Vol. 14, No. 1, pp. 255-265, Februari 2026 DOI: https://doi.org/10.23960/jat.v14i1.9762

Jurnal Agrotek Tropika

P-ISSN: 2337-4993
E-ISSN: 2620-3138

Journal homepage: https://jurnal.fp.unila.ac.id/index.php/JA

EFEKTIVITAS DOSIS PUPUK NPK DAN UREA PADA PERTUMBUHAN DAN HASIL GALUR-GALUR PADI PERSILANGAN CIHERANG × GALUR B11143D

THE EFFECTIVENESS OF NPK AND UREA FERTILIZER DOSES ON THE GROWTH AND YIELD OF RICE LINES OF CIHERANG × B11143D

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ARTICLE HISTORY:

Received: 25 September 2024
Peer Review: 05 October 2024
Accepted: 12 May 2025

KATA KUNCI:

Ciherang, daya hasil, galur B11143D, karakter agronomi, pupuk

ABSTRAK

Pola pemupukan yang efektif dapat mengoptimalkan pertumbuhan dan daya hasil padi. Tujuan penelitian ini adalah untuk menguji efek pemberian dosis pupuk NPK dan urea terhadap pertumbuhan dan daya hasil galur-galur padi hasil persilangan Ciherang × galur B11143D. Perlakuan dalam penelitian disusun secara faktorial (10x4) menggunakan desain Rancangan Petak Terbagi dan diulang tiga kali. Petak utama adalah sepuluh galur padi. Anak petak adalah 4 taraf dosis pupuk yang terdiri dari A1, A2, A3, dan A4. Pengaruh perlakuan dianalisis menggunakan ANOVA. Apabila uji F taraf 5% signifikan, maka analisis dilanjutkan dengan uji DMRT pada taraf 5%. Hasil penelitian menunjukkan terdapat pengaruh nyata galur padi terhadap semua variabel, kecuali bobot gabah isi. Galur P1 dan P2 memiliki tinggi dan jumlah anakan terbaik, serta P5 memiliki bobot gabah total tertinggi. Terdapat pengaruh interaksi antara dosis pupuk dan galur padi terhadap panjang daun bendera, jumlah anakan produktif, dan bobot gabah hampa. Galur P1 dan P2 memiliki panjang daun bendera terbaik masing-masing pada dosis pupuk A2 dan A4. P1 memiliki anakan produktif tertinggi dan bobot gabah hampa terendah pada A4. Hasil studi menunjukkan A4 adalah dosis pupuk terbaik untuk galur-galur padi hasil persilangan Ciherang × galur B11143D di Kabupaten Karawang. P1, P2, dan P5 adalah galur hasil persilangan terbaik dan potensial sebagai bahan uji pada pengujian lapang selanjutnya.

ABSTRACT

Effective fertilizer application can enhance rice growth and yield. The objectives of this study were to test the effect of NPK and urea fertilizers doses on the growth and yield of rice lines from Ciherang × B11143D cross. The treatments were arranged by factorial (10x4) in split plot design and repeated three times. The main plot was ten rice lines and the sub plot was 4 levels of fertilizer, consisting of A1, A2, A3, and A4. The treatment effects were tested using analysis of variance. If the F-test is significant at a significance level of 0.05, the Duncan Multiple Range Test was performed to identify the best treatment at the 5% level. The results showed that rice lines significantly influenced all variables except filled grain weight. P1 and P2 lines had the highest plant height and total tillers, and P5 had the highest total grain weight. The fertilizer doses and rice lines had an interaction effect for flag leaf length, total productive tillers, and unfilled grain weight. P1 and P2 lines had the highest flag leaf under A2 and A4 fertilizer doses, respectively. P1 had the highest total productive tillers and the lowest unfilled grain weight under A4. This study showed that A4 is the best fertilizer dose for the growth and yield of progeny lines of Ciherang × B11143D cross in Karawang regency. P1, P2, and P5 are the best lines and have the potential for further evaluation in the next field test.

KEYWORDS:

Agronomic character, B11143D line, Ciherang, fertilizer, yield

1. INTRODUCTION

Rice production in Indonesia reached 54.41 million tons of milled dry grain (MDG) in 2023, reflecting a decrease of 1.12 million tons (2.1%) compared to 2022 (BPS, 2023). Indonesia has experienced a more substantial decline in rice production over the past few years. In 2023, production levels dropped by 4.59 million tons of MDG, representing a 7.7% reduction from 2018 (BPS, 2023). There are several options to prevent this decline and increase national rice production, such as soil nutrient optimization and superior rice variety releases to fulfill increased food demand (Siregar, 2023; Swastika *et al*., 2021). Sustained development of superior rice varieties must be focused on enhancing both yield and quality (Jauhari *et al*., 2020). Without these efforts, Indonesian national food security could be in danger and more dependent on rice imports (Nurfera, 2022).

Fertilizer management is a key component of rice growth and yield. Continuous cultivation requires appropriate application of fertilizer to maintain nutrient availability in the soil (Sholeh *et al*., 2017). Different plant varieties may react differently to fertilizer applications, so the quantity and type of fertilizer need to be tested for each variety (Bakhtiar *et al*., 2021). Nutrient stress will manifest when there are insufficient soil nutrient levels, therefore it must be monitored and maintained during superior rice variety development (Waluyo and Suparwoto, 2023). Newly released varieties should be tested against different fertilizer doses to formulate the recommended doses to achieve consistent high yield and quality when the new variety is grown in farmers' fields (Jauhari *et al*., 2021).

Appropriate use of inorganic fertilizers at the optimum doses is critical for maximizing rice growth and yield (Raize *et al*., 2013; Ebsan, 2021). Achieving this balance ensures optimal production and sustainable use of other agricultural resources as well (Tando, 2020). This study aimed to investigate the growth and yield performance of Ciherang × B11143D rice lines under varying doses of NPK and urea fertilizers in Pasir Jengkol, Karawang Regency. Those lines were developed to obtain a higher number of grains per panicle in Ciherang through marker-assisted breeding (Susilowati *et al*., 2014; Susilowati *et al*., 2017).

2. MATERIALS AND METHODS

This study was performed from January to April 2024 in Pasir Jengkol Village, Majalaya District, Karawang Regency, West Java, which has an altitude of 18.2 meters above sea level. The rice lines used in the study comprised ten rice lines listed in Table 2. urea fertilizer, NPK fertilizer, alluvial soil, and pesticides (Aspril 100 SC, Amistartop 325 SC, Antracol 70 WP, and Sidametrin 50 EC) were used to cultivate the plants. The utensils utilised in this research included 30-liter buckets, hoes, sickles, labels, sprayers, white and black nets, scissors, raffia rope, stationery, traditional and digital scales, serrated sickles, rulers, verniers, measuring tapes, and a camera.

The experiment was arranged in a split plot design with three replications as block. The main plot consisted of ten rice lines, which included seven progeny lines from Ciherang × B11143D cross and three comparison varieties (Ciherang, B11143D line, and Inpari 32). The sub plot was composed of four levels of fertilizer application: A1 (200 kg NPK + 300 kg urea) (Damayanti *et al*., 2024), A2 (350 kg NPK + 200 kg urea), A3 (300 kg NPK + 150 kg urea) (Rahmah and Aswidinnoor, 2013), and A4 (350 kg NPK + 150 kg urea) (Aliyah *et al*., 2022). The variables observed included plant height (cm), flag leaf length (cm), total number of tillers, number of productive tillers, filled grain weight, unfilled grain weight, and total grain weight. The treatment effects were statistically analyzed using analysis of variance (ANOVA). When the F-test result was significant at the 5% level, Duncan's Multiple Range Test (DMRT) was applied to define the best treatment, also at the 5% significance level.

3. RESULTS AND DISCUSSION

3.1 Effect of Rice Lines and Fertilizer Doses on All Variables

Table 1 summarizes the significance of F-values for the evaluated variables, along with the effects of treatments (rice lines and fertilizer doses) and their interaction. Rice lines significantly influenced all variables except for filled grain weight. An interaction between rice lines and fertilizer doses significantly affected flag leaf length, the total number of productive tillers, and the total grain weight.

3.2 Plant Height

ANOVA results indicated that fertilizer doses and rice lines did not interact to affect plant height. However, rice lines had a significant impact on plant height, as shown in Table 2.

The data in Table 2 revealed that the height of all lines derived from the Ciherang x B11143D cross was similar to that of Ciherang but shorter than B11143D line. This outcome is consistent with expectations since the testing lines were generated by backcrossing. As such, most agronomic traits from the recurrent parent, Ciherang, were restored in the genome of the test lines, except for flag leaf length and total grain weight, which were the target traits from the donor parent, B11143D line. Among all crossed lines, the P1 (20.4.4.G1) line exhibited the greatest height, though it was not significantly different from Ciherang. The P2 (22.4.3 H1), P3 (70.3.2 I1), P4 (72.2.3 J1), and P6 (115.1.5 R1) lines also displayed heights comparable to Ciherang.

3.3 Flag Leaf Length

Table 3 shows that both fertilizer doses and rice lines had a significant interaction effect on flag leaf length. Each factor also significantly affected individually. The average values are presented in Table 3. The data in Table 3 indicate that the flag leaf length varied among the progeny lines of Ciherang x B11143D. Of all the lines, P2 (22.4.3 H1) in the A2 fertilizer dose exhibited the longest flag leaf, with a value of 37.97 cm, which was significantly longer than Ciherang. P1 (20.4.4 G1), under the A4 fertilizer dose, also had a significantly longer flag leaf (35.83 cm) compared to Ciherang. This finding is coherent with the study by Damayanti *et al*., (2024) which reported that the flag leaf area of all rice progenies from Ciherang x B11143D was larger than that of Ciherang. It is likely that the B11143D donor parent successfully transmitted the long flag leaf trait to P2 and P1 lines.

The B11143D plant had the longest flag leaves in all fertilizer treatments, similar to the results obtained by Susilowati *et al*., (2014, 2018), who reported that B11143D consistently grew larger flag leaves than Ciherang. Flag leaf size is a key target trait from B11143D, so it was intentionally selected to improve grain yield in the progenies of the Ciherang x B11143D cross.

Table 1. Significance of F-values of ANOVA Between Rice Lines and Fertilizer Doses Treatments for All Variables.

Variables	Rice lines	Fertilizer doses	Fertilizer doses x Rice lines
Plant height	*	ns	ns
Flag leaf length	*	*	*
Total number of tillers	*	ns	ns
Total number of productive tillers	*	*	*
Filled grain weight	ns	ns	ns
Unfilled grain weight	*	*	*
Total grain weight	*	ns	ns

Notes: * Significant at 0.05 probability levels; ns: non-significant.

Table 2. The Mean of Plant Height (cm) of the Crossed Lines of Ciherang × B11143D Line and Comparison Varieties.

Treatment		Plant height (cm)
Rice lines (p)		
P1 (20.4.4.G1)		87.267[c]
P2 (22.4.3.H1)		87.225[c]
P3 (70.3.2.I1)		86.308[c]
P4 (72.2.3.J1)		85.958[c]
P5 (94.3.3.K1)		84.308[d]
P6 (115.1.5.R1)		86.250[c]
P7 (124.2.3.S1)		83.617[d]
P8 (Ciherang)		86.092[c]
P9 (B11143D line)		95.242[a]
P10 (Inpari 32)		91.492[b]
Coefficient of Variance	KK.a (%)	3.72
Fertilizer doses (a)		
A1 (200 kg NPK+300 kg urea)		87.090[a]
A2 (350 kg NPK+200 kg urea)		87.097[a]
A3 (300kg NPK+150 kg urea)		87.513[a]
A4 (350kg NPK+150 kg urea)		87.803[a]
Coefficient of Variance	KK.b (%)	2.09

Notes: In each column, mean values with the same letter represent no significant difference at the 5% DMRT level.

Table 3. The Mean of Flag Leaf Length (cm) of the Crossed Lines of Ciherang × B11143D Line and Comparison Varieties.

Interaction	Sub plot (Fertilizer doses)			
Main plot (Rice lines)	A1	A2	A3	A4
P1	34.47c E	35.83a E	34.4c E	35,87b B
P2	31.63c H	37.97a B	33.47b E	33,9b B
P3	37.5a D	36.5b E	35.13c D	35,10c B
P4	34.97c F	34.3b F	34.23b E	32,53c C
P5	35.93a E	33.6c F	33.67c E	33,93b B
P6	29.63d J	31.63c G	32.8b F	34,27a B
P7	33.53b G	33.9a F	33.43b E	32,17c C
P8	38.77a C	36.9b D	36.73b C	34,57c B
P9	41.63c A	43.13b A	43.43b A	44,17a A
P10	41.13c B	43.97a A	42.17b B	41,87b A

Notes: In each column, mean values followed by the same letter (uppercase vertical and lowercase horizontal) represent no significant difference at the 5% DMRT level.

In this study, it was found that both plant genotype and fertilizer application significantly affected flag leaf length. According to Marsono (2012) and Alavan *et al.*, (2015) balanced nutrient availability allows optimal cell elongation, especially in stems, which in turn enhances plant growth. The appropriate fertilizer dose promotes a balanced nutrient profile in the soil (Laila *et al.*, 2025). Nitrogen (N), a crucial nutrient during the vegetative phase, stimulates the growth of stems, branches, and leaves (Panga *et al.*, 2021).

3.4 Total Number of Tillers and Productive Tillers

Data analysis revealed that rice lines significantly influenced the total number of tillers and productive tillers. The mean values for both variables are presented in Tables 4A and 4B. The results in Table 4A show that the total number of tillers for most of the Ciherang × B11143D crossed lines was similar to the comparison varieties (Ciherang, B11143D line, and Inpari 32). Among the progeny lines, P1 had the highest number of tillers (36.48), while P3 had the lowest (34.17).

Tables 4A. The Mean of Total Number of Tillers of the Crossed Lines of Ciherang × B11143D Line and Comparison Varieties.

Treatment		Total number of tillers
Rice lines (p)		
P1 (20.4.4.G1)		36.48[ab]
P2 (22.4.3.H1)		35.83[ab]
P3 (70.3.2.I1)		34.17[b]
P4 (72.2.3.J1)		34.67[ab]
P5 (94.3.3.K1)		34.25[ab]
P6 (115.1.5.R1)		34.92[ab]
P7 (124.2.3.S1)		34.75[ab]
P8 (Ciherang)		34.42[ab]
P9 (B11143D line)		36.08[ab]
P10 (Inpari 32)		38.08[a]
Coefficient of Variance	KK.a (%)	4.85
Fertilizer doses (a)		
A1 (200 kg NPK + 300 kg urea)		36.37[a]
A2 (350 kg NPK + 200 kg urea)		34.83[a]
A3 (300kg NPK + 150 kg urea)		34.53[a]
A4 (350kg NPK + 150 kg urea)		36.37[a]
Coefficient of Variance	KK.b (%)	3.77

Notes: Mean values with the same letter represent no significant difference at the 5% DMRT level.

Tables 4B. The Mean of Total Number of Productive Tillers of the Crossed Lines of Ciherang × B11143D Line and Comparison Varieties.

Interaction	Sub plot (Fertilizer doses)			
Main plot (Rice lines)	A1	A2	A3	A4
P1	24.67a	23.33b	21,67b	26,67a
	B	D	C	A
P2	21.33b	19.33b	24a	20b
	E	E	B	G
P3	23.67a	23b	23,67a	22b
	B	D	B	E
P4	21b	18.67c	17,33c	23,67a
	F	F	G	B
P5	19.67b	24a	19,33b	21b
	G	C	F	F
P6	22.67b	24,33a	20c	25a
	C	B	E	B
P7	18.67c	22,33a	22b	23a
	H	E	D	C
P8	25.33a	24,5a	24a	22,33b
	A	B	B	D
P9	23.33d	26,33a	24,67b	27a
	C	A	A	A
P10	21.67c	19,33b	21b	26a
	D	E	C	B

Notes: In each column, mean values followed by the same letter (uppercase vertical and lowercase horizontal) represent no significant difference at the 5% DMRT level.

According to the ANOVA in Table 4B, fertilizer doses and rice lines had a significant interaction effect on the total number of productive tillers. Fertilizer doses and rice lines also separately influenced this variable. Of all the crossed lines, P1 (20.4.4 G1) under the A4 fertilizer treatment (350 kg NPK + 150 kg urea) had the highest number of productive tillers (26.67), which was significantly higher than that of Ciherang.

B11143D line also produced more productive tillers than Ciherang under the A2 (350 kg NPK + 200 kg urea) and A4 fertilizer treatments, with values of 26.33 and 27.00, respectively. This agrees with the results of Damayanti *et al*. (2024), who found that B11143D consistently produced more productive tillers than Ciherang. B11143D is a new plant type rice variety, which typically produces fewer but more productive total tillers. In this study, the total number of tillers in B11143D line was generally greater than that of Ciherang. According to Maman *et al*. (2021), the total number of tillers directly influences the number of productive tillers, and more tillers usually also consist of more productive tillers in rice.

3.5 Filled Grain Weight

No interaction between fertilizer doses and rice lines for filled grain weight per panicle was found in the ANOVA analysis. Neither fertilizer doses nor rice lines had a significant effect on filled grain weight (Table 5). This lack of effect may be the result of the high coefficients of variation (12.29% for rice lines and 14.46% for fertilizer treatments). Sutoro *et al*., (2017) reported that environmental conditions such as high temperatures can disrupt starch synthesis, leading to reduced starch accumulation during the ripening phase and can strongly influence grain yield.

Genotype also plays a crucial role in filled grain weight, as different genotypes showed varying levels of adaptation to environmental conditions and nutrient availability (Hasan *et al*., 2020). In this study, the P7 (124.2.3.S1) line had the highest filled grain weight (4.38 g). The highest filled grain weight was 4.148 g, which was obtained under the A4 fertilizer treatment (350 kg NPK + 150 kg urea).

Table 5. The Mean of Filled Grain Weight per Panicle of the Crossed Lines of Ciherang × B11143D Line and Comparison Varieties.

Treatment		Filled grain weight (g)
Rice lines (p)		
P1 (20.4.4.G1)		3.98[a]
P2 (22.4.3.H1)		3.75[a]
P3 (70.3.2.I1)		4.37[a]
P4 (72.2.3.J1)		4.05[a]
P5 (94.3.3.K1)		4.00[a]
P6 (115.1.5.R1)		4.04[a]
P7 (124.2.3.S1)		4.38[a]
P8 (Ciherang)		4.24[a]
P9 (B11143D line)		3.78[a]
P10 (Inpari 32)		4.06[a]
Coefficient of Variance	KK.a (%)	12.29
Fertilizer doses (a)		
A1 (200 kg NPK + 300 kg urea)		4.079[a]
A2 (350 kg NPK + 200 kg urea)		4.026[a]
A3 (300kg NPK + 150 kg urea)		3.941[a]
A4 (350kg NPK + 150 kg urea)		4.148[a]
Coefficient of Variance	KK.b (%)	14.46

Notes: Mean values with the same letter represent no significant difference at the 5% DMRT level.

3.6 Unfilled Grain Weight

Data analysis revealed a significant interaction between fertilizer doses and rice lines on unfilled grain weight per panicle. Both factors—fertilizer doses and rice lines—had a significant effect on this variable. The average of unfilled grain weight is presented in Table 6.

As shown in Table 6, fertilizer doses and rice lines interacted to significantly influence unfilled grain weight. Among the progeny lines, the P1 (20.4.4 G1) line treated with the A4 fertilizer dose (350 kg NPK + 150 kg urea) had the lowest unfilled grain weight, with a value of 1.24 g. This was significantly lower than the comparison varieties (Ciherang, B11143D, and Inpari 32). In contrast, B11143D treated with the A3 fertilizer dose exhibited the highest unfilled grain weight, with a value of 3.2 g. This is consistent with findings that B11143D, as a new plant type of rice, tends to produce a higher unfilled grain weight. According to Abdullah *et al*., (2008) several new plant types of rice developed in Indonesia still face challenges, such as higher unfilled grain weights (Widyastuti *et al*., 2022).

These results suggest that the A4 fertilizer dose significantly reduced unfilled grain weight in the progeny lines. The balanced presence of nitrogen (N), phosphorus (P), and potassium (K) in the soil plays a critical role in rice productivity by promoting flower and grain formation, especially during the generative phase (Utami *et al*., 2016). Harmawati *et al*., (2023) also highlighted that unfilled grain weight per panicle is influenced by the grain ripening process. The balance between the source (photosynthetic capacity) and sink (grain-filling capacity) is a key determinant of yield potential. High unfilled grain weight reduces yield potential, while lower unfilled grain weight correlates with higher yield potential in rice (Budiarti, 2021).

Table 6. The Mean of Unfilled Grain Weight per Panicle of the Crossed Lines of Ciherang × B11143D Line and Comparison Varieties.

Interaction	Sub Plot (Fertilizer doses)			
Main Plot (Rice lines)	A1	A2	A3	A4
P1	1.3b	1.36c	1.28b	1,24a
	B	D	A	A
P2	1.25a	1.41c	1.3b	1,32b
	A	F	B	B
P3	1.28a	1.4b	1.41c	1,37b
	A	E	E	B
P4	1.39c	1.31a	1.36b	1,33a
	E	B	C	B
P5	1.36c	1.29a	1.39b	1,34a
	D	B	D	B
P6	1.29a	1.34b	1.33b	1,39c
	B	C	B	E
P7	1.32b	1.25a	1.31b	1,35c
	C	A	B	B
P8	1.41b	2.46b	1.44b	1,38a
	F	H	F	D
P9	3a	3.17b	3.2c	3,19b
	G	I	H	G
P10	1.73c	1.84d	1.56b	1,47a
	H	G	G	F

Notes: Mean values with the same letter (uppercase vertical and lowercase horizontal) represent no significant difference at the 5% DMRT level.

3.7 Total Grain Weight

ANOVA results indicated no significant interaction between fertilizer doses and rice lines for total grain weight. However, rice lines had a significant effect on this variable. The average total grain weight values are presented in Table 7. Among the progeny lines, P5 (94.3.3.K1) had the highest total grain weight, with a value of 64.93 g, while P3 (70.3.2.I1) exhibited the lowest, at 58.89 g. Lines P5 (94.3.3.K1), P1 (20.4.4.G1), P2 (22.4.3.H1), and P6 (115.1.5.R1) lines had significantly higher total grain weights than Ciherang.

Table 7. The Mean of Total Grain Weight of the Crossed Lines of Ciherang x B11143D Line and Comparison Varieties.

Treatment		Total grain weight (g)
Rice lines (p)		
P1 (20.4.4.G1)		63,894[b]
P2 (22.4.3.H1)		63,582[b]
P3 (70.3.2.I1)		58,890[c]
P4 (72.2.3.J1)		62,200[c]
P5 (94.3.3.K1)		64,930[a]
P6 (115.1.5.R1)		63,950[b]
P7 (124.2.3.S1)		62,226[c]
P8 (Ciherang)		63,261[c]
P9 (B11143D line)		64,618[ab]
P10 (Inpari 32)		64,658[ab]
Coefficient of Variance	KK.a (%)	13,35
Fertilizer doses (a)		
A1 (200 kg NPK + 300 kg urea)		65,6150[a]
A2 (350 kg NPK + 200 kg urea)		61,8270[a]
A3 (300kg NPK + 150 kg urea)		61,4837[a]
A4 (350kg NPK +150 kg urea)		64,3590[a]
Coefficient of Variance	KK.b (%)	12,67

Notes: Mean values with the same letter represent no significant difference at the 5% DMRT level.

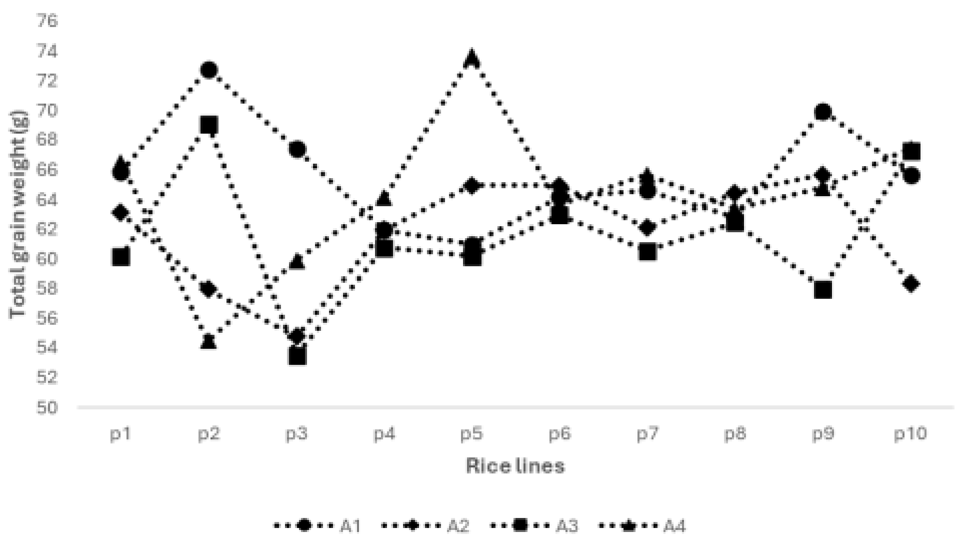

Figure 1. Total grain weight of all rice lines in four fertilizer doses (A1, A2, A3, and A4). P1-P7 = progeny lines of Ciherang x B11143D line; P8 = Ciherang; P9 = B11143D line; P10 = Inpari 32.

Figure 1 illustrates the total grain weight of the seven progeny lines of Ciherang x B11143D and the comparison varieties under four fertilizer doses. Several progeny lines outperformed Ciherang in total grain weight, notably P2 (22.4.3.H1) under the A1 and A3 fertilizer treatments, and P5 (94.3.3.K1) under the A4 fertilizer dose. On the other hand, Ciherang produced consistent total grain weight across all fertilizer treatments, while B11143D showed higher total grain weight under the A1 treatment. B11143D and Inpari 32 had lower total grain weights under A3 and A2, respectively.

The A4 fertilizer treatment appeared to have a positive impact on several important variables, such as the total number of productive tillers, unfilled grain weight, and total grain weight. Optimal fertilizer application is important for enhancing plant growth and development, especially during the generative phase (Supandji *et al*., 2019). During this phase, optimal photosynthesis is crucial for maximizing grain yield. Nitrogen in fertilizers is essential for photosynthesis, and optimal photosynthesis will ensure that the plant has sufficient energy to support grain filling and other critical functions.

4. CONCLUSIONS

Based on the results of this experiment, the following conclusions can be drawn: the rice lines had a significant influence on plant height, total number of tillers, and total grain weight. Among them, the P1 (20.4.4 G1) line had the greatest plant height, as well as the highest total number of tillers (36.48). Furthermore, the P1 (20.4.4 G1) line under the A4 treatment had the highest total number of productive tillers (26.67), which is significantly higher than Ciherang. In terms of total grain weight, the P5 (94.3.3.K1), P1 (20.4.4.G1), P2 (22.4.3.H1), and P6 (115.1.5.R1) lines all showed significantly higher values compared to Ciherang. There was a significant interaction between fertilizer doses and rice lines for flag leaf length, total number of productive tillers, and unfilled grain weight. The P2 (22.4.3 H1) line under the A2 fertilizer treatment had the longest flag leaf length (37.97 cm), while the P1 (20.4.4 G1) line under the A4 treatment had a flag leaf length of 35.83 cm. Both values were significantly greater than those of the Ciherang variety. Additionally, the P1 (20.4.4 G1) line under the A4 treatment had the lowest unfilled grain weight, with a value of 1.24 g, which was significantly lower than the comparison varieties.

The A4 fertilizer treatment (350 kg NPK + 150 kg urea) was identified as the most effective dose combination, as it positively influenced key variables such as the total number of productive tillers, unfilled grain weight, and total grain weight. The P1 (20.4.4.G1), P2 (22.4.3.H1), and P5 (94.3.3.K1) lines emerged as the top-performing lines across several traits, indicating their potential for higher yield performance.

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