonga variety (19). The number of productive tillers of the varieties studied showed a significant difference in the comparison varieties. This is because the varieties tested have good adaptability in rice fields intruded by seawater in Mootilango village, Duhiadaa sub-district, Pohuwato district. The number of tillers and plant height varies because each variety has different gene properties [18]. Good genetic properties and environmental conditions that are suitable for plant growth and development greatly affect the number of tillers [19]. The number of productive tillers is closely related to the results of production, the more the number of tillers produced, the higher the production results [20].

| Treatment (Variety) | Maximum Plant Height (cm) | Number of Productive Tillers (stems) |
|---------------------|---------------------------|-------------------------------------|
| Banyuasin           | 107.80b                   | 26a                                 |
| Mekongga            | 110.47ab                  | 19b                                 |
| Inpari 34           | 115.93a                   | 23ab                                |
| Inpari 30           | 114.67a                   | 24a                                 |

Note: The numbers followed by the same letter in the same row and column mean that they are not significantly different at the Duncan test level of 5%.

3.2. Plant production
The adaptability of a variety to certain environmental stresses can be seen by how much production it produces. The performance of rice production in the study area is presented in table 2. Table 2 presents the yield components (length of panicle, number of filled grains, weight of 1000 grains and yield of tonnes/ha GKP) for each VUB studied. Banyuasin variety (24.53 cm) produced a longer average panicle length compared to other varieties, but it was not significantly different from Inpari 30 (23.22 cm). The shortest panicle length was produced by Inpari 34 variety (22.26 cm) and was significantly different from Banyuasin. The longer average length of rice panicles, the more grain is produced, but it does not always give high yields because it is influenced by the percentage of filled and empty grains [21]. The variety of panicle length in the studied varieties is caused by several factors, including the ability to
Table 2. Average panicle length, number of filled grains, weight of 100 grains, and yield of lowland rice VUB GKP in paddy fields intruded by seawater.

| Treatment (Variety) | Panicle length (cm) | Number of filled grains (grains) | Weight 1000 grains (grams) | GKP yield (tonnes/ha) |
|---------------------|---------------------|----------------------------------|---------------------------|-----------------------|
| Banyuasin           | 24.53a              | 208a                             | 26.99a                    | 6.63a                 |
| Mekongga            | 22.54b              | 196a                             | 23.00b                    | 4.58a                 |
| Inpari 34           | 22.36b              | 197a                             | 23.04b                    | 5.16a                 |
| Inpari 30           | 23.22ab             | 200a                             | 24.88ab                   | 5.79a                 |

Note: The numbers followed by the same letter in the same row and column mean that they are not significantly different at the Duncan test level of 5%.

Table 2 shows the average weight of 1000 grains of grain in the varieties studied as having diversity. Banyuasin variety had the highest weight of 1000 grains (26.99 g), it is not significantly different from the Inpari 30 variety (24.88 g). The Mekongga variety has the lowest 1000 grain weight (23.00 g), which is significantly different from the Banyuasin and Inpari 30 varieties. The size or size of the grain of a variety can be measured from the weight of 1,000 grains of grain, the heavier the weight of 1,000 grains, indicating that the variety is large grain. [16]. The difference in weight of 1,000 seeds between varieties shows that there is a difference in seed filling due to differences in the supply of assimilate to the seeds by different sink and source strength conditions, the photosynthate source of plants that are stressed will be less than those that do not [24]. Osmotic stress will increase during the generative phase, salinity stress results in the accumulation of morphological and physiological changes in plants, where salinity will affect morphological changes that will cause disruption of metabolic processes in plants, resulting in low production [25]. The highest yield of harvested dry unhulled rice (GKP) was the Banyuasin variety which produced an average production (6.63 tonnes/ha) which was not significantly different from the Inpari 30 variety (5.79 tonnes/ha). The lowest was the Mekongga variety (4.48 tonnes/ha). The yield of the Banyuasin variety in this study exceeds the yield potential of these varieties (4-6 tonnes/ha). This shows that the Banyuasin and Inpari 30 varieties can adapt well to the studied environment, namely rice fields intruded by seawater. The difference in the comparison of the average yield to the yield potential shows the maximum ability of a variety to produce at the test location with certain environmental conditions [26]. This study proves that Banyuasin and Inpari 30 can be recommended as the main varieties to be developed on coastal rice fields in Mootilango village, Duhiadaa district, Pohuwato Regency.

4. Conclusion

The result of the adaptation test study showed that the new superior varieties of rice had a fairly good ability to adapt to seawater intrusive paddy fields in Mootilango village, Duhiadaa district, Pohuwato Regency. The highest yield was achieved by the Banyuasin variety (6.63 tonnes/ha). Meanwhile, the yield of other varieties ranged from (4.48 - 5.79 tonnes/ha). The new superior varieties of Banyuasin...
and Inpari 30 are well adapted to seawater intrusive rice fields and have good potential to be developed in Pohuwato Regency, especially in coastal rice fields.

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