Research article

Ecology Journal

ISSN (Print): 2957-4471, ISSN (Online): 2708-6364, Website: https://journal.esbangladesh.org
Ecol. J. (2022) 4 (1) : 37-45

GROWTH AND YIELD PERFORMANCE OF MUSTARD VARIETIES UNDER NATURAL PEST MANAGEMENT CONDITION

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Received: 20 January 2022, Revised: 16 February 2022, Accepted: 24 February 2022

ABSTRACT

The experiment was conducted at the experimental field of the Department of Entomology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during Rabi season of 2019-20 to investigate the growth and yield performance of mustard varieties without taking insect pest and disease management approach. The experiment was arranged in a randomized complete block design consisting of seven mustard varieties, viz. BARI Sarisha-11, BARI Sarisha-12, BARI Sarisha-13, BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-16, and BARI Sarisha-17 as treatments and replicated thrice. All the growth and yield attributes including yield, substantially varied among the mustard varieties except the phenological parameters. The findings showed that varieties differed significantly in the durations of their vegetative and reproductive stages except branch initiation. The lowest duration was BARI Sarisha-12 (72.5±12.0 days) and the highest duration for crop maturity was recorded in BARI Sarisha-11 (118.3±2.0 days). There was significant variation in seed yield (t/ha) and harvesting index (HI) among the varieties but there was no statistical variation in seed yield/plot and 1000-seed and weight. BARI Sarisha-13 secured the highest seed yield (2.1±0.2 t/ha) and harvest index (HI) (34.5±1.3%), therefore this variety is recommended for cultivation for higher yield.

Keywords: Marginal pest management, *Brassica*, growth, biological yield, Harvest Index (HI).

Introduction

Mustard (*Brassica spp*.) is an important edible oilseed and income generating crop. It is the most vital oilseed crop in Bangladesh, and second largest producer next to soybean in the world (FAO 2014). 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 (Sarker *et al*. 2021). The oil is a good source of essential fatty acids (linoleic, linolenic, oleic and palmitic acid), and fat soluble vitamins A, D, E and K (Khobragade *et al*. 2008). The leaves of young plants are used as vegetable as they supply enough sulphur and mineral in the diet.

Mustard is mainly grown in winter season in Bangladesh, holds the first position in terms of area and production. It occupies an area of 336.5 thousand hectares of land and produces about 362.9 thousand metric tons of oilseeds (BBS 2017). Actually mustard is covering above 69.9% of the oil cropped area and producing 38.8% of the total oil seed production in Bangladesh. In Bangladesh, mainly three species of mustard are cultivated namely, *Brassica campestris, Brassica juncea* and *Brassica napus.*

The per capita consumption of edible oil in Bangladesh is 10-12 g/day. The oil production is low compared to our demand. The internal production of edible oil only meets less than one-third of the annual requirement (Mondal and Wahab 2001). For this reason every year a large amount of oil and oil seeds are imported in the country. Increasing production of mustard may be one of the ways to minimize demand supply gap of edible oil in the country. 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). Farmers of Bangladesh mostly cultivate this crop without proper insect pest and disease management practices. There is a great scope for increasing yield of mustard by selecting appropriate high yielding varieties, soil topography, and weather condition with improved management practices (Bhuiyan *et al*. 2011).

As a short duration crop, mustard can be introduced in the existing cropping pattern of Bangladesh after harvesting T. Aman to make a better use of the fallow land and increase the copping intensity with minimal management practices. Mustard-boro rice cultivation is also a popular croping pattern in Bangladesh. Besides local varieties, Bangladesh Agricultural Research Institute (BARI) has developed a number of short duration improved mustard varieties. Therefore, the present study was carried out to evaluate the growth and yield performance of some mustard varieties under natural condition (without taking insect pest and disease management approach).

Materials and Methods

Experimental site, duration and materials: The experiment was conducted in the experimental field of the Department of Entomology, BSMRAU, Gazipur in rabi season during November 2019 to March 2020. BARI Sarisha-11 (*Brassica juncea*), BARI Sarisha-12 (*B. campestris*), BARI Sarisha-13 (*B. napus*), BARI Sarisha-14 (*B. campestris*), BARI Sarisha-15 (*B. campestris*), BARI Sarisha-16 (*Brassica juncea*) and BARI Sarisha-17 (*B. campestris*) were used in this experiment as planting materials. The seeds of selected mustard varieties were collected from the Oilseed Division, Bangladesh Agricultural Research Institute, Gazipur, Bangladesh.

Experimental design and condition of crop cultivation: All the mustard varieties were grown in natural condition (exposed to pest infestation) following randomized complete block design (RCBD) with plot size 3.0×2.0 m^2 and three replications. The study area located to the agroecological zone of Madhupur tract (AEZ 28). The textural class of soil was mostly silty clay loam, silt loam, clay loam, silt clay and clay. The soil was highly to moderately acidic with pH 5.8-6.5.

The spacing between block to block and plot to plot was 1.0 m in both cases. Seeding was done following line sowing method where row to row distance was 30 cm, and in rows seeds were sown continuously. Seed rate of the varieties were 10 kg ha^{-1}. Seeds were placed at 2 cm depth then rows were covered with loose soil properly. Plant to plant spacing was maintained 5 cm by thinning of weak plants at 15 days after germination. Fertilizers were applied according to FRG (2012). Intercultural operations such as thinning and irrigation were provided when necessary, but no plant protection measure was taken.

Sampling and data collection: Five sample plants were selected randomly avoid the border plants and marked in each plot. Data on duration for first branch and inflorescence initiation, 50% flowering, siliqua elongation and siliqua maturity, plant height (cm), number of leaves/plant, number of primary branch at 30, 45 and 60 days after sowing (DAS) for each, leaf area (mm^2), number of inflorescences/plant, number of flower/inflorescence, number of siliqua/inflorescence number of seeds/siliqua, yield/plot (kg/ha), weight of 1000 seeds (g), biological yield (t/ha) and harvest index (%) were recorded and analyzed.

Data analysis: The data were analyzed using one-way analysis of variance (ANOVA) using IBM SPSS 21.0. (IBM SPSS statistics 21.0, Georgia, USA). The results were expressed as mean ± SE and the Tukey HSD posthoc statistic was used to test for differences among the means.

Results and Discussion

Crop duration: There was no significant variation in days required to first branch initiation among the varieties studied (Table 1). The lowest duration for first branch initiation was recorded in BARI Sarisha-12 (22.0±1.8 days) followed by BARI Sarisha-14 (23.0±0.5 days), BARI Sarisha-13 (23.3±0.8 days) and BARI Sarisha-15 (24.0±0.8 days). The highest duration for first branch initiation was recorded in BARI Sarisha-11 (27.3±0.8

Table 1. Phenology of mustard varieties grown in Gazipur region during Rabi, season 2019-20

Variety	Branch initiation	Inflorescence initiation	50% flowering	Siliqua elongation	Maturity
BARI Sarisha-11	27.3±0.8a	36.3±1.4a	48.0±2.3a	53.3±0.8a	118.3±2.0a
BARI Sarisha-12	22.0±1.8a	27.0±3.2b	34.6±4.4b	37.5±5.0b	72.5±12.0c
BARI Sarisha-13	23.3±0.8a	28.0±1.1b	37.0±1.7b	38.0±0.5b	83.6±0.8bc
BARI Sarisha-14	23.0±0.5a	28.6±1.2ab	37.0±1.7b	40.0±1.7b	84.3±1.2bc
BARI Sarisha-15	24.0±0.8a	30.0±1.1ab	40.6±0.8ab	44.3±1.4ab	83.0±1.1bc
BARI Sarisha-16	25.0±1.5a	30.0±1.1ab	42.6±0.6ab	45.0±0.5ab	105.3±1.4ab
BARI Sarisha-17	27.0±1.1a	33.3±1.4ab	43.3±0.8ab	45.6±0.8ab	89.0±2.0bc

Means within a row followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

days) followed by BARI Sarisha-17 (27.0±1.1 days) and BARI Sarisha-16 (25.0±1.5 days).

Significant variation was observed in days required to inflorescence initiation among the selected mustard varieties. The lowest duration for inflorescence initiation was recorded in BARI Sarisha-12 (27.0±3.2 days) which was statistically similar to BARI Sarisha-13 (28.0±1.1 days). The highest duration for inflorescence initiation was recorded in BARI Sarisha-11 (36.3±1.4 days) which was followed by BARI Sarisha-17 (33.3±1.4 days), BARI Sarisha-15 & 16 (30.0±1.1 days) and BARI Sarisha-14 (28.6±1.2 days).

Significant variation was observed in days required to 50% flowering among the selected mustard varieties. The lowest duration for 50% flowering was recorded in BARI Sarisha-12 (34.6±4.4 days) which was statistically similar to all other varieties except BARI Sarisha-11. The highest duration for 50% flowering was recorded in BARI Sarisha-11 (48.0±2.3 days) which was statistically similar to BARI Sarisha-13 & 14 (37.0±1.7 days), BARI Sarisha-15 (40.6±0.8 days), BARI Sarisha-16 (42.6±0.6 days), and BARI Sarisha-17 (43.3±0.8 days).

Significant variation was observed in days required to siliqua elongation among the selected mustard varieties. The lowest duration for siliqua elongation was recorded in BARI Sarisha-12 (37.5±5.0 days) which was statistically similar to all other varieties except BARI Sarisha-11. The highest duration for siliqua elongation was recorded in BARI Sarisha-11 (53.3±0.8 days) which was statistically similar to BARI Sarisha-13 (38.0±0.5 days), BARI Sarisha-14 (40.0±1.7 days), BARI Sarisha-15 (44.3±1.4 days), BARI Sarisha-16 (45.0±0.5 days), and BARI Sarisha-17 (45.6±0.8 days).

Significant variation was observed in days required to maturity among the selected mustard varieties. The lowest duration for crop maturity was recorded in BARI Sarisha-12 (72.5±12.0 days) which was statistically similar to BARI Sarisha-15 (83.0±1.1 days), BARI Sarisha-13 (83.6±0.8 days), BARI Sarisha-14 (84.3±1.2 days) and also BARI Sarisha-17 (89.0±2.0 days). The highest duration for crop maturity was recorded in BARI Sarisha-11 (118.3±2.0 days) which was statistically similar to BARI Sarisha-16 (105.3±1.4 days).

In a similar study, Sarker *et al*. (2018) found that among the tested varieties the fastest seedling emergence (3.3 days) was observed in BARI Sharisha-13 whereas the slowest was observed (4.7 days) in Tori-7. The duration of seedling 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. 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 siliqua formation

Table 2. Plant height (cm) and number of leaves per plant of different mustard varieties grown in Gazipur region during Rabi season 2019-20

Variety	Plant height (cm)			Leaf number		
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
BARI Sarisha-11	24.3±0.3c	75.6±1.2ab	126.6±1.2ab	10.6±0.3b	14.6±0.3c	19.3±0.8c
BARI Sarisha-12	28.0±2.7abc	52.8±8.9d	77.5±15.2c	11.3±0.6ab	18.3±0.7a	24.5±1.8ab
BARI Sarisha-13	34.0±0.5a	71.3±1.2abc	105.0±1.1bc	8.3±0.3c	14.0±0.5c	18.3±0.8c
BARI Sarisha-14	30.3±0.8abc	55.6±1.2cd	79.6±1.2c	10.6±0.3b	19.3±0.8a	27.3±0.8a
BARI Sarisha-15	30.6±1.2ab	67.3±0.8bcd	104.6±1.2bc	9.6±0.3bc	18.0±0.5ab	24.6±0.3ab
BARI Sarisha-16	26.0±0.5bc	84.3±0.3a	144.0±0.5a	10.0±0.3bc	15.0±0.5bc	18.0±0.5c
BARI Sarisha-17	26.3±0.8bc	57.3±0.8cd	89.0±0.5c	13.0±0.5a	17.0±0.5abc	22.0±1.1bc

* DAS= Days after sowing
Means within a row followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

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.

Growth attributes and phenology: Significant variation was recorded in plant height among the selected mustard varieties (Table 2). The highest plant height at 30 Days after sowing (DAS) was recorded in BARI Sarisha-13 (34.0±0.5 cm) which was statistically similar to BARI Sarisha-15 (30.6±1.2 cm), BARI Sarisha-14 (30.3±0.8 cm) and BARI Sarisha-12 (28.0±2.7 cm). The lowest plant height was recorded in BARI Sarisha-11 (24.3±0.3 cm) which was statistically similar to BARI Sarisha-16 (26.0±0.5 cm) and BARI Sarisha-17 (26.3±0.8 cm) and these were statistically similar with BARI Sarisha-12 and BARI Sarisha-14. The highest plant height at 45 DAS was recorded in BARI Sarisha-16 (84.3±0.3cm) which was statistically similar to BARI Sarisha-11 (75.6±1.2 cm) and BARI Sarisha-13 (71.3±1.2 cm). The lowest plant height at 45 DAS was recorded in BARI Sarisha-12 (52.8±8.9 cm) which was statistically similar to BARI Sarisha-14 (55.6±1.2 cm) and BARI Sarisha-17 (57.3±0.8 cm). The highest plant height at 60 DAS was recorded in BARI Sarisha-16 (144.0±0.5 cm) which is statistically similar to BARI Sarisha-11 (126.6±1.2 cm). The lowest plant height at 60 DAS was recorded in BARI Sarisha-12 (77.5±15.2 cm) which was statistically similar to BARI Sarisha-14 (79.6±1.2 cm), BARI Sarisha-17 (89.0±0.5 cm), BARI Sarisha-15 (104.6±1.2 cm) and also in BARI Sarisha-13 (105.0±1.1 cm).

Significant variation was recorded in leaf numbers among the selected mustard varieties at different days after sowing. The highest leaf number at 30 DAS was recorded in BARI Sarisha-17 (13.0±0.5) which was statistically similar to BARI Sarisha-12 (11.3±0.6) and significantly the lowest leaf number was found in BARI Sarisha-13 (8.3±0.3) which was statistically similar to BARI Sarisha-15 (9.6±0.3) and BARI Sarisha-16 (10.0±0.3) followed by BARI Sarisha-16 (10.0±0.3) and both in BARI Sarisha-11 and 14 (10.6±0.3). Significantly the highest leaf number at 45 DAS was recorded in BARI Sarisha-14 (19.3±0.8) which was statistically similar to BARI Sarisha-12 (18.3±0.7), BARI Sarisha-15 (18.0±0.5) and BARI Sarisha-17 (17.0±0.5). Significantly the lowest leaf number at 45 DAS was recorded in BARI Sarisha-13

(14.0±0.5) which was statistically similar to BARI Sarisha-11 (14.6±0.3), BARI Sarisha-16 (15.0±0.5) and BARI Sarisha-17. The highest leaf number at 60 DAS was recorded in BARI Sarisha-14 (27.3±0.8) which was statistically similar to BARI Sarisha-15 (24.6±0.3) and BARI Sarisha-12 (24.5±1.8). The lowest leaf number at 60 DAS was recorded in BARI Sarisha-16 (18.0±0.5) which was statistically similar to BARI Sarisha-13 (18.3±0.8) and BARI Sarisha-11 (19.3±0.8).

In a similar study by Sarker *et al*. (2018) reported that among the tested varieties at 30 and 40 DAS, BARI Sarisha-8 scored the tallest plant (18.60 cm and 38.33 cm) which was statistically identical with Tori-7 and Rai while the lowest was recorded from BARI Sarisha-11 (15.53 cm and 23.73 cm). At 50 DAS and at harvest, the tallest plant height was observed in BARI Sarisha-16 (118.67cm & 131.33cm) which was statistically identical with BARI Sarisha-11 but the lowest was found in BARI

Table 3. Number of primary branch and leaf area (mm²) of different mustard varieties grown in Gazipur region during Rabi season 2019-20

Variety	Number of primary branch			Leaf area (mm²)
	30 DAS	45 DAS	60 DAS	
BARI Sarisha-11	4.3±0.3a	4.3±0.3a	6.3±0.3a	59.6±1.2a
BARI Sarisha-12	5.1±1.9a	6.1±1.6a	6.1±1.6a	57.1±8.1a
BARI Sarisha-13	3.0±0.0a	5.0±0.0a	5.0±0.0a	35.3±0.8b
BARI Sarisha-14	3.0±0.0a	4.0±0.0a	4.0±0.0a	69.3±1.1a
BARI Sarisha-15	3.3±0.3a	5.0±0.0a	5.0±0.0a	60.3±1.4a
BARI Sarisha-16	4.3±0.3a	6.0±0.0a	6.0±0.0a	57.0±2.0a
BARI Sarisha-17	4.3±0.3a	6.3±0.3a	5.5±0.0a	34.6±0.8b

* DAS= Days after sowing
Means within a row followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

Table 4. Yield contributing characteristics of mustard varieties grown in Gazipur region during Rabi season 2019-20

Variety	No. of inflorescences/ plant	No. of flower/ inflorescence	No. of siliqua/ inflorescence	Seeds/ siliqua
BARI Sarisha-11	23.3±0.8c	29.3±0.8bc	35.3±0.8c	13.0±0.5a
BARI Sarisha-12	29.1±2.3ab	33.6±3.3abc	47.3±5.9ab	22.5±1.6a
BARI Sarisha-13	17.0±0.5d	21.0±0.5d	23.3±0.8d	21.6±0.3a
BARI Sarisha-14	33.6±0.8a	39.3±0.8a	55.0±0.5a	28.0±0.5a
BARI Sarisha-15	29.3±0.8ab	34.6±0.3ab	52.6±0.8a	16.6±3.1a
BARI Sarisha-16	22.0±0.5cd	27.3±0.8cd	36.3±0.8bc	24.6±5.4a
BARI Sarisha-17	24.3±0.3bc	37.3±0.8a	40.0±1.1bc	18.6±5.6a

Means within a row followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

Sarisha-14 (46.00 cm and 49.40 cm) which was similar to BARI Sarisha-8. Leaf number significantly varied among the varieties at 40 and 60 DAS 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) having similarity to all other varieties except BARI Sarisha-11 in which the number of leaves was minimum (15.47) which showed agreement with the current findings. 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 and kashem 2017, Roy 2007, Zakaria and Jahan 1997, Hossain *et al*. 1996).

No significant variation was observed among the selected varieties in case of number of primary branch production at 30 DAS, 45 DAS and 60 DAS (Table 3). The highest number of primary branch at 30 DAS was recorded in BARI Sarisha-12 (5.1±1.9) followed by in BARI Sarisha-11, 16 and 17 (4.3±0.3). The lowest Number of primary branch at 30 DAS was recorded in both BARI Sarisha-13 and 14 (3.0±0.0) followed by BARI Sarisha-15 (3.3±0.3). The highest number of primary branch at 45 DAS was recorded in BARI Sarisha-17 (6.3±0.3) followed by in BARI Sarisha-12 (6.1±1.6), BARI Sarisha-16 (6.0±0.0), BARI Sarisha-13 and 15 (5.0±0.0), BARI Sarisha-11 (4.3±0.3) and BARI Sarisha-14 (4.0±0.0). The highest number of primary branch at 60 DAS was recorded in BARI Sarisha-11 (6.3±0.3) followed by in BARI Sarisha-12 (6.1±1.6), BARI Sarisha-16 (6.0±0.0) and the lowest was recorded in BARI Sarisha-14 (4.0±0.0) followed by both BARI Sarisha-13 and 15 (5.0±0.0).

Significant variation was observed in leaf area among the selected varieties. The highest leaf area was recorded in BARI Sarisha-14 (69.3±1.1 mm^2) which is statistically similar to BARI Sarisha-15 (60.3±1.4 mm^2), BARI Sarisha-11 (59.6±1.2 mm^2), BARI Sarisha-12 (57.1±8.1 mm^2) and also BARI Sarisha-16 (57.0±2.0mm^2). The lowest leaf area was recorded in BARI Sarisha-17 (34.6±0.8 mm^2) which is statistically similar with BARI Sarisha-13 (35.3±0.8 mm^2).

Yield contributing characters: Significant variation was observed in number of inflorescences per plant and number of flower per inflorescence among the selected mustard

Table 5. Yield and harvest index (HI) of different mustard varieties grown in Gazipur region during Rabi season 2019-20

Variety	Seed/siliqua	Seed yield/ plot (kg)	1000 seeds weight (g)	Seed Yield (t/ha)	HI/plot (%)
BARI Sarisha-11	20.0±0.5d	1.1±0.0a	3.5±1.1a	1.9±0.2a	30.0±1.3ab
BARI Sarisha-12	31.6±1.3b	0.7±0.3a	2.5±0.7a	1.3±0.4b	27.3±2.8ab
BARI Sarisha-13	20.0±0.5d	1.2±0.0a	3.6±0.7a	2.1±0.2a	34.5±1.3a
BARI Sarisha-14	41.6±0.6a	0.7±0.1a	3.4±0.8a	1.3±0.2b	29.8±1.3ab
BARI Sarisha-15	25.0±0.5c	0.9±0.0a	3.2±0.9a	1.5±0.1ab	29.9±1.3ab
BARI Sarisha-16	23.0±0.5cd	1.1±0.0a	4.5±1.2a	1.9±0.2a	34.2±1.3a
BARI Sarisha-17	30.3±0.8b	0.9±0.3a	3.2±0.8a	1.5±0.2ab	24.0±1.3b

Means within a row followed by same letter(s) are not significantly different by Tukey HSD posthoc statistic at < 0.05.

varieties (Table 4). The highest number of inflorescences per plant was recorded in BARI Sarisha-14 (33.6±0.8) which was statistically similar to BARI Sarisha-15 (29.3±0.8) and BARI Sarisha-12 (29.1±2.3). The lowest number of inflorescences per plant was recorded in BARI Sarisha-13 (17.0±0.5) which was statistically similar to BARI Sarisha-16 (22.0±0.5) followed by BARI Sarisha-11 (23.3±0.8) and BARI Sarisha-17 (24.3±0.3).

The highest flower per inflorescence was recorded in BARI Sarisha-14 (39.3±0.8) which was statistically similar with BARI Sarisha-17 (37.3±0.8), BARI Sarisha-15 (34.6±0.3) and BARI Sarisha-12 (33.6±3.3). The lowest flower per inflorescences was recorded in BARI Sarisha-13 (21.0±0.5) which was statistically similar to BARI Sarisha-16 (27.3±0.8) followed by BARI Sarisha-11 (29.3±0.8).

Significant variation was observed in number of siliqua per inflorescence among the selected mustard varieties. The highest number of siliqua per inflorescence was recorded in BARI Sarisha-14 (55.0±0.5) which was statistically similar to BARI Sarisha-15 (52.6±0.8) and BARI Sarisha-12 (47.3±5.9). Significantly the lowest number of siliqua per inflorescence was observed in BARI Sarisha-13 (23.3±0.8). The moderate number of siliqua per inflorescence was recorded in BARI Sarisha-11 (35.3±0.8), BARI Sarisha-16 (36.3±0.8) and BARI Sarisha-17 (40.0±1.1) and these were statistically similar with each other.

No statistical variation was observed in number of seeds per siliqua among the selected mustard varieties. The highest number of seeds per siliqua was recorded in BARI Sarisha-14 (28.0±0.5) followed by BARI Sarisha-16 (24.6±5.4) and lowest seeds/siliqua was recorded in BARI Sarisha-11 (13.0±0.5) followed by BARI Sarisha-15 (16.6±3.1).

Five varieties of mustard (Improved Tori-7, BARI Sarisha-6, BARI Sarasha-9, BARI Sarisha-11 and local) were tested in hilly areas of Bangladesh. Among the varieties BARI Sarisha-11 showed maximum plant height and took maximum days for maturity. The same variety also gave the highest number of siliqua per plant, higher seed size and the highest yield (Aziz *et al*. 2011). These findings are in close conformity with the current results where BARI Sarisha-11 showed maximum crop duration and higher yield.

The maximum number of seeds per siliqua (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 (Sarker *et al*. 2018). Variation in seeds per silique among the varieties was in conformity with Mamun *et al*. (2014), who found the highest seeds per siliqua in BARI Sarisha-13 and the lowest seeds per siliqua in BARI Sarisha-16 and these results are in agreement with the findings of Zakaria and Jahan (1997) and Gurjar and Chauhan (1997).

Yield and harvest index (HI): Significant variation was observed in number of seeds per siliqua among the selected mustard varieties (Table 5). Significantly the highest number of seeds per siliqua was recorded in BARI Sarisha-14 (41.6±0.6) which was followed by BARI Sarisha-12 (31.6±1.3) and BARI Sarisha-17 (30.3±0.8). The lowest number of seeds per siliqua was recorded in both BARI Sarisha-11 and 13 (20.0±0.5) which was statistically similar to BARI Sarisha-16 (23.0±0.5).

No statistical variation was observed in seed yield per plot among the selected mustard varieties. The highest seed yield per plot was recorded in BARI Sarisha-13 (1.2±0.0 kg) followed by BARI Sarisha-11 and 16 (1.1±0.0 kg), BARI Sarisha-17 (0.9±0.3 kg) and BARI Sarisha-15 (0.9±0.0 kg). The lowest seed yield per plot was recorded in BARI Sarisha-12 (0.7±0.3 kg) and BARI Sarisha-14 (0.7±0.1 kg).

No statistical variation was observed in 1000 seeds weight among the selected mustard varieties. The highest value of 1000 seeds weight was observed in BARI Sarisha-16 (4.5±1.2 g) followed by BARI Sarisha-13 (3.6±0.7 g), BARI Sarisha-11 (3.5±1.1 g), BARI Sarisha-14 (3.4±0.8 g), BARI Sarisha-15 (3.2±0.9 g) and BARI Sarisha-17 (3.2±0.8 g). The lowest value of 1000 seeds weight was recorded in BARI Sarisha-12 (2.5±0.7 g).

Significant variation was observed in yield (ton ha^{-1}) among the selected mustard varieties. The highest seed yield was obtained from BARI Sarisha-13 (2.1±0.2 ton ha^{-1}) followed by BARI Sarisha-11 and 16 (1.9±0.2 ton ha^{-1}), BARI Sarisha-17 (1.5±0.2 ton ha^{-1}), BARI Sarisha-15 (1.5±0.1 ton ha^{-1}). The lowest seed yield per hectare was obtained from BARI Sarisha-14 (1.3±0.2 ton) followed by BARI Sarisha-12 (1.3±0.4 ton).

Significant variation was observed in harvest index (HI) per plot among the selected mustard varieties. The highest value of HI was recorded in BARI Sarisha-13 (34.5±1.3%) followed by BARI Sarisha-16 (34.2±1.3%) which was statistically similar to BARI Sarisha-11 (30.0±1.3%), BARI Sarisha-15 (29.9±1.3%), BARI Sarisha-14 (29.8±1.3%), BARI Sarisha-12 (27.3±2.8%) and. The lowest value of HI was recorded in BARI Sarisha-17 (24.0±1.3%) which was statistically similar to all the selected varieties except BARI Sarisha-13 and 16.

Aziz *et al*. (2011) observed that the highest yield (1740 kg/ha) of BARI Sarisha-11 was attributed to the maximum number of siliqua per plant, maximum seed weight and maximum grain growth duration. Mondal *et al*. (2003) while conducting a varietal trial at Joydebpur reported that BARI Sarisha-11 was the highest yielder which was attributed to the maximum siliqua per plant, maximum seed per siliqua and maximum grain weight. According to their findings, weight of 1000 seeds was higher (4.2 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 (1.7 g). BARI Sarisha-16 resulted the higher seed yield (1813.3 kg/ha) while the lower (286.7 kg/ha) was obtained from Tori-7. Maximum biological yield (5716.7 kg ha^{-1}) was obtained from BARI Sarisha-16 and the minimum (1020.00 kg ha^{-1}) was obtained from Tori-7. Ahmed and Kashem (2017) found that the mustard var. BARI Sarisha-11 produced the highest number of branches per plant, number of capsules per plant, 1000-seed weight resulting the highest seed yield (1.6 t/ha), followed by BARI Sarisha-15 (1.5 t/ha).

According to the current findings, BARI Mustard-13 provided higher yield under natural condition, i.e. without taking insect pest and disease management approach, and therefore, this variety is recommended for cultivation for getting higher yield than others.

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