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Research Article

Growth And Yield of Transplant Aman Rice (Brri Dhan38) As Affected by Weeding and Zinc Level

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Abstract

The experiment was conducted at the Agronomy Field Laboratory Department of Agronomy and Agricultural Extension, University of Rajshahi, during the period of July 2019 - December 2019 to study the effect of zinc and weeding on the yield of transplant Aman rice (BRRI dhan38). The experiment consisted of two factors i.e., i) four weeding treatments viz. no weeding, one, two and three hands weeding (at 20,40 and 60 DAT) and ii) four levels of Zinc treatments (0, 5, 10, 15 kg Zn ha-1). The experiment was conducted in a Randomized Completely Block Design (RCBD) with three replications. The area of each unit was 10m2. Results revealed that the effect of weeding was significant on plant height, number of tiller hill-1, number of effective and non-effective tiller hill-1, panicle length, number of grain panicle-1, number of effective grain panicle-1, number of non-effective grain panicle-1, weight of 1000 grain, grain yield, straw yield, biological yield and Harvest Index. Among the different weeding regimes, the highest was obtained from the three weedings (completely weed-free condition). The lowest grain yield and yield contributing characters were produced from no weeding condition. On the other hand, the zinc treatment had a significant influence on yield parameters expect the number of non-effective grain panicle-1. Among the different zinc treatment, the highest grain yield was obtained from the fourth level of zinc (15 kg Zn ha-1) and The lowest grain yield was produced from control treatment (0 kg Zn ha-1) From the results, it may be concluded that four weedings with 15 kg Zn ha-1 is better for yield of transplant aman rice (BRRI dhan38).

Key Words: growth; yield; transplant aman rice; weeding and zinc

1.Introduction

Bangladesh is an agrarian nation. Most of her financial exercises primarily depend upon farming. Farming may be a critical segment of the economy of Bangladesh it plays a critical part almost 13.35% of the GDP of Bangladesh and more than 40% individuals included in this segment. Natural and geological condition of this locale are reasonable for rice generation. Rice supply food almost 2 billion individuals in AsiaAfrica and Latin America (IRRI, 1985). Rice may be a primary food of Bangladesh where rice create as it were twice a year amid the final 3 decades and come to very 25 million tons in 2001-2002 (BBS, 2002). The demography of Bangladesh will expand to 173 million in 2020 that's 31% over this condition (FAO, 1998). NAC said that to nourish the expand individuals in 2020 47 million of rice is reaching to be required to supply inside the country. For give sufficent nourishment of this locale rice development is required to be increase from 3 tons per hacter to 5 tons per hacter within the afterward 20 a long time (Mahbub et al., 2001).

The North-Western locale of this nation are more reasonable to delivered scent variety of rice. Concurring to DAE the generation of scent rice has expand than the past time so has the gathering much obliged to HYV. The individuals of Bangladesh favor fragrant rice. It is required more in several celebrations. It is exceptionally tasty. Supplement lack in soil is the vital cause for the less generation of rice in Bangladesh. Fertilizers are irreplaceable for the trim generation framework of later farming. Nowadays inorganic fertilizers hold the key to victory for expanded trim generation being obligated for approximately 50% of the complete development (FRG, 1997). Lack of zinc causes misfortune of grain surrender and rice grain with moo Zinc substance contributes to human dietary zinc lacks (Johnson, 2009). Zinc lacks are broadly spread all through the planet particularly inside the rice lands of Asia and lacks happen in unbiased and calcareous soils. (Tisdal et al., 1997). Lack of micronutrients with stretch to zinc particularly has been detailed in wetland rice soils of Bangladesh and fabulous reaction by application of 5 kg Zn h-1 are recorded (Rahman et al., 1978). it had been detailed that around 2.0 M hectares of Agrarian arrive are zinc lacking beneath distinctive AEZ of this region. Zinc is vital for changed chemical frameworks and is competent of shaping numerous steady bonds with N and S ligands.

The production of T-Aman rice approximately 48.67% of the full rice range and it gives approximately 42.78 percent of the full ricedevelopment (BBS, 1998). But this crop yield is exceptionally less than that of other nations. The most important calculate of moo abdicate is weed pervasion (Mamun, 1986). The climatic condition is reasonable for different weed development that restriction with rice trim. Mamun (1990) detailed that weed development declined the production approximately 64-100% for direct-seeded Aus rice 18-48% for T- aman rice and 22-38% for modern boro rice. Agriculturists spend more capital for weed control in this case. Ordinary weeding is ordinarily tired the numerous regions of Bangladesh. Advanced weeding and chemical control are utilized are the options routine weeding. Numerous mechanical gadgets are utilized in a few regions. BRRI has produced a modern and simple innovation for weed control.

Bangladesh is an agricultural country. Most of her economic activities mainly depend upon agriculture. Agriculture is a important sector of the economy of Bangladesh, it plays a important role about 13.35% of the GDP of Bangladesh and more than 40% people involved in this sector. Environmental and geographical condition of this region are suitable for rice production. Rice supply food about 2 billion people in Asia,Africa and Latin America (IRRI,1985). Rice is a main food of Bangladesh where rice produce only twice a year during the last 3 decades and reached quite 25 million tons in 2001-2002 (BBS, 2002). The demography of Bangladesh will augment to 173 million in 2020 that is 31% above this condition (FAO, 1998). NAC said that to feed the augment people in 2020, 47 million of rice is going to be required to supply within the country. For provide sufficent food of this region, rice cultivation is required to be augment from 3 tons per hacter to 5 tons per hacter in the later 20 years (Mahbub et al., 2001).

Now a days, farmers are more interested of high-yielding rice cultivation because of more production.They are BR5 (Dulabhog), BRRI dhan34, BRRI dhan 37, BRRI dhan 38, BRRI dhan 70, BRRI dhan 75, BRRI dhan 80 and BRRI dhan 50. According to the DAE, the soil and climate in Bangladesh are suitable for producing HYV of rice.

The North-Western region of this country are more suitable to produced fragrance variety of rice. According to DAE, the production of fragrance rice has augment than the past time, so has the assembly thanks to HYV. The people of Bangladesh prefer aromatic rice. It is needed more in different festivals. It is very delicious. Nutrient deficiency in soil is the important cause for the less production of rice in Bangladesh. Fertilizers are indispensable for the crop production system of recent agriculture. Today inorganic fertilizers, hold the key to success for increased crop production, being liable for about 50% of the entire cultivation (FRG 1997). Deficiency of zinc causes loss of grain yield and rice grain with low Zinc content contributes to human nutritional zinc deficiencies (Johnson., 2009). Zinc deficiencies are widely spread throughout the planet, especially within the rice lands of Asia and deficiencies occur in neutral and calcareous soils. (Tisdal et, al, 1997). Deficiency of micronutrients with stress to zinc especially has been reported in wetland rice soils of Bangladesh and spectacular response by application of 5 kg Zn h-1 are recorded (Rahman et al, 1978). it had been reported that about 2.0 M hectares of Agricultural land are zinc deficient under different AEZ of this region. Zinc is important for varied enzyme systems and is capable of forming many stable bonds with N and S ligands.

The production of T-Aman rice about 48.67% of the total rice area and it provides about 42.78 percent of the total rice cultivation (BBS, 1998). But this crop yield is very less than that of other countries. The most important factor of low yield is weed infestation (Mamun, 1986). The climatic condition is suitable for various weed growth that opposition with rice crop. Mamun (1990) reported that weed growth declined the production about 64-100% for direct-seeded Au's rice, 18-48% for T- aman rice, and 22-38% for contemporary boro rice. Farmers spend more capital for weed control in this case. Conventional weeding is usually done in the many areas of Bangladesh. Modern weeding and chemical control are used are the alternatives conventional weeding. Many mechanical devices are used in some region. BRRI has generated a new and easy technology for weed control.

This research trial deals with the effect of zinc and weed control on the growth and yield of T-Aman rice this are given below some objectives:

1.To determine the effect of weeding on yield of T-aman rice.

2.To determine the effect of zinc on yield of T-aman rice.

3To evaluate the combined effect of weeding and zinc on yield of T-aman rice.

2.Material and Methods

The experiment was performed at the Agronomy Field Laboratory Department of Agronomy and Agricultural Extension, University of Rajshahi, Rajshahi. During the period of July 2019 - December 2019 to study the effect of zinc and weeding on the yield of transplant Aman rice (BRRI dhan38).

2.1 Experimental period

The experiment was conducted from July 2019 to December 2019.

2.2 Location and site

The experimental farm is situated on the western side of the Department of Agronomy and Agricultural Extension, University of Rajshahi. Geographically the experimental field is found at 24° 22′ 36″ N latitude and 88° 38′ 27″ E longitude at an elevation of 71ft above the ocean level. The experimental area belongs to the sub-tropical climate under the central-southern a part of High Ganges Floodplain under the Agro-ecological Zone "AEZ-11" (UNDP and FAO,1998). The land was medium-high, flat, well-drained, and above flood level.

2.3 Soil

The soil of the experimental area belonged to the Ganges Floodplain under the Agro-ecological Zone "AEZ-11" The soils of the experimental plots were sandy loam. The PH value of the soil is 8.6 total Nitrogen was 0.04%, organic matter 0.46%, phosphorus 11.33ppm, potassium 0.19 Milli equivalent\100gm soil, zinc 0.78 ppm, and Sulpher 3.10 ppm. the physical and chemical characteristics of the soil of the experimental field are presented in Appendix-I.

2.4 Climate

The experimental area was under the subtropical climate and is characterized by heat and moderate rainfall during Kharif season (April to September) and scanty rainfall related to moderate coldness during Rabi season (October to March).

2.5 Materials of the experiment

3.2.1 planting material

BRRI dhan38 was used as planting material. IT is a Transplant aromatic Aman Rice variety.

3.2.2. Description of the used variety

BRRI dhan38 was selected for the study. Bangladesh Rice Research Institute (BRRI) has developed BRRI dhan38. the variety was released in 1998, originated from Bangladesh. This variety is photo insensitive. Its life cycle is about 145 days. The plant height is 125 cm, clean rice, medium slender and aromatic. The yield is about 3.5 ton/ha.

3.3.1 Treatments

The experiment consists of the following two factors-

Factor A: Weeding Regime

The weeding regime was used for the study as follows:

I. W0 = weeding (Weeds are allowed to grow in this treatment with crop till harvest)

II. W1= 1 Hand weeding (i.e. 1 hand weeding was done at 20 DAT)

III. W2= 2 Hand weeding (i.e. 1st hand weeding was done at 20 DAT and 2nd at 40 DAT)

IV. W3= 3 Hand weeding (i.e. 1st hand weeding was done at 20 DAT, 2nd at 40 DAT and 3rd at 60 DAT)

Factor B: Levels of Zn (4 levels) as

i. Zn0: 0 kg Zn ha-1

ii. Zn1: 5 kg Zn ha-1

iii. Zn2: 10 kg Zn ha-1

iv. Zn3: 15 kg Zn ha-1

3.3.2 Design and the layout of the experiment

The experiment was laid call at a Randomized Complete Block Design with three replications. The experimental area was split into three blocks each representing replications. Again, each block was divided into 16-unit plots where the treatment combination was allocated at randomized. The entire unit plot was 48. The size of the unit plot was 10 m2 (5m×2m).

3.4.1 Seed collection and sprouting

Seeds of aromatic rice varieties were collected from BRRI (Bangladesh Rice Research Institute), Regional Station, Shyampur, Rajshahi, just 20 days before the sowing of seeds during a seedbed. For seedlings, clean and healthy seeds were soaked in water for 24 hours and shown within the seedbed after 72 hours. The sprouted seeds were sown uniformly during a well-prepared seedbed. Proper care was taken to protect the seeds within the seedbed as and when necessary.

3.4.2 Raising of seedlings

The nursery bed was ready by puddling with ploughing followed by laddering. The germinated seeds were sown on beds as uniformly as possible on 21st June 2019. Irrigation was gently served to the bed when necessary.

3.4.3 Land preparation

The experimental field was opened by an influence tiller tractor on 18th July 2019. it had been then ploughed well to make the soil nearly ready for transplanting. Weeds and stubble were removed and thus the sector was leveled by laddering. It was ploughed and cross ploughed 3 times with bullock drawn country plough followed by laddering to urge desirable puddle condition. The corners of the lands were spaded well. The experimental field was then divided into unit plots that were spaded at some point before transplanting for incorporating the fertilizers applied as basal. Finally, a private plot was prepared before transplantation.

3.4.4 Fertilizers and manure application

The fertilizers N, K, P, S, Zn, and B in the form of urea, TSP, MoP, Gypsum, zinc sulphate, and borax, respectively. Urea, TSP, MoP, Gypsum and borax were applied @ 180, 100, 70, 60 and 10 kg ha-1 respectively. Vermicompost was applied @ 76.8 kg h-1. Zn was applied as per treatment. The entire amount of Vermicompost, TSP, MoP, gypsum, zinc sulphate, and borax were applied during final land preparation. Urea was applied as in installments as basal and top dressing at 25, 45, and 65 DAT.

3.4.5 Transplanting of seedling

The seedbeds were made wet by the appliance of water both within the morning and evening on the previous day before uprooting. The seedlings were then uprooted carefully to attenuate mechanical injury to the roots and kept on soft mud within the shade before they were transplanted on 30th July 2019 during a good puddle plot with the spacing of 20cm×15 cm. Two seedlings were transplanted in each hill.

3.6 Data Collection and recording

Data was collected two times such as before harvest and after harvest.

3.6.4 Procedure of recording data

A brief outline of the info recording procedure is given below:

1. Plant height

Plant height was measured from the soil level to the apex of the leaf or panicle in randomly 5 hills of every plot.

2. Number of tiller hill-1

The tillers which had a minimum of one leaf visible were counted. It included both effective and non-effective tillers.

3. Number of effective tiller hill-1

The total number of effective tiller hill-1 was counted because the number of panicles bearing tillers during harvesting. Data on effective tillers hill-1 were counted from 5 selected hills and therefore the average value was recorded.

4. Number of non-effective tiller hill-1

The total number of non-effective tiller hill-1 was counted because the number of non-panicles bearing tillers during harvesting. Data on non-effective tillers hill-1 were counted from five selected hills and therefore the average value was recorded.

5. Panicle length

The length of the panicle was measured with a meter scale from 5 selected panicle and therefore the average length was recorded as per panicle in cm.

6. Number of total grain panicle-1

The total numbers of grain were calculated by adding effective and non-effective grain selected five plants of a plot and average number of grain panicle-1 was recorded.

7. Number of effective grain panicle-1

The total numbers of effective grain were collected randomly from selected 5 panicles of a plot supported on grain within the spikelet then average number of effective grain panicle-1 were recorded.

8. Number of non-effective grain panicle-1

The total number of non-effective grain were collected randomly from selected five plants of a plot based on not a grain in the spikelet and then average number of non-effective grain panicle-1 were recorded.

9. Grain yield

Grains obtained from each unit plot were sun-dried and weighed carefully. The dry weight of grains of every plot was taken and converted to ton hectare-1 (t ha-1).

10. Straw yield

Straw obtained from each unit plot were sun-dried and weighed carefully. The dry weight of straw of each plot was taken and converted to ton hectare-1 (t ha-1).

13. Biological yield

Grain yield and straw yield together were regarded biological yield. The biological yield was calculated with the subsequent formula:

Biological yield = Grain yield + Straw yield.

12. Weight of 1000 grains (g)

One thousand cleaned dried grains were randomly collected from the seed stock obtained from five hills of every plot and were dried in an oven at 14% moisture content and weight by using an electrical balance.

13. Harvest index

Harvest index was calculated from the grain and straw yield of rice for every plot and expressed in percentage.

HI (%) =Economic yield (grain weight) Biological yield (total dry weight) × 100

3.8 Statistical analysis

The recorded data were subjected to statistical analysis. Analysis of variance technique and mean differenceswere adjudged by Duncan's New multiple Range test (DMRT) with the help of MSTAT-C program.

3.Results and Discussion

3.1 Effect of Weeding

3.1.1 Plant height

The result presented in Table exhibits that weeding had a 5% level of significant effect on plant height. (Table-13) shows that the highest plant height (123.273 cm) was recorded in W3 and the lowest plant height (89.528 cm) was recorded in W0 (no weeding) treatment (Table 1). Weed conflict was strike with no weeding state and those plant height of rice were waned. On the other in weed-free treatment through the crop growth period, the competition of weed with the plant was less and the height was increased. Wayan et al., (1982) and Ghobrial (1983) also reported that heavy weed infestation in rice significantly reduced plant height.

3.1.2 Number of tillers hill-1

It was a 1% level of Significant difference observed in respect of a number of total tillers hill-1. The results dedicated in (Table 1) manifested that the highest number of total tillers hill-1 (16.201) was recorded in W3 and the lowest number of total tillers hill-1 (11.511) was recorded in W0 treatment. (Table 1). Ghobrial (1983) also found that unrestricted weed growth reduced the no. of total tillers hill-1

3.1.3 Number of effective tillers hill-1

There was 1% level of Significant variation observed in respect of a number of effective tillers hill-1. The results dedicated in (Table 1) manifested that the highest number of effective tillers hill-1 (14.804) was recorded in W3(weed-free) and the lowest number of effective tillers hill-1 (8.183) was recorded in W0 (no weeding) treatment. (Table 1). The result conforms with that of De Datta, (1980); Tillers plant -1 increased discovering were also indicated by Wayan et al., (1982), Ghobrial (1983), and Haque (1993).

3.1.4 Number of non-effective tiller hill-1

There was a 1% level of Significant variation observed in respect of a number of non-effective tillers hill-1. The results dedicated in (Table 1) manifested that the maximum number of non-effective tillers hill-1 (1.397) was recorded in W3(weed-free) and the lowest number of non-effective tillers hill-1 (3.328) was recorded in W0 (no weeding) treatment. (Table 1).

3.1.5 Panicle length

There was a 1% level of Significant variation investigated in respect of panicle length. The results presented in (Table 13) exhibited that the highest number of panicle length (23.817) was recorded in W3(weed-free) and the minimum number of panicle length (10.482) was recorded in W0 (no weeding) treatment (Table 1). The result is in conformity with that of De Datta, (1980); and Wayan et al., (1982).

3.1.6 Number of effective grains per panicle

There was a 1% level of Significant variation observed in respect of a number of effective grains per panicle. The results dedicated in (Table 1) exhibited that the highest number of effective grains per panicle (142.411) was recorded in W3(weed-free) and the lowest number of effective grains per panicle (99.162) was recorded in W0 (no weeding) treatment (Table 1).

3.1.7 Number of non-effective grain per panicle

There was a 1% level of Significant variation observed in respect of a number of non-effective grain per panicle. The results presented in (Table 1) exhibited that the maximum number of non-effective grain per panicle (29.219) was filed in W0(no weeding) and the lowest number of non-effective grain per panicle (17.195) was recorded in W3 (weed-free) treatment (Table 1).

Treatment	Plant height (cm)	No. of tiller hill^{-1}	No. of effective tiller hill^{-1}	No. of non effective tiller hill^{-1}	Panicle length (cm)	No. of effective grain/panicle	No. of non effective grain/panicle
W_0	89.52 d	11.51 d	8.18 d	3.33 a	10.48 d	99.16 d	29.22 a
W_1	96.35 c	14.60 c	12.02 c	2.58 b	13.43 c	111.34 c	25.59 b
W_2	108.71 b	15.06 b	12.80 b	2.26 b	17.93 b	126.48 b	23.18 b
W_3	123.27 a	16.20 a	14.80 a	1.39 c	23.81 a	142.41 a	17.19 c
CV(%)	4.37	5.10	4.25	13.68	4.78	4.48	12.69

Table 1: Impact of weeding on yield and yield contibuting characters of rice

W0= No weeding, W1=1 hand weeding, W2= 2 hand weeding and W3= 3 hand weeding

3.1.8 Number of total grains per panicle

There was a 1% level of Significant variation seen in respect of a number of total grains per panicle. The results dedicated in (Table 2) manifested that the highest number of total grains per panicle (175.250) was recorded in W3(weed-free) and the lowest number of total grains per panicle (116.078) was recorded in W0 (no weeding) treatment (Table 2).

3.1.9 Grain yield

There was a 1% level of Significant variation seen in respect to grain yield. The results presented in (Table 2) exhibited that the maximum grain yield (3.80 t ha-1) was recorded in W3 (weed-free) and the lowest number of grain yields (2.899 t ha-1) was recorded in W0(no weeding) treatment (Table 2).

3.1.10 Straw yield

It was 1% level of Significant variation observed in respect of straw yield. The results dedicated in (Table 2) manifested that the maximum straw yield (4.657 t ha-1) was recorded in W3 (weed-free) and the lowest number of grain yield (3.984 t ha-1) was recorded in W0(no weeding) treatment (Table 2).

3.1.11 Biological yield

There was a 1% level of Significant variation found in respect of biological yield. The results presented in (Table 2) exhibited that the maximum biological yield (8.457 t ha-1) was recorded in W3 (weed-free) and the lowest number of biological yield (6.883 t ha-1) was recorded in W0 treatment (Table 2).

3.1.12 Weight of 1000 grains

There was a 1% level of Significant variation observed in respect of thousand grain weight. The weight of thousand grain also differed significantly due to weeding treatment. Table 2 exhibits the highest weight of 1000 grains (21.913g) and the lowest weight of 1000 grains (17.709g) The variation of weight of 1000 grain might be due to the various sizes of grains that were partially subjugted by treatment. Chowdhury et al., (1995) also expressed a similar view.

3.1.13 Harvest index

The impact of the weeding regime on harvest index was found to be significant. However, harvest index (44.93%) was gained from w3 treatment and the lowest (42.11%) was obtained from w0 treatment. (Table 2).

Treatment	No. of total grain/panicle	Grain yield t ha^{-1}	Straw yield t ha^{-1}	Biological yield t ha^{-1}	1000 grain weight (gm)	Harvest index (%)
W_0	75.25 a	2.89 d	3.98 bc	6.88 c	17.70 d	42.11 d
W_1	136.26 c	2.98 c	3.97 c	6.95 c	18.02 c	42.81 c
W_2	156.59 b	3.30 b	4.18 b	7.48 b	19.77 b	44.13 b
W_3	116.07 d	3.80 a	4.65 a	8.45 a	21.91 a	44.93 a
CV(%)	4.22	4.56	4.29	4.44	5.73	4.31

Table 2: Impact of weeding on yield and yield contibuting characters of rice

W0= No weeding, W1=1 hand weeding, W2= 2 hand weeding and W3= 3 hand weeding

3.2 Effect of zinc

3.2.1 Plant height

Plant height various significantly depending on zinc. In Table 3 the highest plant height (108.417 cm) was seen in treatment Zn3 and the lowest height (100.250 cm) was observed from treatment Zn0.

3.2.2 Number of tiller hill-1

Zinc has a significant influence on the no. of tillers hil-1. The highest numbers of total tillers hill-1 (15.287) were obtained at treatment Zn3 and the lowest number of tillers hill-1 (12.963) was obtained at treatment Zn0 (Table 3).

3.2.3 Number of effective tiller hill-1

Zinc hasa great impact on the number of effective tillers hil-1. The highest numbers of effective tillers hill-1 (13.405) were gained at treatment Zn3 and the lowest number of effective tillers hill-1 (9.791) was obtained at treatment Zn0 (Table 3).

3.2.4 Number of non-effective tiller hill-1

Zinc has a great effect on the number of non-effective tiller hil-1. The maximum numbers of non-effective tillers hill-1 (3.173) were gained at treatment Zn0 and the minimum number of non-effective tillers hill-1 (1.883) was obtained at treatment Zn3 (Table 3).

3.2.5 Panicle length

Panicle length varied significantly depending on zinc. From table 3 the maximum panicle length (18.078 cm) was seen in the treatment Zn3 and the lowest (14.971 cm) was observed in treatment Zn0.

3.2.6 No. of effective grain/panicle

Zinc showed flag variation in terms of a number of effective grain panicle-1. However, numerically the large number of effective grain panicle-1 (124.922) was recorded from the treatment Zn3 and the lowest (114.648) was recorded from Zn0. (Table 3).

3.2.7 No. of non-effective grain/panicle

Zinc showed non-significant variation in terms of a number of non-effective grain panicle-1. However, numerically the large number of non-effective grain panicle-1 (25.397) was recorded from the treatment Zn0 and the minimum (22.299) was recorded from Zn3. (Table 3).

Treatment	Plant height (cm)	No. of tiller $hill^{-1}$	No. of effective tiller $hill^{-1}$	No. of non effective tiller $hill^{-1}$	Panicle length (cm)	No. of effective grain/panicle	No. of non effective grain/panicle
Zn_0	100.25 d	12.96 d	9.79 d	3.17 a	14.97 d	114.65 d	25.39
Zn_1	103.37 c	14.22 c	11.88 c	2.41 b	15.77 c	118.02 c	23.86
Zn_2	105.82 b	14.91 b	12.81 b	2.09bc	16.84 b	121.81 b	23.63
Zn_3	108.41 a	15.28 a	13.40 a	1.88 c	18.07 a	124.92 a	22.29
CV(%)	4.37	5.10	4.25	13.68	4.78	4.48	12.69

Table 3: Impact of Zinc on yield and yield contibuting characters of rice

Zn0= 0 kg Zn ha-1, Zn1= 5 kg Zn ha-1, Zn2= 10 kg Zn ha-1 and Zn3= 15 kg Zn ha-1

3.2.8 Number of total grain panicle-1

Zinc showed great variation in terms of a number of total grain panicle-1. However, numerically the highest total number of grain panicle-1 (151.617) was recorded from the treatment Zn3 and the lowest (138.704) was recorded from Zn0. (Table 4).

3.2.9 Grain yield:

There was a great variation in respect to grain yield due to zinc. Results presented in Table 4 showed that the maximum grain yield (3.404 t ha-1) was obtained from the treatment Zn3 and the lowest grain yield (3.058 t ha-1) was obtained from treatment Zn0.

3.2.10 Straw yield

The straw yield of rice varies significantly for zinc gave significantly different straw yields (Table 4). The maximum straw yield (4.435 t ha-1) was recorded from the treatment Zn3 and the minimum straw yield (3.948 t ha-1) was recorded at Zn0.

3.2.11 Biological yield

The biological yield was influenced greatly by zinc. Table 4 revealed that the highest biological yield (7.839 t ha-1) was recorded from the treatment

Zn3 and the lowest biological yield (7.007 t ha-1) was obtained at control treatment Zn0.

3.2.12 Weight of 1000 grains

The grain weight of rice is the least variable yield component. The zinc had a significant effect on 1000-grain weight (Table 4). Results presented in Table 16 revealed that the highest 1000 grain weight (20.329g) was obtained from the treatment Zn3 and the lowest (18.259g) was obtained from treatment Zn0.

3.2.13 Harvest index

The effect of zinc on harvest index was put significant. However, harvest index (43.42%) was gained from zn3 treatment and the lowest (43.64%) was obtained from zn0 treatment. (Table 4).

Treatment	No. of total grain/ panicle	Grain yield t ha^{-1}	Straw yield t ha^{-1}	Biological yield t ha^{-1}	1000 grain weight (gm)	Harvest index(%)
Zn_0	138.70 b	3.05 d	3.94 b	7.00 d	18.25d	43.64 d
Zn_1	145.30 ab	3.23 c	4.10 b	7.33 c	19.15c	44.05 c
Zn_2	148.56 a	3.29 b	4.31 a	7.60 b	19.66b	44.30 b
Zn_3	151.61 a	3.40 a	4.43 a	7.83 a	20.32a	43.42 a
CV(%)	4.22	4.56	4.29	4.44	5.73	4.21

Table 4: Impact of Zinc on yield and yield contibuting characters of rice

Zn0= 0 kg Zn ha-1, Zn1= 5 kg Zn ha-1, Zn2= 10 kg Zn ha-1 and Zn3= 15 kg Zn ha-1

3.3 Interaction effect of weeding and zinc

3.3.1 Plant height

The plant height had a significant impact due to the interaction of weeding and zinc. Apparently, the highest plant height (125.903cm) was observed in the interaction W3Zn3 Whereas the lowest plant height (86.840 cm) was get from the interaction W0Zn0

3.3.2 Number of tiller hill-1

The interaction impact between weeding and zinc was found significant (Table 5). However, the highest number of total tillers hill-1 (17.290) was gained from the interaction W3Zn3 and the lowest number of tillers hill-1 (10.470) was gained from the interaction W0Zn0

3.3.3 Number of effective tiller hill-1

The interaction impact between weeding and zinc was found non-significant (Table 5). However the highest number of effective tillers hill-1 (16.327) was obtained from the interaction W3Zn3 and the lowest number of effective tillers hill-1 (6.570) was obtained from the interaction W0Zn0

3.3.4 Number of non-effective tiller hill-1

The interaction effect between weeding and zinc was found non-significant (Table 5). However the highest number of non-effective tillers hill-1 (3.900) was obtained from the interaction W0Zn0 and the lowest number of non-effective tillers hill-1 (0.963) was obtained from the interaction W3Zn3

3.3.5 Panicle length

The interaction was significant between weeding and zinc (Table 5). it was numerically highest (24.083cm) in the interaction W3Zn3 and the lowest (9.407cm) was obtained from the interaction W0Zn0 in Table 5.

3.3.6 Number of effective grain panicle-1

The interaction effect of weeding and zinc on the number of effective grain panicle-1 was significant (Table 5). Table 5 showed that the highest number of effective grain panicle-1 (145.897) was obtained from the treatment combination W3Zn3 The lowest number of grain panicle-1 (95.560) was obtained from the treatment Combination W0Zn0

3.3.7 Number of non-effective grain panicle-1

The interaction effect of weeding and zinc on the number of non-effective grain panicle-1 was non-significant (Table 5). Table 15 showed that the highest number of non-effective grain panicle-1 (31.360) was obtained from the treatment combination W0Zn0 the lowest number of non-effective grain panicle-1 (15.593) was obtained from the treatment Combination W3Zn3.

Treatment	Plant height (cm)	No. of tiller $hill^{-1}$	No. of effective tiller $hill^{-1}$	No. of non effective tiller $hill^{-1}$	Panicle length (cm)	No. of effective grain/panicle	No. of non effective grain/panicle
W_0Zn_0	86.84 k	10.47 k	6.57 k	3.90	9.40 j	95.56 o	31.36
W_0 Zn_1	88.80 jk	11.37 j	7.910 j	3.46	10.03 j	96.88 n	29.96
W_0 Zn_2	90.22 ijk	12.13 i	8.993 i	3.14	10.92 i	100.60 m	28.66
W_0 Zn_3	92.24 hij	12.06 i	9.260 hi	2.80	11.56 hi	103.60 l	26.89
W_1Zn_0	93.66 ghi	13.46 h	9.997 gh	3.46	12.05 h	106.07 k	25.83
W_1 Zn_1	95.32 gh	14.19 fg	11.50 f	2.68	13.16 g	109.07 j	23.78
W_1 Zn_2	97.06 fg	15.09 de	12.85 d	2.24	13.95 f	113.12 i	26.97
W_1 Zn_3	99.36 ef	15.68 cd	13.74 c	1.94	14.56 ef	117.12 h	25.83
W_2Zn_0	101.04 e	13.68 gh	10.17 g	3.07	14.97 e	119.70 g	25.16
W_2Zn_1	106.03 d	14.62 ef	12.49 de	2.13	16.14 d	124.70 f	23.98
W_2Zn_2	111.61 c	15.83 c	13.81 c	2.02	18.49 c	128.47 e	22.73
W_2Zn_3	116.16 b	16.11 bc	14.290 c	1.82	22.10 b	133.06 d	20.87
W_3Zn_0	119.45 b	14.23 fg	11.98 ef	2.25	23.45 a	137.26 c	19.29
W_3Zn_1	123.32 a	16.70 ab	15.32 b	1.38	23.74 a	141.43 b	17.72
W_3Zn_2	124.40 a	16.58 b	15.59 ab	0.99	23.99 a	145.05 a	16.17
W_3Zn_3	125.90 a	17.29 a	16.32 b	0.96	24.08 a	145.89 a	15.59
CV(%)	4.37	5.10	4.25	13.68	4.78	4.48	12.69

Table 5: Interaction effect of weeding and zinc on yield and yield contibuting characters of rice

W0= No weeding, W1=1 hand weeding, W2= 2 hand weeding and W3= 3 hand weeding

Zn0= 0 kg Zn ha-1, Zn1= 5 kg Zn ha-1, Zn2= 10 kg Zn ha-1 and Zn3= 15 kg Zn ha-1

3.8 Number of total grain panicle-1

The interaction effect of weeding and zinc on the number of total grain panicle-1 was non-significant (Table 6). Table 6 showed that the large number of total grain panicle-1 (171.313) was obtained from the treatment combination W3Zn3 the lowest number of grain panicle-1 (110.550) was gained from the treatment Combination W0Zn0

3.3.9 Grain yield

Grain yield was significantly affected by the interaction between weeding and zinc (Table 6). From Table 17, it was evident that the highest grain yield (3.913 t ha-1) was given by the interaction W3Zn3and lowest grain yield (2.793 t ha-1) was obtained from the interaction W0Zn0

3.3.10 Straw yield

The straw yield was significantly influenced by the interaction between weeding and zinc (Table 6). From Table 15, it was evident that the highest straw yield (4.773 t ha-1) was given by the interaction W3Zn3and lowest straw yield (3.720 t ha-1) was obtained from the interaction W0Zn0

3.3.11 Biological yield

The biological yield was significantly affected by the interaction between weeding and zinc (Table 6). From Table 6, it was evident that the maximum biological yield (8.687 t ha-1) was given by the interaction W3Zn3 and the lowest biological yield (6.513 t ha-1) was obtained from the interaction W0Zn0.

3.3.12 Weight of 1000 grains

Weight of thousand grain vary significantly to the interaction on weeding and zinc (Table 6). Apparently, the highest thousand grain weight (22.970g) was observed in the treatment combination W3Zn3 and the lowest 1000-grain weight (17.110) was seen in the treatment combination W0Zn0 (Table 6).

3.3.13 Harvest index

The interaction effect of weeding and zinc on harvest index was found to be non-significant. However, harvest index (45.044%) was obtained from w3zn3 treatment and the lowest (42.883%) was gained from w0zn0 treatment. (Table 6).

Treatment	No. of total grain/ panicle	Grain yield t ha^{-1}	Straw yield t ha^{-1}	Biological yield t ha^{-1}	1000 grain weight (gm)	Harvest index (%)
W_0Zn_0	110.55	2.79 h	3.72 gh	6.51 h	17.11 k	42.88
W_0 Zn_1	114.56	2.84 gh	3.91 efgh	6.75 gh	17.62 ij	42.07
W_0 Zn_2	114.45	2.95 fg	4.28 bc	7.23 def	17.85 hi	40.78
W_0 Zn_3	124.74	3.01 f	4.02 cdef	7.03 efg	18.25 g	42.81
W_1Zn_0	124.67	2.85 gh	3.69 h	6.55 h	17.50 j	43.59
W_1 Zn_1	135.44	2.92 fg	3.96 defgh	6.88 fgh	17.67 ij	42.44
W_1 Zn_2	140.06	2.99 f	4.01 cdefg	7.0 efg	18.08 gh	42.73
W_1 Zn_3	144.89	3.16 e	4.23 bcd	7.39 de	18.82 f	42.76
W_2Zn_0	148.18	2.93 fg	3.85 fgh	6.78 gh	18.57 f	43.21
W_2Zn_1	154.08	3.33 d	4.00 cdefg	7.33 de	19.22 e	45.41
W_2Zn_2	158.58	3.42 cd	4.15 cde	7.57 d	20.01 d	45.16
W_2Zn_3	165.51	3.53 bc	4.71 a	8.24 bc	21.27 c	42.82
W_3Zn_0	171.41	3.65 b	4.52 ab	8.17 c	19.85 d	44.65
W_3Zn_1	177.12	3.82 a	4.52 ab	8.35 abc	22.11 b	45.78
W_3Zn_2	181.15	3.81 a	4.80 a	8.62 ab	22.72 a	44.24
W_3Zn_3	171.31	3.91 a	4.77 a	8.68 a	22.97 a	45.04
CV (%)	4.22	4.56	4.29	4.44	5.73	4.69

Table 6: Interaction effect of weeding and zinc on yield and yield contibuting characters of rice

W0= No weeding, W1=1 hand weeding, W2= 2 hand weeding and W3= 3 hand weeding

Zn0= 0 kg Zn ha-1, Zn1= 5 kg Zn ha-1, Zn2= 10 kg Zn ha-1 and Zn3= 15 kg Zn ha-1

4.conclusion

The overall result of the research work indicates that the treatment combination of W3Zn3 (Three-hand weeding with 15 kg zinc ha-1) may be the best combination for higher yield of transplanted Aman rice (BRRI Dhan 38).

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