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GROWTH AND YIELD EVALUATION OF MUSTARD VARIETIES GROWN IN A MEDIUM HIGHLAND OF KHULNA REGION

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Abstract

The present research was conducted at the experimental field of Agrotechnology Discipline, Khulna University, Khulna during *Rabi* season 2016-17 to investigate the growth and yield performance of mustard varieties. The experiment was arranged in a randomized complete block design consisting of eight mustard varieties (*viz.* BARI Sarisha-8, BARI Sarisha-11, BARI Sarisha-13, BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-16, Rai and Tori-7) as treatment and replicated thrice. All the growth, yield attributes and yield were substantially influence among the mustard varieties except the phenological parameters. Results of the experiment showed that the highest plant height (131.33 cm), seed yield (1813.33 kg ha⁻¹) and stover yield (3876.67 kg ha⁻¹) were found in BARI Sarisha-16. BARI Sarisha-11 was found better in respect of maximum siliqua plant⁻¹, weight of seeds plant⁻¹, 1000-seed weight and harvest index. Besides this, BARI Sarisha-14 showed the maximum number of seeds siliqua⁻¹. Therefore, findings of this study suggested that BARI Sarisha-16 would be suitable for better productivity and recommended for cultivation in the medium highland of Khulna region of Bangladesh.

Keywords: Mustard, Varieties, Southwestern Bangladesh, Growth and Yield

Introduction

Mustard is one the most vital oil seed crop next to soybean throughout the world (FAO, 2014). Among the oil seed crops grown in Bangladesh, mustard is considered as the principal oil seed crop which belongs to the genus *Brassica* of the family Cruciferae. It is well adapted to all agro-climatic zones of the country and is grown in *Rabi* season (November-March). Mustard seeds have high energy content, having 28–32% oil with relatively high protein content (28–36%) by weight, although these values can vary slightly between varieties, growing regions and crop years.

Actually mustard is covering above 69.94% of the oil cropped area and producing 38.80% of the total oil seed production in Bangladesh. Total area coverage and production of mustard in Bangladesh is 2,94,737 ha and 1,94,000 tons, respectively and rank first among the oil seed crops grown (BBS, 2013). The per capita consumption of edible oil in Bangladesh is 10-12g/day. The internal production of edible oil only meet less than one-third of the annual requirement (Mondal and Wahab, 2001). The major reasons for low yield of mustard in Bangladesh are lack of high yielding variety, appropriate population density and inadequate knowledge of sowing time, sowing methods and proper management practices (Mamun et al., 2014). There is a great scope of increasing yield of mustard by selecting appropriate high yielding varieties, soil topography, weather condition with improved management practices (Bhuiyan et al., 2011).

The area under mustard cultivation is declining in Bangladesh due to late harvesting of high yielding T. aman rice and increased cultivation of boro rice losing an area of 104 thousand hectare with a production 68 thousand tons of mustard and rapeseed in last ten years (Anon., 2006). In Khulna region of southwestern coastal Bangladesh Fallow-Fallow-T. aman is major cropping pattern and after harvest of T. aman most of the land is remains fallow due to excess soil wetness, lack of fresh irrigation water and later increase in soil salinity. Mustard is a short duration crop which can be introduced in the existing cropping pattern of this region to make a better use of the fallow land and increase the copping intensity. In southwestern region only in few areas farmers usually cultivate mustard varieties which are mainly local and low yield potential. Besides local varieties Bangladesh Agriculture Research Institute (BARI) developed a number of short duration improved mustard varieties. After harvest of T. aman there is a scope to cultivate short duration high yield mustard varieties using residual soil moisture. Therefore, the present study was carried out to evaluate the growth and yield performance of mustard varieties and screen out the suitable variety for the medium highland in Khulna region of southwestern Bangladesh.

Materials and methods

The study was carried out in the experimental field of Agrotechnology Discipline, Khulna University, Khulna during *Rabi* season (from November 2016 to February 2017). Eight released varieties of mustard namely BARI Sarisha-8, BARI Sarisha-11, BARI Sarisha-13, BARI Sarisha-14, BARI Sarisha-15 BARI Sharisha-16, Rai Sharisha and Tori-7 were used as treatments in this experiment. Seeds were collected from the Regional Agricultural Research Station (RARS), Jashore.

Land Preparation and fertilizer application

The land was prepared by ploughing and cross ploughing followed by laddering and fertilized uniformly with recommended fertilizer doses of Urea, TSP, MoP, Gypsum, Zinc Sulphate and Boric Acid at the rate of 200 kg, 150 kg, 100 kg, 150 kg, 5 kg and 10 kg ha⁻¹, respectively. One-half of the urea and full doses of others fertilizer were applied during final land preparation and properly incorporated into the soil. The remaining urea was top dressed at 30 days after emergence (DAE).

Experimental design and layout

The experiment was laid out in a randomized complete block design with three replications. The size of unit plot was 4.0 m x 2.5 m. The distance between two rows were 30 cm and plant to plant 5 cm in line sowing method with intra plot spacing 0.50 m and intra block spacing of 1.0 m.

Germination test

Germination test was performed at the laboratory before sowing the seeds in the field. Petridishes were used for laboratory test. Seeds were distributed randomly in eight petridishes. Each petridish contained 25 seeds. On an average, the germination was above 80%. Data on emergence were collected on percentage basis by using the following formula:

$$\text{Germination (\%)} = \frac{\textit{No of seed germinated}}{\textit{No of seed taken for germination}} \times 100$$

Seed sowing

Before sowing the seeds were treated with vitavax-200 @ 2.5 g/ kg seed. The seeds were placed continuously in the furrow at a depth of 3-4 cm from the soil surface after that covered the furrow and slightly pressed. Light irrigation was done immediately after sowing.

Intercultural operations

Intercultural operation such as thinning, weeding, irrigation and plant protection measure were taken as and when necessary.

Sampling and data collection

Five sample plants were selected randomly avoid the border plants and marked in each plot.

Data on the following parameters were collected, calculated and recorded:

- First seedlings emergence and duration of emergence
- First flowering and duration of flowering
- First siliqua formation and duration of siliqua formation
- Plant height (cm) at 30, 40, 50, 60 DAS and at harvest
- Number of leaves plant 1 at 30, 40, 50, 60 DAS and at harvest
- Number of siliqua plant¹
- Number of seeds siliqua⁻¹
- Weight of 1000 seeds (g)
- Seed yield (kg ha⁻¹)
- Stover yield (kg ha-1)
- Biological yield (kg ha⁻¹)
- Harvest index (%)

Harvest and post-harvest operations

Harvesting was done at full maturity when 80% of the siliqua turned yellowish in color. Harvesting was done in the morning to avoid shattering. The harvest area (1 m²) was maintained leaving the border rows from which the seed weight, stover weight and 1000 seed weight were collected after proper drying and then converted to t ha¹. Biological yield and harvest index were later calculated.

Statistical analysis

The collected data were compiled and statistically analyzed following analysis of variance (one-way ANOVA) using the MSTAT-C computer package program. Means were compared by using the Duncan's New Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984).

Results and discussion

Seedlings emergence and duration of emergence

Among the varieties there was no significant difference on first seedlings emergence and duration of seedling emergence (Fig. 1). However, visually the fastest emergence (3.3 days) was observed in BARI Sharisha-13 whereas the slowest was observed (4.7 days) in Tori-7. The duration of seedlings emergence was maximum (12.0 days) in BARI Sharisha-16 and minimum (11.3 days) was recorded from BARI Sharisha-8 and BARI Sharisa-13.

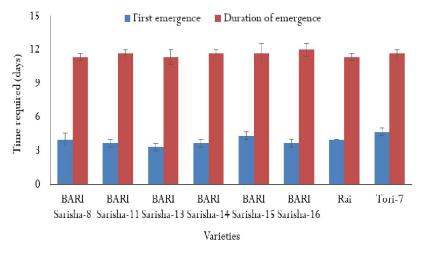


Figure 1. First seedling emergence and duration of emergence of different mustard varieties

First flowering and duration of flowering

On first flowering and duration of flowering there was no significant variation among the varieties (Fig. 2). But numerically the earliest flowering (21.7 days) was found in BARI Sharisha-11 while the late flowering was observed (27.0 days) in BARI Sharisha-13. The duration of flowering was observed maximum (8.3 days) in BARI Sharisha-13, BARI Sharisha-16, Rai and Tori-7 while minimum (7.7 days) was observed in BARI Sharisa-14.

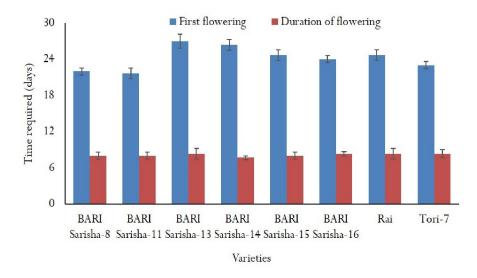


Figure 2. First flowering and duration of flowering of different mustard varieties

First siliqua formation and duration of siliqua formation

Analysis of variance showed that first siliqua formation was statistically significant but duration of siliqua formation was non-significant among the varieties (Fig. 3). The siliqua formation was earlier in BARI Sarisha-8 (26.3 days) which was statistically identical with Rai and BARI Sarisha-11 whereas siliqua formation was delayed in Tori-7 (39.3 days) which was similar to BARI Sarisha-14, BARI Sarisha-15 and BARI Sarisha-16. In BARI Sarisha-15 and Rai the duration of siliqua formation was highest whereas the lowest was observed (11.3 days) in BARI Sarisha-8, BARI Sarisha-11, BARI Sarisha-16 and Tori-7.

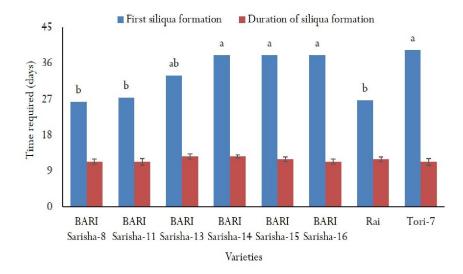


Figure 3. First siliqua formation and duration of siliqua formation of different mustard varieties

Plant height

Plant height was significantly influenced among the different varieties throughout the growing period (Table 1) and at harvest except at 50 DAS. At 30 and 40 DAS, BARI Sarisha-8 scored the tallest plant (18.60 cm & 38.33 cm) which was statistically identical with Tori-7 and Rai while the lowest was recorded from BARI Sarisha-11 (15.53 cm & 23.73 cm). At 50 DAS and at harvest, the tallest plant height was observed in BARI Sarisha-16 (118.67 cm & 131.33 cm) which was statistically identical with BARI Sarisha-11 but the lowest was found in BARI Sarisha-14 (46.00 cm & 49.40 cm) which was similar to BARI Sarisha-8. Variation of plant height was occurred due to the genetic makeup of the varieties. Akhter (2005) also found the variation of plant height among the different varieties. Similar variation of plant height among rapeseed/mustard varieties was also reported by many scientists (Ahmed et al., 2017; Roy, 2007; Zakaria and Jahan, 1997; Hossain et al., 1996). Yeasmin (2013) disagreed with this finding who reported that varietal effect was insignificant on plant height.

Table 1. Plant height (cm) and number of leaves plant-1 of different mustard varieties

Mustard varieties	Plant height (cm)			Leaf number		
	30 DAS	40 DAS	At harvest	30 DAS	40 DAS	At harvest
BARI Sarisha-8	18.60a	38.33a	54.53d	7.07	11.87a	19.00
BARI Sarisha-11	15.53b	23.73d	112.00b	6.47	8.93b	17.33
BARI Sarisha-13	16.70ab	23.80d	89.67c	6.73	10.00ab	18.33
BARI Sarisha-14	15.90ab	29.93bcd	49.40d	6.73	8.80b	17.67
BARI Sarisha-15	17.17ab	30.20bcd	74.53c	7.00	10.00ab	18.33
BARI Sarisha-16	17.00ab	27.53cd	131.33a	6.40	9.13ab	18.67
Rai	17.80ab	32.53abc	55.27d	6.80	10.33ab	19.33
Tori-7	18.47 a	35.67ab	55.90d	7.07	11.47ab	20.00
Level of significance	*	**	**	NS	**	NS
CV (%)	5.63	9.03	9.39	3.55	9.44	8.36

In a column figure having similar letter (s) do not differ significantly

CV = Co-efficient of variation, * = Significant at 5% level of level significance, ** = Significant at 1% level of significance, DAS = Days after sowing, NS = Non- significant

Number of leaves plant1

Leaf number was significantly varied among the varieties at 40 and 60 DAS (Table 1) but at 30 DAS, 50 DAS and at harvest there was no significant variation among the varieties. At 40 DAS, the maximum number of leaf was recorded from BARI Sarisha-8 (11.87) which was statistically similar to

all other varieties except BARI Sarisha-11 and BARI Sarisha-14 in which the number of leaf was minimum (8.93 and 8.80 respectively). At 60 DAS maximum leaf number was recorded at Tori-7 (18.93) which was statistically similar to all other varieties except BARI Sarisha-11 in which the number of leaves was minimum (15.47).

Number of siliqua plant1

Among the varieties number of siliqua plant¹ differed significantly (Fig. 4). Maximum number of siliqua plant¹ (130.8) was recorded in BARI Sarisha-11 which was identical to BARI Sarisha-16 while the minimum (22.8) was recorded from BARI Sarisha-14. Number of siliqua plant¹ is the result of genetic makeup of the crop and environmental conditions (Sana et al., 2003). The findings of Akhter (2005), Roy (2007) and Mamun et al. (2014) are in conformity with the results of this finding that the number of siliqua plant¹ of mustard was significantly affected by the varieties.

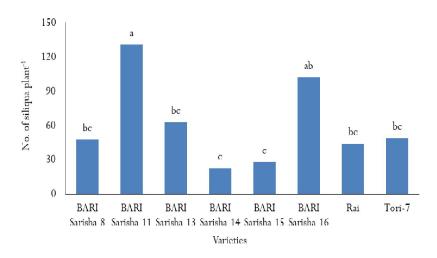


Figure 4. Number of siliqua plant¹ of different mustard varieties

Number of seeds siliqua-1

Number of seeds siliqua⁻¹ was significantly influenced due to the varietal difference (Table 2). The maximum number of seeds siliqua⁻¹ (25.90) was resulted in BARI Sarisha-14 which was on parity with BARI Sarisha-13 whereas the minimum (11.43) was recorded from Tori-7. Variation in seeds siliqua⁻¹ among the varieties was in conformity with Mamun et al. (2014), who found the highest seeds siliqua⁻¹ in BARI Sarisha-13 and the lowest seeds siliqua⁻¹ in BARI Sarisha-16 and this results are in agreement with the findings of Jahan and Zakaria (1997) and Gurjar and Chauhan (1997). But the results are in contradiction with Roy (2007) who found the highest seeds siliqua⁻¹ in improved Tori-7 and the lowest number of seeds siliqua⁻¹ in SAU Sarisha-1.

Weight of 1000 seeds

There was a significant variation among the varieties on weight of 1000 seeds (Table 2). Weight of 1000 seeds was higher (4.20 g) in BARI Sarisha-11 which was statistically at par with BARI Sarisha-13 and BARI Sarisha-8 while Tori-7 produced the lowest 1000 seed weight (1.68 g). The result of this finding was in conformity with that of Mamun et al. (2014). They also observed that BARI Sarisha-13 had the highest 1000 seed weight (4.00 g) whereas the lowest one (2.82 g) was found in SAU Sarisha-3. The 1000-seed weight is the stable part of yield and it varied from variety to variety which is in agreement with that of Mondal and Wahab (2001).

Seed yield

Analysis of variance revealed that seed yield among the varieties were differed significantly (Table 2). BARI Sarisha-16 resulted the higher seed yield (1813.33 kg ha⁻¹) while the lower (286.67 kg ha⁻¹) was obtained from Tori-7. Higher seed yield was attributed by the yield components. The results agreed

with Rahman (2002), BARI (2001), Mondal et al. (1995), Zaman et al. (1991) and Mendham et al. (1981) who reported that seed yield of rape and mustard varied with different varieties. Yeasmin (2013) also found significant varietal effect on seed yield. This findings are in conformity with the findings of Zaman et al. (1991), Chakrabarty et al. (1991) and Uddin et al. (1987) who reported that yields were different among the varieties. But the result was in contradiction with Roy (2007) and McNeilly (1987) who reported that seed yield of rapeseed and mustard was not significantly influenced by the variety.

Stover yield

Stover yield of different varieties of mustard were varied significantly (Table 2). BARI Sarisha-16 produced the highest stover yield (3876.67 kg ha⁻¹) whereas the lowest (633.33 kg ha⁻¹) was recorded from Tori-7.

Table 2. Yield and yield components of different mustard varieties

Treatments	Number of seeds siliqua ⁻¹	1000- seed weight (g)	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
BARI Sarisha-8	14.00c	3.62ab	416.67def	1086.67d	1503.33de	27.67c
BARI Sarisha-11	11.87c	4.20a	1403.33b	2713.33b	4116.67b	33.67a
BARI Sarisha-13	23.90ab	4.08ab	946.67c	1913.33c	2860.00c	33.00a
BARI Sarisha-14	25.90a	1.18de	313.33ef	893.33de	1206.67de	26.00c
BARI Sarisha-15	20.33b	2.38cd	496.67d	1273.33d	1770.00d	28.00c
BARI Sarisha-16	13.67c	3.59b	1813.33a	3876.67a	5716.67a	32.00ab
Rai	14.87c	2.61c	453.33de	1090.00d	1543.33de	29.33bc
Tori-7	11.43c	1.68e	286.67f	633.33e	1020.00e	28.33c
Level of significance	**	**	**	**	**	**
CV (%)	7.38	8.23	8.63	9.43	10.37	3.96

In a column figure having similar letter (s) do not differ significantly

CV = Co-efficient of variation, * = Significant at 5% level of level significance, ** = Significant at 1% level of significance

Biological vield

Biological yield of different varieties of mustard varied significantly (Table 2). Maximum biological yield (5716.67 kg ha⁻¹) was obtained from BARI Sarisha-16 and the minimum (1020.00 kg ha⁻¹) was obtained from Tori-7. Mamun et al. (2014) found similar results on biological yield due to varieties. But this results are in contradiction with the findings of Yeasmin (2013) who found insignificant varietal effect on biological yield.

Harvest index

Harvest index was differed significantly among the tested varieties (Table 2). BARI Sarisha-11 contributed the highest harvest index (33.67%) which was statistically at par with BARI Sarisha-13 and BARI Sarisha-16 while the lowest (26.00%) was calculated from BARI Sarisha-14. Roy (2007) also found the similar result, lowest harvest index in was found in Tori-7. Similar results were also observed by Islam et al. (1994) that harvest index varied significantly among the varieties. Yeasmin (2013) found insignificant varietal effect on harvest index.

Conclusion

The result of this study revealed that the growth, yield and yield attributes of mustard varied substantially among the tested varieties used in this experiment yet no significant variation in phenological parameters. Considering the productivity, BARI Sharisha-16 is suitable and can be recommended for cultivation in the medium highland of Khulna region of southwestern Bangladesh.

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