Rice growth response to CRF fertilizer and biochar in rainfed land under two continuous seasons

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Abstract. Rainfed rice productivity in Indonesia is generally lower than irrigated paddy fields. The low productivity is likely caused by poor soil fertility and low rainfall during the dry season. This research aims to determine the role of controlled release fertilizer (CRF) and rice husk biochar (RHB) for the rice growth in two continuous seasons. The experiment was a randomized complete block design with three replicates and plot size was 5m x 6m. In wet season (WS), rice planted under direct seeded system. In dry season (DS), the rice was transplanted from seed bed. RHB rates were 0, 5, 10 t ha⁻¹, and CRF Urea (42% N) rates were 0, 50 and 100 % of recommended dosage or equal to 0;142.5; 285 kg/ha respectively. As a positive control was 100 % dosage of recommended NPK fertilizers, namely: urea (45% N) 266 kg/ha, SP36 125 kg/ha and KCl 100 kg/ha. Agronomic traits such as plant height, tiller number, leaf greenness under DS and WS increase significantly as treated with a combination of RHB and CRF, while the distribution of roots and N uptake only increases under DS as such. Optimal plant growth and N uptake in rainfed rice were obtained at treatment of 5 t ha⁻¹ RHB and 50% CRF. Therefore, the dosage is recommendable for developing rice production in rainfed areas both in the dry and wet season.

Keywords: Nitrogen, rice husk biochar, CRF, rainfed land

1. Introduction
The demand of rice as staple foods will increase along with the increase of human population. Nowadays, there are some overcomes to sufficient the food needs such as rice field conversion into non-agriculture activities i.e. housing, manufacture, apartment and others. The rice field existence become decrease by the year, in line with natural damage as a result of exploitative development [1]. The main strategy to support the increase in rice production was includes intensification and extensification of rice, the production should be diversified into other ecosystems like rainfed rice dealing with an increasing pressure brought about by the competition for limited water and other resources [2].

The rainfed rice in Indonesia has a potential to support national self-sufficiency food program. The total existing agriculture land in Indonesia was 7.70 million ha, included 3.64 million ha is categorized as non-irrigated land and rainfed was about 3.17 million ha [3]. Rainfed field refers to all agricultural land where the water supply is derived from rainfall and/or surface water. Therefore, rainfed farming is very dependent on rainfall, this condition made the fields vulnerable to the drought risk during the dry season. Rainfed rice fields are commonly associated with or adjacent to dry land, some of them can be converted into rainfed rice fields with rain harvesting infrastructure and facilities requirement [4]. Based
on the agroecosystem characteristic, rainfed area susceptible on drought because of low rainwater efficiency, low soil fertility, poverty, low water use efficiency, poor infrastructure mainly on irrigation unit \cite{5,6}.

Rainfall is a limiting factor that determines the success of rainfed lowland rice. Rainfed lowland in Pati, Indonesia has a unique pattern. It is conducted in 2 \textit{(two)} systems, \textit{i. e.} \textit{gogo rancah} and \textit{walik jerami}. In the \textit{gogo rancah} system, dibbling will be conducted after rain 2-3 times down and the soil has been processed and moist enough to be planted, farmers usually immediately plant rice seeds. But after the seeds germinate, the rain does not fall so that many seeds that die from drought. While on the \textit{walik} rice straw as it is planted before the rainy season ends, it is often drought earlier on the flowering stage or on the filling stage where the crops need of water precisely. As a result, \textit{walik jerami} rice plants suffer from drought and paddy production becomes very low. This is what causes the productivity of straw \textit{walik} rice plant is unstable \cite{7}.

The low productivity in rainfed was resulted from organic matter loss and soil physical degradation, soil erosion and sedimentation, water scarcity and pollution. This condition lead on soil degradation in rainfed area \cite{8}. To improve the fertilizer efficiency, soil amendments and controlled release fertilizer (CRF) can be applied. Biochar effect decreasing N\textsubscript{2}O emission, increasing SOC as well as enhancing crop productivity and pH \cite{9,10}. Biochar also increase Nitrogen content in the soil, especially to maintain ammonium through cation exchange capacity \cite{10}. Biochar can reduce GHG, it can reduce N\textsubscript{2}O emission through ethylene inhibition, so it will inhibit the nitrification process \cite{11}. Biochar become one of ameliorant which is believe can relieve fatigue soil. Biochar is the result of organic material degradation without involving the air, but rather using the temperature (pyrolysis), and the final product is activated charcoal that serves as soil ameliorant \cite{12}. Biochar increases soil fertility especially on ecosystem maintenance, and as a C fixation agent which can affect on climate change mitigation \cite{13,14}. Biochar has a significant role on the dynamic and soil organic microorganism abundance \cite{15}. Soil amendment was one of the agents to increase soil quality, moreover to increase the grain yield need the proper nutrient management. The controlled release fertilizer was one of the fertilizer technologies which environmentally friendly. New technologies employing controlled-release fertilizers and nitrification inhibitors have the potential to reduce N loss markedly and to improve NUE. CRF release N into the soil in a slower manner which more or less matches to the plant demand. Supply N by single application satisfies plant requirement, maintains low concentrations of mineral N in soil throughout the growing season, and can substitute for split application. They reduce the requirement for multiple field operations, reduces labor requirement and minimize fuel costs. It will result an effective way to improve NUE and reduce negative impact to the environment \cite{16}. However, information about the effectiveness of CRF in combination with biochar application in rice still limited. Thus, this study was conducted to evaluate the effect of combined application of CRF and biochar in rainfed rice areas in Indonesia in terms of the rice growth effect in rainfed rice.

2. Materials and Methods

2.1. Site Description

The field experiment was carried out at Jakenan Experimental Station of Indonesian Agricultural Environment Research Institute (IAERI) in Pati, Central Java, Indonesia (latitude 6\textdegree 45', longitude: 111\textdegree 010', 15m a.s.l). Common soil type for lowland rice area is Inceptisols. The experiment was conducted for two consecutive seasons, wet season (WS) from November 2017 to February 2018, and the dry season (DS) from March to May 2018. Average rainfall, maximum and minimum air temperatures are 6.64 mm, 40.71\textdegree C, and 23.55\textdegree C, respectively. The physicochemical characteristics from topsoil were moderately pH H\textsubscript{2}O (5.40), acid pH KCl (4.40), low total C, N, P and K i. e. 0.53\%, 0.20\%, 0.05\%, 0.67\% respectively.

2.2. Experimental Design

The experiment was designed in a randomized complete block with three replication and plot size was 5m x 6m. The individual plots were separated by protection rows that were 0.5 m in width. At the
beginning of the experiment, biochar was applied 1 (one) time at the beginning of WS on the soil surface by broadcasting and incorporated into soil by manual ploughing to 20 cm depth. Crop establishment was by direct seeding in wet season (WS) using dibble in plots and plant spacing of 20 cm x 20 cm, by transplanting in dry season (DS) with 17 days old seedlings. Inpari 38 Agritan variety were used for both seasons. The sowing date in wet season was on November 7, 2017 while transplanting was taken placed on March 3, 2018. Biochar was applied at rates of 0, 5, 10 t ha$^{-1}$ (B0, B1, B2), and Meister (CRF, 42% N) was applied at rates of 0; 142.5; 285 kg/ha (C0, C1, C2). National recommended dosage of inorganic fertilizers was applied at the rate of urea (45% N) 266 kg/ha, SP36 (Super phosphate, 36% P$_2$O$_5$) 125 kg/ha and KCl (60% K$_2$O) 100 kg/ha respectively. The urea was applied in three splits i.e 1/3 before planting, 1/3 at 40 days after germination (DAG) and 1/3 at 55 DAG. SP36 fertilizer was applied before planting and KCl was applied in two splits, i. e. ½ before planting and 1/2 at 55 DAG. All CRF treatments was applied once at basal application. Biochar was produced from rice husk through pyrolysis at 550°C, and it was applied before sowing and manually incorporated into the soil to a depth of 20 cm after rotary tillage. The biochar had C and N contents of 53.3% and 1.04%, respectively, a total ash content of 20.8%, and a pH (H$_2$O) of 7.2.

2.3. Parameters observed

2.3.1. Plant height. Use actual measurement (cm) from soil surface to tip of the tallest panicle (awns excluded) a week before plant harvest. Plant height was measured from 12 samples per plot [17].

2.3.2. Tiller number. The measurement conducted on 12 plant samples per plot, counted tillers number per hill on the main culm a week before plant harvest.

2.3.3. Leaf greenness. Leaf greenness measurement used SPAD 502 on the youngest fully expanded leaf of a plant. Readings are taken on one side of the midrib of the leaf blade, midway between the leaf base and tip. In early growth stages, when leaves are too narrow to allow SPAD measurements on one side of the midrib, the leaf tip can be used for measuring SPAD values. A mean of 12 readings per field or plot is taken as the measured SPAD value. The measurement conducted at filling stage [18].

2.3.4. Root character. Observation of the root character was carried out by taking root samples using a sampling core with a diameter of 27.3 mm which was pressed into the soil as close as possible to the plant (on the outer stem of the clump in 15 cm depth. Sampling was carried out at 2 points (i. e. west and east). Root observations were carried out from 0-10 cm, 10-20 cm and 20-30 cm depth. Each root sample washed carefully [19]. Root observation included:

2.3.4.1. The density of root length (cm cm$^{-3}$). The root samples from each 10 cm depth soil were washed and dried in an oven at 65°C until constant weight. Each sample were arranged on red paper and the total length is measured using Leaf Area Meter. Determination of root length density (RL) is carried out by the formula [20]:

$$ RL = \frac{\text{The total of root length from each 10 cm depth (cm)}}{\text{The soil volume from 10 cm depth (cm$^3$)}} $$

2.3.4.2. The density of the root surface area (cm$^2$ cm$^{-3}$). The density of the root surface area is the ratio between the root surface area and the volume of the soil sample at 10 cm depth. Measurement method for the root surface used Leaf Area Meter. The dried roots were spread on the transparent thick plastic, then the sample was measured by Leaf Area Meter. The root area surface (RAS) is determined by the formula:

$$ \text{RAS} = \pi \cdot d \cdot p $$

Abbreviation:

$\pi$: The ratio between the circumference and the diameter of the circle (3.14)

d: root diameter (mm)
p: root length (mm)
The results of this measurement are converted into the value of the density of the root surface area (RSA) using the formula:

\[
RSA = \frac{\text{Root surface area (cm}^2\text{)}}{\text{Volume of soil sample in 10 cm depth (cm}^3\text{)}}
\]

2.3.4.3. The density of dried root weight (mg. cm\(^{-3}\)). The roots that have been measured for length and surface area are then weighed using analytical scales to find out the density of dried root weight. The density of dried root weight (DRW) is calculated using the formula [20]:

\[
\text{DRW} = \frac{\text{Root dried weight sample at 10 cm depth (g)}}{\text{Soil sample volume at 10 cm depth (cm}^3\text{)}}
\]

2.3.5. Nitrogen uptake. The tissue analysis is conducted once on vegetative maximum stage from each of rice part i.e. root, stem, and leaf. This data is used to calculate the nutrient uptake of N by plants, using the following formula:

\[
\text{Nutrient Uptake (S_0)} = \text{Dry Weight Biomass (g)} \times \text{Tissue Nutrient Content (%)}
\]

2.4. Data Analysis
Data obtained through field experiments were subjected for two-way factorial ANOVA using SAS software. Duncan Multiple Range Test (DMRT) was tested at P < 0.05 to measure statistical differences among means. Some contrasts were defined to distinguish the effects of treatments compared to control.

3. Result and Discussion
3.1. Plant height
Plant height refers to the longest distance between the plant base and the tip of the highest leaf or panicle (longer part) [21]. The plant height data showed in Table 1 below. The increase level of biochar showed no significantly on plant height, but the increase level of CRF respectively showed significant increase (p < 0.05) at the plant height both in WS and DS. The control showed significantly higher than combination treatments in WS, otherwise it showed no significantly difference with control in DS. The plant heights, both combination of treatments and control showed higher than DS. The result on table 1 become the evidence that Nitrogen is an essential constituent of amino acids, nucleic acids, nucleotides, and chlorophyll. It promotes rapid growth (increased plant height and number of tillers) [22]. The increased plant height with increasing rate of N fertilizers was due to enhanced rate of translocation of nitrogen from, culms to leaves and leads to the production of photosynthates, which enhance the translocation of nutrients for developing panicle. Some rice varieties treated with 200 kg N ha\(^{-1}\) of showed better plant height than the level 0-100 kg N ha\(^{-1}\) [22].

3.2. Tiller number.
The application of CRF significantly increase the tiller number than the biochar application both in WS and DS (Table 2). The control showed no significantly different than combination treatments in WS and DS. The tiller number, both combination of treatments and control showed higher in DS than WS. The Rice tillering is an important agronomic trait for grain production and the number of tillers is dynamic and adjustable. Moderate tillering contributes greatly to rice yields, excessive tillering leads to high tiller abortion, poor grain setting, and small panicle size and ultimately reduces grain yield [24]. Tiller primordium was existed in each node of rice shoot. The primordium develops into a tiller depends on such factors as the nutritional status of the plant, the supply of carbohydrate, and the light and temperature conditions. Tillering is highly impaired by nitrogen or phosphorus deficiency [21]. Based on [25], the increase of N levels improved of late emerging tillers to support the population of rice grain.
yields. The late emerging tillers were significantly lower than late emerging ones, it contributed to the spikelets per panicle and the grain filling. This evidence stated the nutrient status of the plant should be related to tillering performance.

Table 1. Plant height of rainfed rice under different level CRF and biochar amendment treatments

| Treatment | WS    | DS    |
|-----------|-------|-------|
| C0        | 73.50c| 72.15c|
| C1        | 97.08b| 87.12b|
| C2        | 100.75a| 91.44a|
| B0        | 90.59x| 82.06x|
| B1        | 90.63x| 84.52x|
| B2        | 90.11x| 84.13x|

Interaction -

Control 96.93p 84.78p
Combination treatments 90.44q 83.57p

Different letters in each column and line represent significant difference at p < 0.05

Table 2. Tiller number of rainfed rice under different level CRF and biochar amendment treatments

| Treatment | WS    | DS    |
|-----------|-------|-------|
| C0        | 10.40c| 10.66c|
| C1        | 12.98b| 15.42b|
| C2        | 14.23a| 17.86a|
| B0        | 12.47x| 14.87x|
| B1        | 12.66x| 14.69x|
| B2        | 12.49x| 14.37x|

Interaction -

Control 12.98p 15.92p
Combination treatments 12.54p 14.65p

Different letters in each column and line represent significant difference at p < 0.05

3.3. Leaf greenness
Soil Plant Analysis Development (SPAD) chlorophyll meter readings provide a simple, rapid, and accurate nondestructive method for estimating leaf chlorophyll content. The SPAD reading could be used at different growth stages for determining N and chlorophyll status [26, 27]. The increase level of biochar showed no significantly on the leaf greenness, but the increase level of CRF respectively showed significant increase on the leaf greenness both in WS and DS. Leaf greenness means in WS showed higher SPAD score in combination treatment, whereas there was no significant difference (p < 0.05) between control and combination treatments both in WS and DS. Leaf greenness means in WS showed higher SPAD score in combination treatment, whereas there was no significant difference (p < 0.05) between control and combination treatments both in WS and DS. [28] stated SPAD threshold value 35 for rice in dry season (DS) and 32 for wet season or low radiation. Based on the threshold value, the SPAD value in WS both combinations and control indicated the rice got sufficient Nitrogen, exclude no Nitrogen treatment. The SPAD means value in DS showed under the threshold, both in combinations treatments and control. The combination treatments using 50 % and 100 % CRF level showed higher SPAD value, it estimated Nitrogen, which released from CRF, available in soil at the last generative plant stage. According to this condition, The CRF on level 50% still had better greenness at last generative stage on WS.

3.4. Root system in two seasons
3.4.1. The root system in wet season (WS). In this study, the roots were taken using a sample drill at the outer part of the clump. The purpose is to get primary roots which close to the clump. The root system
was consisted of the density of root dried weight, the density of root surface area, and the density of root dried weight. The observation of root system become important because roots have a very important role in the growth and yield of rice and others. Grain production is largely influenced by nutrient adequacy, where the organ that plays a role in taking these nutrients is the root [29]. Table 4-6 showed the root condition during wet season. The results of the density of root length showed that there was no significant difference at p < 0.05 between treatments at various level of biochar to root length at 0-10 cm, 10-20 cm and 20-30 cm depth. The combination treatment vs control showed no significant difference at p < 0.05. In WS, the active root system found only at 0-20 cm depth.

**Table 3.** Leaf greenness of rainfed rice under different level CRF and biochar amendment treatments

| Treatment | WS | Treatments | DS |
|-----------|----|------------|----|
| C0        | 23.22c | C0B0       | 20.27f |
| C1        | 37.70b | C0B1       | 22.30ef |
| C2        | 39.54a | C0B2       | 24.43e |
| B0        | 32.67x | C1B0       | 34.80cd |
| B1        | 33.97x | C1B1       | 32.23d |
| B2        | 33.82x | C1B2       | 34.97cd |
|           |       |            |     |

Different letters in each column and line represent significant difference at p < 0.05

**Table 4.** The density of root length (cm) on 0-10 cm; 10-20 cm; 20-30 cm depth of WS

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| C0         | 0.72b   | 0.62a    | 0.04a    |
| C1         | 0.95b   | 0.10a    | 0.03ab   |
| C2         | 1.44a   | 0.10a    | 0.02b    |
| B0         | 0.98x   | 0.64x    | 0.03x    |
| B1         | 1.10x   | 0.10x    | 0.03x    |
| B2         | 1.02x   | 0.09x    | 0.03x    |
| Interaction |        | -        | -        |
| Treatments | 1.03p   | 1.25p    | 0.19p    |
| Control    | 0.59q   | 0.56p    | 0.10p    |

Different letters in each column and line represent significant difference at p < 0.05

The results of the density of root surface area (Table 5) showed that there was no significant difference between treatments at different level of to the root surface area at 0-10 cm, 10-20 cm and 20-30 cm. In the treatment of different level of CRF at 0-10 cm there was a significant difference between treatments on root surface area, where C2 treatment had a wider root surface area than C0 and C1 treatments. There was a significant difference between the treatment and control combinations in the root surface area at 0-10 cm, 10-20 cm, and 20-30 cm. The treatment combination has a wider surface area than the control in the rainy season.

The results of the density on root dried weight (Table 6) showed that there was no significant difference between treatments at various level of biochar at 0-10 cm, 10-20 cm and 20-30 cm depth in the wet season (WS), whereas in the treatment of different level on CRF gave a significant difference at p < 0.05 between combination treatments. CRF treatment at 0-10 cm at a level of 285 kg/ha (C2) had a
higher root dry weight compared to CRF treatment with doses of C0 and C1. Different in 20-30 cm, the treatment dose of 285 kg/ha (C2) had a smaller root dry weight compared to C0 and C1. There was a significant difference at p < 0.05 between combination treatment and control at 0-10 cm and 20-30 cm depth at the density of dried weight root. The combination treatment had a higher density of root dried weight than the control.

**Table 5. The density of root surface area (cm²) on 0-10 cm; 10-20 cm; 20-30 cm depth of WS**

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| C0         | 8.40c   | 0.70b    | 0.15a    |
| C1         | 14.17b  | 1.62b    | 0.24a    |
| C2         | 16.00a  | 1.43a    | 0.19a    |
| B0         | 12.46x  | 1.22x    | 0.17x    |
| B1         | 13.22x  | 1.28x    | 0.18x    |
| B2         | 12.88x  | 1.23x    | 0.23x    |

Interaction: -

| Treatments | -       | 1.25p    | 0.19p    |
|------------|---------|----------|----------|
| Control    | 9.64p   | 0.56p    | 0.10p    |

Different letters in each column and line represent significant difference at p < 0.05

**Table 6. The density of root dried weight on 0-10 cm; 10-20 cm; 20-30 cm depth of WS**

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| C0         | 0.72b   | 0.62a    | 0.04a    |
| C1         | 0.95b   | 0.10a    | 0.03ab   |
| C2         | 1.44a   | 0.10a    | 0.02b    |
| B0         | 0.98x   | 0.64x    | 0.03x    |
| B1         | 1.10x   | 0.10x    | 0.03x    |
| B2         | 1.02x   | 0.09x    | 0.03x    |

Interaction: -

| Treatments | -       | -        | -        |
|------------|---------|----------|----------|
| Control    | 1.03p   | 0.27p    | 0.03p    |
|            | 0.59q   | 0.04p    | 0.10p    |

Different letters in each column and line represent significant difference at p < 0.05

3.4.2. The root system in dry season (DS). In the density of root length parameter at DS (Table 7) showed there was significant difference at p < 0.05 on the CRF level but there was no significant at different level of biochar application. There was no significant difference at p < 0.05 between combination treatment and control at 0-10 cm, 10-20 cm, and 20-30 cm depth.

**Table 7. Root length density on 0-10 cm; 10-20 cm; 20-30 cm depth of DS**

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| C0         | 0.66a   | 0.08a    | 0.02a    |
| C1         | 0.68a   | 0.07a    | 0.03a    |
| C2         | 0.89a   | 0.08a    | 0.03a    |
| B0         | 0.71x   | 0.08x    | 0.03x    |
| B1         | 0.79x   | 0.08x    | 0.03x    |
| B2         | 0.73x   | 0.07x    | 0.03x    |

Interaction: -

| Treatments | -       | -        | -        |
|------------|---------|----------|----------|
| Control    | 0.74p   | 0.08p    | 0.03p    |
|            | 0.70p   | 0.05p    | 0.02p    |

Different letters in each column and line represent significant difference at p < 0.05
The result on the density of root surface area in the dry season showed at Table 8. It showed no significant difference at $p < 0.05$ in all level of biochar on every 10 cm depth, moreover there was a significant different at the different level of CRF only at 0-10 cm depth. The combination treatment showed no significant difference with the control at $p < 0.05$. The density of root dried weight density at DS showed at Table 9. In the dry season, All the different level of biochar and CRF showed no different significant in every 10 cm depth. The more depth, the more density of root dried weight decrease.

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| C0         | 11.53a  | 1.37a    | 0.18a    |
| C1         | 10.32a  | 1.00a    | 0.24a    |
| C2         | 13.37a  | 0.97a    | 0.15a    |
| B0         | 9.93x   | 0.08x    | 0.03x    |
| B1         | 13.07x  | 0.08x    | 0.03x    |
| B2         | 12.23x  | 0.07x    | 0.03x    |

| Interaction | -       | -        | -        |

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| Control    | 11.74p  | 1.12p    | 0.19p    |
|            | 10.16p  | 0.47p    | 0.07p    |

Different letters in each column and line represent significant difference at $p < 0.05$

3.4.3. Nitrogen uptake. Based on the observations of nitrogen uptake at Table 10, there was a significant difference between the combination treatments in WS otherwise only significant at $p < 0.05$ in all different level of CRF at the DS. The biochar at wet and dry season showed that the application of 5 ton/ha h biochar and 50% CRF level gave a significant different with 100% level CRF. The nitrogen uptake in dry season and wet season showed CRF had affected the Nitrogen uptake. The result showed that the 50% of CRF level had the equal Nitrogen uptake with the 100% CRF, this means the 50% level had effectiveness on Nitrogen uptake as well as 100% level to had higher productivity in wet season. The increase of CRF level showed higher nitrogen. CRF as a one-time basal fertilizer (42% N), achieved nearly equal yields with urea prill fertilizer used in a split application (45% N). It showed consistently higher values than the control in WS and DS.

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| C0         | 11.53a  | 1.37a    | 0.18a    |
| C1         | 10.32a  | 1.00a    | 0.24a    |
| C2         | 13.37a  | 0.97a    | 0.15a    |
| B0         | 9.93x   | 0.08x    | 0.03x    |
| B1         | 13.07x  | 0.08x    | 0.03x    |
| B2         | 12.23x  | 0.07x    | 0.03x    |

| Interaction | -       | -        | -        |

| Treatments | 0-10 cm | 10-20 cm | 20-30 cm |
|------------|---------|----------|----------|
| Control    | 11.74p  | 1.12p    | 0.19p    |
|            | 10.16p  | 0.47p    | 0.07p    |

Different letters in each column and line represent significant difference at $p < 0.05$
Table 10. Nitrogen uptake on harvest stage in WS and DS

| Treatments | WS   | DS   |
|------------|------|------|
| C0         | 32.88c | 45.18b |
| C1         | 115.83b | 105.31a |
| C2         | 152.16a | 108.86a |
| B0         | 98.03x  | 84.91x |
| B1         | 98.36x  | 85.75x |
| B2         | 104.47x | 85.70x |

Interaction

- -

Treatments

| Treatments | Control |
|------------|---------|
|            | 100.29p | 96.45p |
|            | 96.87p  | 85.53p |

Different letters in each column and line represent significant difference at p < 0.05

4. Conclusion

Optimal plant growth and N uptake in rainfed rice were obtained at treatment of 5 t ha\(^{-1}\) RHB and 50% CRF. Therefore, the dosage is recommendable for developing rice production in rainfed areas both in the dry and wet season.

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