

The growth and production of field rice (*Oryza sativa* L.) Inpari 9 and Mentik Wangi variety on peat land and peat buried

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Abstract

Rice plant is paddy producing plant needed by most of Indonesians as staple food. Sei Geringging Village in Kampar District, Kampar Kiri Sub-District had technically irrigated field on peat land and peat buried. Farmers on Sei Geringging Village farmed 2 kinds of rice which were prime variety and local variety. Most of prime variety farmed was Inpari 9 and the local variety was Mentik Wangi. Farmers on Sei Geringging Village had been farming the rice without knowing which variety had been best to farm on peat land and on peat buried that the yield had not been optimal. This research aimed to know the comparison of maximum growth and production rate of Inpari 9 and Mentik Wangi variety rice on peat land and peat buried. This research was done by a survey with descriptive method. Treatment combination was repeatedly done 4 times resulting 16 unit trial squares. Each square had 5 sample plants. Best growth was on peat land that planted with the Inpari 9 variety and on peat buried was planted with Mentik Wangi variety resulting yield of 4,20 ton.ha⁻¹

Keywords: Paddy; variety; Inpari 9; peat; peat buried

1. Introduction

Rice plant is paddy producing plant needed by Indonesians as the source of staple food. [1] said that rice contains 49, 6 g of carbohydrates, 4, 10 g of proteins, 0,205 g of fats, 232 g of calories and 0, 74 g of fibre. Based on data from BPS-Statistics of Riau [2] in 2017, the total range of rice field in Riau Province on 2015 was 114,354 Ha. Kampar District on 2015 placed on 4th position from total 12 districts in Riau Province that had the total range of rice field of 10,284 Ha. Sei Geringging Village was one of the villages in Kampar District, Kampar Kiri Sub-District that had technically irrigated their rice fields. [3] said that irrigated rice field is important due to the adequate availability of water as the main factor for cultivating the plants.

Sei Geringging Village has peat soil and peat buried kind rice fields. According to Notohadikusumo [4], peat is the kind of soil constructed from the remains of dead plants that makes it have high level of organic content. While the peat buried is the peat soil heaped or stacked by the mineralized soil [5].

Farmers in Sei Geringging Village farmed 2 kinds of rice which are prime and local varieties. According to Hanum [6] the prime variety is important in increasing the yield, improving and quality diversification, and yield lost prevention due to pests, disease, and environmental hazard. According to Supangkat [3] the existence of local variety at this time is not significantly taken into account due to the high profile of the plant. Local variety has high adaptive measurements to the local soils. Local variety needs to be maintained and sustained as the local assets of germplasm, also as the source of genetical variety.

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The prime variety, most planted by Sei Geringging Village's farmers, was Inpari 9 and the local variety was Mentik Wangi. Farmers in Sei Geringging Village planted rice without knowing which rice variety was suitable for planting on peat soils and on peat buried soils so that the production yields had not been optimal. Not all rice varieties can adapt certain environments, because each variety has its own growing conditions. The aim of this research is to determine the comparison of the best growth and production of Inpari 9 and Mentik Wangi rice variety in peat and peat buried soils.

2. Material and methods

2.1. Research Site

The research was conducted in Sei Geringging Village, Kampar Kiri Sub-District, Kampar District, and Riau Province. Soil analysis was carried out at Central Plantation Services Laboratory, Pekanbaru.

2.2. Research Design

This research was conducted in a survey with the standard deviation method. As for the implementation techniques was carried out by observations and interviews. The research area was randomly selected stratified (*Stratified Random Sampling*) It is based on peat land types and buried peat. For farmer respondents was deliberately selected (*Purposive Sampling*) based on rice varieties grown with a minimum area 1000 m². Combination treatment, i.e.:

P1= Peat Soil + Inpari 9 Variety

P2= Peat Soil + Mentik Wangi Variety

P3= Peat buried Soil + Inpari 9 Variety

P4= Peat buried Soil + Mentik Wangi Variety

The combination of those treatments was repeated 4 times, then 16 units of test plots were obtained. Each plot has 5 sample plants so that there were 80 sample plants in total.

2.3. Statistical Analysis

The data obtained were analyzed statistically by SPSS Alication. The linear model was as follows:

$$Y = \mu + SD$$

Information:

Y = Observation value

μ = Average value

SD = Standard deviation

3. Results

Planting of paddy rice on peat and peat soil buried with Mentik Wangi varieties produced the highest plant height of 77,97 and 92,68 cm (Figure 1)

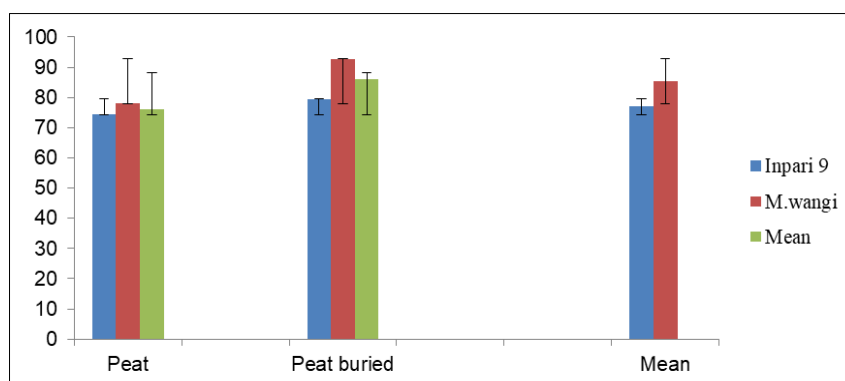


Figure 1 Plant height (cm) of Inpari 9 and Mentik Wangi rice variety on peat soil and Peat buried

Plant height in Inpari 9 and Mentik Wangi varieties based on the description (Appendix A and B) shows that plant height has not reached its maximum growth. Plant height that was still below the description was thought to be due to low soil fertility level (Table 1).

Table 1 Results of the analysis of peat and heaped up peat soil in the village of Sei Geringging

No	Parameters	Heaped Up Peat Soil	Value*	Peat Soil	Value*
1.	pH (H ₂ O)	5,42	Acidic	5,02	Acidic
2.	N Total (%)	0,5	Intermediate	1,21	Very High
3.	P Available	97,73	Very High	48,6	Very High
4.	K Available	0,13	Very Low	0,16	Very Low

Source: Central Plantation Services Laborato-ry [7]

* Values based on soil chemical properties assessment criteria in Table 2.

Table 2 Criteria for assessing soil chemical properties

No	Parameters	Value				
		Very Low	Low	Intermediate	High	Very High
1.	pH (H ₂ O)	<4,5 <i>Very Acidic</i>	4,5–5,5 <i>Acidic</i>	5,5–6 <i>Rather Acidic</i>	6,6–7,5 <i>Neutral</i>	7,6– 8,5 <i>Rather Alkali</i> >8,5 <i>Alkali</i>
2.	N Total (%)	<0,1	0,1–0,2	0,21–0,5	0,51– 0,75	>0,75
3.	P Available	<4	5–7	8–10	11–15	>15
4.	K Available	<5	5–16	17–24	25–40	>40

Planting of Inpari 9 varieties on buried peat and peat soil resulted in the highest number of tillers, namely 14,30 and 13,04 stems (Figure 2). Differences in varieties consisting of prime variety and local variety are thought to be due to genetic factors.

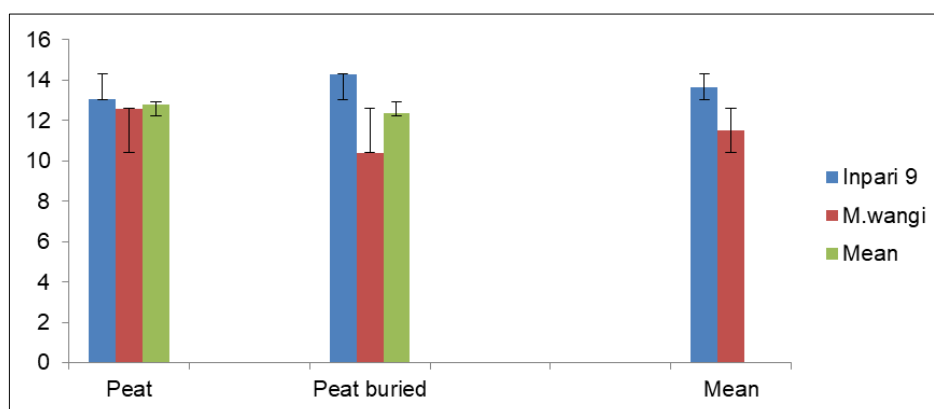


Figure 2 The maximum number of tillers (stems) of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

Planting of Inpari 9 varieties on peat and peat soil was buried resulting in the highest number of productive tillers, namely 8,19 and 9,77 (Figure 3). This result is the same as the maximum number of tillers in planting Inpari 9 variety on peat buried soil (Figure 2).

Planting of Inpari 9 varieties on buried peat and peat soils produced the highest panicle lengths of 21.85 and 22.80 cm (Figure 4). This was allegedly due to genetical factor that was variety and environmental factor that was the soil.

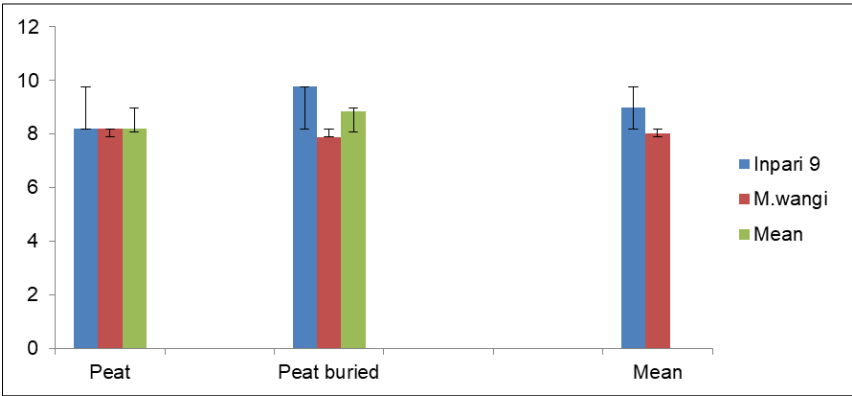


Figure 3 The number of productive tillers (stems) of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

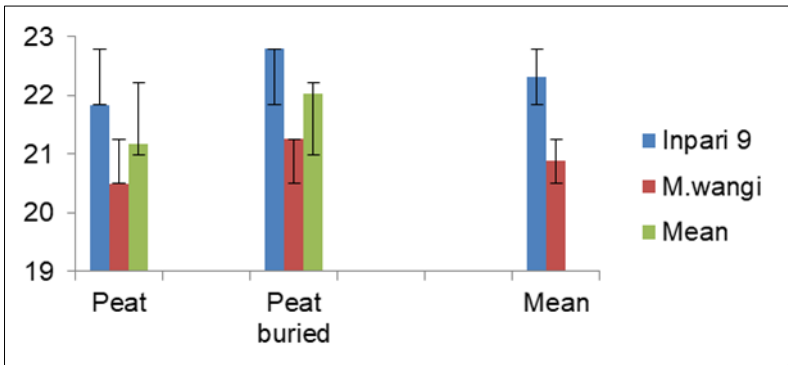


Figure 4 Panicle length (cm) of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

Planting of Inpari 9 varieties on peat soil is Mentik Wangi which is 85, 95 and buried peat is Inpari 9 which is 93, 10 (Figure 5). This is allegedly due to genetic and environmental factors.

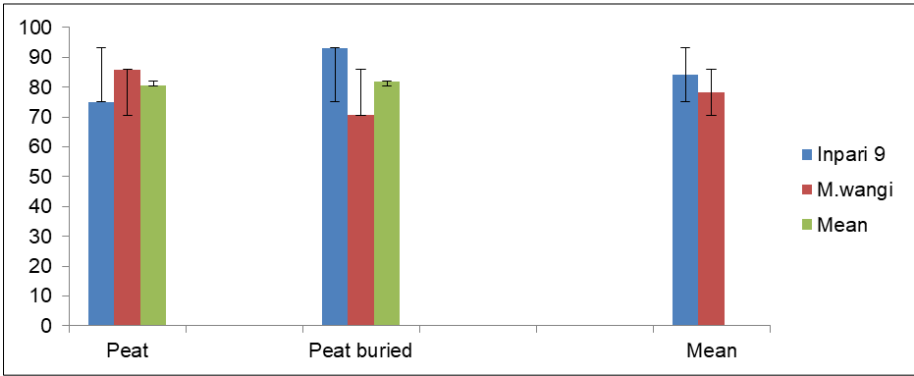


Figure 5 The number of branches of panicles per clump of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

Planting of Mentik Wangi varieties on peat soil and buried peat has the fastest harvesting age of 97, 00 and 91, 00 days (Figure 6).

Planting of Mentik Wangi varieties on peat and peat soil was buried resulting in the highest percentage of rice grain, which was 65, 75% and 75, 50% (Figure 7). This was allegedly due to genetic and environmental factors.

Planting the Mentik Wangi variety on peat soil and buried peat produced the highest 1000 grain weights, namely 24.82 and 27.09 g (Figure 8). This is allegedly due to genetic and environmental factors.

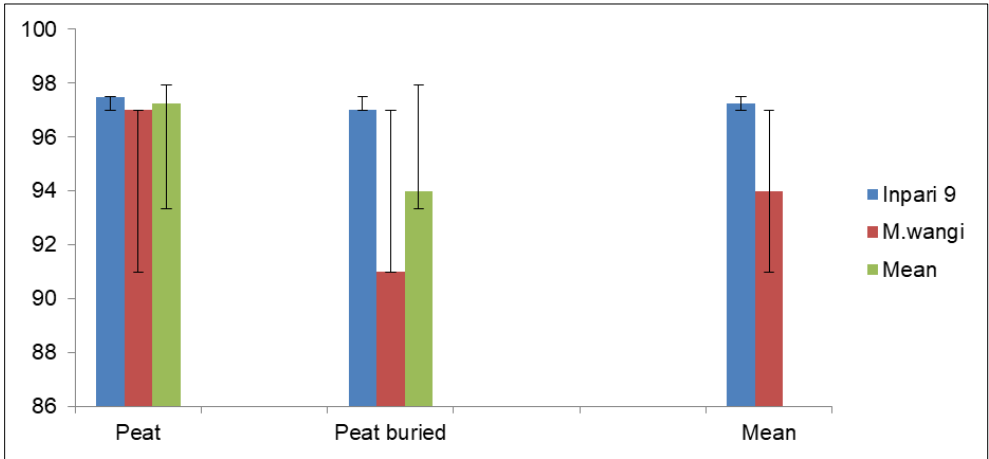


Figure 6 Harvest age (days) of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

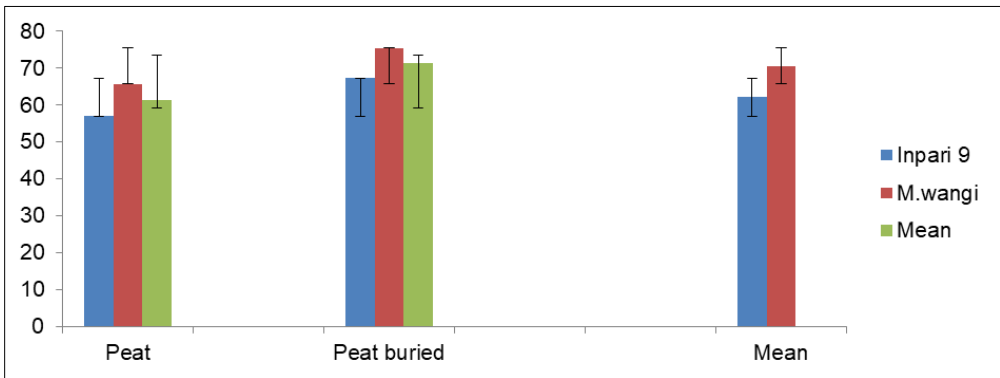


Figure 7 Percentage of filled grain (%) in Inpari 9 and MentikWangi rice variety on peat and Peat buried

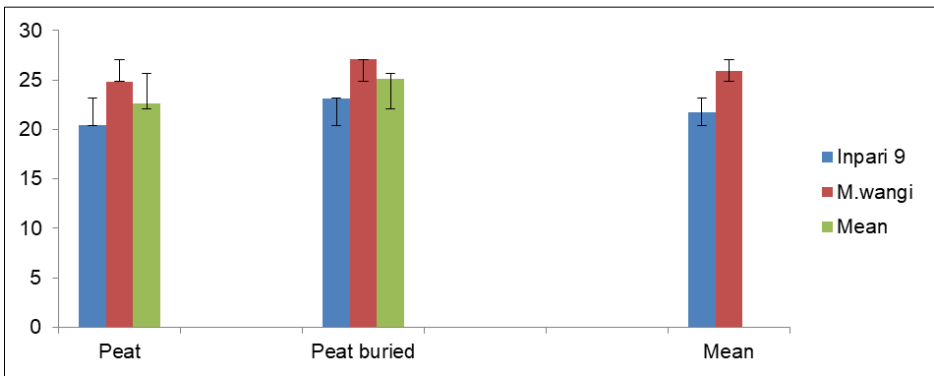


Figure 8 Weight of 1000 grains (g) of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

Planting of Mentik Wangi varieties on buried peat and peat soils has the highest yields of 6.88.00 or 3.46 ton.ha¹ and 838.80 2 g.m⁻² or 4.20 ton.ha¹ (Figure 9). This is allegedly due to genetic and environmental factors.

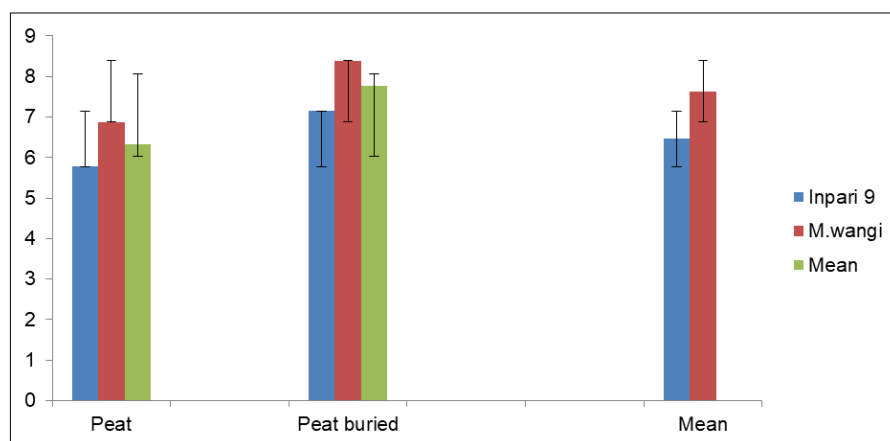


Figure 9 Milled dry grain weight per seed (g.m⁻²) of Inpari 9 and Mentik Wangi rice variety on peat and Peat buried

4. Discussion

4.1. Plant Height

Plant varieties have different properties or characters. The plant height result Mentik Wangi variety on peat buried soil was higher compared to other varieties and the soil was suspected because the Mentik Wangi variety is a local variety which generally has a higher plant height than the prime variety that has undergone selection process. According to Utama [8], the prime variety produces shorter plants and [9] said that Indonesian local varieties generally have a higher plant profile so that they were likely easy to fall down. The height of the plant is influenced by the characteristics that affect the yield result potential of one variety [10]. The shorter varieties would absorb more sunlight than taller one.

The peat buried soils have a higher pH and P available than peat soil (Table 1). According to Lubis et al [11], soil pH was very influential in plant growth, such as the availability of nutrients. Soil acidity is one of the most important factors in the soil [12]. Soil pH could affect the soil nutrient availability and can be a factor related to the soil quality and inhibitor factors for plant growth and production. The optimum availability of some nutrients in the soil was influenced by pH. At pH less than 5.5 phosphate ions would be bound by Fe and Al as compounds that are not soluble in water, whereas above pH 7.0 would react with Ca and Mg to form compounds that were not soluble in water and nutrients phosphorus (P) to be not available to the plants. Phosphorus is an essential nutrient for plants. There was no other element that could replace its function in plants, so plants must get enough P nutrients for their growth.

4.2. Maximum till Amount

According to Fauziah [13], New Prime Variety (NPV) is a group of rice that have many tillering characteristics (more than 20 shoots per clump) and according to [9] Indonesian local varieties generally have a small number of tillers.

According to Arraudeau and Vergara [14], the ability of each variety is different in producing tillers, this is caused by the genetic factors possessed by each of the different varieties [14]. [15] stated that the number of maximum tillers and productive tillers is strongly influenced by varieties that have more adaptation to the environment. [16] also argue that the number of tillers and adaptability is different from each variety because the difference in each variety is determined by the interaction between the genotype and the beneficial environment or according to the growth and development of the rice itself.

4.3. Number of productive tillers

The results of productive tillers would be in line with the maximum tillering results. The more the maximum number of tillers, the more the number of productive tillers would be. This was suitable with the opinion of Arraudeau and Vergara [14] that the number of productive tillers produced is a reflection of the maximum number of tillers.

According to Atman and Yardha [17], the formation of the number of productive tillers was closely related to the maximum number of tillers, the more the number of maximum tillers, the more the number of productive tillers. [18] also argues that the number of productive tillers is tillers that develop further and produce panicles.

4.4. Panicle Length

In accordance with the opinion of Taslim et al [19] result components such as panicle length were influenced by genetical factors and environmental factors. Sometimes these genetic traits did not arise because environmental factors were not appropriate, so human efforts in utilizing environmental factors were required so that genetic traits were expected to emerge.

Peat soil has pH and P which was lower than peat buried soil (Table 1). Soils that have acidic pH would affect plant roots in absorbing nutrients needed for the plants, and if the nutrients needed by plants were not met, it would certainly disrupt the growth and development of the plants. In accordance with the opinion of Sudaryono [20], the optimum availability of some nutrients in the soil was influenced by pH. Soil acidity is one of the most important factors in the soil. The biggest general effect of pH on plants is its effect on the availability of nutrients in the soil.

The low P available on peat soil is influenced by the low pH of the soil. This is suitable with Aksani's opinion that high soil acidity affects the balance of chemical reactions in the soil and the availability of nutrients in it especially phosphate [21]. Phosphorus is an essential nutrient for plants. There is no other element that can replace its function in plants, so plants must get enough P nutrients for their growth. [20] describes the important function of phosphorus nutrients for plants, namely in the process of photosynthesis, respiration, transfer and energy storage, cell division and enlargement and other metabolic processes of plants.

4.5. The number of branches of panicles per clump

In accordance with the opinion of Hutasoit et al [22], the number of panicle branches depends on rice varieties and the genetics of the plants themselves. [23] also argue that each rice variety has its own characteristics and depends on the genetic traits contained in each variety.

The highest number of panicle branches per clump was the same as that found in the highest panicle length treatment. This was in accordance with the opinion of Sitinjak and Idwar [24] that every increase in panicle length will grow grain stalk branches that produce more grain.

The pH and P content on peat buried soil is higher than it is in peat soil (Table 1). This is thought to be the cause of the high result of branches of panicles per clump on peat buried soil. According to Adimihardja [25], one of the factors that determines the ability of plants to absorb nutrients is the level of nutrient availability which is influenced by the level of soil acidity. Availability of nutrients in the soil promotes increased nutrient absorption by plants.

According to Sumardi et al [26], panicle state and the number of panicle branches are the result of interactions between genetic factors and growing environmental factors during the process of growth and development takes place. After the primordial shaped formed, environmental factors will not change the number of panicle branches that have been formed, but the environment will affect the final size. If the environment it receives is a driver of the ongoing growth process, then the possibility that the panicle size occurs will be longer and the number of panicle branches formed would mostly be filled into a grain. Likewise, vice versa, if the environmental factors received were inhibiting growth, the panicles that come out would be shorter and the panicles that have been formed were many that were not filled

4.6. Harvest Age

Based on the description of the plant, the Inpari 9 variety is nearing the harvest age in the description, which is 125 days (Aendix A). However, the harvest age of the Mentik Wangi variety based on the description is still not in accordance with the harvest age obtained from the results of the research. This is allegedly due to genetic and environmental factors. In accordance with the opinion of Manurung [27] that the harvest age can be determined by the phase of good vegetative growth and a good generative phase.

Mentik Wangi variety which is a local variety that has better adaptability to the environment than Inpari 9 variety which is prime variety. In accordance with the opinion of Anhar et al [28] local varieties, naturally tested for their resistance to various environmental stresses and pests and diseases so that local variety is a priceless collection of genetic resources.

The difference in harvest age is far from the description, presumably because the results obtained in the description are in the optimum conditions of the plant, whereas in the research carried out is on acidic soil conditions and lack of nutrients (Table 1). According to Anhar et al [28] the characteristics of prime variety requires more intensive treatment than local variety to achieve its optimal results.

The harvest age of the Mentik Wangi variety which is faster than the Inpari 9 variety is suspected because the Mentik Wangi variety was better able to absorb nutrients even in acidic soils so that growth and development is faster than the Inpari 9 variety. In the opinion of Susanto et al [29] superior varieties require more nutrients to support high growth and yield. According to Efendi and Simanjuntak [30], basically each variety has its certain characteristics. Local rice variety has the potential to grow and produce which is able to match the prime variety, especially in a climatic environment.

4.7. Filled Grain Percentage

In accordance with the opinion of Darti [31] that the properties of each genetic and environmental place of growth of the varieties, would affect the grain density of each panicle, the number of grains per panicle will also be affected the amount of grain formed.

According to Sitinjak and Idwar [24] that the difference in percentage of rice grain is also affected because each variety has different genetic factors in flower formation in each panicle, seeds are formed and the seeds are filled or not. According to Gardner et al [32], genetic factors relate to the ability of rice plants to optimize its production in regulating seed filling by allocating photosynthesis results quickly, so that the supply of photosynthesis into seeds becomes adequate and finally the seeds become stale.

Peat buried soils have high P available compared to peat soil (Table 1). P element would increase the absorption of nutrients which would affect the formation of grain. In accordance with the opinion of Leiwakabessy [33] stated that the sufficient P elements make plants able to develop more roots, if more roots are formed, more nutrients were absorbed. According to Sutedjo [34], P elements in plants can stimulate flower and grain formation, so that P elements are needed in large amount.

4.8. Weight of 1000 grains

In accordance with the opinion of Sitinjak and Idwar [24], genetic factors affected the weight of 1000 seeds because it is related to the shape and size of seeds. [35] also argue that the weight of 1000 seeds is more determined by the ability of filling the grains which varies between varieties. This process is related to the distribution of carbon to the grain which is influenced by the balance of starch-sucrose and involves the activity of the sucrose phosphate synthase enzyme.

The results of soil analysis (Table 1) pH and P that are available on peat buried soil was higher than peat soil. A low pH will affect the availability of P, which helps plants provide the nutrients needed by it. In accordance with the opinion of Sasmita and Tjahjana [36] a low pH can indicate low nutrient solubility especially P because there is a P bond by Al and Fe so that it was less available for plants. According to Satria et al [37], P element stimulates plant roots so that the roots are better at absorbing nutrients that utilized by plants.

According to Taufik et al [38] that by increasing the nutrient uptake, nutrient requirements are more fulfilled and the metabolism runs optimally so that the formation of proteins, carbohydrates, and starch is not inhibited, consequently the accumulation of metabolic materials in seed formation increases so that the seeds formed have a larger size and weight.

4.9. Dry Grain per Plot

In accordance with Kamal [39] the difference in total results is caused by differences in the genetic composition of each rice cultivar, so that the response to the environment is also different. Not only genetic, environmental factors also influence the plant production capacity.

Based on the description, Mentik Wangi variety (Aendix B) has obtained results that exceed the description of 838.80 g or 4.20 ton.ha¹ but the Inpari 9 variety (Aendix A) is very far from the results specified in the description which is 715.00 g or 3.58 ton.ha¹. This is suspected even though the Inpari 9 variety is a superior variety that has high production, but if the conditions are not optimum and the soil with nutrient content was not maximally fulfilled it will still produce low production. In accordance with the opinion of Sari et al [40] to obtain maximum production from superior varieties of rice, must be planted optimally, that is on fertile land, nutrients must be available, adequate irrigation, soil should contain organic matter, integrated pest control, and processing of plants must be done well (7-12 tons.ha⁻¹).

Peat and peat buried soils are soils with low nutrient content (Table 1). One that affects nutrient absorption is pH, which also affects production. In accordance with the opinion of Subandi et al [41] a high pH value could affect the availability of nutrients that would be absorbed by the roots. According to Sasmita and Tjahjana [36] low pH is one of the limiting factors of production because the increase in pH would be in line with the increase in production.

The high yields obtained from planting Mentik Wangi variety on peat buried soil are in line with the high yield of pithy grain weight (Table 1) and 1000 grain weight (Figure 8). In accordance with Zen [42] opinion, the increase in yield of rice in each clump is obtained from grain weight, grain per panicle and high-pitched grain.

Inpari 9 variety was planted on peat buried soil in the observation parameters of the maximum number of tillers, number of productive tillers, panicle length and number of panicles per clump had the highest yield, and Mentik Wangi variety planted on peat buried soil in parameters of grain weight and weight 1000 items had the highest yield. This results in milled dry grain weight amount per plot being was not significantly different, because the number of maximum tillers, number of productive tillers, panicle length and the number of branches of panicles per tall clump does not necessarily produce a lot of grain and 1000 grains weight amount. This is in accordance with the opinion of Hambali and Iskandar [43] that the longer the average length of panicle rice, the more the amount of grains are produced, however it does not always provide high yields because it is also influenced by the percentage of filled grain and empty grain.

[44] stated that rice production is determined, among others, by the percentage of rice grain. The higher the yield components, the plant will also provide higher production. Furthermore, [45] stated that one of the factors that influence the increase in yield is the increase in the value of growth components and components of crop yields, including the number of grain per panicle and the percentage of filled grains.

Appendix A

Description of Inpari 9 rice variety

Plant Age	125 days
Plant Shape	Upright
Plant Height	105 – 121 cm
Productive Tiller	16 – 22 stems
Foot Color	Green
Stem Color	Green
Leaf Ear Color	White
Leaf Tongue Color	Green
Leaf Color	Green
Leaf Surface	Rough
Leaf Position	Upright
Leaf Flag	Upright
Grain Shape	Long and slim (L=6,78mm;W=2,12mm;L/W=3,21)
Grain Color	Clear Yellow
Loss Rate	Intermediate
Rice Texture	Fluffier
Amylose Content	21%
1000 Grains Weight	23,3 g
Yield Average	6,25 t/ha
Yield Potential	9,9 t/ha
Resistance To Disease	Slightly susceptible to WBC pests biotypes 1, 2 and 3 Slightly resistant to race III HDB disease and somewhat vulnerable race IV and VIII, rather resistant to tungro inoculum disease No.73, and resistant to tungro inoculum disease no.031 and no. 013

Prompts for planting	Suitable to be planted in irrigated land with altitudes up to 600 m above sea level
Reason released	Tungro resistant, fluffier rice, high yield potential

Source: [46]

Appendix B

Description of Mentik Wangi rice variety

Accession No.	1754
Accession Name	Mentik wangi
Origin Province	Central Java
Origin District	Magelang
Habitus	Intermediate
Plant Age	112–113 HST
Average Plant Height	106–113 cm
Amount of vegetatif tiller	15
Amount of productive tiller	14
Leaf Color	Green
Foot Color	Goldie Yellow
Leaf Tongue Color	White
Leaf Ear Color	Uncolored
Leaf Neck Color	Light Green
Leaf Surface	Unharied
Leaf Flag Position	Flat
1000 Grains Weight	18 gram
Average Yield	4,18 ton/ha

5. Conclusion

- The best growth of rice is on peat buried soil planted with Inpari 9 variety.
- The best production capacity of rice is on peat buried soil planted with Mentik Wangi variety which produced 838.80 g.m⁻² or 4.20 ton.ha⁻¹

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

All authors declare there is no conflict of interest in this paper.

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