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Effect of sowing time on growth and yield attributes of three mustard cultivars grown in Tidal Floodplain of Bangladesh

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Abstract

The experiment was conducted at the field laboratory of the Patuakhali Science and Technology University, Patuakhali, Bangladesh during the period from November, 2011 to March 2012 under the tidal Floodplain region to find out optimum sowing time for the selected three cultivars (BARI Sharisha-15, BINA Sharisha-5 and BARI Sharisha-9). There were four sowing dates viz. 30 November, 15 December, 30 December and 15 January. Significant variations due to different sowing dates were observed in plant height, total dry matter, leaf area index, number of siliqua plant^{-1}, seeds silique^{-1}, 1000-grain weight, grain yield and HI. Results showed that the highest grain yield (1.73 t ha^{-1}) was obtained from the first sowing (30 November) with BINA Sharisha-5 and it was significantly different from the yields of all other combination.

Keyword: Floodplain, Growth attributes, Mustard, Sowing time, Yield

Introduction

Oilseed rape (*Brassica napus*L.) has become one of the most important oil crops (Miri, 2007) and at present, is the third largest source of vegetable oil all over the world (Starner *et al*., 1999). In Bangladesh context, mustard (*Brassica spp*.) is a popular edible oil in rural area and is considered important for improving the taste of a number of food items (Aziz *et al*., 2011a). Bangladesh is principally an agricultural country and produces a good number of oilseed crops like mustard, sesame, groundnut, linseed, safflower, sunflower, soybean, castor etc. The first three of these are considered as the major oil seed crops. Mustard and rapeseed are quietly significant in Bangladesh economy. It is an important and the top ranking oil seed crop in Bangladesh. Rapeseed (*Brassica campestris* L.) commonly known as mustard oil seed crop in Bangladesh, is a cool season crop. It is also a thermo sensitive as well as photosensitive crop (Ghosh and Chatterjee, 1988). It also serves as an important raw material for industrial use such as in soap, paints, varnishes, hair oils, lubricants, textile auxiliaries, pharmaceuticals, etc. Its oil not only plays a great role as fat substitute in our daily diet but also nourish the economy of the nation. It is widely used as a cooking ingredient, condiment and for its medicinal value. Moreover, mustard oil cake is utilized as cattle feed and small quantities are also used as manure. It accounts about 72% of total oilseed production in the country. The area under rapeseed and mustard is 0.30 million hectares which is about 80% of the total oilseed area (Anonymous, 2003). Last ten years have witnessed gradual decline in an area of 104 thousand hectare and production 68 thousand tons of mustard and rapeseed (Anonymous, 2006). Though the production of edible oil is being decreased, whereas, the demand is increasing day by day with the increasing population. The present domestic edible oilseed production is 267 thousand tons which meets only one third of national demand (Anonymous, 2006).Finally 2010, the total rapeseed harvested area 598000 ha and yield 371 kg acre^{-1} and the production quantity 222000 tons in Bangladesh (BBS, 2011). Cultivation of low yielder local varieties late sowing are the major causes for poor yield of mustard in the country (Alam and Rahman, 2006). High yield potential of a variety is the prerequisite for increasing the production of a crop. In the recent years, Bangladesh Agricultural Research Institute (BARI) & BINA has developed a number of high yielding varieties of mustard with yield potential up to 2.5 t ha^{-1}. The present national average yield of mustard is only 0.79 t ha^{-1} (Anonymous, 2006). Genotypes play an important role in crop production and the potential yield of a genotype within the genetic limit is determined by its environment (Iraddi, 2008). The release of high yielding varieties has contributed a great deal towards the improvement of Mustard yields. The yield potential of these high yielding varieties can be further exploited through better agronomic practices involving many physiological changes. Delayed planting, inappropriate weather conditions in tidal floodplain region during the flowering period, fertilization and pod formation can cause a decrease in duration of maturity period, affect the number of pods per plant, affect the number and weight of grains and finally can lead to decrease in grain yield (Rahnama and Bakhshandeh, 2005). The present study was undertaken to identify suitable genotype with standard sowing time for increase mustard production and expansion of cultivation area in tidal floodplain region of Bangladesh.

Materials and Methods

A field experiment was conducted at the Field Laboratory of the Patuakhali Science and Technology University, Patuakhali, Bangladesh during the period from November, 2011 to March 2012 under the tidal Floodplain region. Geographically, the research farm is located at 22^{o} 37′ N latitude and 89^{o} 10′ E longitudes. The area is covered Gangetic Tidal Floodplains and falls under Agro-ecological Zone "AEZ-13".Soil characteristics of the southern part of the research farm are clay loams. However, the soil of the experimental field was silty caly loam having pH value of 7.00.Generally, Patuakhali region falls under the sub-tropical climate, which is characterized by high temperature and humidity, heavy rainfall with occasional gusty winds in the month of April to September (Kharif Season) and scanty rainfall during the rest period of the year (Biswas, 1987). The Rabi season (October to March) is characterized by comparatively low temperature and plenty of sunshine from November to February (SRDI, 1991).The experiment was consisted with two factors where three Mustard genotypes *viz*., BARI Sharisha-15 (V_1), BINA Sharisha-5 (V_2) and BARI Sharisha-9 (V_3) was used as a factor A and four sowing time *viz.* 30 November (T_1), 15 December (T_2), 30 December (T_3) and 15 January (T_4) were used as a factor B. The experimental design was Randomized Complete Block Design (RCBD) with three replications. The size of each unit plot was 2.0 m × 2.0 m where line to line and plant to plant distances were 10 and 6 cm, respectively, in each plot. The applied fertilizers were mixed properly with the soil in the plot using a spade. Urea (220 kg/ha), TSP (180 kg/ha), MOP (50 kg/ha) and Gypsum (120 kg/ha) (Fertilizer Recommended Guide, BARC, 1997) were used. Data were collected on plant height, Total dry matter, leaf area index, number of siliqua plant^{-1}, number of seed silique^{-1}, 1000 grains weight, and grain yield t ha^{-1}. The collected data were analyzed using computer package MSTAT and mean differences were adjudged by using Duncan's Multiple Range Test.

Table 1. Chemical and physical characteristics of soil at experimental sites

Sample	Phosphorus (ppm)	Potassium (me 100g^{-1})	Sulphur (ppm)	pH	Salinity (ds m^{-1})	Organic Matter	Total N (%)
Soil	16.1	0.30	10.8	7.0	0.65	1.53	0.077
Water	-	-	-	7.3	0.56	-	-

Results and Discussion

Plant height: The effect of different cultivars with sowing time on mustard plant height was measured from 30 DAS until harvest at 15 days interval and the results presented in Table 2. The plant height was significantly higher in all cultivars with 30 November sowing at all the stages. The highest plant height was 112.6 cm found in BINA Sharisha–5 with 30 November sowing and the lowest (93.8 cm) in BARI Sharisha-9 with 15 January sowing at final harvest. Plant height is one of the most important growth contributing characters for any corps which would be related on several factors like genetic makeup, nutrient availability, environmental or climatic condition, soil characteristics, regional adaptability etc. Similar findings were also obtained by Umeh *et al*. (2011). Mahmud Abadi *et al*. (2008) studied the various types of autumnal canola in the region of Bojnoord. They reported that delay (from September 30th to October 26th) in planting the most of its types, leads to a decrease in the plant height and biological performance. These results revealed that the high yielding mustard genotype noticed the higher growth in early sowing.

Total dry matter (TDM): The cumulative accumulation of total dry matter (TDM) of different parts at various stages of growth is presented in Fig. 1 and Table 3. The initial smaller accumulation of TDM linearly increased up to about maturity in most all the treatments. All the cultivars increased the TDM accumulation with 30 November sowing in all the growth stages but maximum DM accumulation was (21.63g plant¯1)found in BARI Sharisha-9 plants treated with 30 November sowing. Hokmalipour *et al*. (2011) observed the similar results with the present study where the total dry matter was affected significantly by canola cultivars and sowing date. The highest quantities of total dry matter were obtained in the first sowing date. So, we can suggest using the first sowing date. Total dry matter was significantly influenced by the combined effect between mustard genotypes and sowing time at different days after sowing (Table 3).

Table 2. Effect of sowing time on plant height at different days after sowing (DAS)in 3 mustard cvs

Genotypes	Sowing time	Plant height (cm) at different DAS				
		30	45	60	75	Harvest
BARI Sharisha-15	30 Nov	36.27 e	59.26 e	76.28 e	94.25 e	99.29 e
	15 Dec	36.00 ef	59.00 e	75.98 e	94.01 e	99.00 ef
	30 Dec	35.11 fg	58.11 ef	75.44 ef	93.12 f	98.12 fg
	15 Jan	34.71 g	57.71 f	74.72 f	92.72 f	97.73 g
BINA Sharisha-5	30 Nov	42.58 a	67.58 a	89.58 a	107.6 a	112.6 a
	15 Dec	41.27 b	66.27 b	88.27 b	106.3 b	111.3 b
	30 Dec	39.99 c	64.66 c	86.67 c	104.7 c	109.7 c
	15 Jan	38.43 d	63.44 d	85.43 d	103.4 d	108.4 d
BARI Sharisha-9	30 Nov	34.42 g	57.42 f	74.43 f	92.43 f	97.76 g
	15 Dec	32.44 h	55.45 g	72.46 g	90.44 g	95.46 h
	30 Dec	31.54 i	54.54 gh	71.54 gh	89.56 h	94.54 hi
	15 Jan	30.77 i	53.77 h	70.77 h	88.78 h	93.78 i
$LSD_{0.05}$		0.9008	1.100	1.121	0.8295	1.033
Level of sig.		0.01	0.05	0.05	0.01	0.01
CV%		1.47	1.09	0.84	0.51	0.60

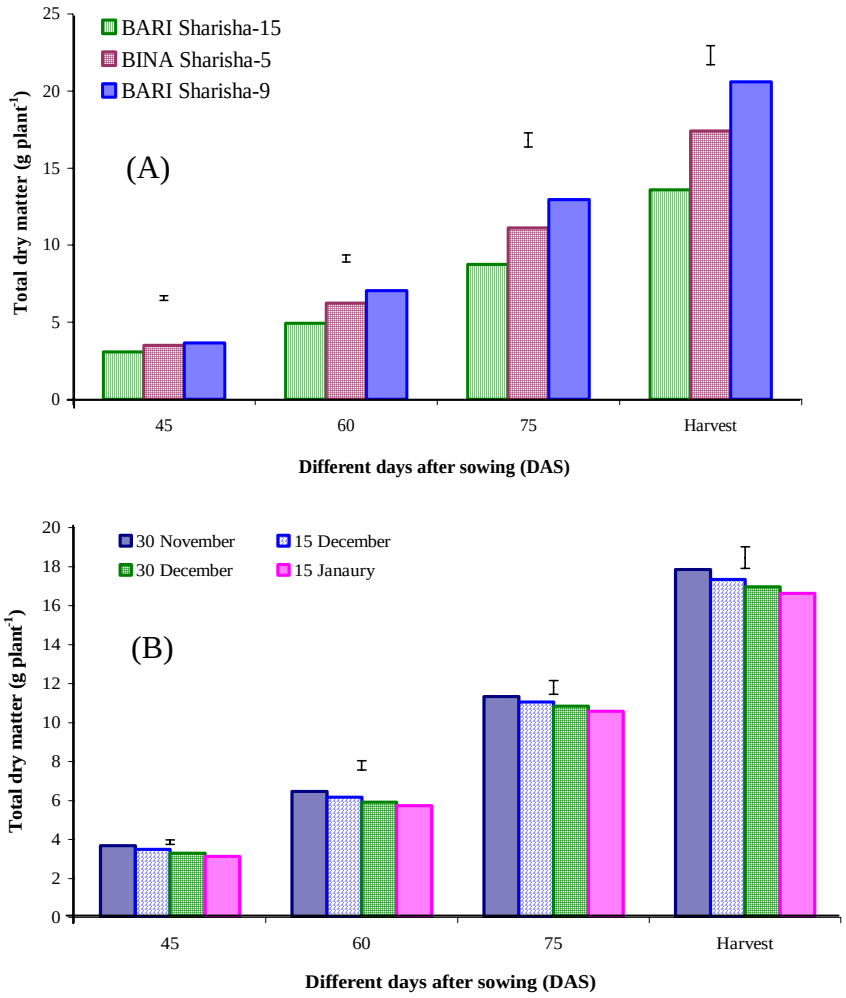

Fig.1. Effect of mustard genotypes (A) and sowing time (B) on total dry matter at different days after sowing. Vertical bars represent LSD at 5% level of probability

Table 3. Effect of sowing time on total dry matter (TDM) at different days after sowing in 3 mustard cultivars

Genotypes	Sowing time	TDM (g plant^{-1}) at different DAS			
		45	60	75	Harvest
BARI Sharisha-15	30 Nov	3.310 de	5.167 f	9.120 e	14.16 d
	15 Dec	3.143 ef	5.003 fg	8.860 ef	13.71 d
	30 Dec	2.973 fg	4.850 fg	8.647 fg	13.47 d
	15 Jan	2.800 g	4.677 g	8.377 g	13.00 d
BINA Sharisha-5	30 Nov	3.710 bc	6.583 cd	11.36 d	17.76 c
	15 Dec	3.517 cd	6.327 de	11.18 d	17.31 c
	30 Dec	3.430 cde	6.083 e	11.05 d	17.11 c
	15 Jan	3.310 de	5.983 e	10.93 d	17.48 c
BARI Sharisha-9	30 Nov	4.057 a	7.640 a	13.51 a	21.63 a
	15 Dec	3.803 ab	7.200 b	13.13 ab	20.99 a
	30 Dec	3.473 cd	6.800 bc	12.80 bc	20.29 ab
	15 Jan	3.300 de	6.570 cd	12.41 c	19.44 b
$LSD_{0.05}$		0.2677	0.4113	0.4148	1.280
Level of sig.		0.01	0.01	0.01	0.01
CV%		1.16	2.16	2.19	1.81

Leaf area index (LAI): The variation of leaf area index (LAI) as influenced by cultivars and sowing time has been evaluated from 45 DAS until maturity and the results are presented in Fig. 2 (A &B).The data on LAI showed that it was gradually increased up to 75 DAS and after attaining the maxima, the LAIs declined up to maturity. Among the cultivars, the LAI had maximum (1.2) in BINA Sharisha–5 at 75 DAS which significantly differed with other cultivars and the lowest LAI (0.91) was found in BARI Sharisha-9 at same stage. This variation was indicated that the different variety were different effect on LAI in case of the variation in genetic makeup and their regional adaptability in southern part of Patuakhali. Ahmed and Jabereldar (2010) were studied on growth and yield of three cultivars of cowpea (Buff, Haydoob and EienElgazal) were the local cultivar (buff) had higher LAI in case of the genetic variability. LAI data was also showed significant different among the sowing times at different days after sowing .Maximum LAI was observed (1.1) in 30 November sowing at 75 DAS which was statistically similar with 15 December sowing. These results indicated that early sowing produces the higher LAI at every stages in case of the similar results was attain for LA. Sharma, *et al*. (2006) reported that the leaf area index was maximum in the crop sown on 22nd and 29th Oct. compared to early and late sowing of 6th Oct. and 12th Nov. respectively. Panda *et al.* (2004) also reported that delayed sowing beyond 16th October reduced the leaf area index leaf (LAI) and area duration (LAD).

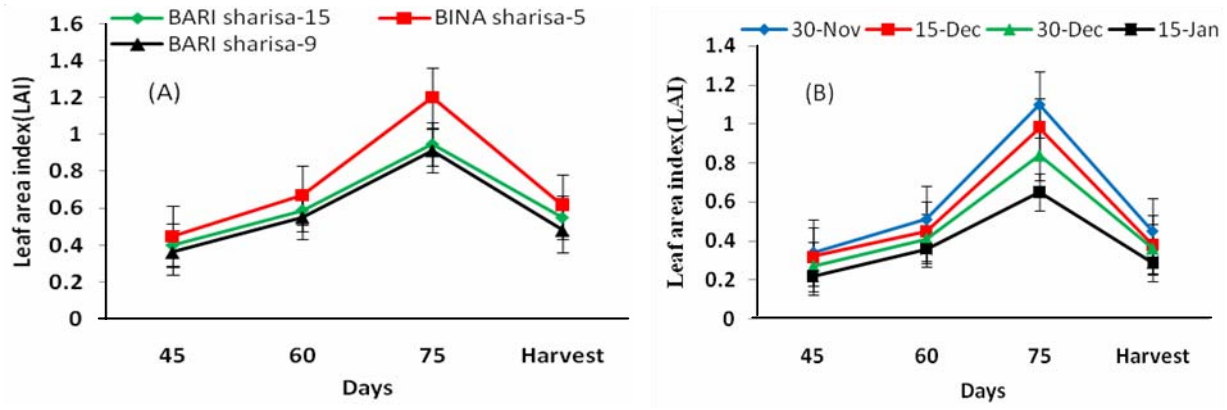

Fig. 2. Effect of mustard cultivars (A) and sowing time (B) on leaf area index at different days after sowing. Vertical bars represent LSD at 5% level of probability

Number of siliqua plant^{-1}: The maximum number of siliqua plant^{-1} (194.70) was found from the treatment combination of the variety BINA Sharisha-5 and early sowing of 30 November and the minimum was117.0 in BARI Sharisha-9 with delay sowing at 15 January (Table 4). Similar findings were also observed by Umeh *et al*. (2011). Aziz *et al*. (2011a) also reported the early planting recorded the higher number of siliqua (253.9).

Number of grainssilique^{-1}: A significant variation was also obtained with the combined effect between mustard varieties and their sowing time (Table 4). The maximum no. of seed siliqua^{-1} (22.00) was found from the variety BINA Sharisha-5 in 30 November sowing which was significantly differed with other treatment combinations. And the minimum no. of seed siliqua^{-1} was 13.00in delay sowing of BARI Sharisha-9. These results indicated that the high yield recommended variety BINA Sharisha-5 produced the maximum seed in early sowing in case of the favorable climatic condition was attained at this period. Umeh*et al*. (2011) found variation among the genotypes where number of seed in TGX 1740 produced the better results compare to Max–TGX 1440. Aziz *et al*. (2011a) found that early sowing mustard on 15 November produced the maximum seeds silique^{-1} (13.40).

Table 4. Effect of genotype and sowing time on yield characters of mustard at harvest

Genotypes	Sowing time	Number of siliqua plant^{-1}	Number of seed siliqua^{-1}	1000-seed weight (g)	Grain yield (t ha^{-1})	HI (%)
BARI	30 Nov	166.7 c	19.33 b	2.89 cd	1.56 d	32.43
Sharisha-15	15 Dec	155.0 e	18.00 bc	2.75 e	1.48 e	31.87
	30 Dec	142.0 f	15.33 def	2.59 f	1.42 ef	31.37
	15 Jan	138.0 g	14.67 efg	2.34 g	1.33 g	31.34
BINA	30 Nov	194.7 a	22.00 a	3.29 a	1.94 a	32.67
Sharisha-5	15 Dec	180.7 b	19.33 b	3.14 b	1.77 b	32.27
	30 Dec	166.0 c	16.67 cd	2.95 c	1.66 c	31.97
	15 Jan	161.3 d	15.67 de	2.78 de	1.59 cd	31.67
BARI	30 Nov	132.0 h	16.67 cd	2.49 f	1.36 fg	31.30
Sharisha-9	15 Dec	126.7 i	15.67 de	2.25 g	1.22 h	30.21
	30 Dec	120.0 j	13.67 fg	2.09 h	1.16 h	29.89
	15 Jan	117.0 k	13.00 g	1.99 h	1.08 i	29.63
$LSD_{0.05}$		3.09	0.092	0.12	0.12	0.26
Level of sig.		0.01	0.01	0.05	0.05	ns
CV%		1.22	3.34	1.50	1.50	1.75

1000–grains weight: The interaction effect of cultivars and sowing times on thousand grain weight showed significant variation at 5% level of probability are presented in Table 4.The highest weight of 1000 seeds (3.29 g) was recorded from the variety BINA Sharisha-5 in early sowing of 30 November which was significantly differed with other treatment combinations. In contrast, the lowest weight of 1000-seeds (1.99 g) was found from the variety BARI Sharisha-9 in delay sowing of 15 January which was statistically similar (2.093 g) with the same variety in 30 December sowing. Similar results were also observed by Ekram and Mahfouz (2010). early sowing mustard on 15 November produced the maximum 1000 grains weight (3.87 g) and reported by Aziz *et al*. (2011a).

Grain yield: A significant variation was observed among the combined effect of the three mustard cultivars and their sowing time in respect of grain yield (Table 4). The highest grain yield (1.94 t ha^{-1}) was recorded from the treatment combination of the variety BINA Sharisha-5 and 30 November sowing and the lowest (1.08 t ha^{-1}) in delay sowing at 15 January with BARI Sharisha-9 (Table 4). These results revealed that all the treatment combinations were showed significant variations regarding to grain yield. Besides, grain yield significantly decreased in increasing sowing time among the varieties. Wang *et al*. (2012) were studied on the impact of sowing date and historical climate where the results revealed that canola yield declined linearly with late sowing time, mainly due to shortened vegetative growth stages, and varied significantly due to inter–annual climate variability. Grain yield also had higher in first or early planting reported by Aziz *et al*. (2011a). As a result, it was found that sowing time is an important factor for seed yield and quality in rapeseed.

Harvest index: No significant variation was observed between cultivars and sowing time (Table 4). Maximum HI was found in BINA sharisha-5 with 30 November combination and the minimum in BARI Sharisha-9 with 15 January seed sowing in southern region in Bangladesh.

Correlation: Total dry matter was positive relation with plant height, no. of branch/plant, LAI, thousand seed wt., grain yield and HI are presented in Table 5.

Table 5. Correlation of total dry matter with morpho-physiological and yield component parameters

	TDM	Plant height	LAI	Thousand seed wt.	Grain Yield	HI
TDM	1	0.111NS	0.24 NS	0.33 NS	0.30 NS	0.52 NS
Plant height		1	0.88**	0.89**	0.93**	0.76**
LAI			1	0.98**	0.97**	0.91**
Thousand seed wt.				1	0.99**	0.95**
Grain Yield					1	0.93**
HI						1

Conclusion

Above the investigation it could be concluded that the maximum yield potential explored in variety BINA Sharisha-5 with30 November sowing recorded the better morph-physiological growth to compare others combination under the southern part of Patuakhali district in Bangladesh.

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