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Impact of supplemental irrigation and organic manure on growth and yield performance of rice variety BRRI dhan103 under terminal drought condition in Aman season

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Abstract: BRRI dhan103 is a transplanting Aman (T. Aman) rice variety that demands sufficient organic manure and supplemental irrigation to ensure successful production. Seven treatments, viz., T1= rainfed control; T2= one supplemental irrigation at 80 days after transplanting (DAT); T3= two supplemental irrigations at 70 and 80 DAT; T4= additional 5 t ha^{-1} poultry compost under rainfed condition; T5= additional 10 t ha^{-1} poultry compost under rainfed condition; T6= additional 2.5 t ha^{-1} biochar under rainfed condition; and T7= additional 5 t ha^{-1} biochar under rainfed condition, were evaluated against BRRI dhan103 to assess the impact of supplemental irrigation and manuring under terminal drought conditions. It was revealed that supplemental irrigation and manuring significantly improved all growth parameters and yield attributes compared to the rainfed control. Notably, T5 treatment provided its greatest performance statistically in respect of SPAD value (36.13), root dry weight (12.43 g), number of tillers $hill^{-1}$ (13.22), panicle length (28.87 cm), panicles $hill^{-1}$ at harvest (9.13), total spikelet (194.53), spikelet $panicle^{-1}$ (197.63), filled spikelet $panicle^{-1}$ (197.63), thousand grain weight (33.78 g), grain weight $panicle^{-1}$ (28.70 g), grain yield $hill^{-1}$ (31.97 g), and above-ground biological yield (3043.35 g m^{-2}). The highest tiller $hill^{-1}$ at harvest (9.53) was achieved when an additional 10 t ha^{-1} of poultry compost was applied under rainfed conditions. This study suggested that additional 10 t ha-1 poultry compost under rainfed conditions performed best to enhance the growth and yield of BRRI dhan103.

Keywords: rice; yield; biochar; compost; supplemental irrigation

INTROTUCTION

Rice (*Oryza sativa* L.) is a crucial cereal crop globally, thriving in diverse climatic zones and serving as a staple food for nearly half of the world's population, predominantly in developing countries. BRRI dhan103 is a high-yielding rice variety developed by the Bangladesh Rice Research Institute (BRRI). This variety is specifically designed to thrive in the agro-climatic conditions of Bangladesh, contributing to increased rice production in the country.

About 90% of rice is cultivated and consumed in Asia. Bangladesh, an agriculture-based nation, grows rice as its main food crop on approximately 11.52 million hectares, covering about 81.79% of the country's cropped area. Rice production accounts for 92% of Bangladesh's total food grain output and more than 50% of the agricultural value, employing around 44% of the total labor force. Rice occupies 78% of the total cropped area of Bangladesh, and the food security of Bangladesh is significantly influenced by the availability and accessibility of rice, as it accounts for 70% of the daily calorific requirement and 56% of the protein consumption of the population (BBS, 2019).

According to the Bangladesh Rice Research Institute (BRRI, 1991a), Aman rice is predominantly rain-fed and grows during the monsoon months. However, the rainfall distribution during this period is uneven. Bangladesh receives about 95% of its annual rainfall (203 cm) between April and October, which can support a good yield of Aman rice. When the monsoon abruptly ends in September, it can cause severe water stress during the T. Aman season. Post-October, rainfall is insufficient for the potential yield of Aman rice, as most of the crop is in the flowering and grain-filling stages during this time (Sattar & Parvin, 2009a); Rashid et. al., 2005). The vigorous crop growth that was improved by Nitrogen fertilizer with manure requires more water supply, notably in the critical growth stage (Wang et al., 2017a). Although the total rainfall during the T. Aman growing period exceeds the crop's water requirements, supplemental irrigation is necessary due to the erratic rainfall distribution. T. Aman rice estimated irrigation water during its later growth phase due to the uneven distribution of rainfall in Bangladesh (Amin et al., 2022), Islam's (2007) model studies confirmed the importance of supplemental irrigation for sustainable T. Aman production, with rainfall being the key climatic factor determining this need (Sattar & Parvin, 2009b).

Supplemental irrigation plays a vital role in mitigating the impact of drought on T. Aman rice. The requirement for supplemental irrigation is higher in October and November. Without timely water supply, rice yield significantly drops. Providing supplemental irrigation during dry spells can overcome yield reductions (Pawar & Dongarwar, 2007). During the T. Aman season, timely supplemental irrigation can boost rice yields by 8 to 71 percent compared to rain-fed conditions (BRRI 1991b). Balanced fertilization helps crops overcome adverse soil conditions, including moisture deficits (Karim & Rahman, 2015).

Environmental concerns arising from the excessive use of chemical fertilizers have prompted the investigation of eco-friendly organic alternatives (Laboni et al., 2024). Organic manures and compost, which are produced from agricultural residues, are essential for enhancing soil fertility and nutrient availability, thereby increasing crop growth and yield (Anee et al., 2022). The utilization of bio-fertilizers and bio-fungicides is a promising approach, as they are adaptable, have a broad antibiotic spectrum, and can develop rapidly (Karim et al., 2024). These bio-fertilizers effectively control soil-borne pathogens and enhance productivity and growth. Manure application boosted yearly yield without irrigation, while mixed fertilization increased production with irrigation (Wang et al., 2017b).

Poultry manure is an excellent nutrient source and can be integrated into most fertilizer programs. Proper soil fertility management is crucial to prevent nutrient imbalances when using manure. Poultry manure, particularly in composted form, can significantly enhance soil nutrient content and crop yields (Chowdhury et al., 2013; Najafi & Abbasi, 2013).

Biochar application mitigates drought's negative effects on plants by enhancing plant growth, biomass, and yield through improved photosynthesis, nutrient uptake, and gas exchange characteristics. It improves soil's physical, chemical, and biological properties, thereby aiding plant growth under water stress (Rani et al., 2019; Hadiawati et al., 2019). During water stress, biochar reduces restrictions on root elongation, volume, and surface area, primarily by improving water status and soil chemical properties (Kartika et al., 2021).

Despite these benefits, there is limited information on the effects of supplemental irrigation and soil organic amendments on mitigating terminal drought stress in transplanted Aman rice in Bangladesh. This study was conducted to explore the effects of terminal drought on the growth, physiology, yield attributes, and yield of T. Aman rice, determine the necessary number of supplemental irrigations during dry spells, and evaluate the efficacy of poultry compost and biochar in alleviating terminal drought stress.

MATERIALS AND METHODS

Experimental setup

The experiment took place from July to December 2023 at the Crop Physiology and Ecology Research Field of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur. The field, which is classified as medium-high land with non-calcareous dark gray floodplain soil, is part of the Old Himalayan Piedmont Plain's under the Agro-Ecological Zone-1 (AEZ-1) of Bangladesh. The sandy loam soil belongs to the Inception order. Located in a subtropical region, the site experiences heavy rainfall from August to October, with minimal rainfall for the rest of the year. Seedbed preparation began on July 1, 2023, with repeated ploughing using a power tiller, followed by the uniform sowing of BRRI dhan103 seeds, which were obtained from the Bangladesh Rice Research Institute in Rangpur, on July 5, 2023. Main field preparation started in the last week of July 2023, involving multiple ploughings and laddering to achieve a fine tilth. Weeds and remnants of previous crops were removed, and the field was leveled. The plots were laid out following the experimental design, and individual plots were cleaned and leveled with a wooden plank before transplanting the seedlings.

The experiment was conducted following a randomized complete block design (RCBD) with seven treatments of supplemental irrigation and doses of organic manure treatments such as, T1= Rainfed (control), T2= One supplemental irrigation at 80 DAT, T3= Two supplemental irrigation at 70 DAT and 80 DAT, T4= Additional 5 t ha^{-1} poultry compost under rainfed condition, T5= Additional 10 t ha^{-1} poultry compost under rainfed condition, T6= Additional 2.5 t ha^{-1} biochar under rainfed condition, and T7= Additional 5 t ha^{-1} biochar under rainfed condition and also three replications. T. Aman rice variety BRRI dhan103 was used as a planting material in this study. The experiment consisted of 21 plots, each measuring 2 m × 2 m, spaced 1 m apart. Various fertilizers, including poultry compost, biochar, TSP, MoP, gypsum, and ZnSO4, were applied during final land preparation. Urea was split into three applications. Seedlings were transplanted on August 6, 2023, with 20 cm × 20 cm spacing. During the final land preparation, poultry compost (15 t ha^{-1}), biochar (10 t ha^{-1}), triple super phosphate (TSP), muriate of potash (MoP), gypsum, and zinc sulfate ($ZnSO_4$) were applied as basal doses according to the experimental treatments. Urea was applied in three equal splits: the first dose at 15 days after transplanting, and subsequent doses at 30 days (active tillering stage) and 75 days (panicle initiation stage). On August 6, 2023, thirty-day-old seedlings were carefully uprooted in the morning and transplanted into well-prepared plots the same day, with a spacing of 20 cm × 20 cm and three healthy seedlings per hill. Intensive care ensured adequate crop growth. Gap filling was done by replacing dead seedlings with those from the same source. Control plots were rainfed, while supplemental irrigated plots received irrigation up to 6 cm as per treatment. Hand weeding was performed twice to remove common weeds. Stem borers were controlled using Curater 5G at 9.88 kg/ha, with no significant disease incidents requiring further pesticide use.

Data Collection

Tillers hill^{-1} had been determined at 50, 70 and 90 days after transplanting, respectively. SPAD values were measured from the middle section of the flag leaf of five main shoots at 60 days after transplanting (DAT) using a SPAD meter (Model: MINOLTA, CHLOROPHYLL METER, SPAD-502, JAPAN). Roots were dried out at 70 °C for at least 48 h, after which their dry weights were recorded following the formula:

$$Root\ Dry\ Weight = \frac{Total\ Dry\ Root\ Biomass(g\ m^{-2})}{Area\ (m^2)}$$

The number of panicles hill^{-1} at the harvesting stage was counted from five hills, and the mean value was observed. Five panicles were randomly selected from different hills to count and average the filled and unfilled spikelet panicle^{-1}. Panicle length (cm) was measured from the basal node of the rachis to the apex of five panicles, and the average value was recorded. A thousand grains from each plot were weighed after sun drying using an electronic balance, and the data were recorded. Grain and straw yields for each plot were measured after sun drying. The grain yield was expressed as grams per square meter (g m^{-2}) at 14% moisture content. The above biological yield was determined by following formula and expressed as kilograms per square meter (kg m^{-2}):

$$Above\ Ground\ Biological\ Yield = \frac{Total\ Dry\ Biomass\ (g\ m^{-2})}{Area\ (m^2)}$$

Data Analysis

The data were analyzed using the Statistix 10 program, with treatment means compared using the LSD test at a significance level of $p \leq 5\%$.

RESULTS AND DISCUSSION

The maximum growth, yield, and yield-contributing characteristics of BRRI dhan103 were significantly influenced by the addition of poultry manure amounts and supplementary irrigation.

SPAD Value

The results showed that at 50 DAT, the maximum SPAD value (36.13) was found when additional 10 t ha^{-1} poultry compost was treated under rainfed conditions (T5), which was statistically similar to 35.40 obtained from additional 5 t ha^{-1} biochar. At 70 DAT, the highest SPAD value (43.17) was found in the T7 treatment, followed by the T1 (40.73) treatment. At 90 DAT, T5 treatment had the highest SPAD value (38.17), followed by T7 (36.13) and T6 (34.70), respectively (Figure 1). Mohanty et al. (2018) determined that the SPAD value of flag leaf was higher in the supplemental irrigated plot than in the rainfed plot. Supplementary irrigation treatments had a substantial impact on the value of flag leaf SPAD, with the highest value (35.97%) observed in two supplemental irrigation plots (Era et al., 2021a).

Root dry weight

Results showed that at 50 DAT, the highest root dry weight (11.58 g) was measured when ad-

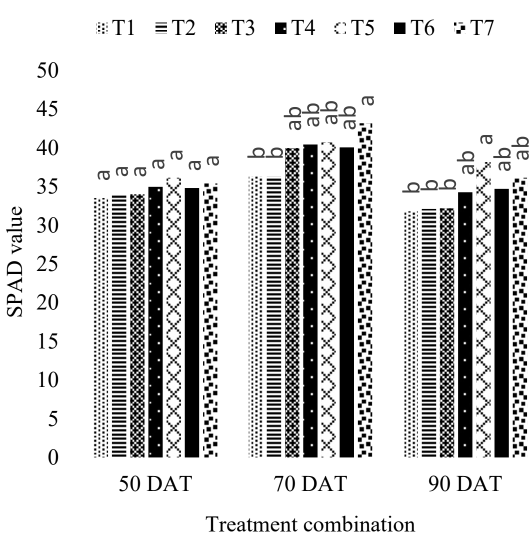

Figure 1. SPAD value of transplanted rice (BRRI dhan103) at 50,70 and 90 days after transplanting as influenced by supplemental irrigation, poultry compost and biochar

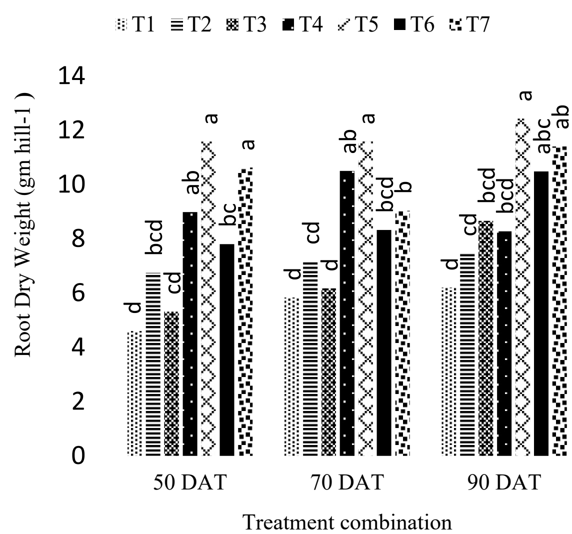

Figure 2. Root dry weight of transplanted rice (BRRI dhan103) at 50,70 and 90 days after transplanting as influenced by supplemental irrigation poultry compost and biochar

ditional application of 10 t ha^{-1} poultry compost was applied under the rainfed condition (T5), which was comparable to the results of 10.62 g collected from additional application of 5 t ha^{-1} biochar (Figure 2). At 70 DAT, the highest root dry weight (11.58 g) occurred when additional application significantly compared with that of 10.49 g obtained from additional application of 5 t ha^{-1} poultry compost (9.03 g). At 90 DAT, the most prevalent root dry weight (12.43 g) was noticed, while additional application of 10 t ha^{-1} poultry compost was employed under rainfed condition (T5), which was statistically equivalent to the 11.40 g from additional application of 5 t ha^{-1} biochar. Alternate wetting and drying at 30, 60, and 90 DAS resulted in higher root dry matter accumulation, which could be due to the enhancement of root oxidation activity and root source cytokinin in intermediate wetting and drying (Nayaka et al., 2021).

Number of tillers hill^{-1}

The results indicated that the highest number of tillers hill^{-1} (13.22) was observed when an additional 10 t ha^{-1} poultry compost was applied under the rainfed condition (T5) at 50 DAT. This figure was comparable to the value of 12.89 for the additional application of 5 t ha^{-1} biochar (Figure 3). At 70 DAT, the maximum number of tillers hill^{-1} (15.11) was found when additional 10 t ha^{-1} poultry compost was applied under rainfed condition (T5), which was as similar as those of (14.66) from additional application of 5 t ha^{-1} biochar (Figure 3). At 90 DAT, the maximum number of tiller hill^{-1} (15.22) was found when additional 10 t ha^{-1} poultry compost was applied under rainfed condition (T5), which was equal to those of (14.11) from the additional application of 5 t ha^{-1} biochar (Figure 3). According to Mahmud (2017), BRRI Dhan-65 had the most tillers (6.96) on hill^{-1}. Lack of water hindered mitosis, cell elongation, and expansion, which in turn led to a reduction in the number of tillers growing and an even smaller number of effective tillers, all of which had an impact on the yield (Hussain et al., 2008; Bakul et al., 2009; Sikuku et al., 2010).

Tiller hill^{-1} at harvest

The highest tiller hill^{-1} at harvest (9.53) was recorded when additional 10 t ha^{-1} poultry com-

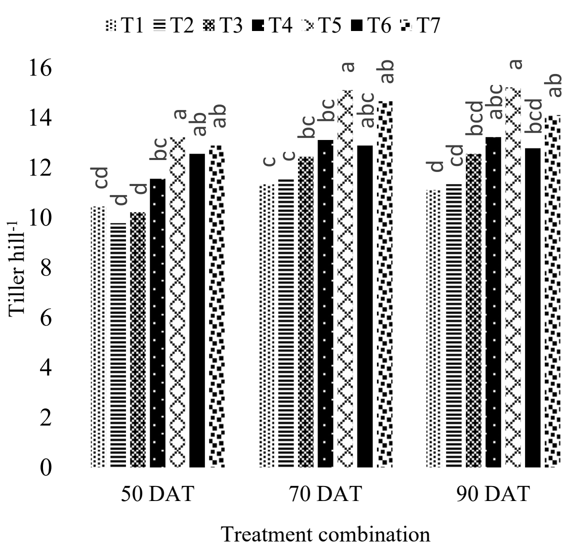

Figure 3. Tiller hill^{-1} of transplanted rice (BRRI dhan103) at 50,70 and 90 days after transplanting as influenced by supplemental irrigation, poultry compost and biochar

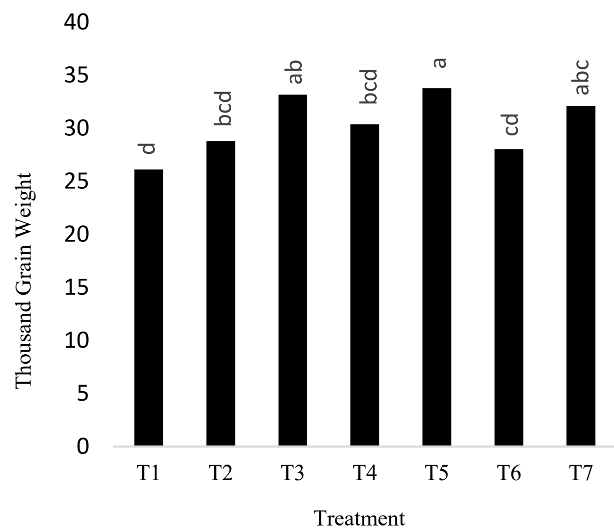

Figure 4. Effect of organic manure and supplemental irrigation on thousand grain weight of BRRI dhan103

post was applied under rainfed condition (T7), which was statistically similar to those of additional application of 5 t ha^{-1} biochar under rainfed condition (9.33). The increase in tillers $hill^{-1}$ was 31.58% in one supplemental irrigation at 70 DAT, 33.66% in two supplemental irrigations at 70 DAT and 80 DAT, 44.21% in additional application of 10 t ha^{-1} poultry compost, 27.34% in additional application of 5 t ha^{-1} poultry compost, 38.93% in additional application of 5 t ha^{-1} biochar, and 32.62% in additional application of 2.5 t ha^{-1} biochar (Table 1).

Panicle length at harvest

The highest panicle length (30.57 cm) during harvest was recorded in the T3 treatment, which was statistically similar to the T5 (28.87cm) treatment. The increment in panicle length was 2.70% in one supplemental irrigation, 12.93% in two supplemental irrigations, 6.65% in additional application of 10 t ha^{-1} poultry compost, 1.22% in additional application of 5 t ha^{-1} poultry compost, 4.06% in additional application of 5 t ha^{-1} biochar, and 0.59% in additional application of 2.5 t ha^{-1} biochar (Table 1). In irrigated plots, there was a 5.86% increase in panicle length for transplanted Aman rice compared to rain fed conditions (Shamsuzzaman, 2007).

Panicles hill^{-1} at harvest

The foremost quantity of panicles $hill^{-1}$ (9.13) was identified when additional 10 t ha^{-1} poultry compost was applied under rainfed condition (T5), which was statistically at the same level as the results of the additional application of 5 t ha^{-1} biochar under rainfed condition (8.8).

The increment in panicles $hill^{-1}$ was 31.60% in one supplemental irrigation at 80 DAT, 36.97% in two supplemental irrigations at 70 DAT and 80 DAT, 44.23% in additional application of 10 t ha^{-1} poultry compost, 27.49% in additional application of 5 t ha^{-1} poultry compost under rainfed conditions, 39.02% in additional application of 5 t ha^{-1} biochar, and 32.70% in additional application of 2.5 t ha^{-1} biochar (Table 1). The number of panicles increased significantly with diverse organic input sources, and the number of grains in panicle-1 showed significant variation across treatments (Yeptho et. al., 2023). The number of reproductive tillers and panicles per hill reduces when water scarcity occurs during the tillering stage (Wopereis et al., 1996).

Total spikelet panicle^{-1}

The maximal number of total spikelet $panicles^{-1}$ (194.53) was identified in poultry compost

Table 1. Effect of supplemental irrigation poultry compost and biochar on tiller $hill^{-1}$, panicle $hill^{-1}$ at harvest, panicle length and total spikelet $panicle^{-1}$ of T-Aman rice

Treatments	Tiller $hill^{-1}$(no.)		Panicle $hill^{-1}$(no.)		Panicle length		Total spikelet $panicle^{-1}$	
	Number	% change over T1	Number	% change over T1	(cm)	% change over T1	Number	% change over T1
T1	6.93d	-	6.33c	-	27.07 b	-	31.67 c	-
T2	8.33c	31.58	8.33ab	31.6	27.80 ab	2.7	41.67 ab	31.58
T3	9.13ab	33.66	8.67ab	36.97	30.57 a	12.93	42.33 ab	33.66
T4	8.40c	27.34	8.07b	27.49	27.40 ab	1.22	40.33 b	27.34
T5	9.53a	44.21	10.20 c	44.23	28.87 ab	6.65	45.67 a	44.21
T6	9.53a	32.62	8.4ab	32.7	27.23 b	0.59	42.00 ab	32.62
T7	9.33ab	38.93	8.4ab	39.02	28.17 ab	4.06	44.00 ab	38.93
CV%	3.69	-	7.05	-	6.33	-	7.05	-
Significance Level	**		**		*		*	

In a column, means followed by similar letter(s) did not differ significantly by LSD test
Here, LS= level of significance, CV= coefficient of variation, *= 5% level of probability, **= 1% level of probability

that was applied under the rainfed condition (T5), which was a statistically similar additional application of 10 t ha^{-1} of poultry compost (194.53). Panicle length increased by 31.58% after one supplemental irrigation, 33.66% after two supplemental irrigations, 44.21% after applying 10 t ha^{-1} poultry compost, 27.34% after applying 5 t ha^{-1} poultry compost, 38.93% after applying 5 t ha^{-1} biochar, and 32.62% after applying 2.5 t ha^{-1} biochar (Table 1). The application of compost resulted in a substantial increase in the number of spikelet panicle^{-1} (Ghorbani et al., 2023).

Unfilled and filled spikelet panicle^{-1}

The highest number of unfilled spikelet panicle^{-1} (16.74) was recorded in rainfed condition (T1), which was statistically similar to one supplemental irrigation (15.80). The highest amount of filled spikelet panicle^{-1} (197.63) was recorded in the T5 treatment, which was statistically similar to those of two supplemental irrigations at 70 DAT and 80 DAT (180.4). Total unfilled spikelet panicle^{-1} decreased by 5.62% in one supplemental irrigation at 80 DAT, 35.48% in two supplemental irrigations at 70 DAT and 80 DAT, 39.07% in an additional application of 10 t ha^{-1} poultry compost, 19.95% in an additional application of 5 t ha^{-1} poultry compost, 36.86% in an additional application of 5 t ha^{-1} biochar, and 29.02% in an additional application of 2.5 t ha^{-1} biochar under rainfed conditions. The increment in filled spikelet panicle^{-1} was 11.51% in one supplemental irrigation at 80 DAT, 19.55% in two supplemental irrigations at 70 DAT and 80 DAT, 30.97% in additional application of 10 t ha^{-1} poultry compost, 5.15% in additional application of 5 t ha^{-1} poultry compost, 16.68% in additional application of 5 t ha^{-1} biochar, and 3.16% in additional application of 2.5 t ha^{-1} biochar under rainfed conditions (Table 2). The characteristics like the number of effective tillers hill^{-1} and non-effective tillers hill^{-1}, the number of filled grains and empty grains panicle^{-1}, panicle length, and grain yield increased in irrigated crops compared to rainfed rice crops (Ghosh et al., 2018) the amount highest grain yield increased with increased rain fed conditions (Howlader et al., 2024)

Thousand grain weight

The results showed that the highest thousand grain weight (33.78 g) was observed in the additional application of 10 t ha^{-1} poultry composts under rainfed conditions (T5), followed by the T3 treatment (Figure 4). When soil moisture levels dropped, the weight of 1000 grains decreased. Lower soil moisture levels may reduce grain as-

Table 2. Effect of supplemental irrigation poultry compost and biochar on unfilled spikelet panicle^{-1}, filled grains panicle^{-1} and grain weight panicle^{-1} of T-Aman rice

Treatments	Unfilled spikelet panicle^{-1}		Filled grains panicle^{-1}		Grain weight panicle^{-1}	
	Number	% change over T1	Number	% change over T1	(g)	% change over T1
T1	16.74 a	-	150.90d	-	21.36d	-
T2	15.80 a	-5.62	168.27abcd	11.51	23.44d	9.74
T3	10.80 c	-35.48	180.40ab	19.55	28.20ab	32.02
T4	13.40 b	-19.95	158.67bcd	5.15	24.73bcd	15.78
T5	10.20 c	-39.07	197.63a	30.97	28.70a	34.36
T6	11.88 bc	-29.02	155.67cd	3.16	24.30cd	13.76
T7	10.57 c	-36.86	176.07abc	16.68	27.10abc	26.87
CV%	9.58	-	7.27	-	7.96	-
LS	**		**		**	

In a column, means followed by similar letter(s) did not differ significantly by LSD test
Here, LS= level of significance, CV= coefficient of variation, **= 1% level of probability

similation transfer, resulting in smaller grains (Zubaer et al., 2007).

Grain weight panicle^{-1}

The T5 treatment had the highest grain weight panicle^{-1} (28.70 g), which was statistically similar to the T3 treatment (28.20 g). The rise in grain weight of Panicle^{-1} was 9.74% in one supplemental irrigation, 32.02% in two supplemental irrigations at 70 and 80 DAT, 28.70% in additional application of 10 t ha^{-1} poultry compost, 24.73% in additional application of 5 t ha^{-1} poultry compost, 26.87% in additional application of 5 t ha^{-1} biochar, and 13.76% in additional application of 2.5 t ha^{-1} biochar under rainfed conditions (Table 2). Drought-induced water stress during vegetative growth, particularly in the early stages of flowering and terminal phases, may retard floral initiation, resulting in spikelet sterility, grain filling deficits, and reduced grain weight and yield (Kumar et al., 2014; Kamoshita et. al., 2008). Yang et al., (2004) recorded that 1000 grain weight was enhanced by the use of inorganic fertilizer along with organic manure.

Grain and straw yield hill^{-1}

The highest grain yield hill^{-1} (31.97 g) was recorded when additional 10 t ha^{-1} poultry compost was applied under rainfed conditions (T5), whereas the minimal amount of grain yield hill^{-1} (29.99 g) was noted from rainfed T. Aman (Table 3). The T5 treatment produced the highest straw yield hill^{-1} (56.15 g), which was statistically comparable to the T3 treatment. One supplemental irrigation at 80 DAT increased grain yield hill^{-1} by 1.50%; two supplemental irrigations increased it by 3.03%; additional applications of 10 t ha^{-1} poultry compost under rainfed conditions increased it by 6.60%; additional applications of 5 t ha^{-1} poultry compost increased it by 1.70%; additional applications of 5 t ha^{-1} biochar increased it by 2.20%; and additional applications of 1.17 t ha^{-1} biochar increased it by 3.16% under rainfed conditions (Table 3). The increment in straw yield hill^{-1} was 3.10% in one supplemental irrigation at 80 DAT, 4.48% in two supplemental irrigations at 70 DAT and 80 DAT, 5.64% in additional application of 10 t ha^{-1} poultry compost, 3.63% in additional application of 5 t ha^{-1} poultry compost, 3.73% in additional application of 5 t ha^{-1} biochar under rainfed conditions, and 3.01% in additional application of 2.5 t ha^{-1} biochar under rainfed conditions (Table 3). When drought coincides with the grain-filling period and flowering, the grain yield is significantly reduced (López-Hernández

Table 3. Effect of supplemental irrigation poultry compost and biochar on grain yield hill^{-1}, straw yield hill^{-1} and above ground biological yield m^{-2} of T-Aman rice

Treatments	Grain yield hill^{-1}		Straw yield hill^{-1}		Above ground biological yield m^{-2}	
	(g)	% change over T1	(g)	% change over T1	(g)	% increase over T1
T1	29.99c	-	53.15c	-	2283.35d	-
T2	30.44bc	1.5	54.8b	3.1	2473.55cd	8.32
T3	30.90b	3.03	55.53ab	4.48	2856.65ab	25.11
T4	30.50bc	1.7	55.08ab	3.63	2626.65bc	15.03
T5	31.97a	6.6	56.15a	5.64	3045.35a	33.37
T6	30.34bc	1.17	54.75b	3.01	2405cd	5.33
T7	30.65b	2.2	55.13ab	3.73	2781.65b	21.82
CV%	1.05	-	1.14	-	5.28	-
LS	**		**		**	

In a column, means followed by similar letter(s) did not differ significantly by LSD test
Here, LS= level of significance, CV= coefficient of variation, **= 1% level of probability

et. al., 2018). The increase in straw yield was due to the influence of fertilizer with different levels of organic manures, which was primarily due to increased tillering (Murthy, 2012). According to Kabir (2011), when rainfed, BINA dhan-7 had the lowest grain yield (3.92 t ha^{-1}), but the highest (5.86 t ha^{-1}) when irrigated four times.

Above ground biological yield

The highest above-ground biological yield (3043.35 g m^{-2}) was recorded when additional 10 t ha-1 poultry compost was applied under rainfed condition (T5), which was statistically as similar as those of two supplemental irrigations at 70 DAT and 80 DAT (2856.65 g m^{-2}). The increase in above-ground biological yield was 8.32% in one supplemental irrigation of 80 DAT, 25.11% in two supplemental irrigations of 70 DAT and 80 DAT, 33.37% in additional application of 10 t ha^{-1} poultry compost under rainfed conditions, 15.03% in additional application of 5 t ha^{-1} poultry compost, 21.82% in additional application of 5 t ha^{-1} biochar, and 5.33% in additional application of 2.5 t ha^{-1} biochar under rainfed conditions (Table 3). The maximum yield (1.61 kg m^{-2}) was obtained from the three supplemental irrigation plots, whereas the lowest yield (1.31 kg m^{-2}) was recorded from the control treatment, demonstrating that supplemental irrigation had no influence on rice above-ground biological yield (Era et. al., 2021b).

CONCLUSION

In summary, this study revealed that the terminal drought stage during the Aman season had an impact on BRRI dhan103's growth, yield, and yield-attributing characteristics. An additional 10 t ha^{-1} of poultry compost under rainfed conditions could successfully alleviate the adverse effects of the terminal drought stage in T. Aman.

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