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EFFECT OF INTEGRATED WEED MANAGEMENT AND SPACING ON THE WEED FLORA AND ON THE GROWTH OF TRANSPLANTED AMAN RICE

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ABSTRACT

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An experiment was carried out at the Agronomy field, Sher-e-Bangla Agricultural University, Dhaka during the period from July to December, 2006 to evaluate the effect of integrated weed management and spacing on the weed flora and on the growth of transplanted aman rice. The experiment comprised of six weeding treatments viz. no weeding, two hand weeding at 15 and 40 days after transplanting (DAT), one weeding with BRRI push weeder at 15 DAT + one hand weeding at 40 DAT, pre-emergence application of M.Chlor 5G (Butachlor) at 5 DAT + one hand weeding at 40 DAT, pre-emergence application of Oxastar 25 EC (Oxadiazon) at 5 DAT + one hand weeding at 40 DAT, pre- emergence application of Rifit 500EC (Pretilachlor) at 5 DAT + one hand weeding at 40 DAT and three plant spacings viz. 20cm x 10cm, 25cm x 15cm and 30cm x 20cm. It was evident that among the weed control treatments Pretilachlor + one hand weeding was found the best for controlling weeds at 30 DAT (79.53%) and moderate for controlling weeds at 60 DAT (75.65%) which ultimately gave the highest plant height (137.20 cm), total tillers hill^{-1} (20.13) and moderately contributed to the leaf area index (5.30) that resulted the higher plant dry matter (23.62 g hill^{-1}) at 60 DAT and higher crop growth rate (0.71 g hill^{-1} day^{-1}) at 45-60 DAT. Among the spacings, the widest spacing (30cm x 20cm) contributed to the highest weed control efficiency (55.30 %) at 30 DAT and the lowest weed control efficiency (62.03%) at 60 DAT and gave the highest growth parameters except LAI. The best growth performance showed by Pretilachlor at the spacing of 25cm x 15cm and after that by BRRI push weeder + one hand weeding at the spacing of 30cm x 20cm.

Key words: Weed management, plant spacing, weed flora and growth

INTRODUCTION

Bangladesh is an agro-based country. Rice (*Oryza sativa L.*) is the staple food of Bangladesh where it's production has increased more than two times during the last 3 decades and reached more than 25 million tons in 2001-2002 (BBS, 2002). For food security of the country, rice production is needed to be increased from 3 tons ha^{-1} to 5 tons ha^{-1} in next 20 years (Mahbub *et al.,* 2001). The majority of rice area is covered by aman (Autumn) rice comprising about 52.77% of the total rice area of which transplanted aman rice cover 87.05% (BBS, 2003). Among the various factors responsible for low rice production, weeds are considered to be as one of the major limiting factors due to manifold harmful effects (Kalyanasundaram *et al*. 2006). Weeds uptake the available nutrients, compete with crops for water, light and space. Weeds are the most competitors in their early growth stages than the later and hence the growth of crops slows down and grain yield decreases (Jacob and Syriac, 2005). Mamun (1990) reported that weed growth reduced the grain yield by 16-48% for transplanted aman rice. To reduce the cost of rice production, it has been urgently needed to adopt alternative method of weed control viz. mechanical weed control, biological weed control, and chemical weed control in combination with manual weeding.

The growth and development of rice and the intensity of weed infestations are greatly influenced by plant spacing. If the planting densities exceed an optimum level, intraplant competition for light or for nutrients becomes severe. Again, if the planting densities do not cover an optimum level, the remaining space will be filling up by the weed species and the interplant competition is at a maximum level. So, to find out the optimum plant population of transplanted aman rice by manipulating the plant spacing in relation to weed management is needed to be examined. The present investigation was to study the influence of integrated weed management and spacing on the weed flora and on growth of transplanted aman rice.

MATERIALS AND METHODS

The field experiment was conducted at the Agronomy field laboratory, Sher-e-Bangla Agricultural University, Dhaka during July to December, 2006. The soil of the experimental area belonged to the Modhupur tract (AEZ No. 28). It was a medium high land with non-calcarious dark grey soil. The pH value of the soil was 5.6. The experiment was laid out in a randomized complete block design (factorial) with three replications. The size of the individual plot was 4.0m x 2.5 m. The field was fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate at the rate of 150, 100, 70, 60 and 10 kg ha^{-1} respectively. The twenty five day old seedlings were transplanted on the well puddled experimental plots on August 5, 2006 by using two seedlings hill^{-1}. Other cultural operations were done properly as and when necessary. The crop was harvested plot wise at full maturity on December 2, 2006. The experiment comprised of six weeding treatments viz. no weeding (W_1), two hand weeding at 15 and 40 DAT (W_2), one weeding with BRRI push weeder at 15 DAT + one hand weeding at 40 DAT (W_3), pre-emergence application of M.Chlor 5G (Butachlor) at 5 DAT + one hand weeding at 40DAT (W_4), pre-emergence application of Oxastar 25 EC (Oxadiazon) at 5 DAT + one hand weeding at 40DAT (W_5), pre- emergence application of Rifit 500EC (Pretilachlor) at 5 DAT + one hand weeding at 40 DAT(W_6) ; three plant spacings viz. 20cm x 10cm (S_1), 25cm x 15cm (S_2) and 30cm x 20cm(S_3). The data were statistically analyzed and the differences were adjusted by least significant difference (LSD) test at 5% level of significance.

The data on weeds were collected from each unit plot at 30 and 60 DAT. A plant quadrate of 0.25 m^2 was placed randomly at three different spots outside an area of 10 m^2 in the middle of the plot. The infesting species of weeds within each quadrate were identified and their number was counted species wise. The average number of three samples was then multiplied by 4 to obtain the weed density m $^{-2}$. The collected weeds were first dried in the sun and then kept in an electrical oven for 72 hours maintaining a constant temperature of 80^{0}c. After drying, weight of each species was taken and expressed to g m $^{-2}$. Weed control efficiency was calculated with the following formula developed by Sawant and Jadav (1985):

Weed control efficiently (WCE) = $\frac{DWC - DWT}{DWC} \times 100$

Where,
DWC = Dry weight of weeds in unweeded treatment
DWT = Dry weight of weeds in weed control treatment

Crop growth parameters

i. Plant height (cm)
ii. Total number of tillers hill^{-1}
iii. Leaf area index (LAI)
iv. Total dry matter (TDM) hill^{-1} (g)
v. Crop growth rate (CGR) (g hill^{-1} day^{-1})

The data of all the crop growth parameters were recorded from 15 days after transplanting (DAT) at 15 days interval upto 75 DAT. The average height of five hills of each plot was considered as the height of the plant for each plot. The average number of tillers of five hills was considered as the total tiller no hill^{-1}. Leaf area index were estimated measuring the length and width of the leaf and multiplying by a factor of 0.75 followed by Yoshida (1981). Crop growth rate was calculated by using the following standard formula (Radford, 1967 and Hunt, 1978) as shown below:

CGR = $\frac{W_2 - W_1}{T_2 - T_1}$ g hill^{-1} day^{-1}

Where
W_1= Total plant dry matter at time T_1
W_2 = Total plant dry matter at time T_2

RESULTS AND DISCUSSION

Weed control efficiency (WCE)

Integrated weed management (W_4, W_5 and W_6) had a significant effect for controlling weeds at 30 DAT but at 60 DAT all the approaches had no significant effect for controlling weeds (Figure 1). At 30 DAT, all the herbicidal treatments had significantly greater effect in controlling weeds over control. The highest weed control efficiency (79.53%) was obtained from W_6 which was statistically similar to the other herbicidal treatments but significantly higher than W_2 and W_3. At 60 DAT, there were no significant differences among the treatments.

There were no significant differences among the spacing for WCE. Numerically at 30 DAT, S_3 gave the maximum WCE (55.3%) among the spacing but at 60 DAT S_2 gave the maximum WCE (64.06 %) among the spacing (Figure 2).

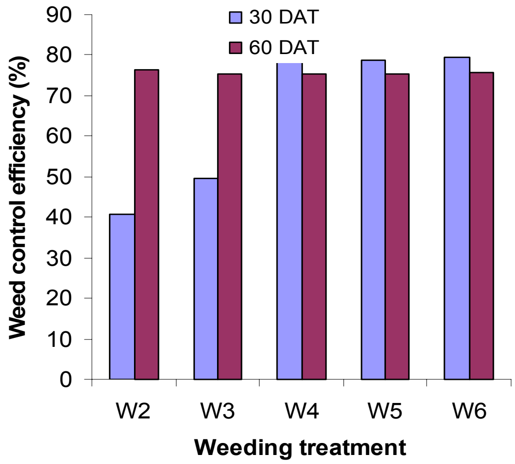

Figure 1. Weed control efficiency as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 30 and 60 DAT were 13.96 and 5.786, respectively)

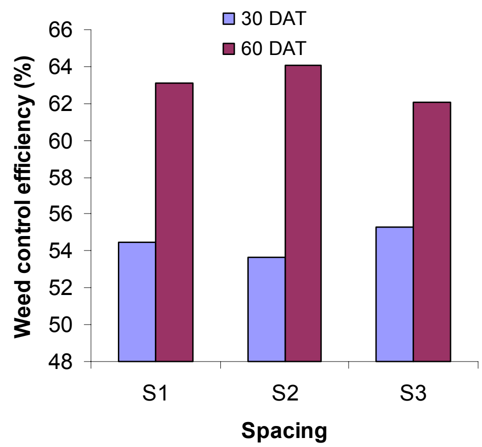

Figure 2. Weed control efficiency as affected by spacing in transplanted aman rice (LSD 0.05 at 30 and 60 DAT were 9.868 and 4.092, respectively)

Among the treatment combinations, W_6S_2 (preemergence application of Rifit 500 EC (Pretailachlor) @ 970 ml ha^{-1} at 5 DAT along with one hand weeding at 40 DAT at 25cm x 15 cm spacing) gave significantly the highest WCE (81.31%) which was statistically similar to WCE obtained from all other herbicidal treatments along with one hand weeding each at different spacing (Table 1) and also to the treatment combination of W_3S_2 (57.62%) but was higher than that of other treatment combinations. At 60 DAT, there had no significant differences among the treatment combinations.

Table 1.Interaction effect of different weed management and spacing on weed control efficiency in transplanted aman rice

Treatment	Weed control efficiency (%)	
	30 DAT	60 DAT
W_1 S_1	-	-
W_1 S_2	-	-
W_1 S_3	-	-
W_2 S_1	50.20	78.82
W_2 S_2	23.07	75.87
W_2 S_3	49.07	75.04
W_3 S_1	48.70	75.77
W_3 S_2	57.62	77.06
W_3 S_3	42.37	73.35
W_4 S_1	74.33	74.22
W_4 S_2	80.97	76.87
W_4 S_3	79.80	74.77
W_5 S_1	76.27	74.91
W_5 S_2	79.17	77.17
W_5 S_3	80.53	74.32
W_6 S_1	77.23	74.86
W_6 S_2	81.31	77.38
W_6 S_3	80.04	74.70
LSD 0.05	24.17	10.02
CV (%)	6.74	9.58

Crop growth parameters

All the crop growth parameters were significantly influenced by different weed control treatments during the periods from 15 DAT to 75 DAT. In case of plant height Figure 3 showed that W_6 treatment produced the tallest plant in all dates of sampling except at 15 DAT and attained to its highest value (146.10 cm) at 75 DAT. Similar findings were also observed by Toufiq (2003) and Attalla and Kholosy (2002).

All the crop growth parameters were significantly influenced by different plant spacings during the periods from 15 DAT to 75 DAT (Figure 4). Plant height increased with the advancement of crop duration and with wider spacing. It was observed that at 75 DAT the widest spacing 30 cm x 20 cm produced the tallest plant stature (146.60 cm) and the closest spacing 20cm x 10cm produced the shortest plant stature (136.80 cm). Ayub *et al.* (1987) in an experiment with fine rice stated that the plant height increased with low plant density.

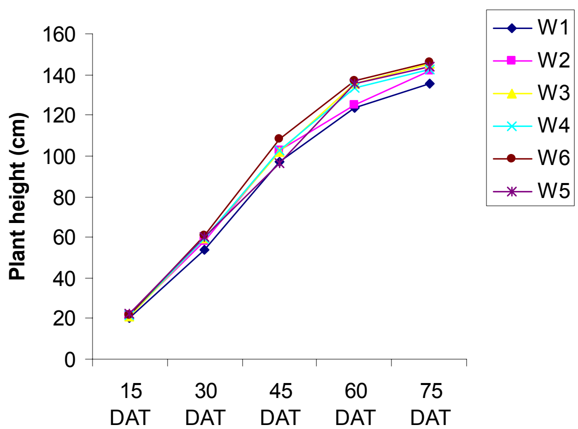

Figure 3. Plant height as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.89, 3.35, 13.17, 5.23 and 3.91, respectively)

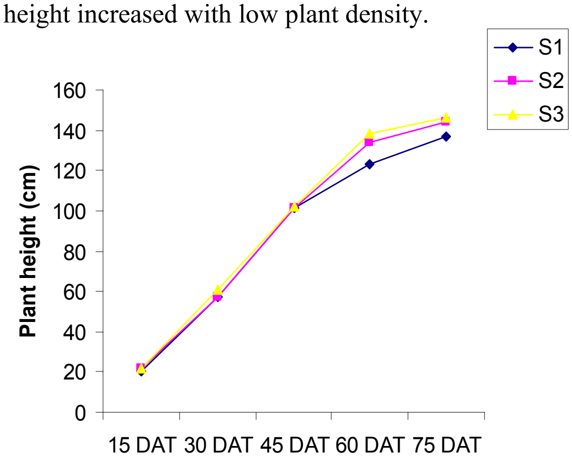

Figure 4. Plant height as affected by spacing in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.63, 2.34, 9.31, 3.70 and 2.76, respectively)

Tillers $hill^{-1}$ increased gradually upto 60 DAT and then decreased in the all weed control treatments due to mortality of ineffective tillers at later stages (Figure 5). At 60 DAT the highest number of tillers $hill^{-1}$(20.13) was found in W_6 which was statistically similar to 19.99, 19.07, 18.64, 19.16 obtained from the W_5, W_4, W_3 and W_2 respectively but was significantly higher than W_1 (15.44).

There was a gradual trend of increasing number of tillers $hill^{-1}$ with the widening of the spacing (Figure 6). Out of three plant spacings, the widest spacing 30cm x 20 cm produced the highest total number of tillers $hill^{-1}$ over time and reached at peak (21.84) at 60 DAT while the closest spacing 20 cm x 10 cm possessed the lowest total number of tillers $hill^{-1}$ (15.87) at the same DAT. Haque and Nasiruddin (1988) and Khalil (2001) also observed that wider spacing produced higher number of total tillers $hill^{-1}$.

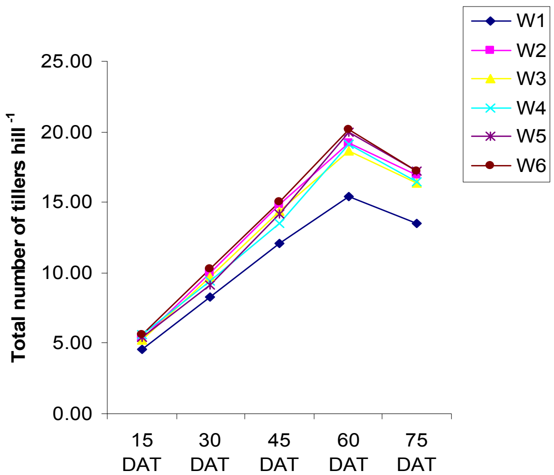

Figure 5. Total number of tillers hill^{-1} as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.5334, 0.649, 1.204, 1.521 and 0.9464, respectively)

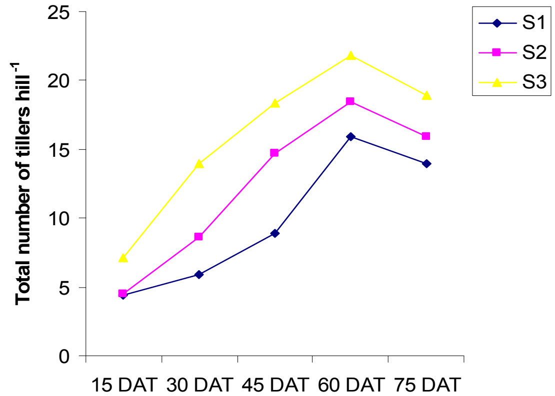

Figure 6. Total number of tillers hill^{-1} as affected by spacing in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.3772, 0.4589, 0.8515, 1.075 and 0.6692, respectively)

AT 15 DAT, W_6 gave the highest LAI (0.45) which was statistically similar to other treatment except W_1 (Figure 7). At 30 DAT, W_3 gave the highest LAI (1.01) which was statistically similar with W_2 and W_4 but significantly different from W_5 and W_6. In all cases unweeded treatment gave the lowest LAI.

LAI increased with the advancement of growth duration until 60 DAT (Figure 8). However, it was reduced after that. Leaf area index increased linearly and the highest LAI obtained at booting stage and then it decreased due to faster leaf senescence in the densely populated stands.

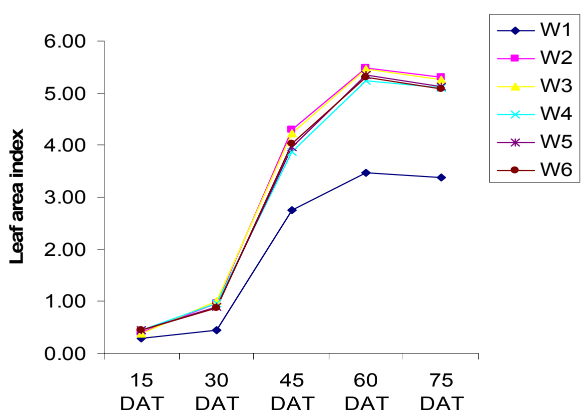

Figure 7. Leaf area index (LAI) as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.04284, 0.05247, 0.2206, 0.1285 and 0.2285 respectively)

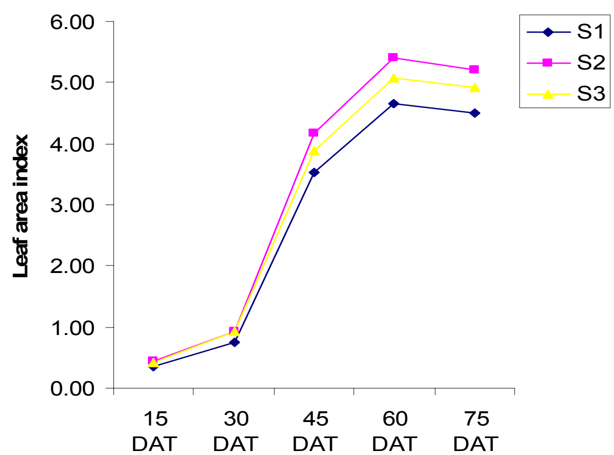

Figure 8. Leaf area index as affected by spacing in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.03029, 0.0371, 0.156, 0.09088 and 0.09088 respectively

From the early stages distinct differences were visible among the weed control treatments in TDM production (Figure 9). The TDM production was increased upto 60 DAT and after that it declined due to tiller mortality. All of the integrated weed managements gave statistically similar results from 15 DAT to 75 DAT except W_2 at 30, 45, 60 and 75 DAT, W_3 at 60 and 75 DAT, W_4 at 30 and 45 DAT and W_5 at 30 and 75 DAT.

TDM hill^{-1} was gradually increased with the widening of the spacing (Figure 10). TDM was increased upto 60 DAT and then it declined due to tiller mortality.

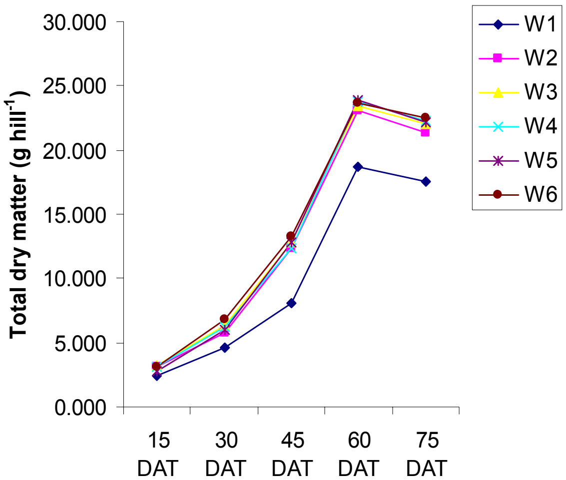

Figure 9. Total dry matter (TDM) as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.57, 0.54, 0.53, 0.39 and 0.32 respectively)

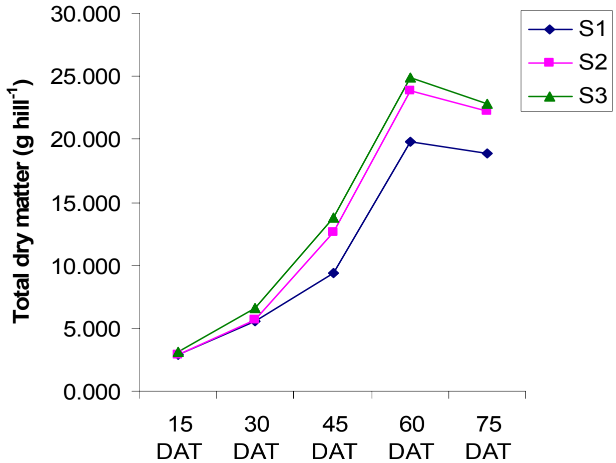

Figure10. Total dry matter (TDM) as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 15,30,45,60 and 75 DAT were 0.40, 0.38, 0.38, 0.27 and 0.22 respectively)

At 15-30 DAT, the W_6 gave the highest CGR (0.25 g hill^{-1} day^{-1}) which was statistically similar to other weed control except W_2 (Figure 11). At 30-45 DAT, all the weed control contributed to the superior CGR over the control and treatment W_5 gave the highest CGR (0.45 g hill^{-1} day^{-1}). At 45-60 DAT, W_4 gave the highest CGR (0.76 g hill^{-1} day^{-1}) which was statistically similar to W_5 (0.74 g hill^{-1} day^{-1}).

It was observed that CGR was always higher at wider spacing compared to those of closer spacings during the period from 15-30 DAT to 30-45 DAT (Figure 12). This result was similar with the findings of Yoshida (1981) and Khalil (2001) who reported that CGR values were higher when planted at wider spacing. But during the period from 45-60 DAT to 60-75 DAT, treatment S_2 gave the highest CGR (0.7417 and 0.1065 g hill^{-1} day^{-1} respectively) which was statistically similar to S_3.

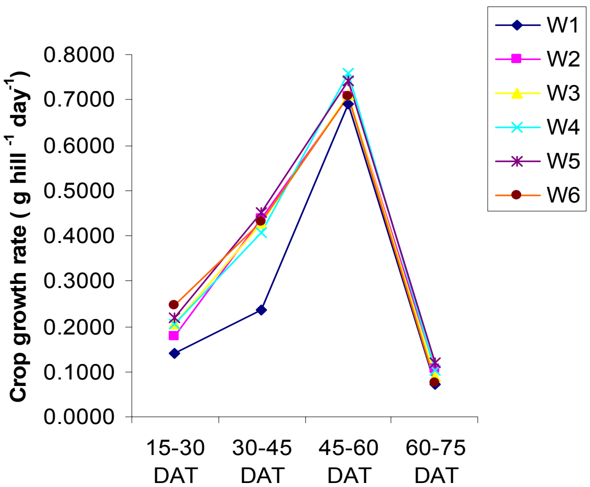

Figure 11. Crop growth rate (CGR) as affected by weed control treatment in transplanted aman rice (LSD 0.05 at 15-30, 30-45, 45-60 and 60-75 DAT were 0.525, 0.428, 0.043 and 0.052, respectively)

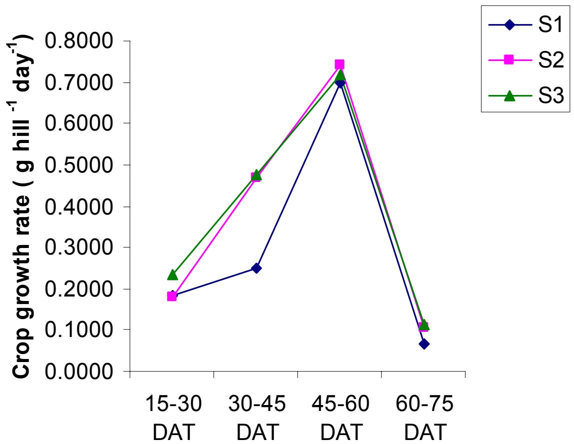

Figure12. Crop growth rate (CGR) as affected by spacing in transplanted aman rice (LSD 0.05 at 15-30, 30-45, 45-60 and 60-75 DAT were 0.371, 0.303, 0.030 and 0.037, respectively)

Interaction effect of plant spacing and different weed control had significant effect on different crop growth parameters (Table 2 and 3). The W_6S_3 contributed to almost highest plant height (110.50, 141.70 and 149.40 cm) from 45 DAT to 75 DAT. The widest spacing 30 cm x 20cm in each weed control had the highest total tillers hill^{-1} at each sampling period and it reached maximum at 60 DAT and afterwards it declined with the advancement of crop growth duration. On the contrary, the closest spacing (S_1) in combination with all weeding treatments produced the lowest number of tillers hill^{-1} at each period except 15 DAT where S_2 produced the lowest. Unweeded treatment in combination with all spacings produced the lowest LAI. AT 60 DAT, the highest LAI (6.05) was found in W_3S_3 which was statistically similar to W_2S_2 and W_6S_2 (5.97 and 5.90 respectively). The W_3S_3 produced the higher TDM from 30 DAT to 75 DAT (8.16, 15.95, 26.33 and 24.65 g hill^{-1} respectively). It might be due to the luxuriant growth of weeds upto 15 DAT in the treatment plot was well controlled by BRRI push weeder at that spacing. At the beginning of the crop growth (15-30 DAT), W_3S_3 showed the highest CGR (0.328 g hill^{-1} day^{-1}). At 30-45 DAT, W_3S_2 showed the highest CGR (0.585 g hill^{-1} day^{-1}). At 45-60 DAT, W_2S_2 gave the highest CGR (0.800 g hill^{-1} day^{-1}) among all the treatment combinations. It implied that several integrated weed management effectively controlled the weeds in wider spacing than the narrower spacing.

Table 2. Interaction effect of different weed management and spacing on different growth attributes of transplanted aman rice

Treatment	Plant height (cm)					Total number of tillers hill^{-1}					LAI				
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT
W_1 S_1	19.83	53.03	96.98	118.20	133.40	4.00	5.6	8.73	14.17	12.90	0.26	0.38	2.58	3.32	3.20
W_1 S_2	21.61	52.05	88.45	116.50	130.00	3.87	7.8	12.40	15.60	13.63	0.32	0.50	3.08	3.81	3.68
W_1 S_3	19.23	55.90	106.20	137.30	142.40	5.87	11.33	15.13	16.57	13.97	0.28	0.49	2.64	3.31	3.25
W_2 S_1	20.19	55.95	99.09	115.00	133.50	4.30	6.33	10.60	17.07	14.77	0.38	0.83	4.15	5.19	5.01
W_2 S_2	22.01	56.33	102.50	128.60	144.90	4.53	9.27	15.53	18.50	16.07	0.46	0.96	4.61	5.97	5.73
W_2 S_3	22.01	60.67	106.80	131.80	147.70	7.20	14.40	18.47	21.90	19.83	0.34	1.10	4.13	5.30	5.15
W_3 S_1	21.05	59.35	103.60	129.80	141.90	4.33	6.60	9.47	14.93	13.17	0.35	0.86	3.69	4.92	4.77
W_3 S_2	20.48	55.98	95.98	139.10	147.50	4.73	8.60	14.67	18.07	15.33	0.44	1.07	4.41	5.43	5.23
W_3 S_3	20.46	63.38	106.10	137.40	146.30	6.73	14.00	18.93	22.93	20.47	0.36	1.10	4.63	6.05	5.79
W_4 S_1	19.65	55.30	99.28	122.90	134.70	4.87	5.73	7.40	16.47	14.00	0.39	0.82	3.43	4.91	4.79
W_4 S_2	22.20	60.97	103.60	138.00	145.90	4.13	7.40	14.27	18.13	16.30	0.46	1.06	4.18	5.57	5.42
W_4 S_3	23.03	62.23	105.70	139.50	147.60	7.80	15.13	18.90	22.60	19.10	0.48	1.01	3.99	5.21	5.08
W_5 S_1	20.87	59.18	105.20	126.30	137.70	4.33	5.33	8.40	16.90	14.83	0.39	0.77	3.58	4.92	4.73
W_5 S_2	22.47	58.93	108.30	139.80	148.60	4.40	8.20	15.00	19.73	16.39	0.47	0.99	4.42	5.80	5.54
W_5 S_3	23.20	61.10	76.03	140.80	146.00	7.60	13.73	19.00	23.33	20.40	0.50	0.94	3.91	5.35	5.12
W_6 S_1	20.69	61.43	104.50	128.10	139.70	4.33	5.67	8.67	15.80	14.23	0.40	0.79	3.70	4.74	4.51
W_6 S_2	22.80	59.50	109.00	141.80	149.20	5.17	10.13	16.47	20.87	17.90	0.46	0.97	4.33	5.90	5.62
W_6 S_3	22.00	61.67	110.50	141.70	149.40	7.27	14.93	19.93	23.73	19.60	0.50	0.89	4.04	5.28	5.08
LSD 0.05	1.55	5.80	22.81	9.06	6.77	0.92	1.12	2.09	2.63	1.64	0.074	0.091	0.382	0.223	0.223
CV (%)	4.37	5.98	13.53	4.14	4.86	10.49	7.17	8.98	8.47	6.07	4.99	5.97	5.17	4.68	4.76

Here, W_1= No weeding, W_2= Two hand weeding (HW), W_3= BRRI push weeder + 1 HW, W_4=Butachlor + 1 HW, W_5= Oxadiazon + 1 HW, W_6= Pretilachlor + 1 HW and

S_1 = 20 cm x 10 cm, S_2 = 25 cm x 15 cm, S_3 = 30 cm x 20 cm

Table 3. Interaction effect of different weed management and spacing on different growth attributes of transplanted aman rice

Treatment	Total dry matter (g $hill^{-1}$)					CGR (g $hill^{-1}$ day^{-1})			
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	15-30 DAT	30-45 DAT	45-60 DAT	60-75 DAT
W_1 S_1	2.16	4.36	6.90	16.07	15.71	0.146	0.170	0.610	0.024
W_1 S_2	2.41	4.88	9.66	20.53	18.90	0.165	0.318	0.730	0.109
W_1 S_3	2.82	4.45	7.75	19.41	18.17	0.109	0.220	0.780	0.083
W_2 S_1	2.86	5.44	9.49	19.68	17.94	0.172	0.270	0.680	0.120
W_2 S_2	2.88	5.82	12.66	24.91	22.79	0.196	0.456	0.800	0.120
W_2 S_3	3.43	5.99	14.77	24.47	23.25	0.171	0.585	0.640	0.078
W_3 S_1	3.26	5.21	8.92	20.12	19.18	0.130	0.2473	0.750	0.060
W_3 S_2	3.35	5.64	13.41	23.83	22.35	0.153	0.518	0.690	0.100
W_3 S_3	3.24	8.16	15.95	26.33	24.65	0.328	0.519	0.690	0.110
W_4 S_1	3.51	5.99	9.63	21.01	20.64	0.165	0.243	0.760	0.030
W_4 S_2	3.11	5.69	13.41	24.79	22.68	0.172	0.514	0.760	0.140
W_4 S_3	2.85	7.09	14.10	25.56	23.41	0.282	0.467	0.760	0.140
W_5 S_1	2.69	5.73	10.57	21.59	20.15	0.203	0.323	0.730	0.100
W_5 S_2	2.66	5.51	13.50	24.35	22.67	0.190	0.533	0.720	0.110
W_5 S_3	2.86	6.74	14.15	25.82	23.54	0.258	0.500	0.780	0.150
W_6 S_1	2.84	6.95	10.65	20.55	19.67	0.274	0.247	0.660	0.060
W_6 S_2	3.24	6.31	13.42	24.71	23.80	0.205	0.474	0.750	0.060
W_6 S_3	3.30	7.24	15.76	25.60	24.17	0.263	0.568	0.660	0.110
LSD	0.99	0.93	0.92	0.67	0.55	0.091	0.074	0.074	0.091
% CV	10.04	9.46	4.64	4.9	5.47	7.96	11.52	10.37	6.66

From the above discussion, it can be concluded that weed infestation was identified as one of the major constraints of transplanted aman rice cultivation and different weed control and plant spacings had significant effect on crop growth parameters viz. plant height, tiller no. $hill^{-1}$, plant dry weight, leaf area index (LAI), and crop growth rate (CGR) at different DAT. Interaction between different weed control and plant spacings significantly influenced crop growth parameters. Among the integrated weed control, herbicidal treated plots along with one hand weeding gave better results than the other two approaches. The widest spacing (30cm x 20 cm) also gave superior result than the other two spacings. But in case of interaction effect between different weed control and plant spacings, Pretailachlor application along with one hand weeding at 25cm x 15cm plant spacing or weeding once with BRRI rice weeder along with one hand weeding at 30cm x 20cm plant spacing might be the best practice to keep weed infestation at minimum level to ensure optimum crop growth for higher yield.

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