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EFFECT OF SPACING AND WEED MANAGEMENT ON THE GROWTH OF BRRI dhan56

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ABSTRACT

Sen A, Sarkar MAR, Begum M, Zaman F, Ray S (2014) Effect of spacing and weed management on the growth of BRRI dhan56. *Int. J. Expt. Agric.* 4(3), 20-29.

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during June to October 2013 to examine the effect of spacing of planting and weed management on the growth performance of short duration transplant *Aman* rice (cv. BRRI dhan56). The experiment consisted of four spacings *viz*. 25 cm × 10 cm, 25 cm × 15 cm, 20 cm × 10 cm and 25 cm × 20 cm and five weed managements *viz*. no weeding, one hand weeding at 20 DAT, two hand weedings at 20 and 35 DAT, three hand weedings at 20, 35 and 50 DAT and herbicide pyrazosulfuron-ethyl 10WP. The experiment was laid out in a Randomized Complete Block Design with three replications. At 65 DAT, the highest plant height, maximum number of tillers hill^{-1}, leaf area index and total dry matter were obtained in 25 cm × 15 cm spacing and the lowest ones were obtained at 20 cm × 10 cm spacing. At 65 DAT, the highest plant height, maximum number of tillers hill^{-1}, leaf area index and total dry matter were obtained in three hand weedings and the lowest was found in control. At 65 DAT, maximum number of tillers hill^{-1} was obtained in 25 cm × 20 cm spacing with three hand weedings, the highest leaf area index was obtained in 25 cm × 15 cm spacing with two hand weedings at 20 and 35 DAT, the highest total dry matter was observed in 25 cm × 15 cm spacing with three hand weedings. Therefore, it can be concluded that short duration *Aman* rice (cv. BRRI dhan56) can be transplanted at 25 cm × 15 cm spacing with three hand weedings at 20, 35 and 50 DAT to achieve proper growth of *Aman* rice.

Key words: *spacing, weed management, growth, BRRI dhan56*

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal food crops in the world. It is the vital food for more than two billion people in Asia and four hundred millions of people in Africa and Latin America (IRRI 2010). It provides about 70% of the calories consumed by 160 million people of Bangladesh. About 77.07% of cropped area of Bangladesh is used for rice cultivation, with annual production of 33.54 million tons from 11.52 million ha of land (BBS 2011).

Improvement of rice production can be achieved through different agronomic practices and treatments like proper spacing and weed management. Plant spacing has an important role on growth of rice. Many studies reval that closer spacing may cause mutual shading, lodging, insect pest infestation due to more intra-specific competition (Bond *et al*. 2005; Tan *et al*. 2000). Optimum plant density ensures the plant to grow properly with their aerial and underground parts by utilizing more solar radiation and soil nutrients (Mondal *et al.* 2013). The maximum benefit can be derived from a rice field, if the crop is properly spaced between rows and within rows.

Weeds are the major biotic constraint to increased rice production worldwide. The importance of their control has been emphasized in the past by various authors (De Datta 1990; Ahmed *et al*. 2005). Weeds, besides harboring insects, compete with crop for water, light and plant nutrients and adversely affect the micro-climate around the plant (Behera *et al*. 1996 and Yaghobi *et al.* 2008). The climatic and edaphic conditions of Bangladesh are favorable for the growth of numerous noxious weed species. Weed infestation in rice crop not only reduce the rice growth but also it may reduce the grain yield by 68-100% for direct seeded *Aus* rice, 14-48% for *Aman* Rice and 22.36% for modern *Boro* Rice (IRRI 1998). However, plant growth loss due to weeds depends upon some variables like magnitude of weed infestation, type of weed species and time of association with crop (Moody and De Detta, 1998). Therefore, proper weed management is essential for satisfactory rice growth as well as production in Bangladesh.

This study was undertaken to evaluate the effect of spacing and weed management on the growth performance of short duration transplant *Aman* rice (cv. BRRI dhan56).

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during June to October 2013. The experimental site belongs to the Sonatala series of Old Brahmaputra Floodplain Agro-ecological Zone (AEZ-9) having non-calcareous dark grey floodplain soils (UNDP and FAO, 1998). The experimental field was medium high land having sandy loam soil with pH 6.8. Soil of the experimental field was low in organic matter content (1.027%) and its general fertility level was also low (0.09% total N, 5.68 ppm available P, 49.12% exchangeable K and 82.8ppm available S). There were four spacings *viz.* 25 cm × 10 cm, 25 cm × 15 cm, 20 cm × 10 cm and 25 cm × 20 cm and five weed managements *viz*. no weeding, one hand weeding at 20 DAT, two hand weedings at 20 and 35 DAT, three hand weedings at 20, 35 and 50 DAT and herbicide pyrazosulfuron-ethyl 10WP were included as an experimental treatment. The experiment was laid out in a Randomized Complete Block Design with three replicates. The *Aman* rice cv. BRRI dhan56 was used in this experiment as test crop. The size of each unit plot was 2.5 m × 2.0 m. Seedlings were raised in the wet seedbed method. Seeds were soaked in the water for 24 hours. Then they were taken out of

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water, covered with wet gunny bags and kept for sprouting. The sprouted seeds were broadcast uniformly in a well prepared nursery bed on 30 June 2013. Seedling were ready for transplanting at 30 days after sowing when sixth or seventh leaves were formed. The eperimental land was fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate at the rate of 220, 90, 75, 60 and 8 kg ha^{-1}, respectively. Cowdung was applied @10 t ha^{-1}. The entire amounts of triple super phosphate (TSP), muriate of potash (MoP), gypsum and zinc sulphate were applied at final land preparation. Urea was applied as top dressing in three equal splits at 15, 30 and 45 days after transplanting. Thirty one days old seedlings were uprooted from the nursery bed carefully and then transplanted at the well puddled plots @2 seedlings $hill^{-1}$ on 31 July 2013 maintaining spacing as per experimental treatments. Crop management practices such as drainage, plant protection measures were done as per requirement. Growth parameters such as plant height, LAI, no of tillers $hill^{-1}$ and total dry matter production $hill^{-1}$ were determined. Five hills were marked by bamboo stick excluding boarder rows to collect data on plant height and tiller number. Five hills were destructed on every sampling dates for leaf area index (LAI) and total dry matter (TDM). Number of tillers $hill^{-1}$ were recorded from the selected 5 hills. The leaf area was measured by an automatic leaf area meter (Type AAN-7, Hayashi Dam Ko Co., Japan). Leaf area index was calculated as the ratio of total leaf area and total ground area of the sample as described by Hunt (1978).

$$LAI = \frac{LA}{P}$$

Where, LA = Total leaf area of the leaves of all sampled plants (cm^2)

P = Area of the ground surface covered by the plant (cm^2)

Crop growth rate (CGR) is the increase in the plant diameter production per unit of time per unit of ground (Hunt 1978) and it was calculated by using the following formula:

$$CGR = \frac{W_2 - W_1}{T_2 - T_1} (g\ m^{-2}\ d^{-1})$$

Where, W_1= Total dry weight at time (T_1) and W_2 = Total dry weight at time (T_2)

Total dry matter (TDM) was determined by selecting two representative rice hills outside of harvest area (central 1 m^2) at 20, 35, 45 and 65 DAT. The roots of each plant were removed, then the plants were washed with tap water and the plant samples were packed in labeled brown paper bags and dried in the oven at $70±5^oc$ for 72 hours until constant weight was reached. The samples were weighed carefully after oven drying to measure the dry weight of the plant.

Data on different parameters were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done with the help of computer package MSTAT. The mean differences among the treatments were tested with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of spacing and weed management on the plant height

The effect of spacing on plant height was significant at 20 DAT, 50 DAT, 65 DAT and at harvest time except 35 DAT (Fig. 1). At 50 DAT, 65 DAT and harvest highest plant height was obtained from S_2 where 25 cm × 15 cm spacing was applied and the lowest plant height was obtained from S_4 treatment where 20 cm × 10 cm spacing was applied. Results revealed that the tallest plant was recorded in S_2 treatment at most of the growth stage followed by S_3 treatment with same statistical rank. These results indicate that plant height increased with increased in the spacing and decreased with closest spacing due to the plant completion for space, light and low uptake of nutrients.

The effect of weed management on plant height was also significant at 20 DAT, 35 DAT, 50 DAT, 65 DAT and at harvest time (Fig. 2). At 25 DAT, 35 DAT and harvest time highest plant height were obtained from W_4 treatment where herbicide Pyrazosulfuron-ethyl 10 WP was applied and at 50 DAT, 65 DAT tallest plant was obtained from W_2 and W_1 treatment respectively. The lowest plant height was recorded from W_0 treatment at most of the growth stage where no weeding (control) was maintained. The result showed that weed free condition increased the plant height due to less completion of light, space and nutrient. On the other hand, weedy condition decreased the plant height due to more completion between weed and plant. Similar results was reported by Akhtaruzzaman (2007) who reported that the tallest plant was produced by weed free condition and the shortest plat was found in no weeding plot. Similar results were also reported by Bari (2004) and Bhowmick (2005) in rice. They reported that weeding within 20 to 60 DAT was the best for superior plant growth and development.

Effect of interaction between spacing and weed management on plant height

Plant height was significantly influenced by the interaction between spacing and weed management at 20, 35 and 50 DAT (Table 2) but was non-significant at 65 DAT. At 20 DAT, the highest plant height (50.01 cm) was obtained in the interaction between 25 cm × 10 cm spacing and Pyrazosulfuron-ethyl 10 WP application and the lowest plant height (30.12 cm) was in the interaction between 20 cm × 10 cm and no weeding treatment. At 35 DAT, the tallest plant (72.47 cm) was obtained in the interaction between 25 cm × 10 cm spacing and one hand weeding and the lowest plant height (52.30 cm) was in the interaction between 20 cm × 10 cm and no weeding treatment. At 50 DAT the highest plant height (92.33 cm) was obtained in the interaction between 25 cm × 15 cm spacing and Pyrazosulfuron-ethyl 10 WP application and the lowest plant height (70.16 cm) was in the interaction between 20 cm × 10 cm and no weeding treatment. In contrast, the shortest plant was observed in no weeding with any spacing at all growth stages. At maturity the tallest plant (114.37 cm) was obtained in 25 cm × 10 cm plant spacing with Pyrazosulfuron-ethyl 10 WP application which was statistically identical to 25 cm × 20 cm plant spacing and Pyrazosulfuron-ethyl 10 WP application and the lowest one was obtained in closest plant spacing (20 cm × 10 cm) with no weeding treatment which was statistically identical to 25 cm × 10 cm plant spacing and no weeding treatment.

Effect of spacing and weed management on the Number of total tillers hill^{-1}

Effect of spacing on number of total tillers hill^{-1} was significant at 20 DAT, 35 DAT, 50 DAT, 65 DAT and harvest time (Fig. 3). The highest number of total tillers hill^{-1} was obtained from S_2 treatment where 25 cm × 15 cm spacing was applied and the lowest number of total tillers hill^{-1} was obtained from S_4 treatment where 25 cm × 10 cm spacing was applied at 20 DAT, 35 DAT, 50 DAT, 65 DAT. The result showed that as the closer spacing the number of total tillers hill^{-1} decreased. The reason might be wide spaced plants received more nutrients, moisture and light thus produced higher number of tillers hill^{-1}. Number of total tillers hill^{-1} was decreased at 65 DAT and maturity due to senescence of tillers at later stages of growth.

The effect of weed management on number of total tillers hill^{-1} was significant at 20 DAT, 35 DAT, 50 DAT, 65 DAT and harvest time (Fig. 4). Maximum number of total tillers hill^{-1} was produced at three hand weedings and the lowest from control treatment at all sampling dates. Result indicates that proper weed management increased the number of total tillers hill^{-1}. No weeding treatment produced the lowest number of total tillers hill^{-1} with any spacing at all growth stages. It might be due to competition for nutrients in between weeds and plant.

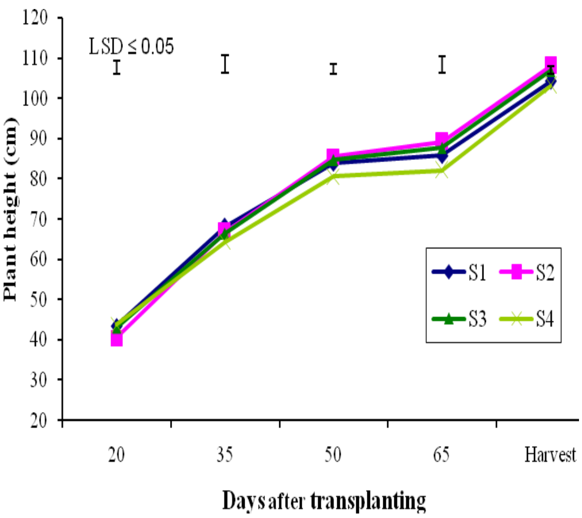

Fig. 1. Effect of plant spacing on plant height at different days after transplanting and harvest
S_1 = 25cm × 10cm, S_2 = 25cm × 15cm,
S_3 = 25cm × 20cm, S_4 = 20cm × 10cm

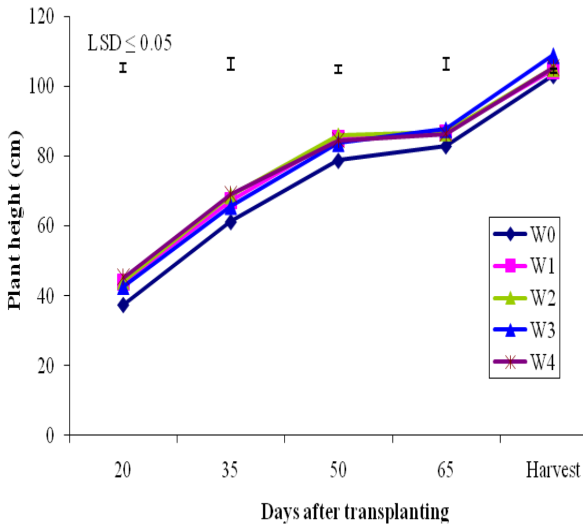

Fig. 2. Effect of weed management on plant height at different days after transplanting and harvest
W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weedings at 20 and 35 DAT, W_3 = Three hand weedings at 20, 35 and 50 DAT, W_4 = Pyrazosulfuron-ethyl 10 WP

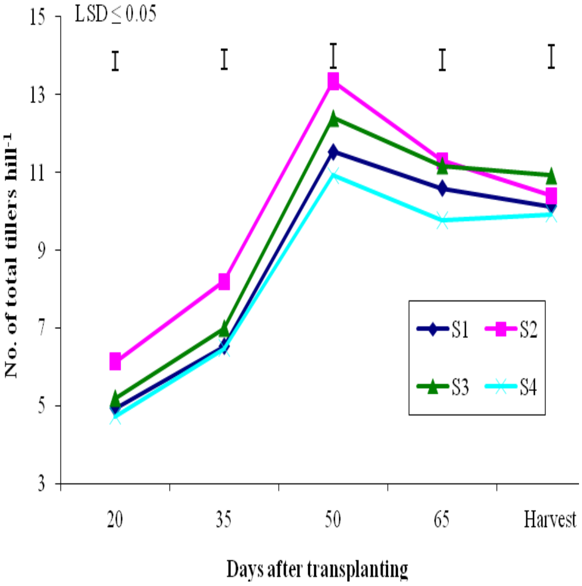

Fig. 3. Effect of plant spacing on number of total tillers hill^{-1} at different days after transplanting and harvest

S_1 = 25cm × 10cm, S_2 = 25cm × 15cm, S_3 = 25cm × 20cm, S_4 = 20cm × 10cm

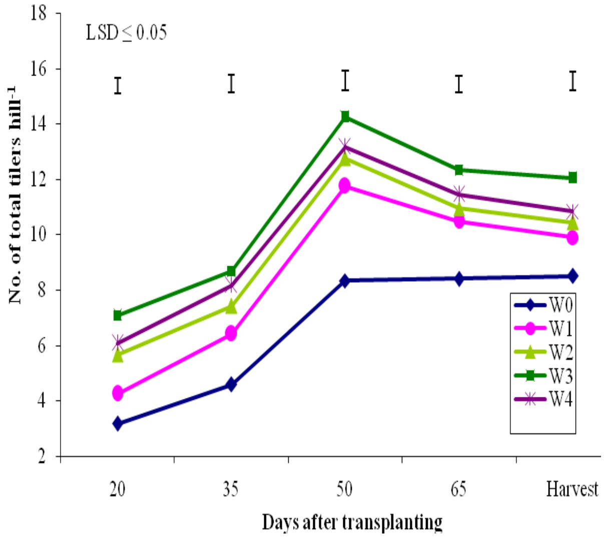

Fig. 4. Effect of weed management on number of total tillers hill^{-1} at different days after transplanting and harvest

W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weedings at 20 and 35 DAT, W_3 = Three hand weedings at 20, 35 and 50 DAT, W_4 = Pyrazosulfuron-ethyl 10 WP

Effect of interaction between spacing and weed management on number of total tillers hill^{-1}

The interaction effect between plant spacing and weed management was found significant at 20, 50, 65 DAT and harvest but insignificant at 35 DAT (Table 2). The maximum number of total tillers hill^{-1} (16.00), (13.75) and (12.72) was obtained in the widest spacing (25 cm × 20 cm) with three hand weedings at 20, 35 and 50 DAT. At 20 DAT, the maximum one was found in spacing 25 cm × 15 cm. The minimum number of tillers hill^{-1} (2.33), (7.00), (7.67) and (7.33) was found in spacing 20 cm × 10 cm, 25 cm × 10 cm, 20 cm × 10 cm and 25 cm × 20 cm, respectively with control treatment at 20, 50, 65 DAT and at harvest. The growth stage effect was pronounced by decreasing number of tillers hill^{-1} during flowering stage and post flowering stage might be due to senescence of tillers at later stages of growth.

Effect of spacing and weed management on growth attributes

Leaf Area Index (LAI)

The effect of spacing on leaf area index (LAI) was significant at 20 DAT, 35 DAT but at 65 DAT except 50 DAT (Fig. 5). The highest LAI was found in S_3 treatment where wider spacing 25 cm × 20 cm was applied at 20 and 35 DAT but at 65 DAT, the highest LAI was found in spacing 25 cm × 15 cm. The lowest LAI was found at the closest spacing where 20 cm×10 cm was maintained at all sampling dates but at 20 DAT, the lowest leaf area index was statistically identical to spacing 25 cm × 15 cm and 25 cm × 10 cm and at 65 DAT it was identical to spacing 25 cm × 20 cm. Results reveal that highest leaf are index (LAI) was attained in wider spacing and lowest one with closest spacing. Closer spacing reduced the leaf are index (LAI) due to an increased intra plant competition. Ali *et al*. (2008) found an increase in all growth parameters except LAI in closest spacing (15 × 15 cm) under his study.

Effect of weed management on leaf area index (LAI) was significant at different days after transplanting (Fig. 6). The highest leaf area index (LAI) was found in W_3 treatment where three hand weeding was applied at 20, 35 and 50 DAT and the lowest leaf area index (LAI) was found in no weeding treatment. Result reveal that weed infestation reduced the leaf area index (LAI) of the crop significantly. The LAI continuously increased up to 50 DAT and then it declined towards maturity due to leaf senescence. Similar results were reported by Ashraf *et al*. (2014). They reported that the improved leaf area index in spacing 20 cm × 20 cm might be due to reduced intra plant competition maximum light interception and provision of a weed free environment where weeds are discouraged to grow after the application of spray.

Total dry matter (TDM)

The effect of spacing on total dry matter (TDM) production hill^{-1} was significant at different days after transplanting except 35 DAT (Table 1). The highest TDM hill^{-1} was obtained at 25 cm × 15 cm plant spacing at all sampling dates. The lowest TDM hill^{-1} was obtained in the spacing (25 cm × 10 cm) at 20 and 35 DAT which was statistically identical to 25 cm × 20 cm and 20 cm × 10 cm spacing at 20 DAT. The lowest TDM hill^{-1} was obtained in the spacing 25 cm × 20 cm at 50 and 65 DAT. Result reveal that wider spacing produce highest amount of dry matter hill^{-1}. This may be at the wider spacing, plant produce more tillers as well as leaf area were produced in lower population levels, which have the capacity to capture more sunlight because of less mutual shading effect among the leaves and less competition for nutrients in wider spacing plants producing greater TDM hill^{-1} than closer spacing (Mondal *et al.* 2013).

Effect of weed management on total dry matter (TDM) production hill^{-1} was significant at different dats after transplanting (Table 1). The highest total dry matter (TDM) was found in W_3 treatment where three hand weeding was applied at 20, 35 and 50 DAT and the lowest total dry matter (TDM) was found in no weeding treatment. The result showed that weed free condition produced greater TDM hill^{-1} compared to the weed infestation condition due to the less intra specific completion.

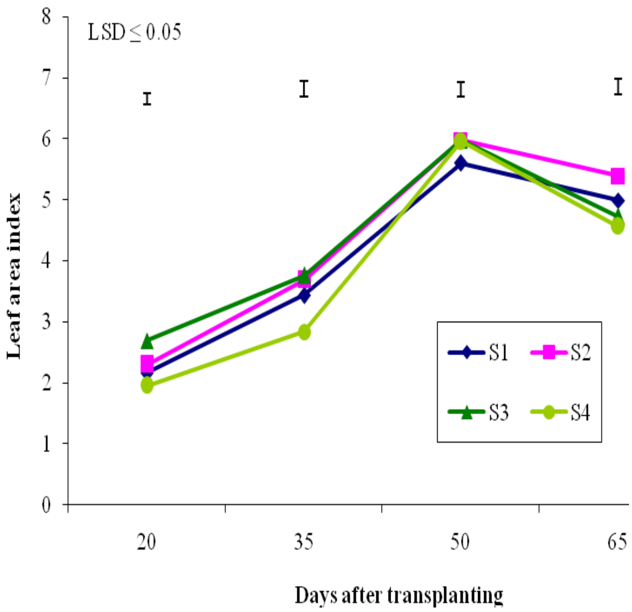

Fig. 5. Effect of plant spacing on leaf area index (LAI) at different days after transplanting
S_1 = 25cm × 10cm, S_2 = 25cm × 15cm,
S_3 = 25cm × 20cm,

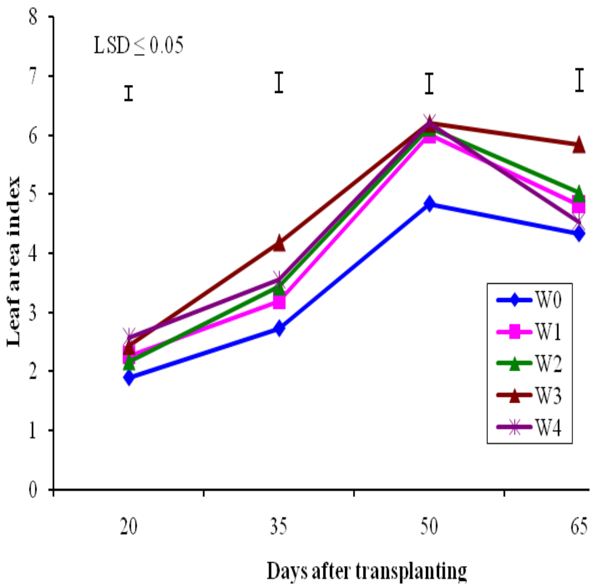

Fig. 6. Effect of weed management on leaf area index (LAI) at different days after transplanting
W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weedings at 20 and 35 DAT, W_3 = Three hand weedings at 20, 35 and 50DAT, W_4 = Pyrazosulfuron-ethyl 10 WP

Crop growth rate (CGR)

The effect of spacing on crop growth rate (CGR) was significant at 20-35 DAT, 35-50 DAT and 50-65 DAT (Fig. 7). The highest crop growth rate was recorded from 25 cm × 15 cm spacing at all growth stage followed by 25 cm × 20 cm and 25 cm × 10 cm spacing. Lowest CGR was found in the closest spacing which might be to due maximum intra plant competition for acquisition of resources and ultimately crop growth rate declined. Similar result was found by Ashraf *et al.* (2014). They found that wider spacing produce the highest crop growth rate and closest spacing produce the lower crop growth rate.

The effect of weed management on crop growth rate (CGR) was significant at 20-35 DAT, 35-50 DAT and 50-65 DAT (Fig. 8). Maximum crop growth rate was produced at W_3 treatment where three hand weedings was applied at 20, 35 and 50 DAT and the lowest crop growth rate was recorded at no weeding treatment. Results reveal that in weed free condition plant accumulate maximum growth rate compared to weed infestation condition. Islam *et al.* (2000) also stated the same results and reported that maximum crop growth rate can be achieved when there is no or lesser weed competition and adequate resource availability to the crop. Moreover, weed infestation minimizes the crop growth rate adversely

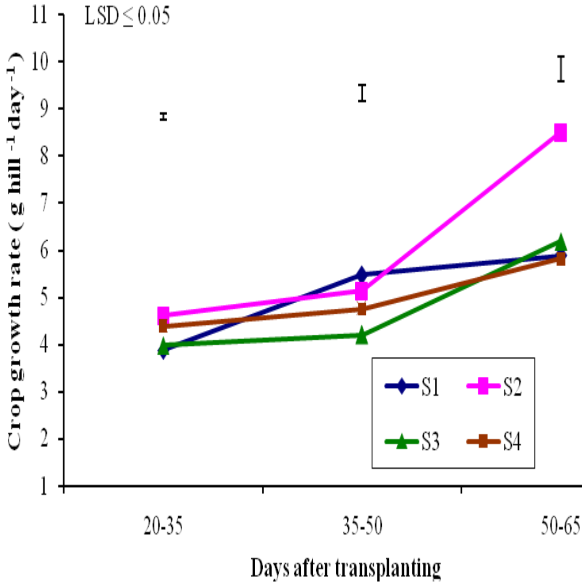

Fig. 7. Effect of plant spacing on crop growth rate (CGR) at different days after transplanting
S_1 = 25cm × 10cm, S_2 = 25cm × 15cm,
S_3 = 25cm × 20cm, S_4 = 20cm × 10cm

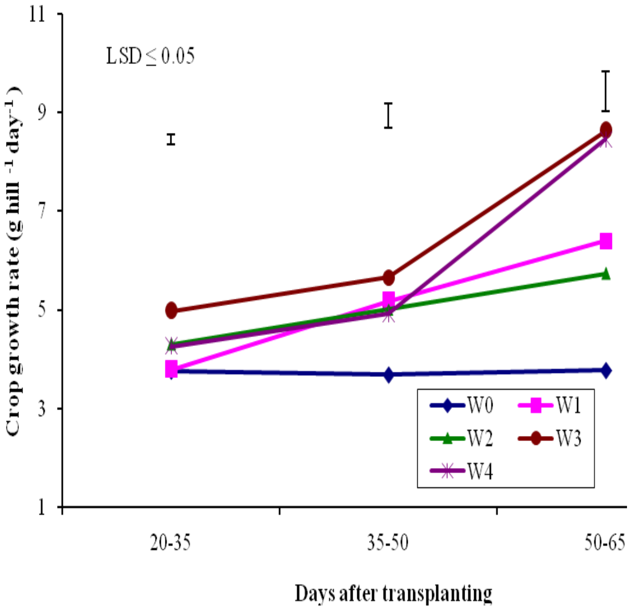

Fig. 8. Effect of weed management on crop growth rate (CGR) at different days after transplanting
W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weedings at 20 and 35 DAT, W_3 = Three hand weedings at 20, 35 and 50 DAT, W_4 = Pyrazosulfuron-ethyl 10 WP

Effect of interaction on Leaf Area Index (LAI), Total dry matter (TDM) and Crop growth rate (CGR)

The interaction effect of different plant spacing and weed management had significant effect on leaf area index at all sampling dates except 50 DAT (Table 3). At 20 DAT, the highest LAI (3.07) was obtained from widest spacing 25 cm × 20 cm with three hand weedings treatment which was statistically identical to spacing 25 cm × 15 cm with three hand weedings treatment and 25 cm × 10 cm with two hand weedings. The highest LAI (5.72) and (7.50) at 35 and 65 DAT was obtained from spacing 25 cm × 15 cm with three hand weedings treatment. The lowest LAI (1.64), (2.20) and (2.76) at 20, 35 and 65 DAT was found at closet spacing 20 cm×10 cm in control plot. The interaction effect between plant spacing and weed management was significant at 20 DAT but not at 35, 50 and 65 DAT (Table 3). The highest total dry matter (4.22) was observed in the spacing 25 cm × 15 cm with three hand weedings treatment and the lowest one (1.44) was found at the closest spacing (20 cm×10 cm) with control at 20 DAT. The interaction effect between plant spacing and weed management was significant at 50-65 DAT but not significant at 20-35 and 35-50 DAT (Table 3). At 50-65 DAT, the highest CGR (11.98 g $hill^{-1}$ day^{-1}) was found in the spacing (25 cm × 15 cm) with three hand weedings which was statistically identical to spacing (25 cm × 15 cm) with herbicidal weed control and the lowest CGR (2.71 g $hill^{-1}$ day^{-1}) was found in the spacing (25 cm × 20 cm) with control condition.

Table 1. Effect of spacing of transplanting and weed management on total dry matter (TDM) production at different days after transplanting

Plant Spacing (cm)	**Total dry matter (g hill^{-1})**			
	Days after transplanting (DAT)			
	20	**35**	**50**	**65**
25cm × 10cm	2.11b	7.92	16.13b	24.96b
25cm × 15cm	3.06a	9.98	17.67a	30.42a
25cm × 20cm	2.23b	8.20	14.51c	23.78b
20 cm × 10cm	2.25b	8.83	15.95b	24.67b
CV(%)	7.29	4.55	4.69	5.82
Level of sig.	**	NS	**	**
Weed management (Days after transplanting)	**Total dry matter (g hill^{-1})**			
	Days after transplanting (DAT)			
	20	**35**	**50**	**65**
W_0	1.68c	7.31c	12.83c	18.48d
W_1	2.19bc	7.85bc	15.60b	25.20c
W_2	2.62ab	9.07b	16.59b	25.18c
W_3	2.95a	10.41a	18.90a	31.83a
W_4	2.63ab	9.03b	16.41b	29.11b
CV(%)	7.29	4.55	4.69	5.82
Level of sig.	**	**	**	**

Mean values in a column having the same letter do not differ significantly as per DMRT. ** Significant at 1% level, * Significant at 5% level. NS= non-significant
W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weedings at 20 and 35 DAT, W_3 = Three hand weedings at 20, 35 and 50 DAT, W_4 = Pyrazosulfuron-ethyl 10 WP

Table 2. Interaction effect of spacing and weed management on the plant height and number of total tillers hill^{-1}

	Plant height (cm)					Number of total tillers hill^{-1}				
	Days after transplanting (DAT)									
Interaction (S × W)	**20**	**35**	**50**	**65**	**Harvest**	**20**	**35**	**50**	**65**	**Harvest**
$S_1 \times W_0$	41.15cd	61.30c	74.38f	85.23	97.83i	2.67jk	4.00	7.00h	9.33efg	9.33f
$S_1 \times W_1$	43.89bcd	72.47a	86.60bc	88.49	99.42i	3.33ijk	5.33	12.67cd	10.42cde	7.83g
$S_1 \times W_2$	43.71bcd	69.27ab	88.23b	89.92	103.14gh	5.33efg	7.33	11.33de	10.08c-f	9.83ef
$S_1 \times W_3$	38.71de	65.52abc	78.32e	88.40	105.86e-h	7.33ab	8.33	13.33bc	11.08bcd	12.50ab
$S_1 \times W_4$	50.01a	72.33a	91.93a	93.84	114.37a	6.00c-f	7.67	13.33bc	12.08b	11.17b-e
$S_2 \times W_0$	39.66de	64.87ab	85.27bc	83.67	108.37cde	4.00hi	6.00	10.67ef	8.92fgh	9.67ef
$S_2 \times W_1$	43.92bcd	65.27abc	82.93cd	88.00	109.60cd	5.67def	7.33	14.33b	12.08b	9.50f
$S_2 \times W_2$	41.34cd	70.87ab	92.33a	87.27	110.77bc	6.33b-e	7.67	13.67bc	11.42bc	10.83c-f
$S_2 \times W_3$	35.49e	63.07bc	83.92cd	88.29	105.47e-h	7.67a	10.00	14.33b	12.08b	12.17abc
$S_2 \times W_4$	41.91cd	69.73ab	83.00cd	90.94	105.73e-h	7.00abc	10.00	13.67bc	11.42bc	9.83ef
$S_3 \times W_0$	39.15de	66.67abc	85.50bc	86.67	103.19gh	3.67ij	4.67	7.67h	7.67h	7.33g
$S_3 \times W_1$	38.93de	66.80abc	85.00bc	86.93	104.00gh	3.67ij	6.33	9.33fg	10.65cde	11.43a-d
$S_3 \times W_2$	46.22sbc	65.00abc	83.50cd	87.27	106.27efg	6.00c-f	8.00	14.33b	12.08b	10.92c-f
$S_3 \times W_3$	47.48sb	69.23ab	86.30bc	84.70	107.83c-f	6.67a-d	8.33	16.00a	13.75a	12.72a
$S_3 \times W_4$	43.31bcd	64.20bc	83.30cd	83.20	112.73ab	6.00c-f	7.67	14.67ab	12.42b	12.18abc
$S_4 \times W_0$	30.12f	52.30d	70.16g	76.38	97.80i	2.33k	3.67	8.00gh	7.67h	7.67g
$S_4 \times W_1$	48.62ab	64.67abc	86.33bc	84.37	107.23def	4.33ghi	6.67	10.67ef	8.73gh	10.83c-f
$S_4 \times W_2$	45.77abc	70.00ab	79.96de	82.77	104.80fgh	5.00fgh	6.67	11.67de	10.17c-f	10.17def
$S_4 \times W_3$	48.62ab	64.67abc	86.33bc	84.37	102.68h	6.67a-d	8.00	13.33bc	12.42b	10.83c-f
$S_4 \times W_4$	45.77abc	70.00ab	80.35de	82.85	103.20gh	5.33efg	7.33	11.00e	9.83d-g	10.17def
CV (%)	2.54	5.23	6.24	5.23	5.63	7.48	7.45	4.66	3.95	5.82
Level of sig.	**	**	**	NS	**	**	NS	**	**	**

Mean values in a column having the same letter(s) do not differ significantly whereas mean values having different letter(s) differ significantly as per DMRT
**= Significant at 1% level of probability, NS= Not significant, CV= Co-efficient of variance
S_1 = 25cm × 10cm, S_2 = 25cm × 15cm, S_3 = 25cm × 20cm, S_4 = 20cm × 10cm
W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weedings at 20 and 35 DAT, W_3 = Three hand weedings at 20, 35 and 50 DAT,
W_4 = Pyrazosulfuron-ethyl 10 W

Table 3. Interaction effect of spacing and weed management on the total dry matter, crop growth rate and leaf area index

Interaction (S × W)	Total dry matter (TDM) (g hill^{-1})				Crop growth rate (CGR) (g m^{-2}day^{-1})			Leaf area index (LAI)			
	Days after transplanting (DAT)										
	20	35	50	65	20-35	35-50	50-65	20	35	50	65
$S_1 \times W_0$	1.55cd	6.31	11.98	17.25j	3.17	3.78	3.52ef	1.76cde	3.38c-g	3.85	3.94def
$S_1 \times W_1$	1.97cd	7.16	16.36	26.60ef	3.46	6.13	6.83bcd	1.71de	2.26fg	5.49	4.51b-e
$S_1 \times W_2$	2.23bcd	7.57	15.91	26.71ef	3.56	5.56	7.20bcd	2.92a	2.54fg	6.08	3.89ef
$S_1 \times W_3$	2.51bcd	9.98	19.41	27.23def	4.97	6.29	5.21c-f	2.84ab	3.22c-g	6.07	5.05b-e
$S_1 \times W_4$	2.30bcd	8.61	17.00	27.00def	4.21	5.60	6.67bcd	2.73abc	3.90b-e	6.51	5.42bc
$S_2 \times W_0$	2.17bcd	8.18	14.16	22.27gh	4.01	3.98	5.41c-f	1.94b-e	2.82d-g	5.67	5.45bc
$S_2 \times W_1$	2.67bcd	8.86	17.77	29.43cde	4.13	5.94	7.77bcd	2.13a-e	2.42fg	6.20	3.75ef
$S_2 \times W_2$	2.86bc	9.84	18.13	26.26ef	4.65	5.53	5.42c-f	2.24a-e	3.93b-e	6.13	5.34bc
$S_2 \times W_3$	4.22a	12.70	21.04	39.02a	5.65	5.56	11.98a	2.92a	5.72a	6.48	7.50a
$S_2 \times W_4$	3.40ab	10.31	17.27	35.13b	4.61	4.64	11.91a	2.12a-e	3.50c-g	5.39	4.90b-e
$S_3 \times W_0$	1.56cd	7.09	12.08	16.14j	3.69	3.33	2.71f	1.80cde	2.53fg	4.76	4.26cde
$S_3 \times W_1$	1.94cd	7.36	12.83	20.44hi	3.61	3.65	5.07c-f	2.67a-d	3.90b-e	6.58	5.46bc
$S_3 \times W_2$	2.92bc	9.14	15.38	22.37gh	4.15	4.15	4.66def	2.79ab	4.87ab	6.15	5.82b
$S_3 \times W_3$	2.53bcd	9.36	17.15	31.00c	4.56	5.19	9.23ab	3.07a	2.62efg	6.06	5.29cd
$S_3 \times W_4$	2.20bcd	8.04	15.09	28.95cde	3.89	4.70	9.24ab	2.54a-e	3.23c-g	6.32	3.74ef
$S_4 \times W_0$	1.44d	7.65	13.10	18.26ij	4.14	3.64	3.44ef	1.64e	2.20g	5.08	2.76f
$S_4 \times W_1$	2.16bcd	8.04	15.45	24.32fg	3.92	4.94	5.91cde	1.66e	4.23bc	5.76	5.58bc
$S_4 \times W_2$	2.47bcd	9.71	16.92	25.37fg	4.82	4.81	5.63c-f	1.79cde	3.58c-f	6.46	5.02b-e
$S_4 \times W_3$	2.54bcd	9.59	18.01	30.08cd	4.70	5.61	8.05bc	2.40a-e	3.99bcd	5.90	5.58bc
$S_4 \times W_4$	2.64bcd	9.17	16.28	25.34fg	4.35	4.74	6.04cde	1.78cde	3.58c-f	6.58	5.02b-e
CV (%)	7.29	4.55	4.69	5.82	7.48	7.25	4.75	7.48	7.58	4.66	3.96
Level of sig.	**	NS	NS	**	NS	NS	**	*	**	NS	**

Mean values in a column having the same letter(s) do not differ significantly whereas mean values having different letter(s) differ significantly as per DMRT
**= Significant at 1% level of probability, *= Significant at 5% level of probability, NS= Not significant, CV= Co-efficient of variance
S_1 = 25cm × 10cm, S_2 = 25cm × 15cm, S_3 = 25cm × 20cm, S_4 = 20cm × 10cm and W_0 = No weeding (control), W_1 = One hand weeding at 20 DAT, W_2 = Two hand weeding at 20 and 35 DAT, W_3 = Three hand weeding at 20, 35 and 50 DAT, W_4 = Pyrazosulfuron-ethyl 10 WP

CONCLUSION

From the results of the present stud it may be concluded that, proper spacing and weed management plays an important role on the growth of *Aman* rice. Proper spacing allows the plant growth properly due to utilizing more more solar radiation and uptaking more soil nutrient. On the other hand, weed management also significantly influences the growth of rice. This may be due to less competition of light, nutrient, space and so on, thus enhance rice plant grows properly. Therefore, proper spacing of transplanting and weed management is essential for satisfactory rice growth as well as production in Bangladesh.

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