Improving Rice Productivity Through the Implementation of Jajar Legowo Super (Jarwo Super) Technology in Jambi Province

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Abstract. Jarwo super rice cultivation is the result of the development of integrated rice cultivation technology from Indonesian Agency for Agricultural Research and Development based on the legowo row planting method. The purpose of the study was to determine the adaptation of new superior varieties of rice and increase rice production by using the Inpari 30, Inpari 32 and Inpari 33 varieties through the application of jarwo super technology. The assessment activity was carried out in Rantau Panjang Village, Batang Asai District, Sarolangun Regency, Jambi Province, cooperated with the Tanjung Harapan farmer group (involving 21 farmers) with area of 10 ha. The activity was carried out from September to December 2016. The purpose of the study was to determine the growth performance and increase in production of new superior varieties Inpari 30, Inpari 32 and Inpari 33 through the application of super jarwo technology. The components of super jarwo rice cultivation technology included new superior varieties with high yield potential, straw decomposers, biological fertilizers, balanced fertilization based on the Paddy Soil Test Tool, and control of Plant Pest Organisms with vegetable and chemical pesticides based on control thresholds, as well as agricultural machinery (transplanter and combine harvester). The results of the study showed that the innovation of super legowo row (jarwo) cultivation technology with superior varieties Inpari 30, Inpari 32 and Inpari 33 was able to increase yields by an average of 3.41 t/ha (40 - 50%), with the production of each variety was Inpari 30 (5.60 - 8.58 t/ha), Inpari 33 varieties (6.50 - 8.20 t/ha), and Inpari 32 (7.25 - 7.30 t/ha). The results were higher than the average yield of the Cherang comparison variety (4.60 t/ha) which was commonly grown in the Rantau Panjang location. Dissemination of Jarwo Super technology has been carried out through technology guidance, fields meeting, and leaflets, generally farmers can receive the introduced super jarwo technology.

Keywords: Technology, Jarwo Super, New Superior Varieties, Production, Dissemination

1. Introduction

The development of food agriculture, especially lowland rice, is still focused on efforts to increase production which must be accompanied by the development of agribusiness-based farming, in order to increase farmers' income. Rice is an important food crop commodity in Jambi Province, so this commodity is a priority in supporting agricultural programs. However, the productivity of rice plants is still relatively low, with planting spread in the highlands and lowlands. The harvested area for paddy rice in Jambi Province is 69.396,06ha with a total production of 309.932,68tnes and an average...
production of 4.45tnes / ha [4]. From these data, it can be seen that the wetland rice intensification system that has been implemented has not been able to increase production and productivity.

Low rice productivity in Jambi Province is mainly due to: a) incomplete tillage, b) the use of quality seeds, where farmers usually use seeds from previous crops that are no longer pure as well as the quality/labeled seeds are difficult to obtain on time, and c) the use of fertilizers is not balanced. With the removal of fertilizer subsidies, it is increasingly difficult for farmers to buy fertilizers, because the price is high, and many farmers do not use inorganic fertilizers at all. Compared to the potential production and available land, the current production still needs to be increased considering that rice production is very important because in addition to meeting consumption in Jambi Province it can also fulfill some of the needs of neighboring Provinces. The purpose of the study was to determine the adaptation of new superior varieties of rice and increase rice production by using the Inpari 30, Inpari 32 and Inpari 33 varieties through the application of jarwo super technology.

2. Materials and Method
The assessment activity was carried out in Rantau Panjang Village, Batang Asai District, Sarolangun Regency from September to December 2016, and cooperated with the Tanjung Harapan farmer group (involving 21 farmers) with area of 10 ha. The components of super jarwo rice cultivation technology were included: Utilization of new superior varieties with high yield potential, use of straw decomposers, use of biological fertilizers, use of balanced fertilizers based on Rice Test Equipment, and control of Plant Pest Organisms with vegetable and chemical pesticides based on control thresholds, and using agricultural machinery (transplanter and harvesters combined), [7]. The detail of super jarwo components explained as follow:

1. The use of superior seeds:
The seeds used for the super jarwo system must be superior seeds. Superior seeds that have been tested include the Inpari 30 Ciherang Sub-1, Inpari 32 HDB and Inpari 33 [6].

2. Application of biodecomposers:
Before the soil is processed, first provide a biodecomposer to compost the remaining straw from the previous harvest. Biodecomposer speeds up the process of composting the straw from about two months to just 1-2 weeks.

3. Use of biological fertilizers:
Biofertilizer is a fertilizer that contains live microorganisms that function as nitrogen fixers and increase soil fertility. The activity of microorganisms in biological fertilizers helps to increase the absorption of soil nutrients by plants.

4. Integrated pest and plant disease control:
Implement pest and disease control using natural pesticides and synthetic pesticides in a balanced manner. Natural pesticides have a lower toxic effect and are safe for animals and humans. That way, microbes or insects that are useful for rice will not be eradicated.

5. Agricultural mechanization
Using agricultural machines for the harvesting process such as a combine harvester. Agricultural machinery can suppress grain loss in the harvesting process. So, cultivation becomes more efficient and productivity increases [7].

The parameters observed were: plant height, number of tillers, panicle length, number of grain per panicle, number of filled grain / panicle, number of empty grain / panicle, weight of 1000 seeds and yield.

3. Results and Discussion
3.1. Regional Characteristics
Rantau Panjang Village is one of the rice fields located in the agricultural extension work area of Batang Asai District, Sarolangun Regency, Jambi Province with an area of 2,800 ha. Based on the topography, 50 percent of the area is hilly land, the rest is flat and undulating land, 600 m above sea level, while based on its type most of the land is categorized as red and yellow podsolic soil, soil pH is between 5.5-
6.5, moderate N, P and K status. The use of land as paddy fields is only 75 ha, plantations are 150 ha and the largest is community forest, covering an area of 976 ha. Flat topography of 700 ha and average rainfall of 2600 mm / year. The land in Rantau Panjang Village is characterized by a Red-Yellow Podsolic. Soil conditions require improvement to optimize rice growth and yield. The addition of organic matter in the form of manure / compost can add nutrients, improve soil physical properties and can bind excess micro-nutrients [5,1]. Furthermore, [9], the nutrients most needed by plants are nitrogen and potassium. According to [3], that the land for rice cultivation is classified as land suitability class with the S1 category, which is very suitable for lowland rice and the S3 category, which is marginal, has a limiting factor for oxygen availability so that good drainage is needed to obtain optimal productivity and additional input in the form of fertilizer organic and inorganic fertilizers. Based on the results of soil analysis, several soil properties and optimal soil characteristics to support the growth of rice plants are: 1) pH between 5.5-6.5, 2) clay texture, well drained 3) 1: 1 type of clay minerals and nutrient-rich parent materials, 4) moderate organic matter content, 5) adequate availability of nutrients and micro-nutrients [8].

3.2. Rice Plant Growth

The application of super jarwo technology innovation in irrigated rice fields significantly increased plant growth, especially the number of productive tillers compared to existing technology / farmers (Table 1) with three new superior varieties as Inpari 30, Inpari 32 and Inpari 33 By applying technology super jarwo, especially in the nursery phase, giving Agrimeth (biological fertilizer containing bacteria and multistrain fungi can improve the quality of rice seed growth). The application of the M-Dec decomposer improved the process of decomposing the remaining rice straw from the previous planting season so that the rhizosphere environment was improved by adding nutrients through fertilization became more effectively absorbed by the soil and the availability of nutrients in particular. N, P and K.

Table 1. The average plant height and number of new superior varieties of rice productive tillers in the implementation of Jarwo super technology in Rantau Panjang Village, Batang Asai District, Sarolangun Regency, Jambi Province.

| No. | Varietas      | Plant height (cm) | Number of productive tillers / clumps |
|-----|---------------|-------------------|---------------------------------------|
| 1.  | Inpari 30     | 91,60             | 19,60                                 |
| 2.  | Inpari 32     | 95,80             | 18,80                                 |
| 3.  | Inpari 33     | 104,147           | 16,80                                 |
| 4.  | Ciherang (non jarwo super) | 84,07             | 12,27                                 |

From Table 1, it can be seen that there were variations in plant height between Inpari 30, Inpari 32 and Inpari 33, as well as the varieties used by farmers (Ciherang). The highest plants were found in Inpari 33 (104.147 cm) and the lowest were in Ciherang (84.07 cm). Plant height was a standard feature (descent). The difference in the height of a line / variety was caused by the influence of environmental conditions. If the growing conditions are good, the height of lowland rice plants is usually 80-120 cm. From the plant height data, it can be seen that the rice varieties tested with plant height between 84.07 cm - 104,147 cm were medium plant height for lowland rice and adaptive enough to be developed because the plant height was included in the medium plant height category for lowland rice (<110 cm). The criteria for selecting rice plants include the height of the rice plant, where the short plant height is related to the length and shortness of the panicles and the resistance of the plant to lying down. Plants will be lower at locations that are higher than sea level [10].

The formation of productive tillers greatly determines the number of panicles from rice plants. It is the more productive the tillers, the greater the number of panicles. There is a correlation between the number of panicles and the yield, because the more panicles will be the higher the rice yield. Productive tillers per clump or the area of the union are the determinants of the number of panicles, so that productive tillers are one of the yield components that have a direct effect on grain yield levels [10].
From Table 1 it can be seen that there was a variation in the number of tillers among varieties Inpari 30, Inpari 32 and Inpari 33, as well as the varieties used by farmers (Ciherang). The highest number of tiller was found in Inpari 30 (19.6), followed by Inpari 32 (18.8), Inpari 33 (16.8), and the lowest was in Ciherang. From these data, it can be seen that the use of the new superior varieties Inpari 30, Inpari 32 and Inpari 33 has increased the number of tillers compared to the use of the Ciherang.

The response of new high yielding varieties of rice through the application of jarwosuper technology increased yield components (number of filled grains and weight of 1000 seeds) over existing technology/farmers. Table 2 shows an increase in yield components (length of panicle, number of grains per panicle, number of filled grains, number of empty grain and weight of 1000 seeds) from Inpari 30, Inpari 32 and Inpari. A total of 33 varieties was above the existing technology/farmer, the highest was in the Inpari 30. The highest number of milled grains was found in the Inpari 30 (114.07 grains), the lowest was the Ciherang variety (37.67 grains). For the number of empty grain the highest was found in Ciherang variety (32 items) and the lowest was Inpari 30 (26.23 items) (Table 2).

This empty grain indicates the plant’s inability to fill the grain of the plant, vacuum conditions cause crop yields are not high, this could be due to genetic or environmental factors. Empty unhulled rice will affect rice yields, the higher the percentage of empty grain, the greater the effect on rice yields, where the higher the empty seeds, the lower the rice production. The number of filled grains per panicle has a significant correlation with the yield, so the number of filled grains per panicle is one of the criteria for selecting high yield criteria. The number of filled grains has a significant relationship with yield but is strongly influenced by empty grain. Likewise, the weight of filled grain is one of the determinants of yield weight [10].

From Table 2, it can be seen that there were variations in the weight of 1000 seeds (26.7 - 29.5 gr), the highest weight of 1000 seeds was found in Inpari 32 variety (29.5 gr) and the lowest was in Ciherang variety (26.7 gr). 1000 grain weight indirectly describes the size or grain size of a line or rice variety. The line/variety with a large grain weight of 1000 will be high, and vice versa. Grain size is influenced by genetic characteristics and the ability to adapt to the growing environment. In the highlands, the dry season with low temperatures greatly affects the weight of 1000 grains of grain. The difference in the weight of 1000 grains of grain is a plant characteristic where the ability of a variety / line to produce a lot of grain is often at odds with the ability to produce large and heavy grain, but high production can also be achieved with a large number of grains even though the size is not so large [10].

**Table 2.** The average yield component a new superior varieties of rice in the application of the super Jarwo technology in RantauPanjang Village, BatangAsai District, Sarolangun Regency, Jambi Province.

| No | Varietas       | Long of Panicle (cm) | Number of grain / panicle (grain) | Number of filled grain / panicles (grain) | Number of empty grain / panicle (grain) | Weight of 1000 seeds (g) | Yield (t / ha HDG*) |
|----|----------------|----------------------|-----------------------------------|------------------------------------------|----------------------------------------|-------------------------|---------------------|
| 1. | Inpari 30      | 29.47                | 140.31                            | 114.07                                   | 26.23                                  | 27.71                   | 8.58                |
| 2. | Inpari 32      | 22.17                | 151                               | 103.9                                    | 47.1                                   | 29.5                    | 7.3                 |
| 3. | Inpari 33      | 23.95                | 92.3                              | 71.2                                     | 21.1                                   | 29                      | 8.2                 |
| 4. | Ciherang (non jarwo super) | 21.13 | 69.67                            | 37.67                                    | 32                                     | 26.7                    | 4.6                 |

*HDG : Harvested Dry Grain*

Rice production is determined by yield components such as the number of filled grains per panicle and the weight of 1000 grains. Correlation of real results with a weight of 1000 items and filled grains per panicle is one of the selection criteria for obtaining high results. The yield of a plant is determined by the yield components of a plant, then it is stated that the characteristics of the yield components are...
closely related to one another, the imbalance between these yield components will greatly affect the yield potential obtained.

Table 2 shows that the new superior varieties Inpari 30, Inpari 32 and Inpari 33 obtained higher yields than the Ciherang varieties (existing/farmer). The highest production was Inpari 30 (5.6 - 8.58 t / ha GKP, followed by Inpari 33 (6.5 - 8.2 tons / ha) and Inpari 32 (7.25 - 7.3 tons / ha) while the lowest was Ciherang (4.6 t / ha). From these data it can be seen that the use of new high yielding varieties Inpari 30, Inpari 32 and Inpari 33 can increase rice production by 40-50%. This was also supported by the high component of inpari rice 30, especially the number of filled grains per panicle (Table 2). The response of new superior rice varieties through the application of super jarwo technology significantly increases yields during this time/technology.

3.3. Problems and Control of Plant Pest Organisms.

There was a rat pest attack, this pest had the ability to destroy by cutting the leaves and stems of rice which resulted in the death of rice plants. The recommended control applied was the application of Linear Trap Barrier System (LTBS) Technology, and composting. LTBS was applied with the aim of trapping that had migratory properties, between rats and fields. It was hoped that the installation of a plastic fence equipped with traps can reduce the pest population. This control technique was combined with fumigation using sulfur. To do this, sulfur powder was burned together with dry grass in the fumigator device, then the fumigator was pumped into the rats hole. If smoke emerged from a hole around the main hole, then the hole was closed with mud. This was done until the sulfur smoke came back out of the hole where it was previously inserted. This condition signed that the entire room in the hole had been filled with sulfur fumes, and it was expected that the rats in it will be experience death.

To maintain rice cropping conditions in protection from pest attacks, insect pest monitoring was carried out using light traps. This monitoring method was to trap insects using a petromax lamp which was turned on in the afternoon before sunset for ± 2 hours, then a bucket of soapy water was added under the lamp. The pests were attracted to the light source, and fall into the bucket.

| Table 3. Types of pests that attack rice cultivation in super jarwo activities in Rantau Panjang Village, Batang Asai District, Sarolangun Regency, Jambi Province. |
|---|---|---|---|
| Variety | Types of pests | Attack area (%) | Area (ha) | Age (DAP) |
| Inpari 30 | Seed flies, Groundbuckles, Golden snail, Rat pests | 20-50 | 25 | 14-30, 30 – 35, 55-80 |
| Inpari 32 | Walang stinks | 30 | 1 | 14 – 30, 50, 80 |
| Inpari 33 | Seed flies, Earthbuckles, Walang stinks | 20 - 50 | 2 | 30 – 35, 55 -80 |

*DAP : Days After Planting

3.4. The response of cooperative farmers, non-cooperator farmers and stakeholders to the Super Jarwo technology.

The implementation of the super jarwo activity in Rantau Panjang Village, Batang Asai District, Sarolangun Regency received a fairly high response from farmer cooperators, non-cooperator farmers and stakeholders. This can be seen from the desire of farmers to apply super jarwo technology to rice farming, especially the use of the new superior varieties Inpari 30, Inpari 32 and Inpari 33, and on how to plant legowo 2:1, use of Agrimeth (seed treatment before sowing), use of M-Dec in When cultivating the soil, fertilize using a Rice Soil Test Tool and utilize organic matter (manure) and use Agricultural machinery (planting equipment/transporter, and harvesting equipment/combined harvester). During the implementation of the super jarwo activity, the location of the activity received guest visits consisting
of many stakeholders from all Batang Asai district and farmers around the location. The impact of the implementation of the super jarwo activity, during the field meeting, the extension workers and invitees/participants expressed their desire to develop new superior rice varieties and other super jarwo components such as the use of Agrimeth and M-dec. The problem is, these products have not yet been sold on the market so they must be ordered in advance for use. In the discussion, it was stated that the Jambi AIAT would help order Agrimeth and M-Dec to the producer.

4. Conclusion
1. Technological innovation of super legowo row (jarwo) cultivation with superior varieties Inpari 30, Inpari 32 and Inpari 33 was able to increase yields by an average of 3.41 t/ha (40 - 50%).
2. Jarwo Super technology applied to demfarm in Rantau Panjang, Batang Asai District, Sarolangun Regency, Jambi Province with average production: Inpari 30 (5.6 - 8, 58 t/ha), followed by Inpari 33 variety (6.5 - 8.2 t/ha) and Inpari 32 (7.25 - 7.3 tn / ha). These yields were higher than the average yield of comparison varieties Ciherrang (4.6 t/ha) (existing/farmer) which has been commonly planted in the Rantau Panjang location.
3. Dissemination of super jarwo technology has been carried out through socialization, technical guidance, field meetings, and leaflets. In general, farmers can receive the super jarwo technology introduced.

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