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Contribution of nitrogen and methods of weeding on the yield components and yield of hybrid boro rice (HEERA 4)

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Abstract:

Experiment was carried out at the Agronomy Field of Sher-e-Bangla Agricultural University, Dhaka during the period from December, 2012 to May, 2013 to investigate the response of different levels of nitrogen and methods of weeding on the yield of hybrid boro rice (Heera 4). The treatments consisted of four nitrogen levels viz., N_0

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= 0 kg N ha^{-1}, N_1 = Urea super granules (2.7 g) @ 75 kg N ha^{-1}, N_2 = 140 kg N ha^{-1}, N_3 = 180 kg N ha^{-1} and five different weed control methods viz., W_0 =No weeding (Control), W_1= One weeding (30 days after transplanting), W_2= Two weeding (30 DAT & 50 DAT), W_3= Sunrice 50WG at recommended dose (100g ha^{-1}), W_4=Topstar 80WG at the recommended dose (@80g ha^{-1}). The experiment was laid out in a split plot design with three replications having nitrogen doses in the main plots, weed control in the sub plots. Nitrogen and weed control had significant response on yield and yield components of hybrid rice viz., effective tillers hill^{-1} (No.), panicle length (cm), number of filled grains panicle^{-1}, number of unfilled grains panicle^{-1}, total grain panicle^{-1}, weight of 1000-grain, grain yield, straw yield, biological yield and harvest index (%). From the economic point of view, significant highest (9.48 t ha^{-1}) grain yield was found from the combination of USG with Sunrice 150.

Key words: Nitrogen Levels, Methods of Weeding, Yield Components and Hybrid Boro Rice

Introduction

Among cereal crops Rice (*Oryza sativa*L.) is one of the most important in the world. The area and production of hybrid rice in boro season were about 0.658 hectares and 33.01 lac metric tons, respectively (AIS, 2013). The population of Bangladesh is still growing by two million every year and may increase by another 30 million over the next 20 years. Thus, Bangladesh will require about 27.26 million tons of rice for the year 2020. But the average yield of rice is poor (4.34 t ha^{-1}) in Bangladesh (BRRI, 2011). Whereas the average rice yield in China is about 6.30 t ha^{-1}, Japan is 6.60 t ha^{-1} and Korea is 6.30 t ha^{-1} (FAO, 2008). Agronomically fertilization, weeding practices are most important factors in response of yield contributing traits of rice. Therefore, attempts should be taken to increase the yield per unit area through use of comparatively high yielding varieties. The efficient N management can increase crop yield and reduce

production cost. Inadequate and improper applications of N are now considered one of the major reasons for low yield of rice in Bangladesh. Weeds pose a major threat for increasing rice productivity. Uncontrolled weed growth caused significant loss of grain yield of rice (Hasanuzzaman *et al.*, 2007). Any delay in weeding will lead to increased weed biomass as a result drastic reduction in yield. Mamun (1990) reported that weed growth reduced the grain yield by 68-100% for direct seeded aus rice, 16-48% for transplanted aman rice and 22.36 % for modern boro rice. The principle objectives under present research work is to evaluate the response of nitrogen and weed control methods on the yield components and yield of hybrid boro rice (HEERA 4) along with judicial application of all the treatments.

Materials and methods

Experiment was carried out at the Agronomy field ($23^0$74/N latitude and $90^0$35/E longitude with an elevation of 8.2 meter from sea level under Madhupur Tract-AEZ 28), Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from December, 2011 to May, 2012. The planting crop was rice variety (hybrid heera-4). The experiment consisted of two factors, namely factor A: Nitrogen (level 4) viz., N_o = 0 kg N ha^{-1}, N_1 = Urea super granules (2.7 g) @ 75 kg N ha^{-1}, N_2 = 140 kg N ha^{-1} and N_3 = 180 kg N ha^{-1} and factor B: weed control method (level 5) viz., W_0 =No weeding (Control), W_1= One weeding (30 Days after transplanting), W_2= Two weeding (30 DAT and 50 DAT), W_3= Sunrice 150 WG at recommended dose (100g ha^{-1}) and W_4 =Topstar80WG at the recommended dose (80g ha^{-1}). Thirty days old seedlings were uprooted and transplanted on well puddled plots. The experiment was laid out in a split plot design with three replications. The experimental plots were fertilized with P, K, Zn and S @ 140,134.7, 7.5, 60 kg ha^{-1} in the form of triple super phosphate (TSP), muriate of potash (MOP), zinc sulphate and gypsum($CaSO_4.2H_2O$), respectively (BRRI,

2010) as basal. The USG weighing 2.7 g each were placed at 5-10 cm soil depth at 10 DAT in the center of four hills in alternate rows @ 1 granule in one spot to supply 75 kg N ha^{-1}. Nitrogen in the form of USG and prilled urea (PU) was given following treatment levels. Split application of nitrogen was done only for PU at 10, 35 and 55 DAT. Gap filling, weeding, application of irrigation water and plant protection measures were taken properly as per when needed. From the present study data on effective tillers $hill^{-1}$ (No.), panicle length (cm), number of filled grains $panicle^{-1}$, number of unfilled grains $panicle^{-1}$, total grain $panicle^{-1}$, weight of 1000-grain, grain yield, straw yield, biological yield and harvest index (%) were collected. Data were compiled and analyzed statistically by using a computer package program MSTAT-C and the mean differences were compared by Duncan's Multiple Range Test (DMRT).

Results and discussion

Table 1: Response of nitrogen and weed control methods and their interaction on yield contributing characters of hybrid boro rice (HEERA 4)

Treatment combinations	Effective tillers $hill^{-1}$	Panicle length (cm)	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	Total grain $panicle^{-1}$	1000 grain weight (g)
Nitrogen						
N_0	9.82b	23.01c	130.00c	18.67a	148.67c	28.22a
N_1	13.40a	24.17a	176.50a	11.17c	187.67a	29.20a
N_2	12.84a	23.58b	156.50b	15.11b	171.61b	28.73a
N_3	12.67a	24.10ab	169.10a	13.38b	182.48ab	28.66a
SE	0.42	0.19	4.27	0.66	4.24	0.29
CV(%)	16.84	3.21	10.47	17.63	9.53	3.85
Weed control methods						
W_0	9.14b	22.55b	137.70c	18.63a	156.33c	27.67b
W_1	9.44b	23.81a	151.60b	15.10b	166.7bc	28.46b
W_2	10.58ab	23.74a	161.20ab	13.10bc	173.68ab	29.48a
W_3	11.61a	24.29a	173.00a	12.48c	185.48a	30.36a
W_4	9.84b	24.19a	166.70a	13.62bc	180.32ab	30.03a
SE	0.49	0.22	4.78	0.74	4.74	0.32
CV(%)	16.84	3.21	10.47	17.63	9.53	3.85

Interaction effect of nitrogen and Weed control methods						
N_0W_0	6.33d	21.73f	108.80h	28.47a	137.27h	26.70h
N_0W_1	6.89d	22.53d-f	126.30gh	21.07b	147.37e-h	28.03e-h
N_0W_2	8.22cd	23.23c-e	130.30f-h	14.37c-g	144.67f-h	28.80d-h
N_0W_3	10.78a-c	23.97a-e	149.30d-g	17.30b-e	166.60c-h	28.50d-h
N_0W_4	8.56b-d	23.60b-e	135.00e-h	12.17e-h	147.17e-h	29.07c-g
N_1W_0	8.89b-d	23.07c-f	159.30c-f	11.50f-h	170.80b-g	29.77c-e
N_1W_1	10.89a-c	23.73b-e	183.70a-c	10.60gh	194.3a-c	29.50c-f
N_1W_2	11.89ab	24.13a-c	181.70a-c	11.80f-h	193.50a-c	30.07bc
N_1W_3	12.67a	25.23a	205.70a	8.93h	214.63a	31.77a
N_1W_4	10.89a-c	24.33a-c	191.70ab	11.27f-h	202.97ab	30.90b
N_2W_0	10.89a-c	22.53ef	125.70gh	16.87b-e	142.57gh	27.30f-h
N_2W_1	8.89b-d	23.73b-e	136.30e-h	12.67d-h	148.97d-h	28.00e-h
N_2W_2	12.67a	23.70b-e	154.30c-g	14.40c-g	168.70c-g	29.00c-g
N_2W_3	8.56b-d	24.03a-d	166.00b-f	15.47c-g	176.7b-e	28.97c-g
N_2W_4	11.89ab	23.90a-e	160.30b-f	16.17c-f	176.17b-e	30.37b-d
N_3W_0	10.45a-c	22.87c-f	156.70c-g	17.67bc	174.37b-f	26.93gh
N_3W_1	11.11a-c	25.20a	160.00b-f	16.07c-f	176.07b-e	28.30d-h
N_3W_2	11.89ab	23.90a-e	178.30a-d	9.36h	187.60bc	29.07c-g
N_3W_3	11.11a-c	24.83ab	171.00b-d	10.7.gh	179.93b-d	30.20b-e
N_3W_4	8.01cd	24.03a-d	179.70a-d	14.87c-g	194.57a-c	28.80d-h
SE	0.98	0.44	9.55	1.48	9.49	0.65
CV (%)	16.84	3.21	10.47	17.63	9.53	3.89

Note: N_o = 0 kg N ha^{-1}, N_1 = Urea super granules (2.7 g) @ 75 kgN ha^{-1} , N_2 = 140 kg N ha^{-1} , N_3 = 180 kg N ha^{-1} ,W_0 =No weeding (Control methods) ,W_1= One weeding (30 Days after transplanting),W_2= Two weedings (30 DAT and 50 DAT),W_3= Sunrice 150 WG at recommended dose (100g ha^{-1}),W_4=Topstar 80WG at the reco mmended dose(80g ha^{-1})

Effective tillers $hill^{-1}$: The number of effective tillers $hill^{-1}$ was significantly influenced by nitrogen (Table 1). The highest number of effective tiller $hill^{-1}$ (13.40) was observed from N_1 (Urea super granules @ 75 kg N ha^{-1}) that similar to N_2 and N_3 and the lowest (9.82) from N_0 (control methods) treatment. It was in agreement with Rama *et a1.* (1989), who reported that USG produced higher numbers of panicle m^{-2} than splits application of urea. Weed control methods by Sunrice (W_3) gave the highest effective tiller (11.61) that similar to two weedings (10.58) (Table 1) and lowest (9.14) from no weeding (W_0).The results was supported by Raju *et al.* (2003) who stated that use of weedicide (Ronstar 25 EC, Safener and Butachlor) gave the highest effective tiller. The effect of interaction between N levels and weed control methods was found to be significant in respect of number of effective tillers $hill^{-1}$ (Table). The highest

number of effective tiller hill^{-1} (12.67) was found from N_1W_3(Urea super granules (2.7 g) @75 kgN ha^{-1})with Sunrice 150 WG at recommended dose) (100g ha^{-1}) followed by N_2W_2 (12.67), N_1W_2 (11.89), N_2W_4 (11.89) and the lowest(6.33) from N_0W_0 (control treatment combination).

Panicle length: Panicle length was statistically significant by forms of nitrogen (Table 1).The longest (24.17 cm) panicle was produced due to application of USG @ 75 kg N ha^{-1} and the shortest (23.01 cm) was produced in control methods. Sen and Pandey (1990) also found similar panicle length by applying 38.32 kg N ha^{-1} either in the form of USG or prilled urea. The panicle length varied significantly due to weed control methods shown in (Table 1). It was observed that the longest panicle (24.29 cm) was observed from the treatment W_3 (Sunrice 150WG), which was statistically similar with W_1, W_2 and W_4 and the shortest (22.55 cm) from control methods (W_0). Results confirmed by Khan and Tarique (2011) who observed that panicle length was varied due to different weed control methods treatments. Panicle length was statistically influenced by the interaction of nitrogen fertilizer and weed control methods (Table 1). The highest panicle length (25.23 cm) was observed from N_1W_3 (Urea super granules (2.7 g) @ 75 kgN ha^{-1} with Sunrice 150 WG at recommended dose (100g ha^{-1}) and the lowest (21.73 cm) panicle length was produced form N_0W_0 treatment.

Number of filled grains panicle^{-1}: There was a statistical variation in number of filled grains panicle^{-1} due to N fertilizer (Table 1). Results showed that the highest number of filled grains panicle^{-1}(176.50) was obtained with USG @ 75 kg N ha^{-1}that similar to N_3 and the lowest (130.00) from control methods (W_0). Rama *et al.* (1989) found significantly higher filled grains panicle^{-1} with 40, 80 or 120 kg N ha^{-1} applied as USG over split application of urea which support the present

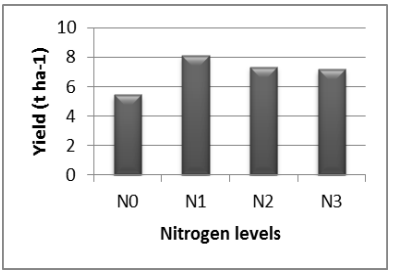
results. Significant variation was found in filled grains panicle^{-1} due to the effect of weed control methods (Table1). The highest filled grains (173.00) were obtained from the effect of Sunrice 150WG (W_3) followed by Topstar 80 WG (W_4) and W_2 (Two weedings) and the lowest (137.70) from no weeding treated plot (W_0). Results supported by Salam *et al.* (2010) who showed that application of herbicide contributed mainly increasing the number of grains panicle^{-1}. Interaction effect of N fertilizer and weed control methods was found significant on filled grains panicle^{-1} (Table 1). Results observed that the highest (205.70) filled grains panicle^{-1}was found from the combination of Urea super granules (2.7 g) @ 75 kgN ha^{-1} with Sunrice 150 WG (N_1W_3) and the lowest (108.80) from combination of control treatment (N_0W_0).

Number of unfilled grains panicle^{-1}: Number of unfilled grains panicle^{-1} was statistically influenced from the N fertilizer (Table 1). The lowest (11.17) unfilled grains panicle^{-1} was obtained from the application of USG (N_1) and the highest (18.67) from control methods (N_0). Hasan *et al.* (2002) also observed that unfilled grains panicle^{-1} was differed by the application of USG and PU. Effect of weeding showed significant variation in unfilled grains (Table 1). No weeding (W_0) gave the highest unfilled grain (18.63) and the lowest (12.48) from Sunrice 150WG (W_3). Interaction of nitrogen fertilizer and weed control methods showed significant response on unfilled grainspanicle^{-1} (Table 1). The lowest (8.93) unfilled grains panicle^{-1} was observed from N_1W_3treatment and the highest (28.47) from N_0W_0 treatment.

Total grains panicle^{-1}: The total grain panicle^{-1}was significantly affected by the source of N (Table 1).The highest total grains panicle^{-1} (187.67) was observed from N_1 treatment that similar to N_3 and the lowest (148.67) from N_0 treatment. Significant variation was observed on total grain panicle^{-1} due

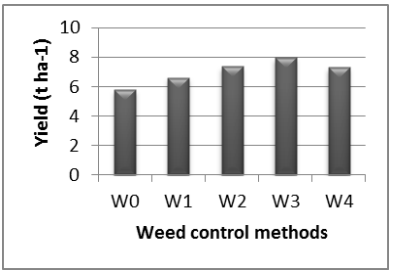
to different weed control methods (Table 1). Among the weed control methods treatments, the highest total grains panicle^{-1}(185.48) was recorded from Sunrice 150WG (W_3) and the lowest (156.33) from from no weeding (W_0) treatment. Significant effect was observed in total grain panicle^{-1} from the interaction of N fertilizer and weed control methods (Table 1). The highest total grains panicle^{-1} (214.63) was obtained by the interaction of Urea super granules with Sunrice 150 WG and the lowest (137.27) from the control (N_0W_0) treatment.

1000-grain weight: There was significant variation in 1000-grain weight due to different forms of N fertilizer (Table 1). The highest 1000-grain weight (29.20g) was obtained from N_1 treatment and the lowest (28.22 g) from N_0 treatment. Hasan *et al.* (2002) also reported that the effect of application method of USG and PU was not significant in respect of 1000-grain weight. Effect of weeding showed significant variation in 1000 grain weight (Table 1). Sunrice 150WG (W_3) gave the highest 1000 grain weight (30.36 g) followed by Topstar 80WG (W_4) and two hand weeding (W_2) and the lowest (27.67 g) from no weeding (W_0). Results supported by Raju *et al.* (2003) who showed that weeding regime had significant effect on 1000 grain weight. Interaction of different forms of N fertilizer and weed control methods was showed significant variation on 1000-grain weight of rice (Table 1). The highest (31.77) 1000-grain weight was observed from N_1W_3 treatment and the lowest (26.70) from N_0W_0 treatment.



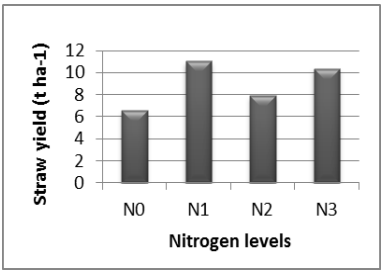
A)

Fig.1. Effect of nitrogen levels on yield of rice (SE=0.09**)**



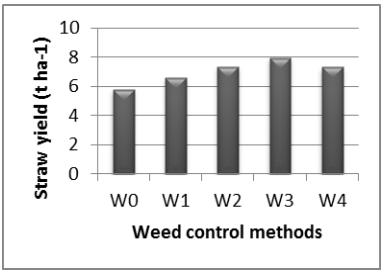
B)

Fig. 1. Effect of weed control methods on yield of rice (SE = 0.10)



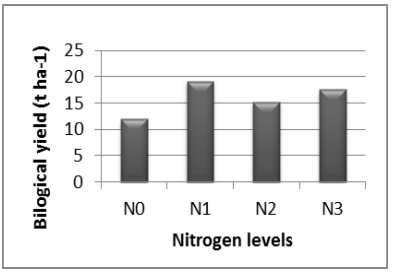
C)

Fig. 1. Effect of nitrogen on straw yield of rice (SE=0.29**)**



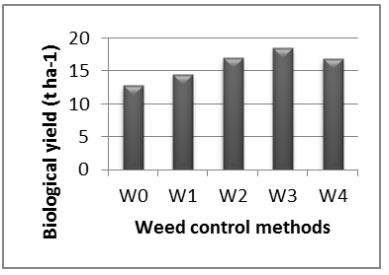
D)

Fig. 1. Effect of weed control methods on straw yield of rice (SE = 0.32)



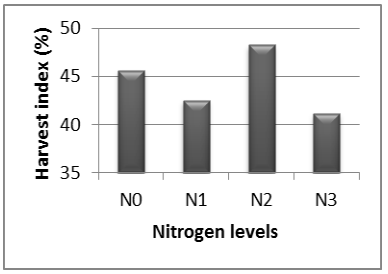
E)

Fig. 1. Effect of nitrogen on biological yield of rice (SE=0.33**)**



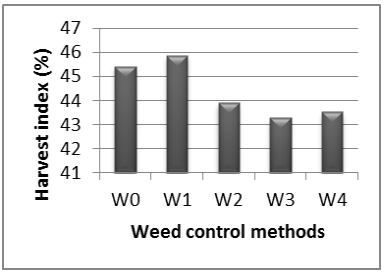
F)

Fig. 1. Effect of weed control methods on biological yield of rice (SE = 0.37)



G)

Fig. 1. Effect of nitrogen on harvest index of rice (SE=0.75)



H)

Fig. 1. Effect of weed control methods on harvest index of rice (SE = 0.84)

Fig. 1(A-H): Effect of nitrogen and weed control methods on yield of hybrid boro rice (HEERA 4)

Table 2: Interaction effect of nitrogen and weed control methods on grain yield, straw yield, biological yield and harvest index of hybrid boro rice (HEERA 4)

Treatment combinations	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
N_0W_0	4.66h	5.57j	10.23k	45.87ad
N_0W_1	5.05h	6.03ij	11.08j-k	46.00a-d
N_0W_2	5.66g	6.76g-j	12.42i-k	45.70a-e
N_0W_3	6.06g	7.19f-j	13.25g-j	45.93a-d
N_0W_4	5.78g	7.20f-j	12.98h-j	44.57a-e
N_1W_0	6.70f	8.40e-h	15.10e-h	44.37a-e
N_1W_1	7.57c-e	9.35d-f	16.92c-e	44.77a-e
N_1W_2	8.63b	12.63ab	21.26a	40.57d-f
N_1W_3	9.48a	12.77ab	22.25a	42.50b-f
N_1W_4	8.10b	11.98a-c	20.08ab	40.47d-f
N_2W_0	5.91g	6.36h-j	12.27i-k	48.17ab
N_2W_1	7.12ef	7.14f-j	14.26f-i	49.97a
N_2W_2	7.67c-e	7.94f-i	15.61d-g	49.20a
N_2W_3	8.12b-d	9.18d-g	17.30c-e	47.03a-c
N_2W_4	7.85bd	8.90e-g	16.75c-e	46.97a-c
N_3W_0	5.89g	7.77f-j	13.66f-i	43.23b-e
N_3W_1	6.75f	9.10d-f	15.85d-f	42.70b-f
N_3W_2	7.48de	11.12b-d	18.60bc	40.13ef
N_3W_3	8.21bc	13.60a	21.81a	37.63f
N_3W_4	7.5de	10.31cd	17.81cd	42.10c-f
SE	0.20	0.67	0.75	1.67
CV (%)	5.04	12.34	8.14	6.53

Note: N_0 = 0 kg N ha^{-1}, N_1 = Urea super granules (2.7 g) @ 75 kgN ha^{-1} , N_2 = 140 kg N ha^{-1} , N_3 = 180 kg N ha^{-1} ,W_0 =No weeding (Control methods) ,W_1= One weeding (30 Days after transplanting),W_2= Two weedings (30 DAT and 50 DAT),W_3= Sunrice® 150 WG at recommended dose (100g ha^{-1}),W_4=Topstar 80WG at the recommended dose(80g ha^{-1})

Grain yield: Grain yield affected significantly due to the forms of N-fertilizer (Fig 1 A). The highest grain yield (8.10 tha^{-1}) was obtained from Urea super granules (N_1) which was 32.84% higher than control plot having the lowest grain. Placement of nitrogen fertilizer in the form of Urea super granules (2.7 g) @ 75 kgN ha^{-1}in the present experiment produced the highest number of effective tillers $hill^{-1}$, filled grains $panicle^{-1}$which ultimately gave higher grain yield than split application of urea. This result was supported with those of BRRI (2000) where USG gave 18% yield increase over the recommended prilled urea. Significant variation was observed for grain yield due to different weed control methods (Fig.1 B). The highest yield (7.97 t ha^{-1}) was recorded from Sunrice 150WG (W_3) which was 27.35% higher than control plot having the lowest grain. Similar findings were reported by Al-Mamun *et al.* (2011) who observed that application of chemical herbicides significantly increases grain yield of rice. Interaction of N fertilizer and weed control methods significantly affected the grain yield (Table 2). Significantly the highest (9.48 t ha^{-1}) grain yield was found from the combination of USG with Sunrice 150 WG (N_1W_3) and the lowest (4.66 t ha^{-1}) from combination of control (N_0W_0).

Straw yield: From (Fig.1 C), it was revealed that straw yield was significantly affected due to the application of nitrogen. The highest straw yield of 11.03 t ha^{-1} was obtained from N_1 (USG @ 75 kg N ha^{-1}) and the lowest (6.55 t ha^{-1}) from N_0 (0 kg N ha^{-1}). Hasanuzzaman *et al.* (2009) reported application of 200 kg N ha^{-1} and USG @ 75 kg N ha^{-1} gave the highest straw yield. Significant variation was observed due to different weed control methods (Fig. 1 D). The highest straw yield (10.68 t ha^{-1}) was

recorded from Sunrice 150WG (W_3) and the lowest (7.03 t ha^{-1}) from no weeding (W_0) treatment. Results supported by Salam *et al.* (2010), who revealed that weeding had significant variation on straw yield of rice. Interaction effect of nitrogen and weed control methods was observed significant on straw yield (Table 2). The highest (13.60 t ha^{-1}) straw yield was found from the combination of N_3W_3 (180 kg N $ha^{-1}$and Sunrice 150 WG), which was statistically similar with N_3W_3 and the lowest straw yield (5.57 t ha^{-1}) was found with the combination of N_0W_0.

Biological yield: The biological yield was significantly affected by the nitrogen (Fig.1 E). The highest (19.13 t ha^{-1}) biological yield was measured from the N_1 (USG @) 75 kg N ha^{-1}) treated plots and the lowest (11.95 t ha^{-1}) from N_0 (0 kg N ha^{-1}). The result agreed with the findings of Ahmed *et al.* (2005) who observed the effect of nitrogen dose on biological yield (t ha^{-1}) of rice. The biological yield varied significantly due to different weed control methods treatments shown in (Fig. 1 F). Weeds control methods led by Sunrice 150WG (W_3) gave the highest biological yield (18.55 t ha^{-1}) and no weeding (W_0) treatment gave the lowest biological yield (12.85 t ha^{-1}). Interaction effect of nitrogen and weed control methods was found significant on biological yield (Table 2). The highest biological yield (22.25 t ha^{-1}) was found from the combination of N_1W_3 (USG @ 75 kg N ha^{-1} and Sunrice 150WG) which was statistically similar with N_1W_2 and N_3W_3 and more than two times of control (N_0W_0) recorded 10.23 t ha^{-1}.

Harvest index: Effect of nitrogen doses exerted significant variation on harvest index (Fig. 1 G). Harvest index was the highest (48.27%) in N_2 (140 kg N ha^{-1}) and the lowest (41.16%) was observed in N_3 (180 kg N ha^{-1}). Awan *et al.* (2011) reported that highest harvest index was found with 156 kg N ha^{-1}. Significant variation was observed in harvest index due to the effect of weeding (Fig. 1 H). The highest harvest index (45.86%)

was found due to the effect of one weeding (W_3). Sunrice 150 WG (W_0) gave the lowest harvest index (43.28%). The interaction effect of nitrogen and weed control methods had significant effect on harvest index on hybrid boro rice (Table 2). Among the treatment combinations N_2W_1 produced the highest harvest index (49.97%) and the lowest harvest index was obtained from the treatment combinations of N_3W_3(37.63%).

Conclusion

From the economic point of view, production of hybrid boro rice (HEERA 4) under present study it may be concluded that, by applying the nitrogen and weed control methods it is possible to enhance the yield of rice. Significant highest (9.48 t ha^{-1}) grain yield was found from the combination of USG with Sunrice 150.

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