Effect of Organic and Inorganic Fertilizer on the Growth and Yield Components of Traditional and Improved Rice (*Oryza sativa* L.) Genotypes in Malaysia

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** Abstract:** Rice is the most important staple cereal human nutrition and consumed by 75% of the global population. Rice plants need a supply of essential nutrients for their optimal growth. Rice production has increased tremendously in Malaysia insensitive irrigation and the use of inorganic fertilizers and pesticides. However, the effect of using inorganic fertilizers resulted in contamination of ground water and decreased the productivity of soil, which in turn affected the rice production in the long term. The use of organic manure may help to regain the soil health, but that is insufficient for providing the essential nutrients to achieve optimal growth. Therefore, the use of organic manure combined with inorganic fertilizers is applied to obtain optimum yields. This study aims to test the effect of organic and inorganic fertilizers on the growth and yield components of 65 rice genotypes. The pot experiment was conducted at the net house on field 10, University Putra Malaysia, UPM, Malaysia, during the period of February to June 2019 and August to December 2019 in a randomized complete block design (RCBD) with three replications. There were three treatment combinations viz. T1: 5 t ha⁻¹ chicken manure (CM), T2: 2.5 t ha⁻¹ CM + 50% CFRR, T3: 100% (150 N: 60 P₂O₅: 60 K₂O kg ha⁻¹) and chemical fertilizer recommended rate (CFRR). Grain and straw samples were collected for chemical analysis, and physical parameters were measured at the harvest stage. Results showed that most of the growth and yield components were significantly influenced due to the application of organic manure with chemical fertilizer. The application of chemical fertilizer alone or in combination with organic manure resulted in a significant increase in growth, yield component traits, and nutrient content (N, P, and K) of all rice genotypes. Treatment of 2.5 t ha⁻¹ CM + 50% CFRR as well as 100% CFRR showed a better performance than the other treatments. It was observed that the yield of rice genotypes can be increased substantially with the judicious application of organic manure with chemical fertilizer. The benefits of the mixed fertilization (organic + inorganic) were not only the crop yields but also the promotion of soil health, the reduction of chemical fertilizer input, etc.

**Keywords:** organic manure; crop productivity; rice; soil health; nutrient content

1. **Introduction**

Rice (*Oryza sativa* L.) is a widely farmed food crop that provides sustenance for more than half of the world’s population. “Rice is life” is the most appropriate slogan for the world, as this grain is critical to our national food security and provides a source of income.
for millions of rural people. Despite the enormous area under rice production, production is low due to a number of interrelated problems. One of the main causes of low production is an imbalance in fertilizer use, and the continued use of inorganic fertilizers has resulted in a decline in soil fertility. The use of inorganic fertilizers in conjunction with organic resources resulted in the highest grain and straw yields [1]. Using organic manure and chemical fertilizers in tandem would be very promising, not just in terms of increasing output stability but also in terms of improving soil fertility [2].

Organic manuring is becoming an increasingly significant part of environmentally healthy, long-term farming. Plant nutrients are replenished in agricultural soils primarily through inorganic, organic, and biofertilizers [3]. Inorganic fertilizers are used indefinitely, causing a decline in soil chemical, physical, and biological qualities, as well as soil health [4]. Chemical fertilizer’s negative effects, combined with rising prices, have sparked a surge in interest in organic fertilizers as a nutritional source [4,5]. For sustainable agricultural production, the use of organic resources as fertilizers has obtained plenty of attention [6,7]. Organic materials have a plenty of potential as a source of numerous nutrients and as a method for improving soil properties [8].

However, due to the comparatively low nutrient content of organic manures, they may not be enough to meet the plant’s needs. The application of organic manure with chemical fertilizer increases microbial activity, nutrient usage efficiency, and the availability of native nutrients to plants, resulting in increased nutrient uptake [9]. To obtain optimal yields, it is vital to employ organic manures in conjunction with inorganic fertilizers to provide the soil with all of the plant nutrients in easily available form and to maintain good soil health [10]. With a combination of safe modern technologies and traditional organic agriculture, which is not in its orthodox form, it has the potential to be approved for increased yields.

The use of organic manure in conjunction with chemical fertilizers has the potential to improve soil fertility and crop output. Integrated plant nutrition systems, particularly using organic manure, could improve crop productivity in intensive cropping systems. Organic manure has lately been discovered to be an excellent source of plant nutrients in the soil. Farmyard manure (FYM) and inorganic N and P fertilizers were used together to improve chemical and physical qualities, which could lead to increased and sustainable rice production [11]. Organic manure can provide a good amount of plant nutrients, which can help increase rice yield. As a result, in order to achieve a sustainable crop yield without depleting soil fertility, it is necessary to fertilize and manure in a coordinated manner.

Most cultivated soils in the world have less than 1.5% organic matter, although a good agricultural soil should have at least 2% organic matter. The use of organic manure in conjunction with chemical fertilizers can significantly boost rice output and soil productivity [12]. In a rice–rice cropping pattern, the integrated use of chemical and organic manure is critical for long-term crop productivity and soil fertility [2]. Soil organic matter boosts crop output by improving the physicochemical characteristics of the soil. Organic waste, farmyard manure, compost, and chicken manure have recently received attention as the most effective techniques for boosting soil fertility and thus crop output. Higher crop production necessitates a well-balanced mix of organic and inorganic fertilizer sources.

Inorganic fertilizers were employed with little or no addition of organic manure to generate increased rice yields. Even while inorganic fertilizers resulted in increased agricultural yields, the overuse of them was linked to deteriorated soil characteristics and degraded soils, resulting in lower yields in the future [13]. Chemical fertilizers, growth regulators, and pesticides are completely reliant on chemical fertilizers, growth regulators, and pesticides in the Western world to boost crop yield. Chemical fertilizer use has been linked to a number of negative health and environmental consequences [14]. Taking these factors into account, a middle ground between organic and inorganic fertilizer use for rice cultivation is necessary.

Chicken manure has been considered to be a soil additive to reduce the use of mineral fertilizers because it provides required nutrient amounts, increases cation-exchange capac-
ity, and improves water-holding capacity. Chicken manure not only increases the yield of rice but can also substitute chemical fertilizers to some extent.

However, the use of organic manure alone might not meet the plant requirement due to presence of a relatively low content of nutrients. The application of organic manure with chemical fertilizer accelerates the microbial activity, increases nutrient use efficiency, and enhances the availability of the native nutrients to the plants, resulting in a higher nutrient uptake. Therefore, in order to make the soil well supplied with all the plant nutrients in the readily available form and to maintain good soil health, it is necessary to use organic manure in combination with inorganic fertilizers to obtain optimum yields.

Therefore, the present research work was undertaken to investigate the effect of the combined application of organic and inorganic fertilizers on the growth and yield of traditional and improved rice genotypes.

2. Materials and Methods

2.1. Plant Material

A total of 64 traditional and improved rice cultivars were evaluated in this study. The cultivars were obtained from different sources. The genotypes names and origin are presented in Table 1. First, the seeds were dried under sunlight for 8 h before soaking in a Petri dish and being placed in a dark incubator for 2 days. After that, the germinated seeds were sown in the seed tray.

Table 1. Name, origin, grain size, shape, and status of sample of 64 traditional and improved rice genotypes.

| Code No | Name of Genotype | Source Country | Grain Size and Shape | Status of Sample |
|---------|------------------|----------------|----------------------|------------------|
| G1      | Pukhi            | Bangladesh     | MS                   | Traditional cultivar |
| G2      | Panbira          | Bangladesh     | SB                   | Traditional cultivar |
| G3      | Dharial          | Bangladesh     | MB                   | Traditional cultivar |
| G4      | Utri             | Bangladesh     | MS                   | Traditional cultivar |
| G5      | Luanga           | Bangladesh     | MS                   | Traditional cultivar |
| G6      | Kaisa panja      | Bangladesh     | MS                   | Traditional cultivar |
| G7      | Vandana          | Bangladesh     | MS                   | Traditional cultivar |
| G8      | Dular            | Bangladesh     | MB                   | Traditional cultivar |
| G9      | Sondhamoni       | Bangladesh     | MB                   | Traditional cultivar |
| G10     | Hasikamli        | Bangladesh     | MS                   | Traditional cultivar |
| G11     | Dumai            | Bangladesh     | MS                   | Traditional cultivar |
| G12     | Parija           | Bangladesh     | MS                   | Traditional cultivar |
| G13     | Kataktara        | Bangladesh     | MS                   | Traditional cultivar |
| G14     | Baldia           | Bangladesh     | SB                   | Traditional cultivar |
| G15     | Binnatoa         | Bangladesh     | MS                   | Traditional cultivar |
| G16     | Parangi          | Bangladesh     | MB                   | Traditional cultivar |
| G17     | Chengri          | Bangladesh     | MS                   | Traditional cultivar |
| G18     | Dhala saitta     | Bangladesh     | SB                   | Traditional cultivar |
| G19     | Morich boti      | Bangladesh     | SB                   | Traditional cultivar |
| G20     | Saitta           | Bangladesh     | MB                   | Traditional cultivar |
| G21     | Lal Dular        | Bangladesh     | MS                   | Traditional cultivar |
| G22     | Nayan moni       | Bangladesh     | MS                   | Traditional cultivar |
| G23     | Kalabokra        | Bangladesh     | MB                   | Traditional cultivar |
| G24     | HUA565           | Philippines    | MS                   | Improved cultivar |
| G25     | Takarani         | Philippines    | MB                   | Improved cultivar |
| G26     | Kachalath        | India          | MS                   | Improved cultivar |
| G27     | Wkhi1            | Philippines    | MS                   | Improved cultivar |
| G28     | Hukuriku193      | Philippines    | MB                   | Improved cultivar |
| G29     | ML6              | Malaysia       | LS                   | Breeding line |
| G30     | ML9              | Malaysia       | LS                   | Breeding line |
| G31     | Wanlim-P10       | Malaysia       | MS                   | Traditional cultivar |
| G32     | RENGAN WANG      | Malaysia       | LS                   | Traditional cultivar |
| G33     | PETEH PERAK      | Malaysia       | LB                   | Traditional cultivar |
| G34     | WANGI PUTEH      | Malaysia       | MB                   | Traditional cultivar |
| G35     | KUNYIT           | Malaysia       | MS                   | Traditional cultivar |
| G36     | GHAU             | Malaysia       | LS                   | Traditional cultivar |
| G37     | LALAMG           | Malaysia       | MS                   | Traditional cultivar |
| G38     | MGAWA            | Malaysia       | MS                   | Traditional cultivar |
| G39     | SUNGKAI          | Malaysia       | MS                   | Traditional cultivar |
| G40     | UGAN             | Malaysia       | LS                   | Traditional cultivar |
Table 1. Cont.

| Code No | Name of Genotype | Source Country | Grain Size and Shape | Status of Sample |
|---------|------------------|----------------|----------------------|------------------|
| G41     | TADOM            | Malaysia       | MS                   | Traditional cultivar |
| G42     | BANGKUL          | Malaysia       | MS                   | Traditional cultivar |
| G43     | NMR151           | Malaysia       | LS                   | Improved cultivar |
| G44     | NMR152           | Malaysia       | LS                   | Improved cultivar |
| G45     | MR297            | Malaysia       | LS                   | Improved cultivar |
| G46     | Putra 1          | Malaysia       | LS                   | Improved cultivar |
| G47     | Putra 2          | Malaysia       | LS                   | Improved cultivar |
| G48     | MR 303           | Malaysia       | LS                   | Improved cultivar |
| G49     | MR 309           | Malaysia       | LS                   | Improved cultivar |
| G50     | BR24             | Bangladesh     | MS                   | Improved cultivar |
| G51     | BRRI dhan48      | Bangladesh     | MS                   | Improved cultivar |
| G52     | BRRI dhan82      | Bangladesh     | MS                   | Improved cultivar |
| G53     | BRRI dhan72      | Bangladesh     | MS                   | Improved cultivar |
| G54     | BRRI dhan28      | Bangladesh     | MS                   | Improved cultivar |
| G55     | BRRI dhan39      | Bangladesh     | MS                   | Improved cultivar |
| G56     | BRRI dhan42      | Bangladesh     | MS                   | Improved cultivar |
| G57     | BRRI dhan43      | Bangladesh     | MS                   | Improved cultivar |
| G58     | BRRI dhan46      | Bangladesh     | SB                   | Improved cultivar |
| G59     | BRRI dhan75      | Bangladesh     | MS                   | Improved cultivar |
| G60     | BRRI dhan55      | Bangladesh     | MS                   | Improved cultivar |
| G61     | BRRI dhan69      | Bangladesh     | MS                   | Improved cultivar |
| G62     | B370             | India          | LS                   | Improved cultivar |
| G63     | BINASAIL         | Bangladesh     | MB                   | Improved cultivar |
| G64     | BINA dhan7       | Bangladesh     | MB                   | Improved cultivar |

2.2. Site of Experimentation

The pot experiment was conducted in a net house at the field 10, University Putra Malaysia (UPM), Malaysia. The experiment was conducted in two seasons, the first season being from February 2019 to June 2019 and the second season from August 2019 to December 2019. Geographically, the place is located at about 3°02’ N latitude and 101°42’ E longitude with an elevation of 31 m from the sea level, and it is characterized by a humid tropical climate. Details of the weather information are presented in Table 2.

Table 2. Month-wise average of daily maximum temperature, minimum temperature, mean temperature, and rainfall at UPM during experimentation period from February to June (1st planting season) and from August to December (2nd planting season) 2019.

| Month    | Temperature (°C) | Rain Fall (mm) | Temperature (°C) | Rain Fall (mm) |
|----------|------------------|----------------|------------------|----------------|
| 1st Planting | Max. | Min. | Ave. |          |          | 2nd Planting | Max. | Min. | Ave. |          |          |
| February | 35.52 | 26.23 | 30.88 | 118.76 |          | August | 33.60 | 25.57 | 29.53 | 114.76 |          |
| March    | 35.34 | 26.18 | 30.76 | 119.45 |          | September | 33.24 | 25.34 | 29.29 | 120.39 |          |
| April    | 35.48 | 26.14 | 30.81 | 120.62 |          | October | 32.72 | 25.11 | 28.92 | 232.73 |          |
| May      | 34.75 | 25.77 | 30.26 | 121.58 |          | November | 32.66 | 24.82 | 28.74 | 235.41 |          |
| June     | 34.60 | 25.63 | 30.12 | 121.74 |          | December | 31.54 | 24.59 | 28.07 | 242.93 |          |
| Average  | 35.14 | 25.99 | 30.57 | 602.15 |          | Average | 32.73 | 25.09 | 28.91 | 946.22 |          |
| Total    |          |          |          | 602.15 |          |          |          |          | 946.22 |          |

2.3. Experimental Design and Treatments

The experiment was conducted following a randomized complete block design with three replication on each treatment. Twenty-day-old seedlings of each test genotypes were transplanted, and two seedlings were used per hill in 45 cm diameter and 52 cm height plastic pot with 15 kg soil and 20 cm spacing between hills. There were three (3) treatment combinations with chicken manure (CM) and chemical fertilizer recommended rate (CFRR) for high goal (HYG) as follows—T<sub>1</sub>: CM (5 t ha<sup>−1</sup>), T<sub>2</sub>: CM (2.5 t ha<sup>−1</sup>) + 50% CFRR (NPK) and T<sub>3</sub>: 100% CFRR (NPK).
2.4. Application of Fertilizer and Operational of Intercultural

Organic fertilizer was incorporated into the soil before crop establishment, while a compound fertilizer (NPK 2.16:1.89:0.79) was applied at the rate of 5 t ha\(^{-1}\). Triple super phosphate and muriate of potash were applied during final pot preparation, and urea was applied in two split doses at 25 days after seeding (DAS) and at 55 DAS, to supply total recommended nutrient of 150 N: 60 P\(_2\)O\(_5\): 60 K\(_2\)O kg ha\(^{-1}\). Both organic fertilizer and chemical fertilizer were applied as prescribed by the treatments. Weeding and other management practices were performed as and when required. Irrigation was also conducted whenever required.

2.5. Soil Analyses

Initial soil samples were taken from the surface to a depth of 0–15 cm. The samples were air-dried and crushed to pass through a 2 mm (10 meshes) sieve after being free of weeds, plant roots, stubbles, and stones. After that, the samples were placed in clean plastic bags to be analyzed chemically and mechanically. Standard procedures were used to assess the physical and chemical qualities of the initial and postharvest soil samples in Table 3. The textural class was calculated by projecting the values for percent sand, percent silt, and percent clay to the Marshall’s Triangular Coordinate following the USDA methodology, and the particle size analysis of the soil was performed by hydrometer method [15]. Organic matter was determined by Walkley and Black method [16], soil pH (1:2.5 soil-water) by glass electrode pH meter method [17], total N by semi-micro Kjeldahl method [18], available P by Olsen method [19], exchangeable K by flame photometer after extraction with 1N NH\(_4\)OAc at pH 7.0 [20], available S by extracting soil samples with CaCl\(_2\), solution (0.15%), and by measuring turbidity by spectrophotometer [21] method and CEC by sodium saturation method [15].

Table 3. Physiochemical characteristics of the initial and postharvest soil sample at the pot experiment on over two planting seasons, 2019.

| Soil Characters | Initial | After Crop Harvest |
|----------------|---------|--------------------|
|                |         | 5 t/ha CM | 2.5 t/ha CM + 50% CF | 100% CF |
|                |         | 1st Planting | 2nd Planting | 1st Planting | 2nd Planting | 1st Planting | 2nd Planting |
| pH             | 5.9     | 6.01 | 6.03 | 6.02 | 6.03 | 6.0 | 6.01 |
| EC (\(\mu\)S/cm) | 54      | 57 | 59 | 61 | 63 | 67 |
| CEC            | 16.72   | 17.23 | 17.83 | 18.54 | 19.36 | 19.22 | 19.48 |
| Organic carbon (%) | 0.67   | 0.71 | 0.74 | 0.76 | 0.81 | 0.77 | 0.80 |
| Organic matter (%) | 1.32   | 1.57 | 1.66 | 1.54 | 1.59 | 1.49 | 1.55 |
| Total N (%)    | 0.07    | 0.09 | 0.12 | 0.11 | 0.14 | 0.15 | 0.18 |
| Exchangeable K (cmol\(\text{kg}^{-1}\)) | 0.28   | 0.31 | 0.33 | 0.33 | 0.37 | 0.36 | 0.39 |
| Available P (mgkg\(^{-1}\)) | 17.54  | 17.86 | 18.32 | 18.59 | 19.83 | 19.45 | 19.78 |
| Sand           | 31.63   | 31.95 | 32.24 | 32.56 | 32.84 | 31.69 | 32.27 |
| Silt           | 34.18   | 34.36 | 35.22 | 35.51 | 35.79 | 35.62 | 36.45 |
| Clay           | 27.49   | 27.64 | 28.27 | 28.33 | 28.65 | 27.74 | 28.46 |
| Soil texture   | Clay loam | Clay loam | Clay loam | Clay loam | Clay loam | Clay loam |

Chemical properties of the chicken manure (dry basis).

| Properties | Percentage |
|------------|------------|
| N          | 2.16%      |
| P          | 1.89%      |
| K          | 0.79%      |
2.6. Plant Tissue Analyses

After harvest, plant samples were collected from each treatment, and the samples were separated into the shoot (above ground plant parts excluding the grains), root, and grain, after which they were oven-dried at 70 °C for 72 h. Oven-dried samples were ground in the laboratory using a Wiley hammer mill with 1 mm mesh size. The samples were analyzed for total nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). The nutrients were determined using acid wet digestion method [22]. For the digestion process, ground samples of 0.25 g were transferred to clean 100 mL digestion flask, and 5 mL of concentrated sulfuric acid (H\(_2\)SO\(_4\)) was added to each flask. The samples were allowed to stand for 2 h, after which 2 mL of 50% hydrogen peroxide (H\(_2\)O\(_2\)) was added. The flasks were heated for 45 min at 285 °C and then allowed to cool. This process was repeated twice to let the digestion be clear (colorless). The flasks were then removed from the digestion block, cooled to room temperature, and made up to 100 mL with distilled water filtered through filter paper (Whatman no. 1). The digested samples were stored in plastic vials before analysis for N, P, K, Ca, and Mg. Nitrogen and potassium were determined with auto analyzer (AA) (Lachat instrument, Milwaukee, WI, USA), while potassium, calcium, and magnesium were determined using automatic absorption spectrometer (ASS) (Perkin Elmer, 5100, Waltham, MA, USA).

2.7. Obtaining the Data

The data on morphological, physiological, and yield characteristics were collected in this study, which includes the quantitative characters that can be counted or measured using specific measuring tools such as plant height (PH, cm), total number of tiller per plant (NT, no.), total number of panicle per plant (NP, no.), panicle length (PL, cm), number of filled grains per panicle (NFG, no), number of unfilled grains per panicle (UNFG, no), 1000 grain weight (TGW, g), grain yield per plant (YP, g), straw yield per plant (SY, g), harvest index (HI, %), and nutrient content (N, P, and K) of grain and straw samples.

2.8. Statistical Analysis

All evaluated data were analyzed by pooled statistical analysis software (SAS) version 9.4 to test for significant differences using the analysis of variance (ANOVA) procedure and least significant differences (LSD) (p ≤ 0.001, 0.05) to compare among the significant characteristics mean using the Duncan’s new multiple range test (DNMRT) [23]. Prior to running ANOVA, data were tested for normal distribution and homogeneity of variance. These were used to determine the level of variation of all observed traits, which was brought about by genotypes, seasons, treatments, genotypes by treatments, genotypes by seasons, and genotypes by treatments by seasons to determine the level of variations.

3. Results

3.1. Morphological Traits

3.1.1. Plant Height

Plant height at the time when the plant reaches maturity varied from genotype to genotype; there was a significant difference (p ≤ 0.01) among the rice genotype, treatment, genotype by treatment, and genotype by season (combination of genotype and season) as presented in Table 4. Results indicated that the application of T\(_2\) (2.5 t ha\(^{-1}\) CM + 50% CFRR) produced the tallest plant height recorded in kalabokra (G23) (171.39 cm) followed by Kataktara (G13), Kaisa panja (G6), Saitta (G20), Nayan moni (G22), Parija (G12), and Panbira (G2) (169.98, 169.68, 163.97, 163.87, 163.45, and 162.65 cm, respectively), which were significantly higher than other treatments except T\(_3\) (100% CFRR), which had a similar plant height. The application of T\(_1\) (5 t ha\(^{-1}\) CM) produced a shorter plant height recorded in BRRI dhan69 (G61), BRRI dhan46 (G58), BRRI dhan75 (G59), BRRI dhan42 (G56), BINA dhan7 (G64), BRRI dhan48 (G51), and BRRI dhan55 (G60) (114.77, 115.94, 115.99, 117.56, 117.74, 117.82, and 117.91 cm, respectively) was presented in Table 5.
Table 4. Pooled analysis of variance mean square of growth traits across two planting seasons.

| Variable | DF | PH | NT | NFG | NUFG | NP | PL | 1000-GW | YP | SY | HI |
|----------|----|----|----|-----|------|----|----|----------|----|----|----|
| Replication with seasons (R) | 4  | 188.37 ** | 21.66 ** | 1476.35 ** | 1110.73 ** | 12.53 ** | 7.87 ** | 7.79 ** | 1.71 ** | 86.66 ** | 0.01 ** |
| Seasons (S) | 1  | 137.78 ** | 227.57 ** | 1884.81 ** | 1146.12 ** | 147.20 ** | 0.46 *ns | 5.68 ** | 75.21 ** | 124.79 ** | 0.01 ** |
| Treatments (T) | 2  | 2665.25 ** | 249.86 ** | 13191.15 ** | 3290.56 ** | 120.86 ** | 28.72 ** | 67.11 ** | 119.63 ** | 701.82 ** | 0.13 ** |
| S × T | 2  | 50.15 ** | 2.09 * | 27.93 ns | 34.96 ** | 9.04 ** | 16.95 ** | 1.10 ** | 5.76 ** | 16.10 ** | 0.01 ** |
| S × R × T (Error a) | 8  | 0.84 ns | 14.25 ** | 22.98 ns | 5.11 ns | 11.28 ** | 1.01 ns | 3.50 ns | 9.76 ** | 0.00 ns |
| Genotypes (G) | 63 | 3433.63 ** | 54.74 ** | 8967.37 ** | 1982.55 ** | 28.44 ** | 125.48 ** | 152.32 ** | 186.68 ** | 159.08 ** | 0.20 ** |
| G × S | 63 | 1.92 ** | 0.94 ** | 32.94 ** | 16.30 ** | 0.90 ** | 2.51 ** | 0.27 ** | 0.88 ** | 1.14 ** | 0.00 ** |
| G × T | 126 | 10.62 ** | 2.77 ** | 39.62 ** | 19.56 ** | 1.97 ** | 2.54 ** | 3.59 ** | 0.71 ** | 8.11 ** | 0.00 ** |
| G × S × T | 126 | 2.09 ** | 0.88 ** | 13.60 ns | 4.96 ** | 0.82 ** | 2.27 ** | 0.20 ns | 0.39 ns | 0.83 ns | 0.00 ** |
| Error b | 756 | 0.92  | 0.59  | 11.56  | 3.06  | 0.58  | 0.74  | 0.16  | 0.38  | 0.96  | 0.00  |

** = significant at $p \leq 0.01$, * = significant at $p \leq 0.05$, ns = not significant, DF = degree of freedom, PH = Plant height, NT = Number of tillers per plant, NFG = Number of filled grains per panicle, NUFG = Number of unfilled grains per panicle, NP = Number of panicles per plant, PL = panicle length, 1000-GW = 1000 grain weight, YP = Yield per plant, SY = Straw yield and HI = Harvest index.

3.1.2. Number of Tillers per Plant

The number of tillers per plant showed a significant difference ($p \leq 0.01$) among the rice genotype, treatment, genotype by treatment, and genotype by season (combination of genotype and season) as presented in Table 4. Results indicated that the application of $T_2$ (2.5 t ha$^{-1}$ CM + 50% CFRR) produced a significantly higher number of tillers plant$^{-1}$ recorded in Takanari (G25) (14.88) followed by Putra 1 (G46), MR297 (G45), Putra 2 (G47), BR24 (G50), BRRI dhan48 (G51), and BRRI dhan39 (G55) (14.67, 14.56, 14.55, 13.77, 13.74, and 13.73, respectively), which were significantly higher than other treatments except $T_3$ (100% CFRR), which had a similar number of tillers plant$^{-1}$. The application of $T_1$ (5 t ha$^{-1}$ CM) gave the lowest number of tillers plant$^{-1}$ recorded in RENGAN WANG (G32), KUNYIT (G35), Nayan moni (G22), Kataktara (G13), Panbira (G2), BANGKUL (G42), and Saitha (G20) (6.46, 6.56, 6.55, 6.72, 6.73, 7.37, and 7.46, respectively) was presented in Table 5.

3.2. Physiological Traits

Straw Yield per Plant and Harvest Index

Straw yield per plant and harvest index showed a significant difference ($p \leq 0.01$) among the rice genotype, treatment, genotype by treatment, and genotype by season (combination of genotype and season) as presented in Table 4. Results indicated that the application of $T_2$ (2.5 t ha$^{-1}$ CM + 50% CFRR) produced a significantly higher straw yield recorded in BRRI dhan39 (G55) (28.73 g plant$^{-1}$) followed by BR24 (G50), BRRI dhan75 (G59), BRRI dhan72 (G53), and BRRI dhan48 (G51) (28.63, 28.43, 28.15, and 27.84 g plant$^{-1}$, respectively), and harvest index recorded in MR309 (G49) (0.73%) followed by Putra 1 (G46), BR24 (G50), MR297 (G45), and Putra 2 (G47) (0.73%, 0.72%, 0.70%, and 0.67%, respectively) were significantly higher than other treatments except $T_3$ (100% CFRR), which had a similar straw yield and harvest index. The application of $T_1$ (5 t ha$^{-1}$ CM) recorded a lower straw yield in Kalabokra (G23), Vandana (G7), Kataktara (G13), Luanga (G5), and Panbira (G2) (15.18, 15.75, 16.44, 16.77, and 17.25), and harvest index recorded in RENGAN WANG (G32), Wanxiam-P10 (G31), BRRI dhan43 (G57), B370 (G62), and WANGI PUTEH (G34) (0.30%, 0.32%, 0.32%, 0.34%, and 0.35%, respectively) were presented in Table 6.
### Table 5. Plant height and number of tillers per plant of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (T) | PH (cm) | NT |
|--------------|---------------|---------|----|
| G1           | 1             | 137.14  | 140.56b |
|              | 2             | 140.29a | 145.12a |
|              | 3             | 139.15b | 143.98a |
| LSD(0.05)    | 1             | 2.96    | 2.67 |
|              | 2             | 155.11b | 145.65b |
|              | 3             | 156.81b | 145.02b |
| LSD(0.05)    | 1             | 0.24    | 2.45 |
|              | 2             | 1.34    | 1.65 |
|              | 3             | 2.64    | 3.04c |
| G3           | 1             | 143.69a | 161.74a |
|              | 2             | 146.14a | 163.98a |
|              | 3             | 144.34a | 163.55a |
| LSD(0.05)    | 1             | 0.16    | 0.28 |
|              | 2             | 1.61    | 3.59 |
|              | 3             | 1.33    | 1.56a |
| G5           | 1             | 154.63b | 164.86b |
|              | 2             | 147.13b | 164.53b |
|              | 3             | 153.78a | 161.38b |
| LSD(0.05)    | 1             | 0.27    | 0.84 |
|              | 2             | 0.13    | 0.87 |
|              | 3             | 0.44    | 1.33 |
| G7           | 1             | 159.43a | 169.75a |
|              | 2             | 144.27a | 126.78a |
|              | 3             | 144.02a | 124.61a |
| LSD(0.05)    | 1             | 0.26    | 0.37 |
|              | 2             | 0.27    | 0.34 |
|              | 3             | 0.47    | 0.71 |
| G10          | 1             | 142.77a | 137.78a |
|              | 2             | 141.95a | 135.02a |
|              | 3             | 137.92b | 142.36a |
| LSD(0.05)    | 1             | 0.15    | 0.27 |
|              | 2             | 0.19    | 0.31 |
|              | 3             | 0.39    | 0.53 |
| G12          | 1             | 143.93a | 149.43a |
|              | 2             | 145.53c | 144.43c |
|              | 3             | 137.71a | 140.71b |
| LSD(0.05)    | 1             | 0.28    | 0.42 |
|              | 2             | 0.21    | 0.47 |
|              | 3             | 0.49    | 0.74 |
| G13          | 1             | 145.07a | 134.79a |
|              | 2             | 142.29a | 134.17a |
|              | 3             | 166.25b | 133.54b |
| LSD(0.05)    | 1             | 0.41    | 0.74 |
|              | 2             | 0.28    | 0.53 |
|              | 3             | 0.46    | 0.55 |

In a column, means with similar letter(s) are statistically identical, and those with dissimilar letter(s) differ significantly as per 0.05 level of probability, T1 = 5 t ha⁻¹ CM, T2 = 2.5 t ha⁻¹ 50% CFRR, T3 = 100% CFRR, PH= plant height, and NT= number of tillers per hill.
Table 6. Straw yield and harvest index of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (G) | SY (g) | HI (%) |
|--------------|--------------|--------|--------|
| G1           |              |        |        |
| 1            | 22.62b       | 23.38a | 19.53c |
| 2            | 24.63a       | 24.85a | 23.48a |
| 3            | 24.28a       | 24.17a | 21.36b |
| LSD(0.05)    | 1.31a        | 1.28a  | 1.83a  |
| G2           |              |        |        |
| 1            | 17.25a       | 22.95a | 21.73b |
| 2            | 18.73a       | 24.89a | 23.67a |
| 3            | 18.34a       | 23.78a | 20.19b |
| LSD(0.05)    | 1.82         | 2.44a  | 1.66a  |
| G3           |              |        |        |
| 1            | 25.56ab      | 23.56b | 19.52  |
| 2            | 25.38a       | 27.45a | 23.45b |
| 3            | 23.68b       | 26.63a | 20.63  |
| LSD(0.05)    | 1.69         | 1.81   | 1.81   |
| G4           |              |        |        |
| 1            | 25.57ab      | 24.39a | 18.53a |
| 2            | 24.26a       | 18.93a | 24.61a |
| 3            | 23.35b       | 16.88b | 22.85b |
| LSD(0.05)    | 2.49         | 1.68a  | 2.26a  |
| G5           |              |        |        |
| 1            | 16.75b       | 22.62a | 19.63b |
| 2            | 18.72a       | 25.21a | 24.58a |
| 3            | 18.58ab      | 21.46b | 20.47b |
| LSD(0.05)    | 1.96         | 2.85b  | 4.39b  |
| G6           |              |        |        |
| 1            | 17.83ab      | 17.27b | 18.53b |
| 2            | 20.55a       | 20.84a | 20.74a |
| 3            | 17.42b       | 17.11b | 17.83b |
| LSD(0.05)    | 2.66         | 1.79   | 2.10b  |
| G7           |              |        |        |
| 1            | 15.78b       | 15.18b | 18.93b |
| 2            | 18.33a       | 19.34a | 23.45a |
| 3            | 16.72b       | 16.78b | 19.75b |
| LSD(0.05)    | 1.79         | 2.11a  | 1.99a  |
| G8           |              |        |        |
| 1            | 23.74a       | 27.43a | 22.39a |
| 2            | 23.56b       | 25.93a | 19.63b |
| 3            | 1.72         | 2.24a  | 1.98a  |
| LSD(0.05)    | 1.22         | 2.44a  | 2.22a  |
| G9           |              |        |        |
| 1            | 24.53ab      | 22.97b | 18.37b |
| 2            | 25.96a       | 25.26a | 21.83a |
| 3            | 23.37b       | 22.57b | 18.97b |
| LSD(0.05)    | 2.44         | 2.11   | 2.33a  |
| G10          |              |        |        |
| 1            | 22.69b       | 23.66a | 18.35a |
| 2            | 25.56a       | 26.56a | 22.36a |
| 3            | 24.65a       | 22.83a | 17.82a |
| LSD(0.05)    | 3.21         | 2.11   | 2.33a  |
| G11          |              |        |        |
| 1            | 25.64a       | 19.37b | 22.78b |
| 2            | 21.52a       | 25.64a | 25.25a |
| 3            | 18.86b       | 19.24b | 21.83b |
| LSD(0.05)    | 2.33         | 1.64   | 1.84a  |
| G12          |              |        |        |
| 1            | 17.44b       | 24.08a | 21.67b |
| 2            | 24.35a       | 24.87a | 24.87a |
| 3            | 20.74a       | 25.18a | 23.56a |
| LSD(0.05)    | 1.73         | 2.16   | 1.69   |
| G13          |              |        |        |
| 1            | 16.44b       | 18.24c | 25.46a |
| 2            | 18.57a       | 25.64a | 27.63a |
| 3            | 17.52ab      | 22.86b | 25.96a |
| LSD(0.05)    | 1.69         | 1.80a  | 2.27a  |
| G14          |              |        |        |
| 1            | 23.65b       | 20.75b | 25.17a |
| 2            | 25.85a       | 25.54a | 26.73a |
| 3            | 24.78a       | 24.27a | 25.11a |
| LSD(0.05)    | 1.45         | 1.94   | 2.16   |
| G15          |              |        |        |
| 1            | 22.26b       | 26.38a | 22.87a |
| 2            | 25.63a       | 26.61a | 24.77a |
| 3            | 23.48a       | 24.78b | 5.85a  |
| LSD(0.05)    | 2.27         | 1.31   | 2.49   |
| G16          |              |        |        |
| 1            | 23.56a       | 20.75c | 23.53a |
| 2            | 24.78a       | 22.45a | 26.63a |
| 3            | 23.42a       | 25.63b | 24.93a |
| LSD(0.05)    | 3.28         | 2.48a  | 2.93a  |

In a column, means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability, $T_1 = 5$ t ha$^{-1}$ CM, $T_2 = 2.5$ t ha$^{-1} + 50%$ CFRR, $T_3 = 100%$ CFRR, SY= straw yield per plant, and HI = harvest index.
3.3 Yield and Yielding Contributing Traits

3.3.1 Number of Panicles per Plant and Panicle Length

In order to increase the grain yield, the most important aspect on the growth of rice is the panicle number per plant. There was a highly significant difference (p ≤ 0.01) among the rice genotype, treatment, genotype by treatment, and genotype by season (combination of genotype and season) on number of panicles plant\(^{-1}\) and panicle length as presented in Table 4. Results indicated that the application of T\(_2\) (2.5 t ha\(^{-1}\) CM + 50% CFRR) produced significantly higher numbers of panicles plant\(^{-1}\) recorded in HUA565 (G24) (12.18) followed by MR297 (G45), Putra 1 (G46), Putra 2 (G47), and BRRI dhan39 (G55) (11.37, 11.26, 11.16, and 110.61, respectively) and longest panicle length recorded in Putra 1 (G46), BRRI dhan28 (G54), BRRI dhan48 (G51), and Putra 2 (G47) (26.98, 26.89, 26.86 and 26.55 cm, respectively), which were significantly higher than other treatments except T\(_3\) (100% CFRR), which had a similar number of panicle plant\(^{-1}\) and panicle length. The application of T\(_1\) (5 t ha\(^{-1}\) CM) recorded a lower number of panicles plant\(^{-1}\) in WANGI PUTEH (G34), Nayan moni (G22), Panbira (G2), Katkata (G13), and RANGAN WANG (G32) (4.93, 5.28, 5.27, 5.72, and 5.75, respectively) and the shortest panicle length recorded in Kaisa panja (G6), Vandana (G7), Katakata (G13), Kalobokra (G23), and Saïta (G20) (16.46, 17.16, 17.19, 17.20, and 17.43 cm, respectively) were presented in Table 7.

Table 7. Number of panicles per hill and panicle length of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (T) | NP | PL (cm) |
|-------------|---------------|----|---------|
|             |               |    |         |
| G1          |               | 8.33a| 8.27b  |
| 1           |               | 8.09a| 10.42a |
| 2           |               | 7.28a| 9.38ab |
| 3           |               | 5.22a| 8.52a  |
| LSD(0.05)   |               | 5.26a| 4.93b  |
| G2          |               | 5.63a| 9.73a  |
| 1           |               | 5.48a| 9.45a  |
| LSD(0.05)   |               | 1.16 | 1.99   |
| G3          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G4          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G5          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G6          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G7          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G8          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G9          |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G10         |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |
| G11         |               | 8.27a| 9.24a  |
| 1           |               | 7.28a| 7.19a  |
| LSD(0.05)   |               | 1.65 | 1.63   |

Note: LSD values at P ≤ 0.05.
Table 7. Cont.

| Genotype (G) | Treatment (T) | NP | PL (cm) |
|--------------|---------------|----|---------|
|              | 1             |    |         |
|              | 2             |    |         |
|              | 3             |    |         |
|              | LSD(0.05)     |    |         |
| G12          | 1             | 7.02a | 9.57a | 8.75a | 8.62b | 18.24c | 22.23a | 19.18a | 22.28ab |
|              | 2             | 6.64a | 9.31a | G44   | 9.29a | G60   | 9.56a | G12   | 19.35a |
|              | 3             | 6.59a | 8.64a | G18   | 8.48b | G30   | 9.08b | G22   | 19.08b |
|              | LSD(0.05)     | 1.48 | 1.99  | 1.66  | 0.32  | 0.27  | 0.21  | 0.39  |
| G13          | 1             | 5.72b | 10.73a| 10.28a| 8.27b  | G15   | 17.19b| 21.1ab| 26.96c |
|              | 2             | 7.46a | 9.48b | G45   | 11.57a| G61   | 9.49a | G13   | 18.27a |
|              | 3             | 5.68b | 7.73c | 10.28a| 7.61b  | G13   | 17.3b | 20.6b  | 22.97a |
|              | LSD(0.05)     | 1.18 | 1.17  | 1.18  | 1.67  | 0.35  | 0.40  | 0.24  | 0.39   |
| G14          | 1             | 8.11a | 10.23a| 10.68a| 6.72b  | G14   | 23.3a | 20.13b| 26.35a |
|              | 2             | 8.57a | 9.22b | G46   | 11.26a| G62   | 7.48a | G14   | 24.6b  |
|              | 3             | 8.52a | 7.92b | 9.87a | 7.38b  | G14   | 21.63b| 20.36b| 26.67a |
|              | LSD(0.05)     | 2.2  | 1.79  | 2.23  | 1.19  | 0.60  | 0.39  | 0.49  | 0.41   |
| G15          | 1             | 7.29b | 5.88b | 10.28a| 6.67b  | 23.38a| 19.26b| 25.48b| 22.38a |
|              | 2             | 9.43a | G31   | 6.63a | G47   | 11.16a| G63   | 9.18a | G15   | 23.29a |
|              | 3             | 8.67ab| 7.47a | 10.46a| 7.74ab | G15   | 19.76a| 26.2a | 26.32a |
|              | LSD(0.05)     | 1.97 | 1.18  | 1.79  | 1.91  | 0.56  | 0.91  | 0.25  | 0.28   |
| G16          | 1             | 7.83a | 5.73b | 9.47a | 7.33a  | 21.52b| 20.33b| 24.6a | 23.07b |
|              | 2             | 9.35a | G32   | 6.49ab| G48   | 8.72a | G64   | 8.18a | G16   | 22.37a |
|              | 3             | 8.74a | 6.82a | 9.38a | 8.43a  | G16   | 21.95a| 20.4b | 26.28a |
|              | LSD(0.05)     | 2.31 | 1.18  | 1.51  | 1.9   | 0.288 | 0.33  | 0.33  | 0.35   |

In each column, means with similar letter (s) are statistically identical, and those with dissimilar letter (s) differ significantly as per 0.05 level of probability, T1 = 5 t ha−1 CM, T2 = 2.5 t ha−1 + 50% CFRR, T3 = 100% CFRR, NP = number of panicles per hill, and PL = panicle length.

3.3.2. Number of Filled Grains and Number of Unfilled Grains per Panicle

The number of filled and unfilled grains had a significant difference (p ≤ 0.01) among the rice genotype, treatment, genotype by treatment, and genotype by season (combination of genotype and season) as presented in Table 4. Results indicated that the application of T2 (2.5 t ha−1 CM + 50% CFRR) was significantly higher on number of filled grains panicle−1 recorded in BRRI dhan48 (G51) (176.41) followed by HUA565 (G24), MR297 (G45), BR24 (G50), and Putra 2 (G47) (171.42, 171.26, 170.53, and 168.27, respectively), and a similar number of filled grains panicle−1 were produced in T3 (100% CFRR). The application of T1 (5 t ha−1 CM) recorded the lowest number of filled grains panicle−1 in TADOM (G41), Vandana (G7), GHAU (G36), MGAWA (G38), and Kataktara (G13) (85.39, 85.46, 88.45, 89.46, and 89.56, respectively). The application of T1 (5 t ha−1 chicken manure) was significantly higher on number of unfilled grains panicle−1 recorded in BINASAIL (G63) (67.21) followed by BINA dhana5 (G65), GHAU (G36), RENGAN WANG (G32), and BINA dhan7 (G64) (65.32, 63.33, 63.27, and 62.70, respectively). The application of T2 (2.5 t ha−1 CM + 50% CFRR) recorded the lowest number of unfilled grains panicle−1 in BRRI dhan48 (G51), Putra 1 (G46), Kachalath (G26), Kalabokra (G23), and Putra 2 (G47) (19.26, 20.71, 21.75, 21.87, and 24.22, respectively), and a similar number of unfilled grains panicle−1 also recorded in T3 (100% CFRR) were presented in Table 8.

3.3.3. 1000 Grain Weight and Yield per Plant

When it comes to rice production, stable and high-yielding genotypes are necessary, and 1000-grain weight of grains is a measurement of grain size. Grain size multiplied by grain number results in a measurement of total yield of grain. Here, 1000-grain weight is expressed as an effective function of grain yield. There was a significant difference (p ≤ 0.01) among the rice genotype, treatment, genotype by treatment, and genotype by season (combination of genotype and season) as presented in Table 4. Results indicated that the application of T2 (2.5 t ha−1 CM + 50% CFRR) recorded 1000-grain weight in BRRI dhan48 (G51) (25.85 g) followed by BR24 (G50), Putra 2 (G47), BRRI dhan55 (G60), and BRRI dhan69 (G61) (25.77, 25.73, 25.62, and 25.57 g, respectively), which were significantly higher than the other treatments except T3 (100% CFRR), which had a similar 1000-grain weight. Further, the application of T1 (5 t ha−1 CM) produced the lowest 1000-grain weight observed in KUNYIT (G35), Kataktara (G13), Parija (G12), Nayan moni (G22), and Panbira (G2) (10.05, 14.26, 14.67, 15.58, and 15.70 g). The application of T2 (2.5 t ha−1 CM + 50% CFRR) produced a yield plant−1 recorded in MR297 (G45) (17.34 g), followed by BR24 (G50), Putra 2 (G47), Putra 1 (G46), and BRRI dhan72 (G53) (17.32, 16.85,
Table 8. Number of filled grains and unfilled grains per plant of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (T) | NFG | NUFG |
|-------------|--------------|-----|------|
| G1          | 1            | 121.28 | 133.41 |
|             | 2            | 136.56 | G17  |
|             | 3            | 131.48 |       |
| LSD(0.05)   | 1            | 4.15  | 7.35 |
|             | 2            | 103.26 | 124.57 |
|             | 3            | 114.18 | G18  |
| G2          | 1            | 6.06  | 6.35 |
|             | 2            | 128.31 | G19  |
|             | 3            | 141.05 | G20  |
| LSD(0.05)   | 1            | 5.86  | 5.61 |
|             | 2            | 144.63 |       |
|             | 3            | 135.18 |       |
| G3          | 1            | 5.11  | 8.31 |
|             | 2            | 107.25 | 145.36 |
|             | 3            | 147.34 | G22  |
| LSD(0.05)   | 1            | 5.49  | 5.42 |
|             | 2            | 94.75  |       |
|             | 3            | 111.19 |       |
| G4          | 1            | 7.38  | 7.07 |
|             | 2            | 85.46  | 96.28 |
|             | 3            | 98.38 | G23  |
| LSD(0.05)   | 1            | 95.27  | 63.37 |
|             | 2            | 128.38 |       |
|             | 3            | 140.41 | G24  |
| G5          | 1            | 6.39  | 6.79 |
|             | 2            | 135.65 |       |
|             | 3            | 115.3  |       |
| LSD(0.05)   | 1            | 5.97  | 5.42 |
|             | 2            | 54.975 |       |
|             | 3            | 133.29 | G25  |
| G6          | 1            | 7.62  | 6.89 |
|             | 2            | 137.57 | 141.18 |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 7.97 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |
| G7          | 1            | 9.69  | 6.03 |
|             | 2            | 146.16 | G27  |
|             | 3            | 111.47 | G28  |
| LSD(0.05)   | 1            | 9.85  | 6.85 |
|             | 2            | 104.28 | G29  |
|             | 3            | 98.37 | G30  |
| G8          | 1            | 6.25  | 6.25 |
|             | 2            | 137.57 |       |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 6.94 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |
| G9          | 1            | 9.69  | 6.03 |
|             | 2            | 146.16 | G27  |
|             | 3            | 111.47 | G28  |
| LSD(0.05)   | 1            | 9.85  | 6.85 |
|             | 2            | 104.28 | G29  |
|             | 3            | 98.37 | G30  |
| G10         | 1            | 6.25  | 6.25 |
|             | 2            | 137.57 |       |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 6.94 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |
| G11         | 1            | 9.69  | 6.03 |
|             | 2            | 146.16 | G27  |
|             | 3            | 111.47 | G28  |
| LSD(0.05)   | 1            | 9.85  | 6.85 |
|             | 2            | 104.28 | G29  |
|             | 3            | 98.37 | G30  |
| G12         | 1            | 6.25  | 6.25 |
|             | 2            | 137.57 |       |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 6.94 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |
| G13         | 1            | 9.69  | 6.03 |
|             | 2            | 146.16 | G27  |
|             | 3            | 111.47 | G28  |
| LSD(0.05)   | 1            | 9.85  | 6.85 |
|             | 2            | 104.28 | G29  |
|             | 3            | 98.37 | G30  |
| G14         | 1            | 6.25  | 6.25 |
|             | 2            | 137.57 |       |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 6.94 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |
| G15         | 1            | 6.25  | 6.25 |
|             | 2            | 137.57 |       |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 6.94 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |
| G16         | 1            | 6.25  | 6.25 |
|             | 2            | 137.57 |       |
|             | 3            | 146.63 |       |
| LSD(0.05)   | 1            | 6.94  | 6.94 |
|             | 2            | 143.74 |       |
|             | 3            | 133.28 |       |

In each column, means with similar letter (s) are statistically identical, and those with dissimilar letter (s) differ significantly as per 0.05 level of probability, $T_1 = 5$ ha$^{-1}$ CM, $T_2 = 2.5$ ha$^{-1}$ + 50% CFRR, $T_3 = 100$% CFRR, NFG = number of filled grains per plant, and NUFG = number of unfilled grains per plant.
Table 9. 1000-grain weight and yield per plant of 64 rice genotypes as influenced by treatment and genotype ( pooled over two seasons).

| Genotype (G) | Treatment (T) | 1000-GW (g) | YP (g) |
|-------------|--------------|-------------|--------|
|             |              |             |        |
| G1          |              |             |        |
| 1           | 18.26b       | 20.18b      | 18.53b |
| 2           | 20.43a       | 21.84a      | 20.77a |
| 3           | 18.79b       | 20.48b      | 19.82a |
| LSD(0.05)   | 15.7a        | 19.55a      | 17.88c |
| G2          |              |             |        |
| 1           | 16.25a       | 20.15a      | 19.25a |
| 2           | 15.89a       | 19.74a      | 18.76b |
| 3           | 15.68a       | 19.17a      | 17.66b |
| LSD(0.05)   | 19.77b       | 20.56a      | 10.05b |
| G3          |              |             |        |
| 1           | 21.43a       | 21.11a      | 20.68a |
| 2           | 20.65b       | 20.73a      | 20.87a |
| 3           | 19.52        | 19.58b      | 17.88a |
| LSD(0.05)   | 17.67b       | 21.62b      | 18.52b |
| G4          |              |             |        |
| 1           | 20.45b       | 20.45b      | 20.45b |
| 2           | 20.73a       | 20.39b      | 19.06b |
| 3           | 20.17        | 19.17b      | 17.66b |
| LSD(0.05)   | 16.27b       | 22.07a      | 19.56a |
| G5          |              |             |        |
| 1           | 20.35a       | 18.92b      | 25.25a |
| 2           | 19.51        | 19.82b      | 23.52b |
| 3           | 19.52a       | 19.67a      | 18.37b |
| LSD(0.05)   | 18.55a       | 22.08a      | 18.84b |
| G6          |              |             |        |
| 1           | 20.17        | 17.9a       | 19.95a |
| 2           | 19.89        | 16.46b      | 20.72a |
| 3           | 19.88        | 16.61b      | 17.93a |
| LSD(0.05)   | 16.36b       | 24.18a      | 18.16a |
| G7          |              |             |        |
| 1           | 21.66a       | 22.43a      | 19.64a |
| 2           | 21.28b       | 21.28b      | 19.13a |
| 3           | 19.76b       | 19.75b      | 18.37b |
| LSD(0.05)   | 18.26c       | 23.96c      | 17.88a |
| G8          |              |             |        |
| 1           | 20.63        | 20.63       | 20.63 |
| 2           | 19.52        | 19.67a      | 18.37b |
| 3           | 19.52a       | 19.67a      | 18.37b |
| LSD(0.05)   | 18.78c       | 22.07a      | 19.56a |
| G9          |              |             |        |
| 1           | 20.17        | 17.9a       | 19.95a |
| 2           | 19.89        | 16.46b      | 20.72a |
| 3           | 19.88        | 16.61b      | 17.93a |
| LSD(0.05)   | 16.36b       | 24.18a      | 18.16a |
| G10         |              |             |        |
| 1           | 21.66a       | 22.43a      | 19.64a |
| 2           | 21.28b       | 21.28b      | 19.13a |
| 3           | 19.76b       | 19.75b      | 18.37b |
| LSD(0.05)   | 18.26c       | 23.96c      | 17.88a |
| G11         |              |             |        |
| 1           | 20.63        | 20.63       | 20.63 |
| 2           | 19.52        | 19.67a      | 18.37b |
| 3           | 19.52a       | 19.67a      | 18.37b |
| LSD(0.05)   | 18.78c       | 22.07a      | 19.56a |
| G12         |              |             |        |
| 1           | 20.17        | 17.9a       | 19.95a |
| 2           | 19.89        | 16.46b      | 20.72a |
| 3           | 19.88        | 16.61b      | 17.93a |
| LSD(0.05)   | 16.36b       | 24.18a      | 18.16a |
| G13         |              |             |        |
| 1           | 18.68a       | 22.44a      | 25.3a  |
| 2           | 19.56b       | 20.48b      | 19.82a |
| 3           | 19.52        | 19.67a      | 18.37b |
| LSD(0.05)   | 18.26c       | 23.96c      | 17.88a |
| G14         |              |             |        |
| 1           | 19.72a       | 23.53a      | 25.33a |
| 2           | 19.98a       | 20.66b      | 25.08a |
| 3           | 19.98a       | 20.66b      | 25.08a |
| LSD(0.05)   | 18.64b       | 20.86b      | 24.87b |
| G15         |              |             |        |
| 1           | 19.96a       | 22.23a      | 25.73a |
| 2           | 19.08a       | 21.38a      | 25.18a |
| 3           | 19.08a       | 21.38a      | 25.18a |
| LSD(0.05)   | 19.95b       | 20.18b      | 24.18b |
| G16         |              |             |        |
| 1           | 20.45a       | 21.36a      | 25.32a |
| 2           | 20.57b       | 20.57b      | 24.67b |
| 3           | 20.13ab      | 20.62       | 1.01   |

In each column, means with similar letter (s) are statistically identical, and those with dissimilar letter (s) differ significantly as per 0.05 level of probability, T1 = 5 t ha⁻¹ CM, T2 = 2.5 t ha⁻¹ + 50% CFRR, T3 = 100% CFRR, SP = number of spikelet per panicle, and PFG = percent filled grains.
3.4. Nutrient Content

3.4.1. Nutrient Content (% N) of Grain and Straw

There was a significant effect on N contents in rice grain and straw among the genotype and treatment. Results indicated that the application of T₂ (2.5 t ha⁻¹ CM + 50% CFRR) recorded on N content in grain on genotype Pukhi (G1) (1.40%) followed by Utri (G4) (1.39%), Panbira (G2) (1.36%), Kaisa panja (G6) (1.34%), Dumai (G11) (1.32%), Nayan moni (G22) (1.31%), and Vandana (G7) (1.29%), respectively, were significantly higher than the other treatments. In addition, the application of T₁ (5 t ha⁻¹ CM) recorded lower N content on genotype BRRI dhan28 (G54) (0.89%), BRRI dhan55 (G60) (0.91%), BRRI dhan42 (G56) (0.92%), B370 (G62) (0.93%), and NMR 151 (G43) (0.94%), respectively, were presented in Table 10. On the other hand, the application of T₂ (2.5 t ha⁻¹ CM + 50% CFRR) recorded on N content in straw on genotype Utri (G4) (1.20%) followed by Panbira (G2) (1.19%), Pukhi (G1) (1.18%), Kaisa panja (G6) (1.17%), Dumai (G11) (1.15%), Luanga (G5) (1.14%), and Nayan moni (G22) (1.13%), respectively, were significantly higher than the other treatments, while the application of T₁ (5 t ha⁻¹ CM) recorded lower N content on genotype GHUA (G36) (0.81%), BRRI dhan28 (G54) (0.82%), BRRI dhan55 (G60) (0.83%), and B370 (G62) (0.84%), respectively, in Table 10.

3.4.2. Nutrient Content (% P) of Grain and Straw

There was a significant effect on P contents in rice grain and straw among the genotype and treatment. Results indicated that the application of T₂ (2.5 t ha⁻¹ CM + 50% CFRR) recorded on P content in grain on genotype BRRI dhan72 (G53) (0.40%) followed by Vandana (G7) (0.38%), Pukhi (G1) (0.37%), Dharial (G3) (0.36%), Kaisa panja (G6) (0.35%), Utri (G4) (0.34%), and Dular (G8) (0.33%), respectively, were significantly higher than the other treatments. In addition, the application of T₁ (5 t ha⁻¹ CM) recorded lower P content on genotype BINASAIL (G63) (0.19%), MGAWA (G38) (0.20%), BANGKUL (G42) (0.21%), B370 (G62) (0.22%), BRRI dhan28 (G54) (0.23%), respectively, were presented in Table 11. On the other hand, the application of T₂ (2.5 t ha⁻¹ CM + 50% CFRR) recorded on P content in straw on genotype Dharial (G3) (0.25%) followed by BRRI dhan72 (G53) (0.24%), Pukhi (G1) (0.23%), Kaisa panja (G6) (0.22%), Dharial (G3) (0.21%), Luanga (G5) (0.20%), and Kaisa panja (G6) (0.19%), respectively, were significantly higher than the other treatments, while the application of T₁ (5 t ha⁻¹ CM) recorded lower P content on genotype Sonhamoni (G9) (0.10%), BRRI dhan28 (G54) (0.11%), BRRI dhan42 (G56) (0.11%), and B370 (G62) (0.12%), respectively, in Table 11.

3.4.3. Nutrient Content (% K) of Grain and Straw

There was a significant effect on K contents in rice grain and straw among the genotype and treatment. Results indicated that the application of T₂ (2.5 t ha⁻¹ CM + 50% CFRR) recorded on K content in grain on genotype Putra 2 (G47) (0.19%) followed by MR297(G45) (0.18%), BRRI dhan39 (G55) (0.17%), BRRI dhan75 (G59) (0.16%), and Pukhi (G1) (0.15%), respectively, were significantly higher than the other treatments, while application of T₁ (5 t ha⁻¹ CM) recorded lower P content on genotype BANGKUL (G42) (0.07%), B370 (G62) (0.08%), BRRI dhan55 (G60) (0.09%), BINASAIL (G63) (0.10%), and BRRI dhan39 (G55) (0.11%), respectively, were presented in Table 12. On the other hand, the application of T₂ (2.5 t ha⁻¹ CM + 50% CFRR) recorded on K content in straw on genotype Pukhil (G1) (1.84%) followed by Utri (G4) (1.81%), Panbira (G2) (1.79%), Vandana (G7) (1.78%), Parija (G12) (1.77%), Dharial (G3) (1.76%), and Kaisa panja (G6) (1.74%), respectively, were significantly higher than the other treatments, while the application of T₁ (5 t ha⁻¹ CM) recorded lower K content on genotype B370 (G62) (1.25%), BINASAIL (G63) (1.27%), BRRI dhan55 (G60) (1.28%), and BRRI dhan28 (G54) (1.29%), respectively, in Table 12.
### Table 10. Grain and straw nutrient content (% N) of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (T) | Grain | Straw |
|-------------|--------------|-------|-------|
|             |              | % N   | % N   |
| G1          | 1            | 1.12c | 0.97c |
|             | 2            | 1.15b | 1.27a |
|             | 3            | 1.26b | 1.14b |
| LSD(0.05)   | 1            | 0.034 | 0.028 |
|             | 2            | 1.10c | 1.04c |
|             | 3            | 1.36a | 1.23a |
| LSD(0.05)   | 1            | 0.038 | 0.031 |
|             | 2            | 1.04c | 0.16c |
|             | 3            | 1.13b | 1.16b |
| LSD(0.05)   | 1            | 0.03  | 0.027 |
|             | 2            | 1.11c | 1.06c |
|             | 3            | 1.18b | 1.18b |
| LSD(0.05)   | 1            | 0.032 | 0.025 |
|             | 2            | 1.09c | 1.07c |
|             | 3            | 1.19b | 1.15b |
| LSD(0.05)   | 1            | 0.027 | 0.034 |
|             | 2            | 1.10c | 1.09c |
|             | 3            | 1.22b | 1.20b |
| LSD(0.05)   | 1            | 0.038 | 0.027 |
|             | 2            | 1.11c | 1.10c |
|             | 3            | 1.29a | 1.29a |
| LSD(0.05)   | 1            | 0.031 | 0.026 |
|             | 2            | 1.26a | 1.24a |
|             | 3            | 0.029 | 0.03  |
| LSD(0.05)   | 1            | 0.07c | 1.04c |
|             | 2            | 1.06c | 1.06c |
|             | 3            | 0.03  | 0.034 |
| LSD(0.05)   | 1            | 0.10c | 1.05c |
|             | 2            | 1.28a | 1.25a |
|             | 3            | 0.03  | 0.035 |
| LSD(0.05)   | 1            | 1.31c | 1.04c |
|             | 2            | 1.39a | 1.20a |
|             | 3            | 0.027 | 0.025 |
| LSD(0.05)   | 1            | 1.11c | 1.02c |
|             | 2            | 1.32a | 1.24a |
|             | 3            | 0.029 | 0.028 |
| LSD(0.05)   | 1            | 1.06c | 1.03c |
|             | 2            | 1.25a | 1.27a |
|             | 3            | 0.03  | 0.034 |
| LSD(0.05)   | 1            | 1.10c | 1.05c |
|             | 2            | 1.36a | 1.29a |
|             | 3            | 0.031 | 0.025 |
| LSD(0.05)   | 1            | 1.07c | 1.03c |
|             | 2            | 1.28a | 1.26a |
|             | 3            | 0.023 | 0.024 |
| LSD(0.05)   | 1            | 1.05c | 1.04c |
|             | 2            | 1.25a | 1.23a |
|             | 3            | 0.034 | 0.031 |
| LSD(0.05)   | 1            | 1.09c | 1.01c |
|             | 2            | 1.32a | 1.21a |
|             | 3            | 0.023 | 0.025 |

In each column, means with similar letter(s) are statistically identical, and those with dissimilar letter(s) differ significantly as per 0.05 level of probability, T1 = 5 t ha⁻¹ CM, T2 = 2.5 t ha⁻¹ + 50% CFR, T3 = 100% CFR, and % N = percentage of nitrogen content.
Table 11. Grain and straw nutrient content (% P) of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (T) | Grain % P | Straw % P |
|-------------|---------------|-----------|-----------|
| 1           |               | 0.25c     | 0.23c     |
| 2           | 0.37a         | 0.31a     | 0.33a     |
| 3           | 0.31b         | 0.27b     | 0.27b     |
| LSD(0.05)   | 0.03          | 0.03      | 0.03      |
| 1           | 0.22c         | 0.22c     | 0.22c     |
| 2           | 0.31a         | 0.27a     | 0.24a     |
| 3           | 0.27b         | 0.25a     | 0.25b     |
| LSD(0.05)   | 0.028         | 0.023     | 0.025     |
| 1           | 0.26c         | 0.21c     | 0.21b     |
| 2           | 0.30b         | 0.26b     | 0.23b     |
| 3           | 0.027         | 0.024     | 0.024     |
| LSD(0.05)   | 0.23c         | 0.21c     | 0.21b     |
| 1           | 0.23c         | 0.22c     | 0.21b     |
| 2           | 0.28b         | 0.29b     | 0.24ab    |
| 3           | 0.028         | 0.026     | 0.023     |
| LSD(0.05)   | 0.31a         | 0.25c     | 0.23a     |
| 1           | 0.26c         | 0.24b     | 0.20c     |
| 2           | 0.31b         | 0.27b     | 0.24b     |
| 3           | 0.025         | 0.027     | 0.027     |
| LSD(0.05)   | 0.29a         | 0.24a     | 0.25a     |
| 1           | 0.26b         | 0.29b     | 0.25a     |
| 2           | 0.31b         | 0.27a     | 0.23b     |
| 3           | 0.031         | 0.025     | 0.028     |
| LSD(0.05)   | 0.30a         | 0.29a     | 0.29a     |
| 1           | 0.23a         | 0.29a     | 0.27a     |
| 2           | 0.32b         | 0.35a     | 0.30a     |
| 3           | 0.023         | 0.024     | 0.028     |
| LSD(0.05)   | 0.24c         | 0.22b     | 0.24b     |
| 1           | 0.33a         | 0.26a     | 0.29a     |
| 2           | 0.28b         | 0.31b     | 0.25b     |
| 3           | 0.025         | 0.027     | 0.027     |
| LSD(0.05)   | 0.22c         | 0.26c     | 0.21c     |
| 1           | 0.29a         | 0.32a     | 0.48a     |
| 2           | 0.26b         | 0.30b     | 0.27b     |
| 3           | 0.025         | 0.027     | 0.023     |
| LSD(0.05)   | 0.31a         | 0.36a     | 0.27a     |
| 1           | 0.32b         | 0.34b     | 0.25b     |
| 2           | 0.22a         | 0.25a     | 0.31b     |
| 3           | 0.028         | 0.031     | 0.028     |
| LSD(0.05)   | 0.24c         | 0.24b     | 0.24c     |
| 1           | 0.32b         | 0.33a     | 0.35a     |
| 2           | 0.28b         | 0.30b     | 0.26b     |
| 3           | 0.028         | 0.031     | 0.028     |
| LSD(0.05)   | 0.23c         | 0.25c     | 0.22c     |
| 1           | 0.23a         | 0.36a     | 0.33a     |
| 2           | 0.21b         | 0.26b     | 0.27b     |
| 3           | 0.022         | 0.029     | 0.027     |
| LSD(0.05)   | 0.24c         | 0.21b     | 0.24c     |
| 1           | 0.30a         | 0.47a     | 0.32a     |
| 2           | 0.27b         | 0.24b     | 0.24b     |
| 3           | 0.022         | 0.023     | 0.024     |
| LSD(0.05)   | 0.24b         | 0.31a     | 0.48a     |
| 1           | 0.24ab        | 0.26b     | 0.26b     |
| 2           | 0.028         | 0.024     | 0.027     |

In each column, means with similar letter (s) are statistically identical, and those with dissimilar letter (s) differ significantly as per 0.05 level of probability, T1 = 5 ha⁻¹ CM, T2 = 2.5 ha⁻¹ + 50% CFR, T3 = 100% CFR, and % P = percentage of phosphorus content.
### Table 12. Grain and straw nutrient content (% K) of 64 rice genotypes as influenced by treatment and genotype (pooled over two seasons).

| Genotype (G) | Treatment (T) | Grain % K | Straw % K |
|--------------|--------------|-----------|-----------|
| G1           |              | 0.11b     | 0.11b     |
| G2           |              | 0.15a     | 0.15a     |
| G3           |              | 0.14a     | 0.14a     |
| G4           |              | 0.17a     | 0.17a     |
| G5           |              | 0.15a     | 0.15a     |
| G6           |              | 0.15a     | 0.15a     |
| G7           |              | 0.13a     | 0.13a     |
| G8           |              | 0.17a     | 0.17a     |
| G9           |              | 0.16a     | 0.16a     |
| G10          |              | 0.15a     | 0.15a     |
| G11          |              | 0.14a     | 0.14a     |
| G12          |              | 0.13a     | 0.13a     |
| G13          |              | 0.15a     | 0.15a     |
| G14          |              | 0.17a     | 0.17a     |
| G15          |              | 0.14a     | 0.14a     |
| G16          |              | 0.15a     | 0.15a     |

In each column, means with similar letter (s) are statistically identical, and those with dissimilar letter (s) differ significantly as per 0.05 level of probability; T1 = 5 t ha⁻¹ CM; T2 = 2.5 t ha⁻¹ + 50% CFRR, T3 = 100% CFRR, and % k = percentage of potassium content.
4. Discussion

The results of this experiment revealed that there is a high correlation between plant height and rice plant productivity or growth rate. During the developing stages of rice plants, they grow and flourish to a specific height [24]. Phenotype refers to the process of measuring the basic and complicated traits of a rice species, which include plant height. Organic fertilizer has a positive impact on the growth and production of various crops [25,26]. Plant height is also a major agronomic characteristic that indirectly affects rice plant yields. Traditionally, rice genotypes are tall in stature, are susceptible to loading at maturity, respond poorly to nitrogen fertilizer, and, therefore, produce low yields. For high-yielding varieties, moderate plant heights are desirable. Approximately half of the recommended chemical fertilizer is saved, according to the findings of this study. It differs from the findings of Chandini et al. [13], who discovered that organic fertilizers could potentially replace 50% of needed nitrogen and phosphorus fertilizers by improving. They examined the efficacy of suggested nitrogen and phosphorus fertilizers and lowering chemical fertilizer costs while also preventing environmental contamination from widespread use. Chemical N and P application can be reduced by 50%, while rice yield is boosted with the addition of 5 t ha$^{-1}$ organic fertilizer [27]. However, when organic fertilizers were used in conjunction with a half dose of inorganic fertilizer on lettuce (Lactuca sativa), twenty-five percent (25%) more growth was achieved when only chemical fertilizer was used, and at least fifty percent (50%) of chemical fertilizer was saved by using organic fertilizer [28]. The enhanced vegetative growth and additional nitrogen contribution that occurs in response to the recommended fertilizer dose could be the primary reason for the increase in plant height [29]. The availability of main nutrients was equated to the variance in plant height caused by nutrient sources. Chemical fertilizers provide nutrients that are easily soluble in soil solutions and hence available to plants almost immediately. Microbial action and increased soil physical condition contribute to nutrient availability from organic sources. Bargaz et al. [30] agreed with these conclusions. Variations in the availability of key nutrients were thought to be the cause of plant height variation caused by nutrition source. Setiawati et al. [31] reported similar results in rice crops.

Tillering is a crucial feature for grain production and, as a result, a significant factor in rice output. Siavoshi et al. [32] found that different fertilizer mixes increased the number of tillers in rice plants. According to them, the increased number of tillers per square meter could be related to increased nitrogen availability, which is important for cell division. Organic sources provide plants with a better balanced diet, particularly micronutrients, which have a good impact on the number of tillers in plants [33]. The number of productive tillers (tillers that carry panicles) is more important than the overall number of tillers in determining rice plant productivity. The considerable difference in the number of tiller and panicle plant$^{-1}$ seen in this study can be attributed to genetic differences in their ability to use fertilizers, partition photosynthesis, and accumulate dry matter. The number of panicles grew with increasing nitrogen rates [34,35], and the number of panicles plant$^{-1}$ increased with increasing NPK rates. Organic manure and chemical fertilizers produced the most prolific tillers, which could be attributed to the nutrient availability in the soil. The availability of nutrients from organic sources, on the other hand, is attributed to microbial action and improved soil physical conditions. The excessive application of inorganic fertilizers is not required to generate good tillers if organic manures are supplemented, which also helps to provide vital micronutrients to the plants [36,37]. In rice crops, Mirza et al. [38] found similar findings.

Rice genotypes differed considerably in panicle length and grain yield. These findings are thought to be attributable to the rice plant receiving extra nutrients as a result of the soil amendment. The application of organic manure and chemical fertilizers resulted in a considerable increase in panicle length [1]. Similar findings were reported by [39,40]. In comparison to fertilizers, manure had a stronger effect in increasing the quantity of grains panicle$^{-1}$. It is possible that this owes to the manure’s higher nutrient availability. The application of organic materials as fertilizers provided growth-regulating substances
that helped better grain filling and improved the physical, chemical, and microbial properties of the soil in this study, and the organic manure and chemical fertilizer had a significant effect because the application of organic materials as fertilizers provides growth-regulating substances that helped better grain filling and improved the physical, chemical, and microbial properties of the soil [41]. The use of organic manures and chemical fertilizers resulted in a considerable increase in grains per panicle [12]. These findings are also supported by Iqbal et al. [42].

The combined application of organic manure and artificial fertilizer resulted in statistically significant change in the weight of 1000 seeds. The combined use of organic manure and artificial fertilizers enhanced the 1000-grain weight of rice [43]. The use of organic manure and artificial fertilizer enhanced the 1000-grain weight of rice [44]. Hoque et al. [45] also found that combining organic manure with chemical fertilizers improved grain weight by 1000 grains. Geng et al. [46] reported that the availability of nutrients throughout the reproductive stage resulted in improved grain filling and thus increased grain weight.

The addition of organic manure to chemical fertilizers enhanced grain output significantly in all genotypes. This was due to the effect of organic and chemical fertilizers on encouraging growth and, as a result, increasing yields. The various fertilizers aided tiller growth and helped spikelet formation, resulting in a higher yield. Wang et al. [34] supported these findings. The fact that it improves soil quality, soil health, and crop output could explain this. The observations of [10] backed up this theory. It was demonstrated that applying organic manure can boost photosynthetic efficiency and nutrient availability [9]. Ye et al. [47] suggested the use of organic manure and chemical fertilizers enhanced grain output considerably. Organic manure and chemical fertilizers boosted rice straw yields [48]. These assumptions are supported by [40,49]. Increasing cropping intensity, the use of modern varieties (high-yielding varieties and hybrids), cultivation of high-biomass-potential crops, nutrient leaching, and unbalanced fertilizer application, with no or little addition of organic manure, have resulted in nutrient mining from the soils. To stop nutrient mining, it is not justified to increase the use of only inorganic fertilizers, but the use of organic sources of plant nutrients viz. cow dung, chicken manure, compost, and green manure should be also considered. In this study, nutrient contents of grain and straw of all genotypes showed that the highest N, P, and K contents were recorded in T2 (2.5 t ha\(^{-1}\) CM+ 50% CFRR). These findings are partially similar to these of [50,51], who obtained higher contents of nutrient elements such as N, P, and K in rice by applying chicken manure with inorganic fertilizers. The use of a combination of organic manures and inorganic fertilizers clearly aided plant vegetative growth, resulting in higher straw yield.

5. Conclusions

From the above results, it may be concluded that organic fertilizers in the form of chicken manure have the potential to increase the growth parameters, yield components, and nutritional quality of rice. The use of chicken manure as an organic fertilizer for rice also had positive effects on growth, yield, and nutrient content in the crop. All of the treatments had a significant impact on rice genotypes growth and production. In the current study, it was discovered that 2.5 tons of chicken manure per hectare, combined with 50% of the prescribed chemical fertilizer, resulted in a higher grain yield than the other treatments. From a financial standpoint, producers can employ a combination of organic fertilizer and a lower amount of inorganic fertilizer to increase rice yields while also maintaining and improving soil health.

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References
1. Arif, M.; Tasneem, M.; Bashir, F.; Yaseen, G. Effect of Integrated Use of Organic Manures and Inorganic Fertilizers on Yield and Yield Components of Rice. *J. Agric. Res.* 2014, 52, 197–206.
2. Bilkis, S.; Islam, M.; Jahiruddin, M.; Rahaman, M. Integrated use of manure and fertilizers increases rice yield, nutrient uptake and soil fertility in the boro-fallow-taman rice cropping pattern. *SAARC J. Agric.* 2018, 15, 147–161. [CrossRef]
3. Havlin, J.; Heiniger, R. Soil fertility management for better crop production. *Agronomy* 2020, 10, 1349. [CrossRef]
4. Singh, B. Are Nitrogen Fertilizers Deleterious to Soil Health? *Agronomy* 2018, 8, 48. [CrossRef]
5. Willy, D.K.; Muyanga, M.; Mbuvi, J.; Jayne, T. The effect of land use change on soil fertility parameters in densely populated areas of Kenya. *Geoderma* 2019, 343, 254–262. [CrossRef]
6. Chew, K.W.; Chia, S.R.; Yen, H.W.; Nomanbhay, S.; Ho, Y.C.; Show, P.L. Transformation of biomass waste into sustainable organic fertilizers. *Sustainability* 2019, 11, 2266. [CrossRef]
7. Tahat, M.M.; Alananbeh, K.M.; Othman, Y.A.; Leskovar, D.I. Soil health and sustainable agriculture. *Sustainability* 2020, 12, 4859. [CrossRef]
8. Ding, Y.; Liu, Y.; Liu, S.; Li, Z.; Tan, X.; Huang, X.; Zeng, G.; Zhou, L.; Zheng, B. Biochar to improve soil fertility. A review. *Agron. Sustain. Dev.* 2016, 36, 32–36. [CrossRef]
9. Khaitov, B.; Yun, H.J.; Lee, Y.; Ruziev, F.; Le, T.H.; Umurzokov, M.; Bo, A.B.; Cho, K.M.; Park, K.W. Impact of organic manure on growth, nutrient content and yield of chilli pepper under various temperature environments. *Int. J. Environ. Res. Public Health* 2019, 16, 3031. [CrossRef]
10. Ahmad, A.A.; Radovich, T.J.K.; Nguyen, H.V.; Uyeda, J.; Arakaki, A.; Cadby, J.; Paull, R.; Sugano, J.; Teves, G. Use of Organic Fertilizers to Enhance Soil Fertility, Plant Growth, and Yield in a Tropical Environment. *Org. Fertil. Basic Concepts Appl. Outcomes* 2016, 2016, 85–108. [CrossRef]
11. Tadesse, T.; Dechassa, N.; Bayu, W.; Gebeyehu, S. Effects of Farmyard Manure and Inorganic Fertilizer Application on Soil Physico-Chemical Properties and Nutrient Balance in Rain-Fed Lowland Rice Ecosystem. *Am. J. Plant Sci.* 2013, 4, 309–316. [CrossRef]
12. Kakar, K.; Xuan, T.D.; Noori, Z.; Aryan, S.; Gulab, G. Effects of organic and inorganic fertilizer application on growth, yield, and grain quality of rice. *Agriculture* 2020, 10, 544. [CrossRef]
13. Kumar, R.; Kumar, R.; Prakash, O. The impact of chemical fertilizers on our environment and ecosystem. *Res. Trends Environ. Sci.* 2019, 54, 69–86.
14. Sharada, P.; Sujathamma, P. Effect of Organic and Inorganic Fertilizers on the Quantitative and Qualitative Parameters of Rice (*Oryza sativa* L.). *Curr. Agric. Res.* 2018, 6, 166–174. [CrossRef]
15. Chapman, H.D. Cation Exchange Capacity. In *Methods of Soil Analysis: Part 2*; Norman, A.G., Ed.; Wiley Online Library: Hoboken, NJ, USA, 1965; pp. 891–901.
16. Walkley, A.; Black, I.A. An examination of the degjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. *Soil Sci.* 1934, 37, 29–38. [CrossRef]
17. Pech, M. Hydrogen Ion Activity. In *Methods of Soil Analysis: Part 2*; Norman, A.G., Ed.; Wiley Online Library: Hoboken, NJ, USA, 1965; pp. 914–926.
18. Bremer, J.M.; Mulvaney, C.S. Nitrogen-total. In *Methods of Soil Analysis: Part 2*; Sparks, D.L., Page, A.L., Helmke, P.A., Loepert, R.H., Soltanpour, P.N., Tabatabai, M.A., Johnston, C.T., Sumner, M.E., Eds.; Wiley Online Library: Hoboken, NJ, USA, 1982; pp. 595–624.
19. Olsen, S.R.; Cole, C.U.; Watanable, F.S.; Deun, L.A. *Estimation of Available P in Soil Extraction with Sodium Bicarbonate*; US Department of Agriculture: Washington, DC, USA; Honolulu, HI, USA, 1954; p. 929.
20. Knudsen, D.; Peterson, G.A.; Pratt, F.F. 1982 Lithium, Sodium and Potassium. In *Methods of Soil Analysis: Part 2*; Norman, A.G., Ed.; Wiley Online Library: Hoboken, NJ, USA, 1982; pp. 225–245.
21. Williams, C.H.; Stenbergs, A. Soil sulphur fractions as chemical indices of available sulphur in some Australian soils. *Aust. J. Agric. Res.* 1959, 10, 340–352. [CrossRef]

22. Enders, A.; Lehmann, J. Comparison of Wet-Digestion and Dry-Ashing Methods for Total Elemental Analysis of Biochar. *Commun. Soil Sci. Plant Anal.* 2012, 43, 1042–1052. [CrossRef]

23. Gomez, K.A.; Gomez, A.A. *Statistical Procedures for Agricultural Research*; John Wiley & Sons: New York, NY, USA, 1984.

24. Sritarapipat, T.; Rakwatin, P.; Kasetkasem, T. Automatic rice crop height measurement using a field server and digital image processing. *Sensors* 2014, 14, 900–926. [CrossRef] [PubMed]

25. Hammel, T.B.; Oloruntoba, E.O.; Ana, G.R.E.E. Enhancing growth and yield of crops with nutrient-enriched organic fertilizer at wet and dry seasons in ensuring climate-smart agriculture. *Int. J. Recycl. Org. Waste Agric.* 2019, 8, 81–92. [CrossRef]

26. Purbajanti, E.D.; Slamet, W.; Fuskhah, E. Rosyida Effects of organic and inorganic fertilizers on growth, activity of nitrate reductase and chlorophyll contents of peanuts (*Arachis hypogaea* L.). *IOP Conf. Ser. Earth Environ. Sci.* 2019, 250, 012048. [CrossRef]

27. Naher, U. Biofertilizer as a Supplement of Chemical Fertilizer for Yield Maximization of Rice. *J. Agric. Food Dev.* 2018, 2, 16–22. [CrossRef]

28. Hossain, M.; Ryu, K. Effects of organic and inorganic fertilizers on lettuce (*Lactuca sativa* L.) and soil properties. *SAARC J. Agric.* 2018, 15, 93–102. [CrossRef]

29. Razaq, M.; Zhang, P.; Shen, H.L. Salahuddin Influence of nitrogen and phosphorous on the growth and root morphology of Acer mono. *PLoS ONE* 2017, 12, 1–13. [CrossRef] [PubMed]

30. Bargaz, A.; Lyamloulí, K.; Choutki, M.; Zeroual, Y.; Dhiba, D. Soil Microbial Resources for Improving Fertilizers Efficiency in an Integrated Plant Nutrient Management System. *Front. Microbiol.* 2018, 9, 1606. [CrossRef]

31. Setiawati, M.R.; Prayoga, M.K.; Stöber, S.; Adinata, K.; Simarmata, T. Performance of rice paddy varieties under various organic manures and bio-slurries with chemical fertilizers. *Emir. J. Food Agric.* 2018, 3, 217. [CrossRef]

32. Siavoshi, M.; Laware, S.L.; Laware, L.S. Effect of Organic Fertilizer on Growth and Yield Components in Rice (*Oryza sativa*) L. *J. Agric. Sci.* 2011, 3, 217. [CrossRef]

33. Yadav, S.K.; Babu, S.; Yadav, G.S.; Singh, R.; Yadav, M.K. Role of Organic Sources of Nutrients in Rice (*Oryza sativa*) Based on High Value Cropping Sequence. *Org. Farming-A Promis.* *W. Food Prod.* 2016, 6, 174–182. [CrossRef]

34. Wang, Y.; Lu, J.; Ren, T.; Hussain, S.; Guo, C.; Wang, S.; Cong, R.; Li, X. Effects of nitrogen and tiller type on grain yield and physiological responses in rice. *Aob Plants* 2017, 9, 57–63. [CrossRef]

35. Zhou, W.; Lv, T.; Yang, Z.; Wang, T.; Fu, Y.; Chen, Y.; Hu, B.; Ren, W. Morphophysiological mechanism of rice yield increase in response to optimized nitrogen management. *Sci. Rep.* 2017, 7, 1–10. [CrossRef]

36. Abera, T.; Tufa, T.; Midega, T.; Kumbi, H.; Tola, B. Effect of integrated inorganic and organic fertilizers on yield and yield components of barley in Liben Jawi District. *Int. J. Agron.* 2018, 2018, [CrossRef]

37. Baghdadi, A.; Halim, R.A.; Ghasemzadeh, A.; Ramlan, M.F.; Sakimin, S.Z. Impact of organic and inorganic fertilizers on the yield and quality of silage corn intercropped with soybean. *Peer* 2018, 6, e5280. [CrossRef]

38. Hasanuzzaman, M.; Ahamed, K.U.; Rahmatullah, M.; Akhter, N.; Nahar, K.; Rahman, M.L. Plant growth characters and productivity of wetland rice (*Oryza sativa*) as affected by application of different manures L. Evidences from different AEZ of the country have shown a decrease in the. *Emir. J. Food Agric.* 2010, 22, 46–58.

39. Xu, M.G.; Li, D.C.; Li, J.M.; Qin, D.Z.; Kazuyuki, Y.; Hosen, Y. Effects of Organic Manure Application with Chemical Fertilizers on Nutrient Absorption and Yield of Rice in Hunan of Southern China. *Agric. Sci. China* 2010, 7, 1245–1252. [CrossRef]

40. Moe, K.; Mg, K.W.; Win, K.K.; Yamakawa, T. Combined Effect of Organic Manures and Inorganic Fertilizers on the Growth and Yield of Hybrid Rice (Paletewe-1). *Am. J. Plant Sci.* 2017, 8, 1022–1042. [CrossRef]

41. Ma, X.; Li, H.; Xu, Y.; Liu, C. Effects of organic fertilizers via quick artificial decomposition on crop growth. *Sci. Rep.* 2021, 11, 1–7. [CrossRef]

42. Iqbal, A.; He, L.; Ali, I.; Ullah, S.; Khan, A.; Khan, A.; Akhtar, K.; Wei, S.; Zhao, Q.; Zhang, J.; et al. Manure combined with chemical fertilizer increases rice productivity by improving soil health, post-anthesis biomass yield, and nitrogen metabolism. *PLoS ONE* 2020, 15, 1–24. [CrossRef]

43. Ismael, F.; Ndayiragije, A.; Fangueiro, D. New Fertilizer Strategies Combining Manure and Urea for Improved Rice Growth in Mozambique. *Agronomy* 2021, 11, 783. [CrossRef]

44. Online, I.P.; Basak, K.D.; Kibria, M.G.; Hossain, M.; Hoque, A. Improvement of rice production through combined use of organic manures and bio-slurries with chemical fertilizers. *Asian Aust. J. Biotech.* 2016, 1, 75–78.

45. Hoque, T.; Jahan, I.; Islam, M.; Ahmed, M. Performance of different organic fertilizers in improving growth and yield of boro rice. *SAARC J. Agric.* 2019, 16, 153–166. [CrossRef]

46. Geng, Y.; Id, G.C.; Wang, L.; Wang, S. Effects of equal chemical fertilizer substitutions with organic manure on yield, dry matter.pdf. *PLoS ONE* 2019, 14, 1–16. [CrossRef] [PubMed]

47. Ye, L.; Zhao, X.; Bao, E.; Li, J.; Zou, Z.; Cao, K. Bio-organic fertilizer with reduced rates of chemical fertilization improves soil fertility and enhances tomato yield and quality. *Sci. Rep.* 2020, 10, 1–11. [CrossRef]

48. Haque, M.M.; Datta, J.; Ahmed, T.; Ehsanullah, M.; Karim, M.N.; Akter, M.S.; Iqbal, M.A.; Bazaar, A.; Hadifa, A.; Ahmed, S.; et al. Organic amendments boost soil fertility and rice productivity and reduce methane emissions from paddy fields under sub-tropical conditions. *Sustainability* 2021, 13, 3103. [CrossRef]
49. Bari, M.; Armin, W.; Ashraf-uz-zaman, K.; Zamil, S.S.; Rabin, M.H.; Bhadra, A.K. Combined Effect of Organic and Inorganic Fertilizers on. *Int. J. Sci. Res. Publ.* **2016**, *6*, 557–561.

50. Schmidt, F.; Knoblauch, R. Extended use of poultry manure as a nutrient source for flood-irrigated rice crop. *Pesqui. Agropecu. Bras.* **2020**, *55*, 17. [CrossRef]

51. Moe, K.; Htwe, A.Z.; Thu, T.T.P.; Kajihara, Y.; Yamakawa, T. Effects on NPK status, growth, dry matter and yield of rice (*Oryza sativa*) by organic fertilizers applied in field condition. *Agriculture* **2019**, *9*, 109. [CrossRef]