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Effect of Transplanting date on the Growth and Yield of Aromatic Rice in Irrigated Ecosystem

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Abstract: *A field experiment was conducted at the Bangladesh Institute of Nuclear Agriculture (BINA) farm Mymensingh, Bangladesh during the irrigated ecosystem in December, 2009 to May 2010, with a view to study the performance of aromatic fine rice under different date of transplanting. The experiment was carried out with four aromatic fine rice (V_1= Chinisagar, V_2= Chiniatab, V_3= Basmati, V_4=Awnless Minicat) and three different date of transplanting (D_1=20 January, D_2=5 February, D_3=20 February). The experiment was laid out in split-plot design with three replications assigning four varieties in the main plot and the three different transplanting dates in the sub plot. Aromatic fine rice and dates of transplanting individually showed significant effect on the agronomic parameters. Among the aromatic fine rice Awnless Minicat gave the highest yield (3.10 t ha^{-1}) but that was at per with those of Basmati (1.77 t ha^{-1}). Transplantation on 20 January gave the highest grain yield (2.41 t ha^{-1}) which was at per with the transplantation on 5 February (1.99 t ha^{-1}).The result revealed that 20 January and 5 February produced highest grain yield by all the variety. In later date of transplanting 20 February produced lower grain yield.*

Key Words: *Dates of transplanting, Aromatic fine rice, Yield and Irrigated ecosystem*

I. Introduction

Bangladesh is an agro based country. Most of her economic activates depend on agriculture. Agriculture in Bangladesh is dominated by intensive rice cultivation. The humid tropical climate of this country provides an excellent habitat for rice culture. It is the principal food crop of Bangladesh and constitutes 95% of food grain production in this country. Globally, rice is the second most important crop in terms of area but as food rice is important since it provides more calorie than any other cereals. Among the major rice growing countries of the world, Bangladesh ranks third in respect of growing area and fourth in rice production (Huke and Huke, 1990). In Bangladesh 70-76% of the calorie and 66% protein come from rice (Greengield and Dowling, 1998; Dey et al., 1996). The total area and production of rice in Bangladesh is about 11.65 million hectare and 33.5 million m. ton, respectively (BBS, 2011a). Although the geographical, climatic and ethnic conditions of Bangladesh are favorable for year-round rice cultivation, the national average of rice yield is rather low (2.91 ton ha^{-1}) compared to other rice growing countries (BBS, 2011b), but historically the aromatic rice has been growing in transplanted aman season due to climatic reasons and the T. aman season produces the grain yield. No effort has been made yet by the researchers to develop aromatic fine rice variety for irrigated ecosystem. Therefore, effort should be made to improve the productivity of aromatic fine rice through agronomic manipulation with suitable cultivars for irrigated ecosystem. Many researchers reported the influence of time of transplanting on the yield and yield contributing characters of rice and obtained better results from early transplanting than late transplanting (Hedayetullah et al., 1994). So, selections of right type of variety and suitable date of transplantation are also most important factors for maximizing yield. Response to planting date varies with varieties. Yield of rice also differs due to growing environment, such as different locations, seasonal fluctuations, and different dates of transplanting etc. (Sarker, 2002). Crop growth and development period may be affected by the major environmental factors such as temperature and day length (Van Heemst, 1986). Temperature, apart from day length and solar radiation, plays a vital role in rice production during later stages of crop growth. The yield of rice markedly declines with delayed planting time. However, the yield reduction is less in strongly photoperiod sensitive variety compared to weakly photoperiod sensitive one (Miah et al., 1993). Generally, yield potential of traditional photoperiod-sensitive landrace viz. Nizersail, Talosh, Patijag, Sahibalam, Abchya, Gainja etc. are low (Aditya et al., 2009). The rice economy in Bangladesh can be changed by improving production technologies of aromatic fine rice because of its high export potential, taste as well as better eating qualities. There are several special dishes like polau, khir, firney, paish, chira, khoi, briany, jurda, etc., which are prepared from this kind of milled rice. Aromatic rice varieties are rated best in quality and fetch much higher market price than non-aromatic rice. Among the rice varieties, scented or aromatic rice is popular in Asia and has gained wider acceptance in Europe and United States because of their good flavor and texture. Export of aromatic and fine rice from Bangladesh made a significant rise from 1100 tons in 2002 to 3300 tons in 2003, but the volume is still far below the potential demand of 4 million Bangladeshi living abroad. The export destinations are Middle-East countries, Malaysia, Korea, Japan, Australia, U.S.A, Canada, U.K., Italy and Sweden. The demand of aromatic rice for internal consumption and also for export is increasing day by day (Das and Baqui, 2000). Farmer's prefer to grow photoperiod-sensitive rice varieties because of their timely flowering. So, the present specie of work was under taken to study the performance of aromatic fine rice varieties under different dates of transplanting in irrigated ecosystem of Bangladesh.

II. Materials and Methods

The experiment was conducted at the Bangladesh Institute of Nuclear Agriculture (BINA) farm Mymensingh, Bangladesh, during December, 2009 to May, 2010 in the irrigated ecosystem (Boro season). The experimental land was sandy loam in texture having soil pH 6.8. The unit plot size was 4.0 m x 3.0 m. The experiment was laid out in split-plot design with three replications assigning variety in the main plot and the date of transplanting in the sub plot. The experiment was carried out with four aromatic fine rice (V_1= Chinisagar, V_2= Chiniatab, V_3= Basmati, V_4=Awnless Minicat) and three different date of transplanting (D_1=20 January, D_2=5 February, D_3=20 February). The plots of aromatic fine rice were fertilized with N, P, K, S, and Zn at the rate of 135, 39, 67, 29 and 1.8 kg ha^{-1}, respectively according to the Fertilizer Recommendation Guide (BARC, 2005). The whole amounts of triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied to the soil at the time of final land preparation. Urea was applied in three equal splits. One split of urea was applied with other fertilizers as basal dose and the other two splits were applied at 21 and 45 days after transplanting (DAT). The average value of monthly maximum temperatures during the period of December,2009, to May, 2010 was 20.61^{o}C, 19.19^{o}C, 22.0^{o}C, 24.94^{o}C, 28.29^{o}C and 28.20^{o}C, respectively.). The average value of monthly maximum total rainfall during the period of December, 2009, to May, 2010 was 00.00(cm), Trce, Trce, 1.81(cm), 4.9(cm) and 27.56(cm), respectively. A common procedure was followed in raising of seedling in seed bed. Seedlings of forty-five days old were uprooted from the nursery beds carefully. Only selected healthy seedlings were transplanted in the experimental plots on 20 January, 5 February and 20 February 2010 in 20 cm apart line maintaining a distance of 15 cm from hill to hill with two seedlings hill^{-1}. Intercultural operations weeding, pesticide and irrigation etc. application were done as and when necessary. From each plot, 10 hills (excluding border hills) were selected from the inside rows for collecting different data at 30 DAT, 60 DAT and 90 DAT. Each plant sample was separated from leaf as their area was measured with the help of a protable leaf area meter (Model Fx-3000 Japan). Just after transplanting 10 hills were randomly selected and tagged for measuring plant height, total dry matter production and chlorophyll contents of leaf, Chlorophyll content of leaves were determined with SPAD meter. During harvest 10 hills were again randomly selected from each plot excluding border hills and data on yield contributing characters were collected. Grain and straw were sun dried for having the yield (t ha^{-1}) and the weight of grains was adjusted to 12% moisture content. Data were analyzed statistically using "Analysis of Variance" technique and differences among treatments means were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

III. Results and Discussion

Effect of growth parameters: At 30 DAT, the highest plant (53.8cm) was observed in V_1 while the lowest plant height (46.8cm) was in V_3. At 60 DAT the highest plant height (79.1cm) was recorded in V_1 and the lowest (63.4 cm) was found in V_3. The highest plant height (97.3cm) was in V_1 and the lowest (79.0 cm) was in V_3 at 90 DAT (Table 1). The tallest plant at all the sampling was obtained from D_1 applied plots (Table 1) except D_3. However, results revealed that at 30 DAT, the tallest (56.3cm) was recorded in $V_4 \times D_1$ and the shortest plant height (42.0 cm) was in $V_3 \times D_3$ and $V_4 \times D_3$. At 60 DAT, the tallest plant (83cm) was found in $V_1 \times D_1$ and the shortest plant height (61.3cm) was recorded in $V_3 \times D_3$. At 90 DAT, the tallest plant (99.6cm) was recorded in $V_4 \times D_3$ and the shortest plant height (81.0) was recorded in $V_3 \times D_3$ (Table 1). At 30 DAT, V_4 produced highest total dry matter hill^{-1} (10.2g) and the lowest (7.4g) total dry matter hill^{-1} was produced by V_2. But V_4 produced the highest total dry matter hill^{-1} (12.9g) at 60 DAT and V_2 produced the lowest (9.2g). At 90 DAT, V_4 also had highest total dry matter hill^{-1} (34.0g) and the lowest was in V_1 (31.8g) (Table 1) At 30 DAT, the highest total dry matter hill^{-1} (8.8g) was observed in D_3 date of transplanting applied plots and the lowest (7.4g) was found in D_1 date of transplanting applied plots. At 60 DAT, the highest total dry matter hill^{-1} (11.3g) was found in D_3 date of transplanting. The lowest (9.9g) was recorded in D_1 date of transplanting applied plots. At 90 DAT, the highest total dry matter hill^{-1} (34.1g) was observed in D_2 date of transplanting applied plots and the lowest (31.9g) was found in 20 February date of transplanting applied plots (Table 1). At 30 DAT, the highest total dry matter (11.1g) was observed in $V_4 \times D_3$ date of transplanting and the lowest (4.6g) was observed in $V_2 \times D_2$ date of transplanting. At 60 DAT, the maximum and minimum total dry matter hill^{-1} were 14.6g and 8.8g respectively, observed in the varieties $V_4 \times D_3$ date of transplanting and $V_3 \times D_1$ date of transplanting. At 90 DAT, the highest total dry matter hill^{-1} was observed in $V_4 \times D_3$ date of transplanting (33.3 g) and the lowest (20.6g) was recorded in $V_1 \times D_1$ date of transplanting (Table 1). At 30 DAT, the highest Chlorophyll content leaf^{-1} (36.9 SPAD value) was observed V_4 while the lowest Chlorophyll content leaf^{-1} (38.0 SPAD value) was in V_2. At 60 DAT the highest Chlorophyll content leaf^{-1} (37.0 SPAD value) was in V_2 and the lowest Chlorophyll contain leaf^{-1} (36.7 SPAD value) was found in V_1. The highest Chlorophyll content leaf^{-1} (33.3 SPAD value) was in V_3 and the lowest (31.8 SPAD value) was in V_1 at 90 DAT (Fig. 1). Chlorophyll content leaf^{-1} (36.4 SPAD value) was obtained from D_3 date of transplanting applied plots at 30 DAT. At 30 DAT, the lowest Chlorophyll content leaf^{-1} (34.2 SPAD value) was found in D_1 date of transplanting. At 60 DAT, the highest Chlorophyll content leaf^{-1} (39.3 SPAD value) was found in D_2 date of transplanting. The lowest Chlorophyll content leaf^{-1} (35.1 SPAD value) was recorded in D_1 date of transplanting applied plots. At 90 DAT, the highest Chlorophyll content leaf^{-1} (34.1 SPAD value) was observed in D_2 date of transplanting applied plots and the lowest Chlorophyll content leaf^{-1} (31.9 SPAD value) was found in D_3 date of transplanting applied plots (Fig.2). At 30 DAT, V_1 produced highest leaf area hill^{-1} (338.9cm^2) and the lowest (272.7 cm^2) was produced by V_2, which was statistically identical to $V_1$and V_3. But V_1 produced the highest leaf area hill^{-1} (1675.5 cm^2) at 60 DAT and V_3 produced the lowest (1197.6 cm^2). At 90 DAT. V_4 also had highest leaf area hill^{-1} (777.6 cm^2) and the lowest was in V_1 (679.9cm^2) (Table 1).). From Table 1, it could be seen that at 30 DAT, the highest total leaf area (301.0 cm^2) was produced by D_1 date of transplanting and the lowest leaf area hill^{-1} (275.0 cm^2) produced by D_2 date of transplanting which, was statistically identical to D_3 date of transplanting. At 60 DAT, the highest Leaf area hill^{-1} (1564.9 cm^2) was found in D_1 date of transplanting and the lowest (1270.5 cm^2) was observed in D_3 date of transplanting. At 90 DAT, leaf area was the highest (821.6 cm^2) and the lowest (696.0 cm^2) followed by D_1 date of transplanting and D_2 date of transplanting (Table 1).It was observed that at 30 DAT, the highest leaf area hill^{-1} was (459.0 cm^2) produced $V_1 \times D_1$ date of transplanting. The lowest leaf area hill^{-1} (221.6 cm^2) was found in $V_2 \times D_1$ date of transplanting. At 60 DAT, the highest leaf area hill^{-1} (2489.3 cm^2) was found in $V_1 \times D_1$ date of transplanting. The lowest leaf area hill^{-1} (1042.3 cm^2) was recorded in $V_3 \times D_2$ date of transplanting. At 90 DAT, the highest leaf area hill^{-1} (885.7 cm^2) was observed in $V_2 \times D_1$ date of transplanting. The lowest leaf area hill^{-1} (586.9 cm^2) was recorded in $V_3 \times D_2$ date of transplanting (Table1).

Table 1: Varieties, date of transplanting and combined effect on the growth of aromatic fine rice varieties in irrigated ecosystem

Treatments	Plant height(cm)			TDM(g) hill^{-1}			Leaf area hill^{-1}		
Variety	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT
V_1	53.8	79.1	97.3	7.6	11.1	24.9	338.9	1675.5	679.9
V_2	49.7	67.8	88.0	7.4	9.2	26.5	242.7	1269.9	771.4
V_3	46.8	63.4	79.0	7.5	9.6	27.4	246.6	1197.6	714.7
V_4	51.0	72.3	91.6	10.2	12.9	30.0	305.5	1644.2	777.6
$LSD_{0.05}$	2.36	10.61	6.533	1.633	2.108	3.347	NS	NS	NS
Date of transplanting									
D_1	53.0	75.0	88.9	7.4	9.9	24.2	301.0	1564.9	821.6
D_2	45.4	66.8	83.9	8.3	10.8	26.4	275.0	1430.1	636.0
D_3	52.7	70.0	94.1	8.8	11.3	31.0	275.3	1270.5	750.2
$LSD_{0.05}$	3.451	7.486	5.443	1.252	0.984	1.594	NS	NS	NS
CV(%)	5.74	8.88	5.13	12.74	7.65	6.76	47.74	29.85	27.59
Interaction (V x D)									
V_1D_1	53.0	83.0	97.3	5.8	10.0	20.6	459.0	2489.3	660.0
V_1D_2	53.3	78.0	95.3	8.2	11.3	24.0	275.3	1265.4	649.3
V_1D_3	55.3	76.3	99.3	8.8	12.1	30.3	285.2	1272.0	730.5
V_2D_1	54.0	71.6	87.3	7.4	9.0	22.9	221.6	1158.1	885.7
V_2D_2	44.3	65.3	81.0	4.6	9.7	25.0	234.0	1168.3	639.1
V_2D_3	51.0	66.6	95.6	7.2	9.0	31.0	272.6	1183.4	789.6
V_3D_1	48.6	62.6	77.6	7.1	8.8	26.3	224.6	1042.3	827.6
V_3D_2	42.0	62.3	77.6	7.3	9.6	27.0	265.6	1457.3	586.9
V_3D_3	50.0	61.3	82.0	8.2	10.5	29.0	249.6	1093.3	729.6
V_4D_1	56.3	83.6	93.6	9.4	11.6	27.0	299.0	1570.0	913.3
V_4D_2	42.0	62.6	81.6	10.1	12.6	29.6	325.0	1829.3	668.7
V_4D_3	54.6	70.6	99.6	11.1	14.6	33.3	292.6	1533.3	751.0
$LSD_{0.05}$	6.902	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	5.74	8.88	5.13	12.74	7.65	6.76	47.74	29.85	27.58

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS =Not Significant.

V_1=Chinisagar, V_2=Chiniatab, V_3=Basmati, V_4=Awnless Minicat

D_1=20 January, D_2=5 February, D_3=20 February

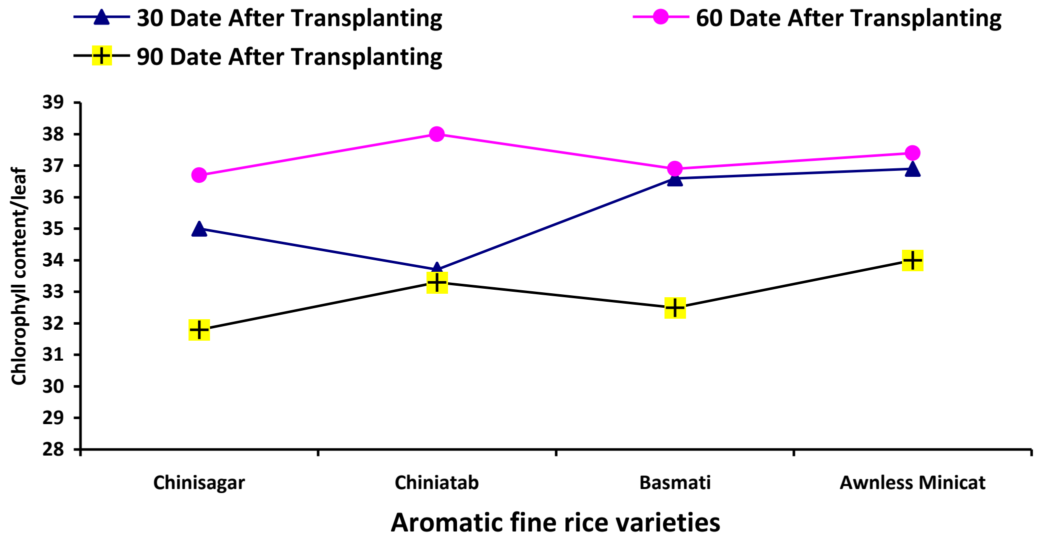

Fig.1. Effect of aromatic fine rice varieties on Chlorophyll content leaf^{-1}

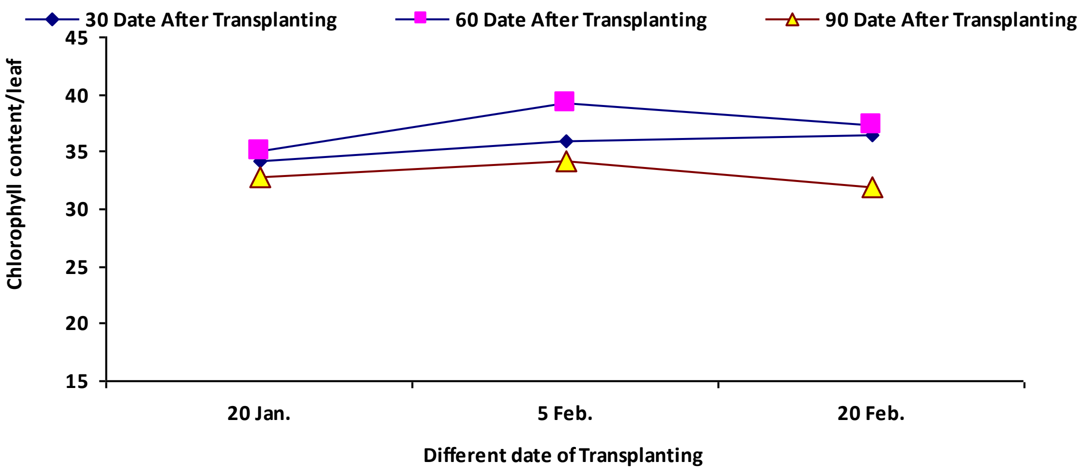

Fig.2. Effect of date of transplanting on Chlorophyll content leaf^{-1}

Effect of yield and yield contributing characters: The date revealed that the tallest plant (140.4cm) was in V_1. The shortest (85.3 cm) was obtained from V_4 (Table 2).Tallest plants (95.9cm and 95.4cm) were obtained from D_2 and D_1 date of transplanting (Table 2). Combined effect (Table 3) showed that all the four varieties produced tallest plant in the early sowing on D_1. Among the varieties, V_1 produced highest plant height (108.3 cm). On D_1 date of transplanting shortest plant (85.0cm) was produced by V_4. The highest number of effective tiller hill^{-1} was obtained from V_4 (10.26), which, was statistically identical to V_2 (Table 2). The lowest number of effective tillers hill^{-1} was found in V_1 (8.33).Early date of transplanting produced higher number of effective tillers hill^{-1} (11.42 and 8.29), which, was statistically identical (Table 2). All the varieties showed higher of effective tillers hill^{-1}(10.0, 11.10, 12.70, and 11.90) on early date of transplanting. The number of effective tillers hill^{-1} was decreased on late date of transplanting (D_2 and D_3) by all the variety. All the variety showed a decreasing trend of number of effective tillers hill^{-1} production as transplanting date was delayed (Table 3). Among the varieties, V_2 produced the highest number of non-effective tillers hill^{-1} (1.87) followed by V_1 (1.83) and V_4 (1.64). The lowest of number non-effective tillers hill^{-1} was obtained by V_3 (1.16), in early date transplanting, higher number of non-effective tillers hill^{-1} (1.75 and 1.58) (Table 2). The highest number of non-effective tillers hill^{-1} (2.6) was found in V_1 respectively transplanting on D_1. The variety V_3 produced number of non-effective tillers hill^{-1} (1.0) transplanting on D_2 (Table 3).

Table 2: Effect of variety and date of transplanting on the yield and yield contributing characters of aromatic fine rice in irrigated ecosystem

Variety	Plant height (cm)	Effective tillers hill^{-1} (No.)	Non-effective tillers hill^{-1} (No.)	Grains panicle^{-1} (No.)	Unfilled spikelets panicle^{-1} (No.)	1000-grain wt (g)	Grain yield (tha^{-1})	Straw yield (tha^{-1})	Harvest index (%)
V_1	104.4	8.33	1.83	116.88	37.6	10.53	1.48	4.62	24.26
V_2	97.4	9.63	1.87	110.10	31.4	10.73	1.53	5.13	22.97
V_3	95.0	9.40	1.16	67.98	49.8	20.45	1.77	5.02	26.06
V_4	85.3	10.26	1.64	87.44	19.0	20.87	3.10	4.98	38.36
$LSD_{0.05}$	4.717	2.925	0.2872	39.51	16.41	2.795	0.4722	0.3223	5.678
Date of transplanting									
D_1	95.4	11.42	1.75	113.39	26.8	15.72	2.41	4.86	33.14
D_2	95.9	8.92	1.58	100.14	32.6	15.84	1.99	4.99	28.51
D_3	95.3	7.87	1.55	73.27	44.00	15.38	1.50	4.95	23.25
$LSD_{0.05}$	-	2.925	NS	35.66	NS	NS	0.3132	NS	3.242
CV (%)	3.65	7.67	18.38	9.20	35.06	4.11	13.34	6.25	9.84

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS =Not Significant.
V_1=Chinisagar, V_2=Chiniatab, V_3=Basmati, V_4=Awnless Minicat
D_1=20 January, D_2=5 February, D_3=20 February

Table 3: Combined effect variety and date of transplanting on the yield and yield contributing characters of aromatic fine rice in irrigated ecosystem

Interaction (V x D)	Plant height (cm)	Effective tillers hill^{-1} (No.)	Non-effective tillers hill^{-1} (No.)	Grains panicle^{-1} (No.)	Unfilled spikelets panicle^{-1} (No.)	1000-grain wt (g)	Straw yield (tha^{-1})	Harvest index (%)
V_1D_1	108.3	10.00	2.60	140.60	23.0	10.33	4.54	29.72
V_1D_2	103.0	8.00	1.30	119.63	30.0	10.80	4.53	23.99
V_1D_3	102.0	7.00	1.60	90.43	60.0	10.47	4.80	18.64
V_2D_1	92.8	11.10	1.30	124.0	21.6	10.53	5.03	28.24
V_2D_2	98.0	9.60	1.90	120.60	34.0	11.00	5.27	23.51
V_2D_3	101.3	8.20	2.40	85.66	38.6	10.67	5.10	16.39
V_3D_1	95.5	12.70	1.40	94.30	35.3	21.00	4.87	34.63
V_3D_2	95.6	8.10	1.00	71.00	51.6	20.36	5.20	22.50
V_3D_3	94.0	7.40	1.10	38.66	62.6	20.00	5.00	19.61
V_4D_1	85.0	11.90	1.70	94.66	27.3	21.03	5.00	38.72
V_4D_2	87.0	10.00	2.10	89.33	15.0	21.20	4.96	40.66
V_4D_3	84.0	8.90	1.10	78.33	14.6	20.40	4.93	35.21
$LSD_{0.05}$	5.976	1.298	0.6994	15.23	20.75	NS	NS	6.483
CV(%)	3.65	7.67	18.38	9.20	35.06	4.11	6.25	9.84

In a column, figures with same letters or without letters do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT. NS = Not Significant.
V_1=Chinisagar, V_2=Chiniatab, V_3=Basmati, V_4=Awnless Minicat
D_1=20 January, D_2=5 February, D_3=20 February

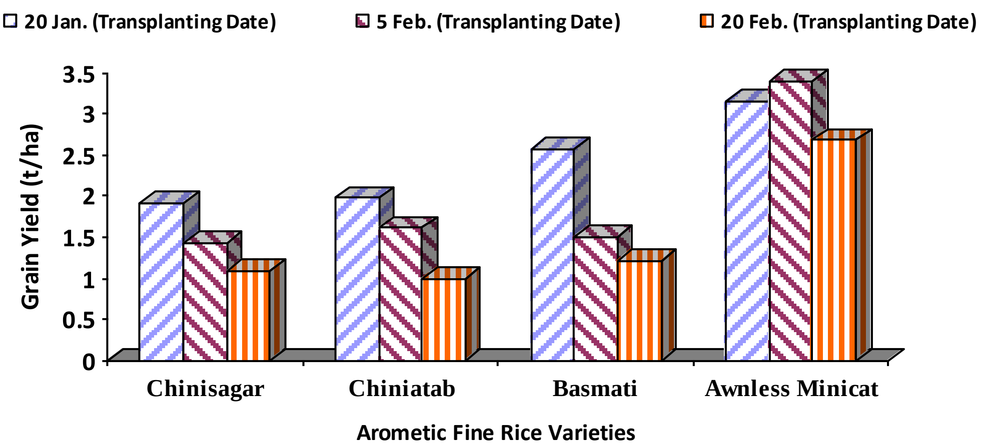

Fig.3. Combined effect of variety and date of transplanting on the grain yield of aromatic fine rice in irrigated ecosystem

Among the varieties, V_1 and V_2 produced the maximum number of grains panicle^{-1} (116.88and 110.10), which, was statistically identical, and V_3 produced the lowest number of grains paniele^{-1} (67.98). Early date of transplanting produced higher number of grains panicle^{-1} (113.39 and 100.14), which, was statistically identical (Table 2).Combined effect showed higher number of grains panielc^{-1} (140.60, 124.0, 94.30 and 94.66) which, were produced by V_1, V_2, V_3 and V_4 transplanting on D_1 respectively. The number of filled grains panicle^{-1} was decreased on late transplanting (D_2 and D_3) by all varieties (Table 3). Among the varieties, results revealed that V_3 produced the highest unfilled spikelets panicle^{-1} (49.8). The lowest unfilled spikelets panicle^{-1} was recorded in V_4 (19.0) (Table 2). In late transplanting, highest number of unfilled spikelets panicle^{-1} (44.0) and second highest number of unfilled spikelets panicle^{-1} (32.6) was produced by D_3 and D_2 respectively. The lowest unfilled spikelets panicle^{-1} was obtained by D_1 (26.8). Highest number of unfilled spikelets panicle^{-1} (62.6) was found in V_3 respectively in D_3 date of transplanting (Table2). In D_3 date of transplanting, the lowest (14.6) number of unfilled spikelets panicle^{-1} was produced by the variety V_4 (Table 2). The lowest unfilled spikelets panicle^{-1} was obtained by D_1 (26.8). Highest number of unfilled spikelets panicle^{-1} (62.6) was found in Basmati respectively in D_3 date of transplanting (Table3).

In D_3 date of transplanting, the lowest (14.6) number of unfilled spikelets panicle^{-1} was produced by the variety V_4 (Table 2).Varieties differed significantly among themselves in respect of their weights of 1000 grains. V_4 ranked first (20.87g) in respect of 1000- grains weight followed by V_3. The lowest (10.53g) was produced by V_1 (Table 2). These differences in 1000 grains weight were in agreement with the results reported by Shamsuddin et al. (1988) who recorded differences in 1000- grains weight among nine varieties Chowdhury et al. (1993) also reported the similar results. Table 2 showed that transplanting on D_1, D_2 and D_3 identical weight of grain was produced (15.72g, 15.84g and 15.38g). Combined effect showed (Table 3) that transplanting on D_2 more weight seeds were produced by the three varieties except $V_3 \times D_1$.The mean yield of different varieties showed that the highest grain yield (3.10 t ha^{-1}) was found in V_4 while the lowest grain yield (1.48 t ha^{-1}) was obtained from V_1 (Table 2). It was observed from (Table 2) that the highest grain yield was obtained in D_1 and D_2 (2.41 t ha^{-1} and 1.99 t ha^{-1}) which, was statistically identical. Transplanted D_3 produced lowest grain yield (1.50 t ha^{-1}). Combined effect showed (Fig. 3) that transplanting on D_1 and D_2 produced highest grain yield by all the variety. In later date transplanting on (D_3) production of grain yield was decreased.

V_2 produced the highest straw yield (5.13 t ha^{-1}), which, was statically identical to V_3 and V_4. The lowest straw yield (4.62 t ha^{-1}) was found in V_2. The highest straw yield (Table 2) obtained transplanting on D_2 (4.99 t ha^{-1}) was identical to D_1 (4.86 t ha^{-1}), and D_3 (4.95 t ha^{-1}). The highest straw yield (5.27 t ha^{-1}) was obtained in D_2 transplanting by V_3. Among the varieties V_1 produced the lowest straw yield transplanting date on D_2 (4.53 t ha^{-1}) (Table 3). Among the varieties, V_4 produced (Table 2) the highest harvest index (38.36%) followed by V_3 (26.06%), V_2 (22.97%) and V_1 (24.26%) (Table 2). Harvest index of all the crops was greatly influenced by transplanting date. The highest harvest index was obtained from early transplanting (33.14%) and significantly reduced in the later transplanting date (28.5% and 23.25%) (table5b) Harvest index of all the varieties showed a decreasing trend in delay of transplanting. The highest harvest index (40.66%) was found in V_4 transplanted on D_2 and the lowest harvest index (16.39%) was recorded from V_2 transplanted on D_3 (Table3).

IV. Conclusion

It could be concluded that Chiniatab, Basmati and Awnless Minicat of the study performed better in most of the evaluating trails like grain yield, straw yield, number of effective tillers hill^{-1} and number of grains panicle^{-1}. However date of transplanting on 20 January and 5 February gave more grain yield, more number of effective tillers hill^{-1}, more number of grains panicle^{-1}and ultimately produced highest grain yield. Among the combination of aromatic fine rice Chiniatab, Basmati and Awnless Minicat produced higher grain yield at date of transplanting in 20 January and 5 February. So, Awnless Minicat, Basmati and Chiniatab with date of transplanting in 20 January and 5 February can be suggested as profitable growing in irrigated ecosystem of Bangladesh.

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