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RESPONSE OF TRANSPLANTED AMAN RICE VARIETIES, SEEDLING RATE AND WATER REGIMES

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ABSTRACT

A pot experiment was carried out in the experimental site of Bangladesh Institute of Nuclear Agriculture, Mymensingh from June to November, 2002 with a view to study the growth and yield performances of two modern varieties of transplant aman rice as affected by number of seedlings hill^{-1} and water regimes. Variety, number of seedlings hill^{-1}, water regimes and their interactions exerted significant influence on almost all the crop characters. At all the growth stages , the maximum values of total tillers hill^{-1}, leaf, stem, root, shoot, and total dry matter hill^{-1}, leaf area index were found in BINA dhan 4×4 seedlings hill^{-1} × intermittent irrigation, whereas the minimum values of those parameters were in BRRI dhan 39× 2 seedlings hill^{-1} × 25-27 cm continuous stagnant water. The highest total dry matter (88.09 g) and grain yield pot^{-1} (31.25 g) were achieved in the treatment combination of BINA dhan 4 with 4 seedlings hill^{-1} and intermittent irrigation.

Key words: T. aman rice, varieties, seedling rate, water regimes, growth and yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is the principal food crop in Bangladesh feeding about hundred percent of her population. Although rice is our staple food, the average yield of rice in our country is around 1.9 t ha^{-1} (BBS, 2001), which is less than the world average (2.9 t ha^{-1}) and frustratingly below the highest yield (6.1 t ha^{-1}) recorded in Korea (Swaminatha, 1997). Low yielding varieties, poor production technologies and unfavourable climatic conditions are considered as major constrains for this. The production efficiency of rice depends on the favourable climatic conditions particularly temperature, sunshine and soil moisture level. Rice plants need adequate moisture throughout its life cycle. It requires 800 to 1200 mm water for its optimum growth and yield (Yoshida, 1981). Water plays a vital role in growth and development of rice plant. Insufficient water affects the germination of seeds, cell division, tillering and nutrient uptake of the plant. For scarcity of water transplanting is not possible, plant growth becomes stunted, proper flowering and fruiting are hampered. It was reported that standing water produces higher yield (Saika and Dutta, 1991) but researchers have also found that equal or even higher yield may be obtained if irrigation water is applied at or near saturation point 1-5 days after disappearance of applied standing water compared to continuous ponding which saves 30-60% of irrigation water (Hassan, 1986 and Hassan *et al.,* 1989). On the other hand for achieving higher yield unit^{-1} area, emphasis should be given to develop suitable production technology. Among the production technology, seedlings hill^{-1} is an important factor for successful *T. aman* rice production because it influences the tiller formation and consequently may affect the solar radiation interception, total sunshine, nutrient uptake and other physiological phenomena and ultimately affect the growth, development and yield of rice plant. Therefore, an experiment was conducted to evaluate the production potentiality of two HYV *T.aman* rice varieties under different water regimes with variable number of seedlings hill^{-1}.

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MATERIALS AND METHODS

The experiment was carried out at the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, during the period June to November 2002. The soil of the experimental field belongs to Sonatola soil series under the Old Brahmaputra Floodplain Agro-ecological Zone (AEZ-9) having non-calcareous dark-grey flood soil.

The experiment comprised of three factors: Factor A, rice variety such as BINA dhan 4 (V_1) and BRRI dhan 39 (V_2), Factor B, seedlings rate such as two seedlings (S_1) per hill four seedlings (S_2) per hill and Factor C, Water regimes such as Intermittent irrigatioin: Irrigating to 5-7 cm depth 1 day after disappearance of the ponded water (W_1), 5-7 cm continuous stagnant water (W_2), 15-17 cm continuous stagnant water (W_3) and 25-27 cm continuous stagnant water (W_4).

The experiment was laid out in randomized complete block design (factorial) with 3 replications. Sprouted seedlings were grown on nursery bed on 22 June, 2002. The collected soil was sun dried and crushed well. Then the sol debris was removed by sieving and the basal fertilizers (urea, TSP, MOP, gypsum and zinc sulfate @ 150, 100, 70, 60 and 10 kg/ha respectively, BARC 1997) were mixed with the soil before placing it into the pots. Each pot was filled up with 16 kg soil. The pots were then placed at the northern yard of Biofertilizer Laboratory, BINA. The pots were pre-labelled for each treatment. Soil in the pots was watered and puddled thoroughly by hand for transplanting. Finally, the soil surface was leveled just before transplanting. Total 48 pots were prepared where transplanting were done on 24 July 2002.

Without causing any mechanical injury to the roots the seedlings were uprooted, washed thoroughly and brought to the experimental site for transplanting. Thirty five day old seedlings of both varieties were transplanted in the pots at 2 cm depth as treatment variable on 27 July, 2002.

The crop was kept completely weed free throughout the crop life cycle. From transplanting day to crop establishment (till 15 DAT) all the pots were kept under continuous 2-3 cm standing water. As soon as the seedlings got establishment the water treatments were applied and continued till the completion of grain filling stage. For imposing the water treatments accurately, centimeter marked sticks of expected height were installed in each pot which were used to measure the height of water and water was supplied through hose pipe daily to impose the different water regimes correctly. The interference of rain water was checked by keeping the pots under a transparent polythene shade. At 15 days before harvest the water of all the pots was fully drained out to ensure maturity of the crops. Dimecron 100 EC @ 1.5 L ha^{-1} was applied three times as a protective measure against insect pest and viral diseases for entire growing period. Different growth and yield data were recorded at different growth stages.

Data were analyzed following computer package MSTATC. The mean differences among the treatments were adjudged by the Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at 5 % level of significance.

RESULTS AND DISCUSSION

Growth characters of transplant aman rice varieties

The tallest plant (71.04 cm) was produced by $V_1S_2W_4$ (BINA dhan 4 × 4 seedlings $hill^{-1}$ × 25-27 cm continuous stagnant water regime) which was similar with $V_1S_1W_4$ (70.35 cm), $V_1S_2W_3$ (70.13 cm), $V_1S_2W_2$ (69.78 cm), $V_1S_1W_3$ (69.73 cm) and $V_1S_2W_1$ (69.53 cm). The shortest one (60.71 cm) was produced with $V_2S_1W_1$ (BRRI dhan39 × 2 seedlings $hill^{-1}$ × intermittent irrigation regime) which was similar to $V_2S_1W_2$ (60.85 cm), $V_2S_1W_3$ (61.47 cm), $V_2S_1W_4$ (61.78 cm), $V_2S_2W_1$ (61.42 cm), $V_2S_2W_2$ (61.53 cm), $V_2S_2W_3$ (62.15 cm) and $V_2S_2W_4$ (62.33 cm). At booting stage the highest plant height (112.81 cm) was found in $V_1S_1W_4$, which was similar to the plant height in $V_1S_1W_4$ (111.42 cm), $V_1S_2W_3$ (110.55 cm), $V_1S_1W_3$ (110.16 cm). The shortest one (96.16 cm) was recorded in $V_2S_1W_1$, which was similar with the plant height in $V_2S_2W_1$ (96.66 cm), $V_2S_1W_2$ (96.75 cm), $V_2S_2W_2$ (97.25 cm), $V_2S_1W_3$ (97.88 cm), $V_2W_2W_3$ (98.40 cm) and $V_2S_1W_4$ (99.22 cm). At maturity stage, $V_1S_2W_4$

produced the tallest plant (144.09 cm) which was similar to $V_1S_1W_4$ (143.58 cm), $V_1S_2W_3$ (142.57 cm), $V_1S_1W_3$ (141.25 cm), $V_2S_2W_2$ (140.35 cm) and $V_1S_1W_2$ (140.16 cm) (Table 1).

Table 1. Effects of seedlings hill^{-1} and different water regimes on the growth characters of transplant aman rice varieties at different growth stages

Variety (V) × number of seedlings hill^{-1} (S) × water regimes (W)	Plant height (cm)			Leaf dry matter hill^{-1}(g)			Stem dry matter hill^{-1}(g)		
	MTS	BS	MS	MTS	BS	MS	MTS	BS	MS
$V_1S_1W_1$	68.45 c	107.87 c	138.89 b	3.46	17.27	6.12 bc	9.05	34.08 abc	31.77 ab
$V_1S_1W_2$	68.66 bc	108.25 bc	140.16 ab	3.32	16.88	6.25 bc	8.82	33.43 bcd	29.95 abc
$V_1S_1W_3$	69.73 abc	110.16 abc	141.25 ab	2.97	15.91	5.81 cd	8.15	32.51 cde	29.03 bc
$V_1S_1W_4$	70.35 a	111.42 ab	143.58 a	2.86	15.05	4.71 efg	7.56	31.50 e	28.16 c
$V_1S_2W_1$	69.53 abc	108.35 bc	139.17 b	3.63	18.52	7.07 a	9.51	35.47 a	33.15 a
$V_1S_2W_2$	69.78 abc	109.22 bc	140.35 ab	3.52	17.23	6.69 ab	9.25	34.98 ab	32.43 ab
$V_1S_2W_3$	70.13 ab	110.55 abc	142.57 ab	3.15	16.36	6.30 bc	8.19	34.00 abc	31.70 ab
$V_1S_2W_4$	71.04 a	112.81 a	144.09 a	2.91	15.21	5.22 de	7.64	32.12 de	30.59 abc
$V_2S_1W_1$	60.71 d	96.16 e	120.72 d	2.80	12.28	4.52 fgh	7.76	26.31 ghi	23.46 de
$V_2S_1W_2$	60.85 d	96.75 e	121.81 cd	2.75	11.95	4.25 fgh	7.15	25.78 ghi	22.51 def
$V_2S_1W_3$	61.47 d	97.88 de	122.93 cd	2.62	10.87	4.12 ghi	6.61	24.81 ij	21.41 ef
$V_2S_1W_4$	61.78 d	99.22 de	124.66 cd	2.48	9.67	3.53 i	5.82	23.86 j	19.65 f
$V_2S_2W_1$	61.42 d	96.66 e	121.59 cd	2.99	13.05	5.28 de	8.12	28.18 f	25.04 d
$V_2S_2W_2$	61.53 d	97.25 de	122.33 cd	2.80	12.61	4.91 ef	7.55	27.54 fg	24.33 de
$V_2S_2W_3$	62.15 d	98.40 de	123.88 cd	2.76	11.76	4.78 efg	6.70	26.83 fgh	29.92 abc
$V_2S_2W_4$	62.33 d	100.13 d	125.15 c	2.65	10.48	3.89 hi	5.97	25.49 hij	21.47 ef
$LSD_{0.05}$	1.48	2.91	3.81	–	–	0.59	–	1.68	3.01
Level of significance	*	*	*	NS	NS	*	NS	*	*

In a column, the means having same letter (s) or without letter do not differ significantly whereas means with different letters differ significantly as per DMRT.

NS = Not significant, MTS = Maximum tillering stage, BS = Booting stage, MS = Maturity stage.
V_1 = BINA dhan 4, V_2 = BRRI dhan 39, S_1 = 2 seedlings hill^{-1}, S_2 = 4 seedlings hill^{-1}.
W_1 = Intermittent irrigation regime, W_2 = 5-7 cm continuous stagnant water regime, W_3 = 15-17 cm continuous stagnant water regime, W_4 = 25-27 cm continuous stagnant water regim.

At maturity stage the highest leaf dry matter hill^{-1} (7.07 g) was found in $V_1S_2W_1$, which was followed by $V_1S_2W_2$ and the lowest leaf dry mater hill^{-1} (3.53 g) was observed in $V_2S_1W_4$, which was at par with $V_2S_2W_4$ (3.89 g) and $V_2S_1W_3$ (4.12 g) (Table 1). At booting and maturity stage, the highest (35.47 g and 33.15 g) and the lowest (23.86 g and 19.65 g) stem dry weight hill^{-1} respectively was obtained from the interaction of $V_1S_2W_1$ and $V_2S_1W_4$ (Table 1).

At booting stage, $V_1S_2W_1$ produced the highest shoot dry matter (53.99 g) which was identically followed by $V_1S_2W_2$ and the lowest dry mater (33.43 g) observed in $V_2S_1W_4$. At maturity stage, the highest shoot dry matter hill^{-1} was obtained from $V_1S_2W_1$ (72.32 g) which was statistically similar to $V_1S_2W_2$ (70.86 g) and the lowest shoot dry matter (41.96 g) was found in $V_2S_1W_4$ (Table 2). At booting stage the highest root dry matter hill^{-1} (16.85 g) was recorded from $V_1S_2W_1$, which was identical to $V_1S_2W_2$ (15.94 g), $V_1S_2W_3$ (15.63 g), $V_1S_1W_1$ (15.60 g). The lowest root dry matter (9.71 g) was recorded from $V_2S_1W_4$, which was as par with $V_2S_1W_4$ (10.22 g), $V_2S_1W_2$ (10.34 g), $V_2S_2W_3$ (10.81 g) and $V_2S_2W_2$ (11.36 g). At maturity stage, $V_1S_2W_1$ produced the highest root dry matter hill^{-1} (15.77 g) and $V_2S_1W_4$ produced the lowest one (7.99 g) (Table 2).

At maturity stage, the highest total dry matter hill^{-1} (88.09 g) was recorded from $V_1S_2W_1$, which was statistically similar with the TDM in $V_1S_2W_2$ (85.25 g), $V_1S_2W_4$ (82.28 g), $V_1S_1W_3$ (76.82 g). Whereas the lowest one (49.95 g) was recorded from $V_2S_1W_4$ (BRRI dhan39 × 2 seedlings hill^{-1} × 25-27 cm continuous stagnant water) which was at par with $V_2S_2W_4$ (54.06 g), $V_2S_1W_3$ (55.57 g), $V_2S_1W_2$ (58.10 g), $V_2S_2W_3$ (59.18 g) and $V_2S_1W_1$ (60.83 g) (Table 2).

Table 2. Effects of seedlings hill^{-1} and different water regimes on the growth characters of transplant aman rice varieties at different growth stages

Variety (V) × number of seedlings hill^{-1} (S) × water regimes (W)	Shot dry matter hill^{-1}(g)			Root dry matter hill^{-1}(g)			Total dry matter hill^{-1}(g)			Leaf area index			Root: Shoot (dry weight basis)		
	MTS	BS	MS	MTS	BS	MS	MTS	BS	MS	MTS	BS	MS	MTS	BS	MS
V1S1W1	12.51	51.35b	67.25c	3.95	15.60abc	14.97b	16.46	66.95	82.22a	1.52	6.60b	2.69	0.315	0.303a-d	0.222
V1S1W2	12.04	50.31bc	65.23cd	3.70	14.44bcd	13.88cde	15.74	64.75	79.11a	1.46	6.43bc	2.75	0.307	0.287c-f	0.212
V1S1W3	11.12	48.42cd	63.52d	3.48	14.25cd	13.30ef	14.60	62.67	76.82a	1.30	6.00d	2.55	0.312	0.294b-e	0.209
V1S1W4	10.42	46.55d	59.36e	2.99	13.43de	12.73f	13.41	59.98	12.09d	1.26	5.63e	2.07	0.286	0.288c-f	0.214
$V_1S_2W_1$	13.14	53.99a	72.32a	4.10	16.85a	15.77a	17.24	70.84	88.09a	1.59	7.15a	3.11	0.312	0.312ab	0.218
$V_1S_2W_2$	12.77	52.2ab	70.86ab	3.88	15.94ab	14.38bc	16.65	68.15	85.24a	1.55	6.59b	2.94	0.303	0.305a-c	0.202
$V_1S_2W_3$	11.68	50.36bc	68.12bc	3.65	15.63abc	14.16cd	15.33	65.99	82.28a	1.38	6.20cd	2.77	0.312	0.310ab	0.207
$V_1S_2W_4$	10.55	47.33d	64.04d	3.16	14.85bcd	13.55de	13.71	62.18	77.59a	1.28	5.70e	2.29	0.299	0.313a	0.211
$V_2S_1W_1$	10.56	38.59fg	50.39gh	3.20	11.16fg	10.44h	13.76	49.75	60.83bc	1.23	4.41gh	1.99	0.303	0.289c-f	0.207
$V_2S_1W_2$	9.90	37.73gh	48.73hi	2.95	10.34g	9.37jk	12.85	48.07	58.10bc	1.21	4.26h	1.87	0.297	0.274 f	0.192
$V_2S_1W_3$	9.23	35.68h	46.62ij	2.79	10.05g	8.95k	12.02	45.73	55.57bc	1.15	3.78i	1.81	0.302	0.281ef	0.191
$V_2S_1W_4$	8.30	33.43i	41.96k	2.66	9.71g	7.99l	10.96	43.14	49.95c	1.09	3.26j	1.55	0.320	0.290c-f	0.190
$V_2S_2W_1$	11.11	41.23e	54.49k	3.39	12.15ef	11.35g	14.50	53.38	65.84b	1.31	4.74f	2.32	0.305	0.29a-e	0.208
$V_2S_2W_2$	10.35	40.15ef	52.97fg	3.14	11.36fg	10.11hi	13.49	51.51	63.08b	1.23	4.55fg	2.16	0.303	0.282 ef	0.190
$V_2S_2W_3$	9.46	38.59fg	49.57h	2.90	10.81fg	9.61ij	12.36	49.40	59.18bc	1.21	4.18 h	2.10	0.306	0.280 ef	0.193
$V_2S_2W_4$	8.62	35.97h	45.24j	2.71	10.22g	8.82k	11.33	46.19	54.06bc	1.16	3.61i	1.71	0.324	0.284d-f	0.194
$LSD_{0.05}$	–	2.08	2.75	–	1.45	0.59	–	–	10.89	–	0.258	–	–	0.106	–
Level of significance	NS	*	*	NS	*	*	NS	NS	**	NS	*	NS	NS	*	NS

In a column, the means having same letter (s) or without letter do not differ significantly whereas means with different letters differ significantly as per DMRT

NS = Not significant, MTS = Maximum tillering stage, BS = Booting stage, MS = Maturity stage.
V_1 = BINA dhan4, V_2 = BRRI dhan39, S_1 = 2 seedlings hill^{-1}, S_2 = 4 seedlings hill^{-1}.
W_1 = Intermittent irrigation regime, W_2 = 5-7 cm continuous stagnant water regime, W_3 = 15-17 cm continuous stagnant water regime, W_4 = 25-27 cm continuous stagnant water regim.

At booting stage, the maximum leaf area index (7.15) was recorded from $V_1S_2W_1$ (BINA dhan4 × 4 seedlings hill^{-1} × intermittent irrigation regime) and the minimum LAI (3.26) was observed in $V_2S_1W_4$ (BRRI dhan39 × 2 seedlings hill^{-1} × 25-27 cm stagnant water) (Table 2). At booting stage, the highest ratio (0.313) of root and shoot hill^{-1} was found in $V_1S_2W_4$, which was followed by $V_1S_2W_1$ (0.312), $V_1W_2W_3$ (0.310), $V_1S_2W_2$ (0.305), $V_1S_1W_1$ (0.303) and $V_2S_2W_1$ (0.294) and the lowest one (0.274) was obtained in $V_2S_1W_2$, which was followed by $V_2S_2W_3$ (0.280), $V_2S_1W_3$ (0.281), $V_2S_2W_2$ (0.282), $V_2S_2W_4$ (0.284), $V_2S_1W_1$ (0.289) and $V_2S_1W_4$ (0.290) (Table 2).

Effects of seedlings rate and water regimes on the yield and yield attributes

The interaction of $V_1S_2W_1$ (BINA dhan4 × 4 seedlings hill^{-1} × intermittent irrigation regime) produced the highest number of non bearing tillers hill^{-1} (4.99) which was statistically similar to $V_1S_1W_1$ (BINA dhan4 × 2 seedlings hill^{-1} × intermittent irrigation regime) and the lowest one (1.09) was produced by $V_2S_1W_4$ (BRRI dhan39 × 2 seedlings hill^{-1} × 25-27 cm continuous stagnant water) which was similar with $V_2S_1W_3$ (1.17) and $V_2S_1W_2$ (1.53) (Table3). The panicle length, grains panicle^{-1} and thousand grain weights did not show any significant variation due to the interaction of variety × number of seedlings hill^{-1} × water regimes (Table 3). Apparently the highest number of sterile spikelets panicle^{-1} (45.25) was produced by the interaction of BINA dhan 4 × 4 sedlings hill^{-1} × 25-27 continuous stagnant water. The lowest number of sterile spikelets panicle^{-1} (30.17) was recorded from the interaction of BRRI dhan39 × 2 seedlings hill^{-1} × intermittent irrigation regime. Similar result was obtained by Jha and Sahoo, (1988). The highest total number of spikelets panicle^{-1} (133.54) was recorded from the interaction $V_1S_1W_3$ (BINA dhan4 × 2 seedlings hill^{-1} × 15-17 cm stagnant water) which was followed

Table 3. Effects of seedlings hill^{-1} and different water regimes on the yield and yield components of transplant aman rice varieties

Variety (V) × No. of seedlings (S) × water regime (W)	Effective tillers hill^{-1} (No.)	Non-bearing tillers hill^{-1} (No.)	Panicle length (cm)	Grains panicle^{-1}	Sterile spikelets panicle^{-1} (No.)	Total spikelet panicle^{-1}	1000-grain weight (G)	Grain yield (g/pot)	Harvest index (%)
$V_1S_1W_1$	11.51	4.81 ab	27.45	90.15	39.95	130.10 ab	26.42	27.25 b	40.52
$V_1S_1W_2$	11.94	4.16 cd	27.32	90.03	40.11	130.14ab	26.20	26.94 b	41.30
$V_1S_1W_3$	10.85	3.77 d	27.07	91.75	41.79	133.54 a	25.98	25.80 bc	40.62
$V_1S_1W_4$	9.67	2.34 f	26.85	89.49	43.48	132.97 a	26.34	22.97 de	38.70
$V_1S_2W_1$	14.19	4.99 a	27.21	84.28	40.87	125.15 b	26.39	31.25 a	43.21
$V_1S_2W_2$	14.25	4.45 bc	26.95	83.56	41.38	124.94 b	26.33	30.98 a	43.72
$V_1S_2W_3$	13.93	3.86 d	26.77	82.97	43.15	126.12 b	25.91	29.87 a	43.85
$V_1S_2W_4$	12.35	2.48 ef	26.53	79.85	45.25	125.10 b	25.85	25.35 bc	39.58
$V_2S_1W_1$	13.35	2.54 ef	23.39	73.52	30.17	103.69 c	21.35	20.77 ef	41.22
$V_2S_1W_2$	13.82	1.53 gh	23.37	70.07	30.80	100.87 c	21.29	20.56 f	42.19
$V_2S_1W_3$	12.97	1.17 h	23.05	70.89	32.05	102.94 c	20.97	18.99 fg	40.73
$V_2S_1W_4$	10.89	1.09 h	22.87	69.81	33.77	103.58 c	20.88	15.75 h	37.54
$V_2S_2W_1$	15.25	2.91 e	23.01	73.47	31.65	105.12 c	21.27	23.55 cd	43.22
$V_2S_2W_2$	14.97	2.58 ef	22.92	72.95	31.91	104.86 c	21.18	22.93 de	43.29
$V_2S_2W_3$	13.75	2.34 ef	22.69	71.64	32.12	103.76 c	20.90	20.12 f	40.59
$V_2S_2W_4$	11.99	1.75 g	22.57	69.98	34.11	104.09 c	20.79	17.35 gh	38.35
$LSD_{0.05}$	–	0.51	–	–	–		–		–
Level of significance	NS	*	NS	NS	NS	*	NS	*	NS

In a column the means having same letter (s) or without letter do not differ significantly whereas, means with different letters differ significantly as par DMRT. NS = Not significant. * indicates significant at 5% level of probability and ** indicates significant at 1% level of probability.

NS = Not significant, MTS = Maximum tillering stage, BS = Booting stage, MS = Maturity stage.
V_1 = BINA dhan4, V_2 = BRRI dhan39, S_1 = 2 seedlings hill^{-1}, S_2 = 4 seedlings hill^{-1}.
W_1 = Intermittent irrigation regime, W_2 = 5-7 cm continuous stagnant water regime, W_3 = 15-17 cm continuous stagnant water regime, W_4 = 25-27 cm continuous stagnant water regim.

by $V_1S_1W_4$ (132.97), $V_1S_1W_2$ (130.14) and $V_1S_1W_1$ (130.10) and the lowest one (108.87) was found in $V_2S_1W_2$ (BRRI dhan39 × 2 seedlings hill^{-1} × 5-7 cm continuous stagnant water) which was statistically at par with $V_2S_1W_3$ (102.94), $V_2S_1W_4$ (103.58), $V_2S_1W_1$ (103.69), $V_2S_2W_3$ (103.76), $V_2S_2W_4$ (104.09), $V_2S_2W_2$ (104.86), $V_2S_2W_1$ (105.12), respectively (Table 3).

The highest grain yield (31.25 g pot^{-1}) was recorded in the interaction of $V_1S_2W_1$ (BINA dhan4 × 4 seedling hill^{-1} × intermittent irrigation regime) which was statistically similar to $V_1S_2W_2$ (30.98 g pot^{-1}) and $V_1S_2W_3$ (29.87 g pot^{-1}). The lowest grain yield (15.75 g pot^{-1}) was obtained in the interaction of $V_2S_1W_4$ (BRRI dhan39 × 2 seedlings hill^{-1} × 25-27 cm continuous stagnant water regime) which was statistically similar with $V_2S_2W_4$ (17.35 g pot^{-1}) (Table 3).

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