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Yield Perfomance Of Rice Genotypes Tolerant To Anaerobic Germination (Ag) In Rainfed Lowland Of Kebumen, Central Java

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ABSTRACT
The main problem in rainfed land is flooding due to poor drainage system, so that it often occurs inundation. Rice varieties tolerant to anaerobic germination. The study aimed to test the performance of Ag-tolerant apdi lines in rainfed rice fields in Kebumen. A total of 9 lines and 3 comparison varieties (Ciherang Ag, Inpari 30 and Inpari 39) were arranged in a randomized block design with 4 replications. The results showed that the tested lines had GKG results that were not significantly different from Inpari 30 and Inpari 39, however there was one line IR 83381-B-B-6-1 which gave a significantly higher yield than Ciherang Ag (Ciherang which has Ag-tolerant genes).

Keywords: Rainfed, Anaerobic Germination, Rice Lines, Results.

INTRODUCTION

Climate change and increasingly unstable weather are currently a serious challenge for agriculture in Kebumen Regency, especially for rice fields affected by excessive waterlogging (Pattiselanno et al., 2020). The problems faced by farmers in rainfed fields who use tabela are usually after sowing seeds, the seedlings are flooded. This will cause the seedlings to experience stress so that the seedlings die. The problem of rice affected by anaerobic germination tolerance in rainfed rice fields is one of the important issues in rice cultivation. Rainfed rice fields rely on rainwater as the main source of irrigation, which can cause less stable environmental conditions. Important problems faced by rice plants with this condition are:

Waterlogging Conditions

In rainfed rice fields, excessive waterlogging often occurs, especially at the beginning of the planting season when heavy rains come. This waterlogging can create anaerobic conditions (without oxygen) in the soil.

Rice Germination

Newly planted rice seedlings often have to germinate under anaerobic conditions. Rice plants usually require oxygen to germinate properly, so anaerobic conditions can inhibit this process.

Effect on Growth

Anaerobic conditions in the early stages of growth can cause seedling death or poor growth. This has a negative impact on the overall harvest.

In dealing with high waterlogging stress, the selection of plant varieties can play an important role in increasing plant resistance to this stress (Idris, 2019). Rice cultivation in rainfed areas requires rice varieties that are tolerant to low oxygen levels during germination and the ability to adapt to waterlogging stress. Many rice cultivars are sensitive to low oxygen levels during germination due to submerged conditions. This condition can occur in irrigated land with uneven soil conditions and in rainfed land that is prone to flooding when rain occurs within a few days after planting (Ismail et al., 2009) (Angaji et al., 2010). As a result, damage

occurs to seeds/seedlings at the beginning of germination and early seedling growth, causing seedlings to be unable to grow strongly, lengthen, and survive in submerged conditions. Seed germination can be hampered if the land is not leveled properly and there are drainage problems, resulting in waterlogging that causes the seeds to be submerged. submerged, if heavy rain occurs immediately after the seeds are sown (Tuong et al., 2000). Slow seed germination and slow seedling growth will be major problems in flood-prone or waterlogged areas that implement a change in planting methods to direct seed sowing (El-Hendawy et al., 2011).

Increasing the tolerance of varieties to submergence conditions during germination and early seedling growth could improve plant growth and encourage widespread adoption of direct seeding. The use of tolerant varieties is the cheapest technology for farmers, especially in developing countries, and is easier to adopt on a large scale than other management practices (e.g., calcining seeds).

Until now, there are no varieties released in Indonesia that have tolerance to anaerobic germination. The results of research conducted in Indonesia have obtained rice lines that are tolerant to anaerobic germination, the Inpari 30 variety which has tolerance to soaking is also reported to be tolerant to anaerobic germination (Kartina et al., 2021; Sitaresmi et al., 2021). This study aims to evaluate the yield of lines that have been confirmed to be tolerant to germination, seen from agronomic performance in Kebumen rainland.

MATERIALS AND METHODS

To test the yield of various types of rice varieties tolerant to anaerobic germination in rainfed rice fields in Kebumen Regency, an experiment was conducted using a comparative method (Putranto et al., 2020). The study was conducted in rainfed rice fields in Argopeni Village, Kebumen District, Kebumen Regency in January - May 2020. There were nine lines tested in this study and used three comparative varieties. The lines and varieties used in this study were BP20106c-SKI-3-1-0, IR 83381-B-B-6-1, IR 83383-B-B-129-4, IR 127165-2-61-Ski-0-Ind-19, IR 129336:11-19-Ski-0-Kn-3, IR 129336:11-8-Ski-0-Kn-8, B14366E-KY-3, B14316E-KA-15, B14897E-SKI-9-7-2, Ciherang Ag, Inpari 30 and Inpari 39. The research design used was Randomized Block Design (RBD) with a single factor, namely genotype/variety. Each genotype was planted with a tile planting system using a planting distance of 25 cm x 25 cm with a plot area of 4m x 5m which was repeated four times. Seedlings were planted when the seedlings were 21 days after planting with 1-3 seedlings per planting hole. PTT was used in this study, namely seeds using labeled seeds and the use of fertilizers according to the dosage, namely NPK Phonska fertilizer 250 kg / ha and Urea 200 kg / ha with a fertilization frequency of 3 times, namely fertilization I = 7 Days After Planting (DAP), II = 22 DAP and III = 35 DAP. Weed, disease and pest control were carried out using the principle of Integrated Pest Management (IPM). Observations were made on the agronomic performance characteristics of plants such as plant height, number of tillers, age of flowering, number of panicles, number of filled grains per panicle, number of empty grains per panicle, weight of filled grains per clump, weight of 1000 grains and yield (harvested dry grain). The observational data were analyzed using the statistical software SPSS via analysis of variance (ANOVA) and tested using the Duncan's Multiple Range Test (DMRT) at a 5% significance level, in the event that differences were found among the treatments.

RESULTS AND DISCUSSION

Table 1. Analysis of yield variance of various types of rice varieties tolerant to anaerobic germination in rainfed rice fields in Kebumen Regency

No	Observation Variables	Nilai F	Probabilitas
1	Plant Height	11,003	0,000**
2	Number of Tillers	2,715	0,013*
3	Number of Panicles	5,739	0,000**
4	Age of 50% Flowering	5,567	0,000**
5	Number of Filled Grains/Panicle	1,934	0,071
6	Number of Empty Grains/Panicle	3,957	0,001**
7	Weight of 1000 grains	5,632	0,000**
8	Yield	3,187	0,005*

Notes:

** = significantly different at the 1% error level
* = significantly different at the 5% error level

Kebumen Regency showed an effect on the observation variables of plant height, number of tillers, age of 50% flowering, number of panicles, number of empty grains/panicle, The results of the analysis of yield variance of various types of rice varieties tolerant to anaerobic germination in rainfed rice fields in weight of 1000 grains and yield and did not affect the variable of number of filled grains per panicle (Table 1).

Table 2. Further testing of yield capacity of various types of rice varieties tolerant to anaerobic germination in rainfed rice fields in Kebumen Regency

No	Varieties	TT	JA	UB	JM	JGABHAM	B1000	Result
1	BP20106c-SKI-3-1-0	100,25 bc	21 b	73 abc	22 de	32 a	24,08 ab	5,83 bc
2	IR 83381-B-B-6-1	106,5 bcd	20 b	72 ab	20 cde	36 a	24,13 ab	6,6 c
3	IR 83383-B-B-129-4	112, 25 d	17 ab	73 abc	20 bcd	41 abc	24,58 ab	5,69 bc
4	IR 127165-2-61-Ski-0-Ind-19	103 bc	17 ab	76 bc	19 bcd	38 abc	26,33 abc	5,27 b
5	IR 129336:11-19-Ski-0-Kn-3	103,75 bc	17 ab	84 d	18 bcd	31 a	27,88 cd	5,98 bc
6	IR 129336:11-8-Ski-0-Kn-8	89 a	18 ab	69 a	24 e	31 a	23,4 a	3,92 a
7	B14366E-KY-3	103,75 bc	15 a	75 bc	16 ab	54 cd	26,93 bc	5,05 b
8	B14316E-KA-15	109 cd	15 a	75 bc	16 abc	58 d	27,75 cd	4,99 b
9	B14897E-SKI-9-7-2	119,75 e	16 a	75 bc	14 a	53 bcd	30 d	5,42 bc
10	Ciherang Ag	105,25 bc	15 a	73 abc	14 a	37 ab	23,4 a	5,17 b
11	INPARI 30	104,75 bc	15 a	78 c	17 abc	29 a	26,25 abc	5,85 bc
12	INPARI 39	107,25 bcd	18 ab	75 bc	19 bcd	29 a	24,02 ab	5,41 bc

Notes: Numbers followed by the same letter in the same column are not significantly different in the 5% level DMRT test. TT = plant height (cm); JA = number of tillers; UB = age of flowering 50% (HSS); JM = number of panicles; JGABHAM = number of empty grains/panicle; B1000 = weight of 1000 grains (g); H = yield (t/ha)

PLANT HEIGHT

The results of further tests on plant height characters of various types of anaerobic germination tolerant rice varieties in rainfed rice fields in Kebumen Regency showed that the B14897E-SKI-9-7-2 line gave the highest plant height compared to other lines, namely 119.75 cm. The IR 129336:11-8-Ski-0-Kn-8 line had the lowest plant height compared to other lines, namely 89 cm. Each line/variety showed different plant height appearances, this was due to the influence of genetic differences in each line/variety. This is in accordance with the results of other studies which state that genetic traits that have different characters or characteristics will give different results for plant height (Yulina et al., 2021). The results of other studies also explain that high diversity in the generative phase shows that characters are more influenced by genetic factors (Hartati et al., 2020).

NUMBER OF TILLERS

The results of further character test of tiller number of various types of rice varieties tolerant to anaerobic germination in rainfed rice fields in Kebumen Regency showed that the BP20106c-SKI-3-1-0 line had the highest number of tillers compared to other lines, which was 21 tillers. The IR 83381-B-B-6-1 line also had a high number of tillers although it was not significantly different from the BP20106c-SKI-3-1-0 line, which was 20 tillers. B14366E-KY-3, B14316E-KA-15, Ciherang Ag and Inpari 30 had the lowest number of tillers compared to other genotypes, which was 15 tillers. The results of the tiller number character test presented in table 2 show that the lines/varieties were able to produce the number of tillers in the large and medium categories, namely in the range of more than 15 tillers. According to one of the research results, it is stated that productive tillers can be grouped into three types, namely less tillers (less than 12 stems per clump), medium tillers

(13-20 stems per clump) and many tillers (more than 20 stems per clump) (Zen et al., 2002). The difference in the number of tillers indicates the ability of the variety to grow according to its genetic potential in various growing environments (Asis et al., 2021). The number of tillers is related to increased productivity because it is directly proportional to the number of panicles which can provide the opportunity to produce larger grains. The maximum number of tillers in each variety is not only influenced by the environmental conditions where the plant grows but also determined by the genetic characteristics of the plant (Maghfiroh et al., 2017).

AGE OF 50% FLOWERING

The results of further testing of the age of 50% flowering character of various types of anaerobic germination tolerant rice varieties in rainfed rice fields in Kebumen Regency showed a relatively short and uniform flowering time. The IR 129336:11-8-Ski-0-Kn-8 line is the line with the shortest of age of 50% flowering, which is 69 days after planting, while the IR 129336:11-19-Ski-0-Kn-3 line is the line with the longest of age of 50% flowering, which is 84 days after planting. The age of flowering character of plants is related to the harvest age so that it can determine the early maturity of a plant. According to the age of flowering is one of the critical points in estimating the harvest age.

According to another study on rice commodities, the age of flowering is 65 days and is positively correlated with the harvest age of plants and shows that the age of plants is very early among other varieties observed. The very early maturing lines resulting from further observations can be used as a source of new varieties of rice with very early maturing and can then be released as new very early maturing varieties (Dewi et al., 2012).

NUMBER OF PANICLES

The results of further tests on the character of the number of panicles of various types of rice varieties tolerant to anaerobic germination in rainfed rice fields in Kebumen Regency showed that the IR 129336: 11-8-Ski-0-Kn-8 line had the highest number of panicles with a value of 24. There were two lines with the lowest number of panicles, namely B14897E-SKI-9-7-2 and Ciherang Ag, namely 14. The number of panicles affects the number of grains formed in each clump of plants including rice so that the number of plant panicles is one of the indicators of plant productivity (Asis et al., 2021). However, apart from the genetic influence of the plant, it is also influenced by environmental conditions so that it will affect the number of panicles that grow. In this study, the condition of the rice fields was rainfed land which resulted in a lot of waterlogging and reduced oxygen around the plants. Christianto et al. (2016) explained that water management had a significant effect on the number of panicles.

NUMBER OF EMPTY GRAINS/PANIC

The results of further tests on the character of the number of empty grains per panicle of various types of anaerobic germination tolerant rice varieties in rainfed rice fields in Kebumen Regency showed the highest value of 58 in the B14316E-KA-15 line, while the INPARI 30 and INPARI 39 lines had the lowest number of empty grains per panicle among the other varieties, namely 29. Based on the DMRT statistical test at a threshold of 5% error rate, the line with the lowest number of empty grains was not significantly different from the other lines, namely IR 129336: 11-19-Ski-0-Kn-3 and IR 129336: 11-8-Ski-0-Kn-8 of 31, the BP20106c-SKI-3-1-0 line of 32 and the IR 83381-B-B-6-1 line of 36. The number of empty grains is one of the indicators of reduced rice yields.

The yield of a line or variety which is a genetic factor of the plant is the cause of empty grain. In addition, environmental factors such as drought or flooding that can cause reduced oxygen (anaerobic) can cause damage to the xylem and phloem vessels, thereby inhibiting the transport of mineral nutrients and photosynthates. These factors often produce empty grain or damage to the panicle which results in low rice yields (Hambali and Lubis, 2015).

1000 GRAIN WEIGHT

The results of further tests on the 1000 grain weight character of various types of anaerobic germination tolerant rice varieties in rainfed rice fields in Kebumen Regency showed that the B14897E-SKI-9-7-2 line had the highest 1000 grain weight of 30 grams. The IR 129336:11-8-Ski-0-Kn-8 and Ciherang Ag lines had the lowest 1000 grain weight values among other varieties, namely 23.4 grams. Observation of the 1000-grain grain weight yield component aims to determine the seed weight at 14% water content when the rice is harvested. At least the 1000-grain grain weight can be used to compare the acquisition of dry grain productivity later (Di et al., 2019). The results of the study by Safriyani et al. (2018) showed that the weight of 1,000 seeds was influenced by the number of large, full-grain grains, thus affecting the weight of seeds per clump and high plant productivity.

RESULTS

The results of further tests on the yield characteristics of various types of anaerobic germination tolerant rice varieties in rainfed rice fields in Kebumen Regency showed that the IR 83381-B-B-6-1 line gave the highest yield among the other lines, namely 6.6 tons per hectare. The IR 129336:11-8-Ski-0-Kn-8 line had the lowest yield, namely 3.92 tons per hectare. Each line/variety showed different but uniform yields as evidenced by the 5% DMRT statistical test. Differences in production can be caused by the genetic composition of each rice cultivar. In addition to genetics, environmental factors also affect rice plant production (Yulina et al., 2021).

Yield character is a determining character because it is related to plant productivity. There are several other characters that are positively or negatively related to rice yield characters. In this study, there was a line with the lowest yield value with a short flowering age, namely the IR 129336: 11-8-Ski-0-Kn-8 line. According to the results of other studies, it was stated that a negative correlation was also obtained between the number of empty grains and the flowering age, the faster the flowering plant causes high empty grains so that it will affect the results. This is thought to be because genotypes with fast flowering ages have a shorter vegetative period which causes a decrease in the accumulation of photosynthate results which will then be distributed to all plant organs for growth until seed filling (Kartina et al., 2017).

CONCLUSION

1. The genotype of anaerobic germination tolerant rice in rainfed rice fields in Kebumen Regency significantly affected the variables of plant height, number of tillers, age of 50% flowering, number of panicles, number of empty grains/panicles, weight of 1000 grains and yield.
2. The lines tested had GKG results that were not significantly different from Inpari 30 and Inpari 39, however there was one line IR 83381-B-B-6-1 which gave a significantly higher yield than Ciherang Ag (Ciherang which has the Ag tolerant gene).

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