The adaptation of new superior varieties on new rice field in Central Sulawesi

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Abstract. One way to increase productivity in new rice field is through adaptation of new superior varieties. The purpose of this study was to obtain 1-2 new locally adaptive superior varieties in a new field rice. The study was conducted in Sirom Village, Lamala District, and Banyataya Village, East Luwuk District, Banggai Regency. The experimental design used was a Random Factorial Pattern Group Design. The treatment consists of two factors; the first factor is two technological packages, namely 1) Jarwo super technology, and 2) existing technology. The second factor was four superior varieties of rice (Inpari 34, Inpari 35, Banyuasin, and Mekongga as control treatments. The adaptation observation includes growth aspects in the form of plant height and number of tillers. The results showed that there had been changes in plant growth even though still not optimal. The control varieties namely Mekongga could not grow in the two research locations while the best results were obtained from the treatment of using Inpari 34 followed by Banyuasin variety with Jarwo Super technology. Yields and generative components of plants showed a significant effect of Jajar Legowo Super technology, introduction of new superior varieties (VUB) and its interactions.

1. Introduction

The goal of the government into world food storage and food exporters in the Asia region in the end of 2025 have lots of challenges such as the occurrence of the conversion of land, the levelling off intensive land, irrigation damage, as well as the dynamics of a climate that rarely have a lesser by the time. A range of challenges has to be faced and anticipated through various programs. In order to anticipate the challenges, the government got several programs simultaneously of them provision of prasana and irrigation, agricultural tools and machinery, the extension and planting through new field development and the increase in planting index.

The expansion of new rice fields and improving plant index was one of government potential objectives to achieve into self sufficiency and as food exporter in 2025. Generally, new fields undertaken by governments are on marginal land, spreading outside of Java island including Central Sulawesi. The expansion of the rice fields through a new fields in Central Sulawesi is located in Poso, Toli-Toli, Morowali, North Morowali, Buol, Parigi Moutong, Donggala, and Banggai districts. [1] Stated that the new paddy field from 2014 to 2017 is 11.353 hectares. This is a potential buffer rice production by raising productivity and increasing planting index [2, 1, 3, : 4].

The expansion of the planting area through the printing of new paddy fields is one of the solutions to accelerate the achievement of self-sufficiency, towards the food barns and Indonesia as the world's rice exporter. Central Sulawesi is an area that has sufficient area of new paddy fields. However, new
paddy fields generally located in marginal areas that have quite a lot of obstacles which have an impact on low productivity. The low productivity of new open paddy fields originating from acid soils is caused by acid soils or pH, low nutrient content of N, P, K and Mg, high P fixation, low soil cation exchange capacity, and high solubility of several micro nutrients such as iron (Fe) and manganese (Mn), as well as aluminum (Al) in large quantities to poison plants [5, 6, 7; 8; 9, 10]. In addition to land factors, in the area of opening new paddy fields, in general infrastructure is still limited, such as: irrigation which generally cannot function optimally. Thus new open field rice fields can be a source of new growth and buffer of national rice production in order to support sustainable rice self-sufficiency by increasing productivity significantly.

New openings of paddy fields can be increased its productivity with specific technological innovations that are affordable and environmentally friendly. Several studies have found that with a good irrigation system and integrated fertilization between chemical fertilizers and organic fertilizers can increase the productivity and efficiency of rice farming. For the sustainability of new open-field wetland management with complex problems, integrated handling is needed but at low cost and friendly to the environment. Complete and integrated fertilization, new variety adaptation are an alternative solution. Integrated fertilization (utilization of straw as organic matter and chemical fertilizer) accompanied by improvement of root area through regulating irrigation systems is a way of handling new open fields which can increase production and being sustainable. Rice straw does not only function as a source of organic matter but also can function as a source of nutrients essential for the growth of rice plants such as potassium (K) and micro elements which are not found in chemical fertilizers. [11] reported that the provision of rice straw in paddy fields could replace part of K fertilizer, because 80% of the potassium absorbed by plants was in straw. Organic matter not only adds nutrients to plants but also balances nutrient availability in the soil [12]. In addition, irrigation management can increase the area that can be planted. Adaptation of superior varieties and site-specific fertilization not only increases farming efficiency, but also increases land productivity, but also improves the plant root system so that it can increase growth and yields. Thus, the adaptation of new superior varieties and site-specific fertilization will be able to increase crop production. The interaction between the use of new superior varieties and site-specific fertilization will improve the ability of nutrient-absorbing plants accompanied by nutrient availability in the root area both through fertilizer and through the surface of the soil. [12] Argues that to reduce the micro nutrient stress, especially iron in rice plantations, is to regulate the atmosphere of the rhizosphere so that it is not too reductive. [13] Argues that intermittent water supply systems have prospects in water management in wetland farming because it can increase the efficiency of water use by 20-30% and 30-50% respectively compared to the provision of stagnant water. Regulating the irrigation system can reduce the formation of greenhouse gases.

To overcome macro and micro nutrient deficiencies in new open fields, it is necessary to provide integrated nutrients between organic fertilizers and inorganic fertilizers and rice straw and micro nutrients [14]. The potential source of organic material (organic fertilizer) in new open fields is rice straw. [15] Suggested that returning straw into new open fields means to fertilize and return potassium into the soil, because 80% of the K content in rice plants is in straw. Thus integrated fertilization in new open fields is expected to not only improve plant growth but also emphasize on improving land conditions and farming efficiency so that they can be sustainable. This activity consists of: 1. Identification of new open paddy fields and improvements in rice cultivation techniques which include water management, integrated fertilization (utilization of rice straw as a source of organic material and chemical fertilizer based on soil testing), use of superior varieties and improved cropping patterns and the establishment of high-yielding adaptive varieties and increased capacity of farmers. This study aims to get 1-2 new locally adaptive superior varieties in new open field rice fields.
2. Materials and Methods

2.1. Study area
The study was carried out on farmers' land in East Luwuk District and Lamala, Banggai District, Central Sulawesi. Determination of the location of the study is based on the extent of the new open paddy fields and the request of the Regional Government, where the East Luwuk and Lamala Subdistricts have the widest new paddy field area and until now the rice growth is not normal [1]. The research location is at an altitude of 70 meters above sea level, with annual average rainfall ranging from 1800 mm to 2600 mm so that it includes a wet climate. The irrigation system is classified as semi-technical irrigation. The research will be carried out for 8 months and starts from May to December 2018.

2.2. Materials and tools
The materials and equipment used in this study consist of:
1. The land used is paddy fields that have been opened for less than 3 years.
2. The rice seeds used are rice seeds consisting of 4 (four) varieties which are expected to adapt and produce well in new open paddy fields with 95% sprout power.
3. Chemical fertilizer (NPK).
4. Hand tractor soil processing equipment and planting tools adapted to field needs / conditions.
5. Bio-activators and biological fertilizers.
6. Herbicides and pesticides are adapted to field conditions.

2.3. Research Experiment Design
The experimental design used in the field study was a randomized block design (RBD) factorial pattern. The treatment consists of 2 (two) factors. The first factor consists of two technological packages, namely: the jarwo super technology package, and the existing technology. While the second factor is three combinations of new superior varieties and fertilization, namely: addition of organic fertilizer / straw compost and recommendations for chemical fertilizers based on soil tests. The use of superior varieties consisting of 3 (three) new superior varieties and 1 comparative variety / existing variety.

The level of combination of the technology package in factor I is:
p1: Jarwo super technology package
p2: Existing technology

And the second factor consists of five levels of combination treatment using superior varieties in factor II are:
v1: Inpari 34 variety
v2: Inpari 35 variety
v3: Banyuasin variety
v4: Mekongga variety (control treatment).

2.4. Implementation of Research
The research was carried out in the farmers' paddy fields where they were sampled during location identification activities. The experimental land is perfectly processed and plot plots are made. The size of the plot is 50 m x 50 m or depends on the condition of the land. Planting is done by using the Legowo 4: 1 system with a spacing of 40 cm x 20 cm x 15 cm on the Jarwo Super technology package and existing packages. Irrigation treatment based on the desired condition (intermittent). The Bio-decomposer application was carried out when the first tillage was completed with a dose adjusted to the treatment. Biofertilizers are applied to rice seeds during play and seed scattering. While the initial fertilizer is all P and K fertilizers and 1/3 dose of N fertilizer. Follow-up N fertilization is done when 28-day-after planting, plants are given 1/3 dose and when the plants enter the initiation phase are given
1/3 dose. Measurements of N, P and K fertilizers refer to the results of soil test analysis (Permentan No. 40 of 2007). Rice seeds are sown for 20 days then transferred to land that has been completely processed.

To find out the treatment effect of this study, periodic observations were made on several things that could support field research consisting of soil properties and characteristics and nutrient content of organic fertilizers. Observations made on field research consist of: a. Physical and chemical properties of the initial soil of the study and after the study. b. Plant growth consisting of (plant height and maximum tillers) were observed randomly at plant age 55 days after planting.

2.5. Data analysis
The physical and chemical properties of the soil were analyzed before and after the study in the laboratory. Analysis of observational data obtained both in the field and in the laboratory was carried out using analysis of variance (ANOVA) and continued with Duncan's Multiple Range Test at a real level of 5% if there was a difference in response [16].

3. Results and Discussion

3.1. Plant Growth
The results of observations on plant growth indicate that the adoption of technological innovations for adaptation of new superior varieties, namely (Inpari 35, Inpari 34, and Banyuasin) produces good plant growth, while existing varieties (Mekongga) could not grow in the two research locations shown in Figure 1. This is thought to be due to high soil salinity. The jarwo super technology management approach shows better growth compared to existing technology. The results of statistical tests show significant differences between varieties on growth components. Components of plant growth (number of tillers and plant height) showed the same pattern, namely Inpari 35 and Inpari 34 varieties had better growth than Banyuasin and Mekongga varieties shown in Table 1 and Table 2. Statistical tests on plant height observations and number of tillers showed that interaction occurs between treatments. The best results were shown in the use of the Inpari 35 variety, although it was not different compared to the use of the Inpari 34 variety (Table 2).

![Figure 1. The growth of Mekongga variety in the two research location.](image)

The results of statistical tests show that interactions occur and show significant differences between the application of technology and the varieties used especially the use of Inpari 34 and Banyuasin varieties. These results indicate that the influence of the varieties is quite significant and the same pattern in the two locations of Inpari 35 and Inpari 34 varieties improves growth compared to the Banyuasin and Mekongga varieties which shown in Table 1.
**Table 1.** The Effect of Combination Jarwo Super Treatment and Varieties towards the Plant High.

| Treatment                  | Bantaya Village Luwuk Timur sub district | Desa Sirom Kecamatan Lamala |
|---------------------------|-----------------------------------------|-----------------------------|
|                           | Inpari 35 | Inpari 34 | Banyuasin | Jarwo Super Technology | 102 b | 115 a | 99 b | 97 b | 105 a | 98 b |
|                           | A         | A         | A         | Existing Technology | 90 b  | 112 a | 89 b | 89 b | 112 a | 97 a |
|                           | B         | A         | B         | CV (%)           | 16,57 | 12,13 |
|                           |           |           |           |                  |       |       |
| Statistical tests on observations of plant height and number of tillers showed that there was an interaction between treatments. The plant height components and showed the best results in the use of innovative jarwo super and varieties technology, especially Inpari 34 and Inpari 35 varieties, although not different if between the two varieties which shown in Table 2. The three varieties introduced and combined with Jarwo Super technology in two locations, that inpari 35 varieties show good growth compared to Banyuasin varieties. These results show that each variety gives a different response to the conditions of new open fields in Banggai District.

**Table 2.** The Effect of Combination Jarwo Super Treatment and Varieties towards Productive Plant

| Treatment                  | Bantaya Village Luwuk Timur Sub district | Sirom Village Lamala Subdistrict |
|---------------------------|-----------------------------------------|---------------------------------|
|                           | Inpari 35 | Inpari 34 | Banyuasin | Jarwo Super Technology | 14 a  | 15 a  | 11 a  | 10 a  | 13 a  | 9 a  |
|                           | A         | A         | A         | Existing Technology | 9 a   | 10 a  | 9 a   | 9 a   | 9 a   | 9 a  |
|                           | B         | A         | A         | CV (%)           | 16,57 | 10,12 |
|                           |           |           |           |                  |       |       |
| Note: The value of which followed by the same letters not markedly dissimilar based on Duncan Multiple Range Test at 5 percent significance level.

The results of the analysis of variance on observations of yields and generative components of plants showed a significant effect of Jarwo Super technology, introduction of new superior varieties (VUB) and interactions (Table 3). It was seen that the best results on observing yields (harvested dry grain) were obtained in a combination of super jarwo technology with the use of Inpari 34 varieties, but were not different compared to the use of the Inpari 35 variety, despite a decrease in yield.
Table 3. The Effect of Combination Jarwo Super Treatment and Varieties towards Production

| Treatment                  | Bantaya Village Luwuk Timur Sub district | Sirom Village Lamala Subdistrict |
|----------------------------|------------------------------------------|----------------------------------|
|                            | Inpari 35 | Inpari 34 | Banyuasin | Inpari 35 | Inpari 34 | Banyuasin |
| Jarwo Super Technology     | 3.2 b     | 3.7 a     | 3.4 b     | 2.2 b     | 3.4 a     | 3.1 b     |
|                            | A         | A         | A         | A         | A         | A         |
| Existing Technology        | 2.9 b     | 3.2 a     | 2.2 c     | 1.9 b     | 3.1 a     | 1.9 b     |
|                            | B         | B         | B         | A         | B         | A         |
| CV (%)                     |           |           |           |           | 11.10     | 12.16     |

Note: The value of which followed by the same letters not markedly dissimilar based on Duncan Multiple Range Test at 5 percent significance level.

Observations of growth to harvest on the study of the introduction of new superior varieties and fertilization in new open paddy fields in Central Sulawesi indicate that not all rice varieties can grow and develop properly. Mekongga varieties cannot grow and develop on the condition of the land. There were differences in plant growth in the two study locations. Likewise, existing technology shows that Inpari 34 varieties are higher than Inpari 35 and Banyuasin varieties. This is thought to be caused by the relatively high salinity and micro-solubility problems, thus inhibiting plant growth. Efforts that can be made to optimize new open-land farming are: developing plants based on agro-climate conditions and applying technological innovations as a whole and location-specific accompanied by good land processing techniques and empowerment of farmers, given that a plant planted in appropriate agroecosystem conditions and varieties right, the plant will demonstrate its maximum genetic ability to grow and develop well so as to provide optimal, efficient and sustainable results (17, 18, 19).

4. Conclusions

Plant growth and production have not been optimal, and the highest yield obtained in the use of Inpari 34 and Banyuasin varieties in both two research locations. However, technically the effect of jarwo super technological innovation has been able to improve plant growth and crop yields. Further research is still needed, to better examine the components of technology that can significantly influence the growth and yield of crops accompanied by coaching farmers and farmer groups.

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