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Growth and results test of adaptive superior rice varieties through integrated components in the rainfed of Central Java

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Abstract. The study aims to find new adaptive rice varieties with superior potential that was core out in three districts in 2016 growing season. The study area was 2,000 m² each involving farmer cooperators. The assessment method used was the on farm research participant (OFCOR) approach in the demonstrations plot area. The superior varieties tested were Inpari 30, Inpari 10, Mekongga, and Ciherang variety as comparison. The parameters observed included the variability of plant growth and yields component, pest attack, and farmers response. The analytical method used was ANOVA to compare the mean of each tested variable using the Least Significance Difference (LSD) advanced test. The results show that the diversity of the new superior variety of Inpari 30 by applying the integrated components provided the highest growth performance and yield compared to the Ciherang variety, that is commonly planted by farmers, with an increase of 1.9 t/ha (36.5%) GKG and the Mekongga 1.7 t/ha (32%) GKG. The lowest yields were obtained for the Inpari to variety of 5.1 t/ha GKG and Ciherang. Mekongga and Inpari 30 had the same chance to be adapted more quickly by farmers because it provides increased yields and has the potential to be developed as site specific land.

1. Introduction

Food self-sufficiency is one of the benchmarks for national food security that the government always strives for with various programs. The long history of achieving phase one of rice self-sufficiency (Green Revolution Era) proves that increasing rice productivity cannot be separated from the role of technological innovation. Technological innovations that played a role in boosting rice production at that time were fertilization and superior varieties. To achieve rice self-sufficiency again, the opportunities for increasing rice productivity, especially in rainfed lowlands, appear to be increasingly limited, as reflected in the production slowdown [1].

Jepara Regency is one of the regions with declining production. This is due to the increase in population that requires local governments to continue to strive to increase rice production. Several factors that lead to the sloping down production are the use of fertilizers that have exceeded the limits of technical and economic efficiency [2, 3]. Excessive use of fertilizers, although sometimes increases the production, will minimize the benefits received by farmers [4].

Despite sloping down, rice production in Jepara Regency is still in surplus and has become a food supplier for Central Java. Responding to the constraints and demanding situations in terms of rice production, local governments have carried out numerous packages along with a pilot software for growing incorporated rice production (P3T), enhancing the implementation of rice intensification through the implementation of Integrated Crop Management (PTT) in irrigated rice fields. But the



program has not been able to solve the existing problems [5]. Thus, efforts need to be clear to find technology that can provide added value and increase farm efficiency [6].

Based on these various problems, the support for the innovative concept of integrated crop management technology plays a major role in supporting efforts to increase rice production and productivity. The strategy undertaken is to apply the concept of the PTT approach using new superior varieties (VUB) of rice [7].

2. Methods

The adaptive rice VUB paddy assessment through an integrated component approach (PTT) was carried out in the form of demonstration plots in three regions of Jepara Regency, namely in the village of Kontakoyot, Keling District with Ngudi Rahayu farmers group as the implementer; Karangrandu Village, Pecangaan Subdistrict, with Sido Makmur farmers group as the implementer; and Mindah Kidul Village, Batealit District, with Mandiri Rejeki farmers group as the implementer. The activity was carried out in 2016 growing season (MT-2016) with a land area of 1,500-2,000 m² each in the form of a demonstration plot and elaborated 3 farmer cooperators. The assessment method used on-farm research participation, in which farmers who are members of them actively participate in the implementation of activity stages. The application of the innovative technology received guidance from researchers assisted by field extension workers from local districts. The OFCOR (On-Farm Client-Oriented Research) approach method tested several location-specific superior rice varieties, namely Inpari-10, Inpari-30, Mekongga varieties, and Ciherang variety as a comparison. The innovation introduced refers to the concept of an integrated crop management approach (PTT).

The variables observed in the growth phase were plant height, several tillers in the active tiller phase ($\pm$ 21 days after sowing (DAS) and 45 DAS), primordia time, harvest time, and the intensity of the main rice pest attack in each demonstration plot location. Data collection was carried out on 10 clumps of plant samples in each treatment replicate plot. The yield component data was taken from each replicate plot at 3 random points with a diameter of 2.7 x lengths between plants (alleys) with a 2:1 legowo row planting system (20 x 10 x 40 cm). The grain is converted into milled dry weight (water content 14%). Observation of pests and diseases of rice plants is carried out once a week. Agronomic performance/ growth data, yield components, and grain yield (productivity) were analyzed descriptively by comparing the average yield of each variety. The data obtained were analyzed for the variance. The least significant difference test (LSD) was conducted at the level of 0.1 to determine the differences between varieties. Farmers' responses and perceptions of the technology component of PTT for the adaptive superior rice varieties were carried out on 30 farmers using a Likert scale [8].

3. Results

Table 1 shows that the adaptive superior variety test by applying the concept of integrated crop management affected the growth and yield variability of Inpari 30, Inpari 10, and Mekongga varieties carried out in three locations. The growth and yield performance were different when compared to the Ciherang which is usually planted by farmers. Inpari-30 variety gave the highest yield, namely 7.1 t / ha with an increase of 1.9 t / ha (36.5%) of milled dry grain (GKG). The use of adaptive superior varieties of lowland rice with the implementation of integrated crop management (PTT) can increase grain yield and rice quality. The production of each variety was Mekongga 6.9 t / ha (32%) GKG and Inpari-10 of 6.1 t/ha (17.3%) GKG. Meanwhile, other high yielding varieties did not show any significant difference or were lower, namely, Inpari-10 produced 5.2 t/ha of GKG. The comparison variety Ciherang yielded 5.2 t/ha of GKG. Besides genetic factors, the superior characteristics of varieties are strongly influenced by the growing environment [9]. Rice farming in the rainy season (MH) is recommended to use planthopper-resistant and disease-resistant varieties, while in the dry season (MK) it is recommended to use relatively dry-tolerant varieties and less favored by borers [10]. Each rice variety shows its ability to take advantage of the environment in which it grows and develops [11]. A variety is said to be adaptive if it can grow well in its distribution area, has high productivity, is stable in production, has high economic value, is socially acceptable and sustainable [12].

Increased productivity of lowland rice through Integrated Crop Management (PTT) was able to successfully increase rice productivity by 8.85% to 47.13% with new superior varieties [13]. Although it has not been able to achieve the potential yield, several studies have shown that the results of the adaptation of superior lowland rice varieties with integrated crop management are different in each test location. Lowland rice adaptation tests with new high yielding varieties carried out in Papua in 2019 resulted in the study sites being production varieties between 4.47 t / ha to 5.9 t / ha . Each variety gives optimal results when planted on suitable land [14].

Table 1. The productivity of rice varieties in cropping season of 2016.

No	Location	Varieties	Rice variety agronomic performance				Productivity t/ha GKG
			Plant height 21 DAS (cm)	Number of tillers (21 DAS)	Plant height 45 DAS (cm)	Number of tillers (45 DAS)	
1.	Village	Inpari 30	41.5a	14.2a	83.4b	14.1b	6.7
	Karangrandu	Mekongga	38a	9.0cb	82.7b	9.7d	6.2
	District	Inpari 10	34.6b	10.7b	90.3a	10.7cb	5.1
	Pecangaan	Ciherang	36ab	9.3cb	90.2a	11.1cb	5.3
2.	Village	Inpari-30	41.2a	9c	84.8b	11.6cb	5.4
	Sambungoyot	Mekongga	36.3b	11.2ab	77.6c	12.2cb	6.1
	District Keling	Inpari 10	30.7c	10.2b	80.9bc	10c	5.2
		Ciherang	34.2b	10.4b	89.2a	12.2cb	5.6
3.	Village	Inpari 30	37.8ab	13.7a	87.6a	17.2a	7.1
	Mindahan	Mekongga	40.7a	13.6a	84.7b	14.0b	6.9
	Kidul	Inpari 10	34.6b	10.7b	90.1a	10.9c	5.1
	District Batealit	Ciherang	37.2ab	11.4ab	89.5a	12.2bc	6.1

Figures followed by same letters are not significantly different at 5% standard or are not very significantly different at 1% standard (LSD). DAS = Days After Sowing.

Based on the results of observations of the morphological performance of the superior varieties at the vegetative stage (21 DAS), the average was quite good where inpari 30 gave the highest number of plant height parameters for the growth phase of 21 days after planting, namely 41.5 cm with the number of tillers 14.2. The lowest value was the Inpari 10 variety, which was 30.7 cm with 10.2 tillers. The generative phase (45 DAS) showed that the highest mean number of tillers was Inpari-30, 17.2 with a plant height of 87.6 cm. The lowest number of tillers was the Mekongga variety with 9.7 with a plant height of 82.7 cm. The Ciherang variety has a plant height of 89.2 cm. The difference in yield is presumably due to the character of growth on the stability and genetic variability traits of each variety which adapt well to the growing environment.

Superior rice varieties characterized by short stalks do not affect yield components, they can only provide more energy for growth and reproduction [15]. This is due to environmental factors where rice varieties can grow in an optimal environment, however, these factors do not affect plant growth.

The diversity of plants in the comparison locations showed that the uniformity level was quite good, namely between 104.4 - 110.40 cm. The number of productive tillers varied between varieties, namely 10.2 to 13.7 per clump. The highest value was obtained by Inpari-30, followed by Mekongga, Ciherang, and Inpari-10 varieties. Plant characteristics affect the appearance of plants in addition to genetic factors, soil fertility levels, and other growing environments. The difference in the appearance of plant height of the five varieties is thought to be due to the genetic characteristics of the varieties and the influence of

environmental conditions. Plant height is also one of the selection criteria for rice plants, but this high growth does not guarantee the level of production [16].

Table 2. Growth performance and yield of superior rice varieties at harvest of stadia in the 2016 planting season in Jepara District.

Varieties	Benchmark morphology				
	Maximum plant height (cm)	The number of productive tillers per clumps	The number of grain pithy / 5 panicles	The number of grain hollow panicles 5	Long panicles (cm)
Inpari-10	100.4ab	10.2b	467b	268a	20.2b
Inpari-30	110.40a	13.7ab	556a	132c	26.4a
Mekongga	105.5ab	13.1a	552a	176b	23.7b
Ciherang	105.2ab	10.7b	541a	175b	23.2b

Figures followed by same letters are not significantly different at 5% standard or are not very significantly different at 1% standard (LSD).

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The number of pithy grains of the Inpari-30 variety gave the highest number, namely 556 seeds. Then followed by other varieties by providing pithy grain between 467 - 556 seeds. Inpari 30 variety had a fairly good panicle length of 26.4 cm with the lowest void percentage of 132 / panicle. Optimization of the increase in yield components is still possible if the conditions of the plants are cultivated optimally. The yield potential of a rice variety can be increased with good cultivation technology, especially on the four supporting components, namely panicle length, the number of grains per panicle, percentage of filled grains, empty grain, and weight of 1000 grains of grain[17].

The characters of superior plant varieties in producing pithy grain are very diverse, including the number of productive tillers, the number of panicles and panicle length, and the number of nutrients. The difference in the number and length of panicles has an effect on the difference in the number of grain ovaries with a tendency that the longer the grain is formed [18]. The differences that result from each variety are caused by genetic factors/and the growing environment of each variety [19].

Table 2 shows that the heavier the grain, the higher the resulting productivity, this shows that the Inpari 30 variety has the highest productivity level. This can be seen from the highest number of productive tillers and panicle length, with the highest number of pithy grains resulting in the heaviest grain and the highest productivity per hectare. Ciherang variety obtained the number of productive tillers and panicle length did not differ much from the other 2 varieties. The ciherang variety has been cultivated by farmers for a long time/ so that the development of plant growth is quite adaptive to the growing environment.

The introduction of adaptive superior varieties is expected to be able to increase production compared to varieties planted in the previous season. The introduction of new high yielding varieties supported by other technologies was able to provide 21-54% higher yields. This indicates that the yield of a variety must be supported by technology and an optimal growing environment. The use of high yielding varieties with the application of integrated plant management technology component assemblies can

provide better growth performance and yields [20]. This is so that it can be believed that adaptive alternative varieties can be introduced as superior varieties.

Table 3 shows the population development of pests and natural enemies as well as the intensity of damage due to diseases categorized as mild to moderate attack symptoms. Rice stem borer ranges from 2-5% in the form of sundep symptoms and 2-4% in the form of symptoms of outsiders. The brown planthoppers are classified as threatened with an average of 3-7 individuals per clump, while the symptoms of rice rats and golden snails (*Pomacea canaliculata*) only range from 1-2%. The intensity of damage due to kresiek/bacterial leaf blight is moderate (4-7%), while in the symptoms of *Pyricularia oryzae* disease (blast) the intensity of the damage is around 3-4%. And the WBC attack rate is still classified as a mild attack symptom, giving 4%.

Table 3. Plant and development of age population pest and enemy in rice in the natural demplot in 2015 in Jepara Regency.

Varieties	Plant age and pest development					
	Time		Types of pest and disease and natural enemy			
	Scatter plot	Planting	Pest	Disease	Predator	Volume of pest (%)
Inpari-30	18	20	Rats	Blast	Spider, verania	<5%
Inpari-10	18	21	Stem borer	Crackle	Spider, verania	5-8%
Mekongga	18	20	Snails/Rats	Crackle	Spider, verania	<5%
Ciherang	21	23	Snails/Rats	Crackle	Spider, verania	>5%

Source: Primary data, 2016.

3.1. Perceptions and responses.

The farmers' perceptions of the demonstration plot cooperators on the nature of integrated component innovation through the integrated component concept approach are positive because it is easy to apply by following under the physical environment, culture/habits, and the results of its application are easy to see the advantages. Opined that in the context of increasing rice productivity, the ability of farmers' social conditions and perceptions of innovation to be adjusted is adjusted by the application of integrated components that can provide better performance for rice plant growth [21].

Also, adaptive superior variety innovation with the application of integrated components can increase the productivity and income of farming communities. Bananiek and Abidin, 2013. The application of an integrated component of lowland rice also has a positive impact on changes in farmer income [22].

Table 4. Farmers participants perception on the demonstration plot of PTT rice VUB in Jepara Regency against the character of PTT innovation - 2015.

Character of innovation	Farmers' perception		
	(Positive)	(Neutral)	(Negative)
The use of varieties superior adaptive with the application of an integrated components benefit than before	22 (73)	6 (20)	2 (6)
Paddy superior varieties adaptive by applying components reduces the integrated than ever	20 (66)	10 (33)	0 (0)
The adaptive superior varieties by applying the integrated easy to try	25 (83)	10 (33)	0 (0)
The use of rice varieties superior adaptive with the application of an integrated components in accordance with the physical environment	26 (87)	3 (10)	1 (17)

The adaptive superior varieties in accordance with environmental / cultural habits	20 (66)	10 (33)	0 (17)
Appearance varieties superior adaptive with integrated menerapkan components easy to be seen its excellence	30 (75)	0 (0)	0 (0)
The results on average	23.8 (68.3)	6.5 (21.9)	0.6 (9.5)

Table 4 shows that the response of the demonstration plot farmer cooperators to the application of integrated component technology innovation is positive. Most farmers tend to say that the use of adaptive superior varieties with the application of integrated components is the hope of all farmers to add insight, experience, and knowledge about proper and easy crop management. The appearance or qualification of the innovation is determined by five things: complexity, suitability, relative advantage, experiment ability, observability [21]. Based on the results of the hedonic test questionnaire on the appearance of each variety, it proves that farmers still need a lot of technological innovation information in implementing agricultural activities to increase farm income.

The survey conducted with farmers indicated that the Inpari 30 and Mekongga varieties were very popular because of their rice production and taste. the Inpari-10 variety is unwelcome and neutral. This proves that apart from the yield and taste of rice, the number of productive tillers, plant height, and plant age are the determining factors in the appearance of plant veritas. The general characteristics possessed by superior varieties are high yield, resistance to pests/diseases, and tolerance to climate change and are preferred because of the quality and taste of rice [10]. These results make the reason for the importance of location-specific superior varieties by following the wishes of farmers.

4. Conclusion

- The performance of new high yielding rice varieties by applying the concept of integrated components affects growth and yield variability. Inpari-30, Mekongga adaptive superior varieties provided better growth performance and yields compared to Ciherang varieties which are commonly planted by farmers with the highest increase of 36.52%.
- Integrated crop management using the Inpari-30 high yielding variety gave the highest yield compared to the Ciherang variety which is commonly planted by farmers with an increase of 1.9 t / ha (36.5%) GKG, followed by the Mekongga 1.7 t / ha variety (32 %) GKG. The lowest yield was obtained for Inpari-10 variety of 5.1 t / ha GKG and Ciherang variety yielding 5.2 t / ha GKG
- Two high yielding varieties (Mekongga and Inpari-30) are quite adaptive and have the same opportunity to be adopted more quickly by farmers, besides high production, each VUB has a market bargaining value and provides a fairly good display of growth performance.
- Farmers responded positively to superior varieties of rice because it could provide increased yields and had good enough potential to be developed on specific land areas.

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