EVALUATION OF LATE SOWING POTENTIALS OF RAPESEED VARIETIES ON SEED YIELD AND YIELD CONTRIBUTING CHARACTERS IN MYMENSINGH

M.S. Islam[1], M.I. Ali[1] and A. Mahmud[1*]

Abstract

Rapeseed mustard are an important oilseed in Bangladesh. The yield performance and crop geometry of Bangladesh Institute of Nuclear Agriculture (BINA) newly released mustard variety is still under question in lately sowing potentiality after harvesting Aman rice. The first experiment was conducted with four varieties viz. Tori-7, BARI Sarisha-14, Binasarisha-7 and Binasarisha-9 for the sowing date on 13 December with split plot design. The next experiment conducted with six variety viz. Binasarisha-4, Binasarisha-8, Binasarisha-9, Binasarisha-10, BARI Sarisha-14 and BARI Sarisha-17 for two dates of sowing i.e. 30 November & 10 December with split plot design at the research field of BINA during Rabi season of 2019-20 and 2020-21 to observe their late sowing potentialities. In 13 December sowing, Binasarisha-9 produced the highest seed yield. In 2020-21, seed yield was highest on sowing dates 30 November where Binasharisha-9 performed the best both in seed yield and yield contributing characters which indicates that Binasarisha-9 has the late sowing potential among the six tested varieties.

Key words: Mustard, late potential, seed yield, variety

Introduction

Rapeseed mustard are the third most important source of edible oil crops and at present, is the third largest source of vegetable oil all over the world next to soybean (*Glycine max*) and palm (*Elaeis guineensis* Jacq.). It is grown in certain tropical and subtropical regions as a cold season crop (Shekhawat *et al.,* 2012). Rapeseed mustard seed in general, contains 30-43% oil, 17-25% proteins, 8-10% fibers, 6-10% moisture, and 10-12% extractable substances (Pandey *et al.,* 2013). In Bangladesh context, rapeseed mustard (*Brassica spp.)* are popular edible oil in rural area and accounts about 72% of total oilseed production in the country. This oil is important for improving the taste of a number of food items (Aziz *et al.,* 2011). The total rapeseed mustard oil production was 3,11,740 metric ton occupying 6,67,242 acres area which is about 62.5% of the total oilseed area in the year of 2018-19 (BBS, 2019). The overall production of mustard and rape was declining due to a decrease in the covered area and it was recorded 352 thousand ton in 2018 which declining to 312 thousand ton in 2019 (www.ceicdata.com). Demand of edible oil has been increased with increasing population and improvement in the living standard of the people, resulting thereby in short supply of edible oils which is being met with imports. Thus, there is need to boost the oilseed production through area expansion and productivity enhancement.

[1]Agronomy Division, Bangladesh Institute of Nuclear Agriculture, BAU Campus, Mymensingh-2202
[*]Corresponding authors' email: applemahmud885@gmail.com

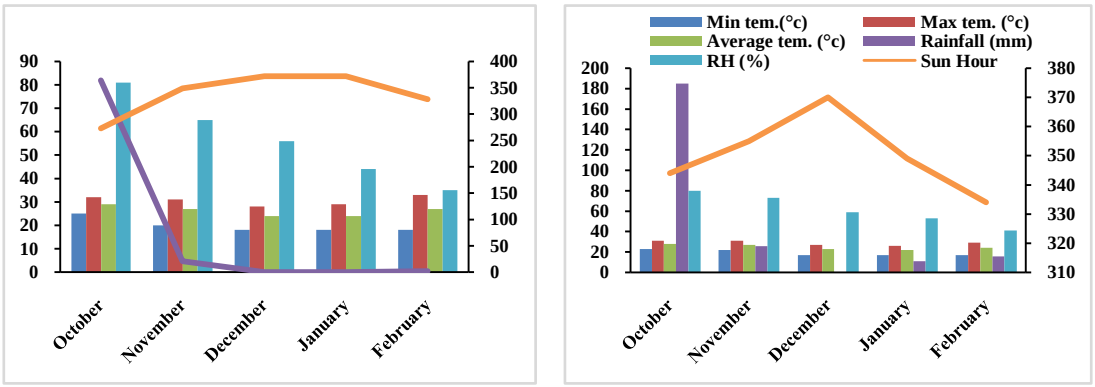
Different sowing dates provide variable environmental conditions within the same location for growth & development of crop (Panda *et al.,* 2004). The late sowing of mustard decreased seed yield through synchronization of siliqua filling period with high temperatures, the decrease in assimilates production, drought stress occurrence, shortened siliqua filling period and acceleration of plant maturity (Mendham *et al.,* 1981) as it is a thermo sensitive as well as photosensitive crop (Angrej *et al.,* 2002). Cultivation of low yielder local varieties in late sowing are the major causes for poor yield of rapeseed mustard in the country (Alam and Rahman, 2006). High yield with late potential of a variety is the prerequisite for increasing the production of a crop. In the recent years, Bangladesh Agricultural Research Institute (BARI) and BINA have developed a number of high yielding with late potential rapeseed mustard varieties with high seed yield potentiality up to 2.5 t ha^{-1}. To this point of view, 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. Therefore the present study was undertaken to identify rapeseed mustard varieties having suitable late sowing potential for the expansion of cultivation area in Bangladesh.

Material and methods

The field experiment was conducted at the Field Laboratory of the BINA HQ farm, Mymensingh during the period from during Rabi season (November to March) of 2019-20 and 2020-21 in two consecutive years. Geographically, the research field is located at 24.74° N latitude and 90.42° E longitudes. Mymensingh district falls under the sub-tropical climate, which is characterized by high temperature and high humidity in Kharif season and the Rabi season (October to March) is characterized by comparatively low temperature and plenty of sunshine from November to February. The climatic parameters during the growing period of rapeseed mustard in Mymensingh are presented in Figure 1.

Soil characteristics in the study areas were silt loam to silty clay having pH value range from 5.2 to 7.8. The first experiment was consisted with only single sowing time (December 13), in 2019-20 with Tori-7 (V_1), BARI Sarisha-14 (V_2), Binasarisha-7 (V_3) and Binasarisha-9 (V_4) with split plot design. In the next year the experiment consisted with two sowing time 30 Nov. (D_1) and 10 Dec. (D_2) in 2020-21 with six rapeseed mustard variety viz, Binasarisha-4 (V_1), Binasarisha-8 (V_2), Binasarisha-9 (V_3), Binasarisha-10 (V_4), BARI Sarisha-14 (V_5) and BARI Sarisha-17 (V_5) with split plot design where sowing time was placed in the main plot and varieties was placed in the sub-plot. Three replications were maintained in both years. The size of each unit plot was 4 m × 3 m where line to line and plant to plant distances were 30 and 6 cm, respectively. All the weeds and stubbles were removed after proper ploughing and the land was laid out as per the experimental design. Fertilizers were applied at the rate of 70, 30, 50, 90 and 3 kg/acre urea, muriate of potash

(MOP), triple super phosphate (TSP), gypsum and Zinc sulphate, respectively at final land preparation (Fertilizer Recommended Guide, BARC, 2018). The *Alternaria* blight disease was controlled by spraying of propiconazol 250 EC @ 20 ml per 5 decimal lands. Weeds were controlled by two hands weeding.



(a) (b)

(www.Worldweatheronline.com/Mymensingh)

Figure 1. Meteorological condition during the *Rabi* season in Mymensingh for two consecutive years 2019-20 (a) and 2020-21 (b).

The crop was harvested at full maturity and the harvested crop was brought to the threshing floor and was dried for three days. The yield of seed was adjusted at 10% moisture level. Data on yield contributing characters were recorded at harvest. The yield contributing characters were recorded from 10 randomly selected plants in each plot and their mean values were determined. The yields were taken plot-wise by harvesting central 10 m^2 area of each plot and then it was converted to hectare basis. The collected data was on plant height (cm), population m^{-2}, no. of branches $plant^{-1}$, no. of siliqua $plant^{-1}$, no. of seeds $Siliqua^{-1}$, siliqua length (cm), 1000 seed weight (g), seed yield (t ha^{-1}), stover yield (t ha^{-1}) and maturity period. The collected data were analyzed using statistical computer package Statistics 10 and mean differences were adjudged by using LSD (Gomez and Gomez, 1984).

Results and discussion

Effect of variety on growth and yield of rapeseed

All the varieties used in the experiment were differed in respect of seed yield and yield contributing characters and it was considered from least significance difference (LSD) value. The result of the first experiment during 2019-20 showed that the silique length (7.1 cm), seed yield (1.3 t ha^{-1}), maturity duration (81 days) was the highest in Binasarisha-9 but plant height (47.7 cm) was lowest where the Tori 7 exhibited the highest plant height (64.7 cm), branches $plant^{-1}$ (4.4), silique $plant^{-1}$ (43.9), 1000 seed weight (3.5) and also showed least maturity duration (66 days) (Table 1). On the other hand, the experiment conducted in

2020-21 exhibited that all the varieties differed in their yield and yield components (Table 2). The Binasarisha-4 exhibited the highest numbers of seeds silique^{-1} (32.9) and 1000 seed weight (3.5g) but lowest in maturity duration (66 days). The plant height (104.4 cm), branches plant^{-1} (101.9) and 1000 seed weight (3.5g) was observed maximum in Binasarisha-8. Eventually the Binasarisha-9 showed the highest seed yield (1.4 t ha^{-1}) due to the highest siliqua length (7.2 cm) and numbers of seed silique^{-1} (29.9). The BARI Sarisha 17 produced the highest branches plant^{-1} (5.5), stover yield (3.8) and maturity duration (82 days) (Table 2). This result is in agreement with the findings of Al-Juheishy and Ghazal, (2017) investigated growth and yield performance of rapeseed including two varieties of rapeseed (Pactol and Srew) with four seed rates (4, 6, 8, 10 kg ha^{-1}). The Srew variety significantly exceeded the highest mean of the trait of the number of branches plant^{-1}, number of siliqua plant^{-1}, the weight of 1000 seeds, seed yield, while the Pactol variety scored the highest mean for plant height and the number of seeds silique^{-1} respectively.

Table 1. Effect of rapeseed mustard varieties on seed yield and yield contributing characters during 2019-2020 (13 December)

Varieties	Plant height (cm)	Branches plant^{-1} (no.)	Silique plant^{-1} (no.)	Seeds Siliqua^{-1} (no.)	Silique length (cm)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Maturity duration (days)
Tori 7	64	4.4	43.9	23.7	5.4	3.5	1.1	2.9	66
BARI Sarisha-14	60	3.0	31.5	34.2	5.0	3.5	1.3	3.1	74
Binasarisha-7	55	2.7	39.0	26.0	4.8	3.3	1.0	2.9	78
Binasarisha-9	47	2.7	31.9	28.4	7.1	3.4	1.3	2.9	81
$LSD_{0.05}$	3.7	0.5	2.4	4.4	0.6	0.3	0.2	0.1	3.1

Table 2. Effect of rapeseed mustard varieties on seed yield and yield contributing characters in 2020-2021

Varieties	Plant height (cm)	Branches plant^{-1} (no.)	Silique plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	Silique length (cm)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Maturity duration (days)
Binasarisha-4	87	3.3	40.8	32.9	7.1	3.5	1.3	2.9	66
Binasarisha-8	104	3.8	101.9	11.3	3.7	3.5	1.2	3.1	74
Binasarisha-9	86	4.1	46.6	29.9	7.2	3.3	1.4	2.9	78
Binasarisha-10	74	4.6	91.1	18.1	4.3	3.4	1.2	3.0	81
BARI Sarisha-14	74	5.4	42.5	29.9	4.1	3.4	1.3	2.9	79
BARI Sarisha 17	83	5.5	46.5	28.5	3.9	3.3	1.3	3.8	82
$LSD_{0.05}$	7.1	0.2	4.4	1.8	0.5	0.3	0.1	1.1	2.13

Effect of sowing dates on growth and yield of rapeseed

The effect of different sowing dates significantly affected on plant height, number of plant population m^{-2}, number of branch plant^{-1}, number of siliqua plant^{-1}, number of seed siliqua^{-1}, siliqua length 1000 weight, seed yield and stover yield are presented in Table 3. The yield and yield contributing characters such as plant height (92.7 cm), branches plant^{-1}

(4.26), seeds siliqua^{-1} (27.4), 1000 seed weight (3.40) was recorded highest in 10 December and it was significantly different from the all other treatments. On the other hand, the traits population m^{-2} (114.47), siliqua plant^{-1} (67.68), seed yield (1.27) and stover yield (3.11) showed highest in 30 November. These results are in agreement with the result of Rahman *et al.,* (2007) who stated that plant height differed significantly among the studied mustard varieties. The results of present study were also supported by the results of Tripathi *et al.,* (2021) in mustard who observed the three sowing dates (15 Oct., 10 Nov. and 05 Dec.) and stated that the 10 November was superior compare to rest of the planting dates and showed effectively increasing the growth, oil content and oil yield. On the other hand the lowest yield recorded under dates at 15 October.

Table 3. Effect of sowing dates of mustard varieties on yield and yield contributing characters in 2020-2021

Treatment	Plant height (cm.)	Popula. m^{-2} (no.)	Branches plant^{-1} (no.)	Silique plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	Siliqua length (cm)	1000 seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Dates of sowing:									
November 30 (D_1)	77	114.5	4.3	67.7	22.8	4.8	3.3	1.3	3.1
December 10 (D_2)	92	103.1	4.6	55.4	27.4	5.3	3.4	1.2	2.9
Significance level	*	*	NS	**	**	*	NS	NS	NS

Interaction effect of sowing dates and variety

The interaction of sowing dates (30 November and 10 December) and varieties (Binasarisha-4, Binasarisha-8, Binasarisha-9, Binasarisha-10, BARI Sarisha 14, BARI Sarisha 17) had significant effect on yield and yield contributing characters (Table 4). Results showed that the Binasarisha-8 (V_2) exhibited the highest plant height (116.27 cm) where the seed yield (1.6 t ha^{-1}) was observed in Binasarisha-9 (V_3) at December 10 (D_2). The seeds siliqua^{-1} also observed highest at 10 December (D_2) in Binasarisha-4 (V_1). On the other hand, Binasarisha-10 (V_4) exhibited maximum siliqua plant^{-1} (131.4) and siliqua length (7.4 cm) was highest in Binasarisha-9 (V_3) at the sowing dates November 30 (D_1). The findings were complied with Aziz *et al.,* (2011) who stated that sowing time is an important factor for seed yield and quality in rapeseed and the highest grain yield (1.94 t ha^{-1}) was recorded from the treatment combination of the variety Binasarisha-5 at 30 November sowing and the lowest (1.08 t ha^{-1}) in delay sowing at 15 January with Binasarisha-9. These results are also in conformity with the findings of Akhter *et al.,* (2015) who observed that the variety P-3 sown on 1st October recorded significantly higher seed yield of 19.13 q ha^{-1}. The higher seed yield in this interaction might be due to significantly higher number of primary and secondary branches per plant, higher number of siliqua per plant and 1000 seed weight.

Table 4. Interaction effect of sowing dates and variety on yield and yield contributing characters of rapeseed mustard during 2020-2021

Treatment	Plant height (cm.)	Branches plant^{-1} (no.)	Silique plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	Silique length (cm)	1000 seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
$D_1 V_1$	81	3.2	36.5	29.9	7.0	3.5	1.4	3.0
$D_1 V_2$	92	4.1	104.8	11.8	3.6	3.3	1.3	3.2
$D_1 V_3$	83	4.9	50.2	26.4	7.4	3.4	1.2	3.5
$D_1 V_4$	69	4.6	131.4	17.7	3.7	3.4	0.8	2.9
$D_1 V_5$	65	4.5	41.5	25.3	3.8	3.3	1.5	3.0
$D_1 V_6$	72	4.2	41.7	25.6	3.6	3.5	1.4	3.9
$D_2 V_1$	93	3.4	45.1	35.9	7.2	3.3	1.3	3.3
$D_2 V_2$	116	3.4	99.1	10.8	3.8	3.4	0.9	3.4
$D_2 V_3$	90	3.2	42.9	33.5	7.1	3.4	1.6	3.1
$D_2 V_4$	79	4.5	50.9	18.4	5.0	3.3	1.4	4.0
$D_2 V_5$	83	6.4	43.4	34.6	4.3	3.5	1.1	3.6
$D_2 V_6$	94	6.7	51.3	31.4	4.3	3.3	0.9	3.9
$LSD_{0.05}$	10.1	0.6	6.1	2.6	0.7	3.4	0.10	3.9
CV%	7.8	8.2	4.3	3.9	8.2	3.5	6.4	8.1

N.B: D_1, November 30; D_2, December 10; V_1, Binasarisha-4; V_2, Binasarisha-8; V_3, Binasarisha-9; V_4, Binasarisha-10; V_5, BARI Sarisha 14; V_6, BARI Sarisha 17.

Conclusion

From the results it may be concluded that the maximum late sowing seed yield potentiality explored by the variety Binasarisha-9 supported the better seed yield and yield contributing characters compared to other tested varieties in Mymensingh district of Bangladesh.

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References

Akhter, S., Singh, L., Rasool, R. and Ramzan, S. 2015. Effect of date of sowing and varieties on yield of Brown Sarson (*Brassica Rapa* L.) under temperate Kashmir. Int. J. Eng. Sci. Invention. 4(3): 65-69.

Alam, M.M. and Rahman, M.M. 2006. Effect of row spacing on seed yield of five varieties of Rapeseed. Bangladesh J. Crop Sci., 17(1): 163-168.

Al-Juheishy, W.K.S. and Ghazal, S.A.Y. 2017. Effect of Seed Rates on Growth and Yield of Two Varieties of Rapeseed (*Brassica juncea* L.). Indian J. Ecol. (13): 301-305.

Angrej, S., Dhingra, K.K., Jagroop, S, Singh, M.P., Singh, J. and Singh, A. 2002. Effect of sowing time and plant density on growth, yield and quality of Ethiopian mustard (*Brassica carinata*). J. of Res., Punjab Agril. Univ. 39(4): 471-475.

Aziz, M.A., Rahman, A.K.M.M., Chakma, R., Ahmed, M. and Ahsan, A.F.M.S. 2011. Performance of mustard varieties in the hilly areas of Bangladesh. J. Expt. Biosci., 2(2):7–10.

BBS (Bangladesh Bureau of Statistics). 2019. Bangladesh Bureau of Statistics Division, Govt. of the People's Republic of Bangladesh. pp.123.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research. John Wiley and Sons.

http://www.barcapps.gov.bd/documents/books/Fertilizer%20Recommendation%20Guide%20-%202018.pdf.

https://www.ceicdata.com/en/bangladesh/production-by-commodity-annual/production-rape-and-mustard.

https://www.Worldweatheronline.Com/Gazipur-Weather-Averages/Bd.Aspx.

Iraddi, V.S. 2008. Response of mustard (*Brassica juncea* L.) varieties to date of sowing and row spacing in northern transition zone of Karnataka. MS thesis in Agron. Department of Agron., College of Agri., Dharwad Univ. of Agri. Sci., Dharwad-580005. pp. 1-81.

Mendham, N.J. and Salisbury, P.A. 1981. Physiology: Crop development, growth and yield. Pages 11-64 in D. Kimber and D.I. McGregor, ed. *Brassica* oilseeds: Production and utilization. CAB International, Slough, UK.

Panda, B.B., Shivay, Y.S. and Bandyopadhyay, S.K. 2004. Growth and development of Indian mustard (*Brassica juncea* L.) under different levels of irrigation and date of sowing. Indian J. Plant Physiol. 9(4): 419-425.

Pandey, S., Manoj, K.M. and Tripath, M.K. 2013. Study of inheritance of erucic acid in Indian mustard (*Brassica juncea* L.). Octa J. Biosci. 1: 77-84.

Rahman, M.M., Sarker, P.K. and Das, B.C. 2007. Effect of intercropping with mustard with onion and garlic on aphid population and yield. J. Biosci. 15: 35-40.

Shekhawat, K., Rathore, S.S., Premi, O.P. and Chauhan, J. S. 2012. Advances in agronomic management of Indian mustard (*Brassica juncea* L.). An overview. Int. J. Agric. 1-14.

Tripathi, K.B.M., Gaur, T., Pandey, L., Singh, A., Tiwari, A., Prakash, V. and Singh, R.K. 2021. Effect of Sowing Dates on Growth and Yield of Indian Mustard (*Brassica juncea* L.). Int. J. curr. microbiol. appl. sci.10: 3046-3057.