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EFFECT OF SOWING DATES ON YIELD OF MUSTARD IN SYLHET REGION

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Abstract

The experiment was carried out on a multilocational testing (MLT) site, Hobiganj district to find out suitable sowing dates of rapeseed mustard (*Brassica campestris* and *Brassica napus*). The mustard var. BARI Sarisha-18 was cultivated during *rabi* season of two consecutive years 2022-23 and 2023-24 in randomized complete block (RCB) design with 3 replications. The treatments were five sowing dates *viz.* 15 November, 30 November, 15 December, 30 December and 15 January. The 30th November sowing performed best with seed yield of 2.73 t ha^{-1} by producing 85.71% higher seed yield than 15th January with seed yield of 1.47 t ha^{-1}. It was noticed that the sowing time of mustard should be adjusted considering weather change.

Keywords: Sowing dates, rapeseed mustard, seed yield.

Introduction

Mustards are several plant species under genera *Brassica* and *Sinapis*, play a vital role in the agricultural production of Bangladesh. Among the three species of this genus, *Brassica campestris* and *Brassica napus* are recognized as rape seed and *Brassica juncea* is regarded as mustard. It is a cool season Photo-thermo-sensitive crop (Ghosh and Chatterjee, 1988) providing major edible oil in the country. A total of 3% cultivable land is utilized for oil seed production in the country, where mustard alone holds 60% of the area among the oil crops Anon., 2022). However, there is a potentiality of extending this area to 2.2 million hectares where the land remains fallow in between *Aman* and *Boro* or other crops (*Chowhan et. al*., 2021; *Chowhan et. al., 2019; Chowhan, 2022*).

Rice based rainfed ecosystem is prominent in Sylhet region. The major cropping patterns are Fallow-T. *Aus*-T. *Aman*, Fallow-Fallow- T. *Aman* and Fallow-*Boro*-Fallow, mustard could be inserted in this fallow land for increasing cropping intensity and productivity (Nazrul, 2019). The delayed and or insufficient pre-monsoon downfall makes late transplantation of *Aus* rice, which hampered the cultivation of subsequent *Aman* rice and *Rabi* cops also. As a result, large areas remain fallow shortly after the harvest of T. *Aman* rice due to inadequate information on sowing or planting dates of winter crops under changing climates.

Though agroclimatic conditions of this country are favorable but some reasons are accountable for improper growth and yield of mustard *viz*. sowing time, inadequate

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soil moisture, selection of HYVs and improved management practices. In earlier reports suggested sowing in the late October yields higher than late November (Alam *et al.,* 2014) and on the contrary, delayed sowing of mustard didn't affect the yield and related attributes (Chowhan, *et al.,* 2023). This might be due to weather shift. However, due to delayed harvesting of T. *Aman* rice, mustard sowing become late in the rice-based cropping system at northern-east region of Bangladesh. Late-planted mustard is exposed to high-temperature stress during the reproductive phase enhancing force maturity and increased senescence, shortening the length of the seed filling period, reducing seed size and resulting considerable yield loss (Sharif *et al.,* 2017). Timely sowing permits the crop plants to complete both vegetative and reproductive growth phases with better yield (Sharghi *et al.,* 2011). Furthermore, air temperature gradually rises at the end of winter which is favorable for insect infestation (Das, 2002; Ansary *et al.*, 2007) and late sowing plants also get less time for growth and directly moves to the reproductive stage.

Further due to global climate change and disparities of weather factors, a continuous shifting of winter season is being noticed every year. Being photo-thermosensitive, mustard plants must be adapted to this change. Hence, late sowing results in early flowering and may also cause severe insect pest infestation. Whereas early sowing results in proper vegetative growth and takes more time for floral initiation, consequently affecting seed yield and quality. Now it is climate change that leads demands for fixing areas or region-specific sowing times depending on the weather information for mustard cultivation. The experiment was, therefore, conducted to find out suitable sowing dates of rapeseed mustard (*Brassica campestris* and *Brassica napus*) in Sylhet region.

Materials and Methods

Description of experiment site

The experimental location was multilocation testing (MLT) site of BARI, Hobiganj (Agro Ecological Zone-20). This location was distinguished by Surma-Kushiyara Floodplain and major land types of medium high-low to low land. Soils were non-calcareous grey ranging from dark grey to brown. Organic matter content is low to medium, whereas dark grey soils have a greater amount. Soils were mostly acidic, with a fertility deficiency (FRG, 2018).

Two years' average climatic data of experimental site and period and ten years back meteorological parameters of same site have been depicted in Figure 1 and Figure 2, respectively. The past and present climatic data of experimental site showed that the minimum and maximum temperature, relative humidity, total rainy days and amount of rainfall were increased with time. From both graphs it was revealed that sporadic precipitation had occurred but ten years before the amount was very small than experimental years. Monsoon started in April and continued until October.

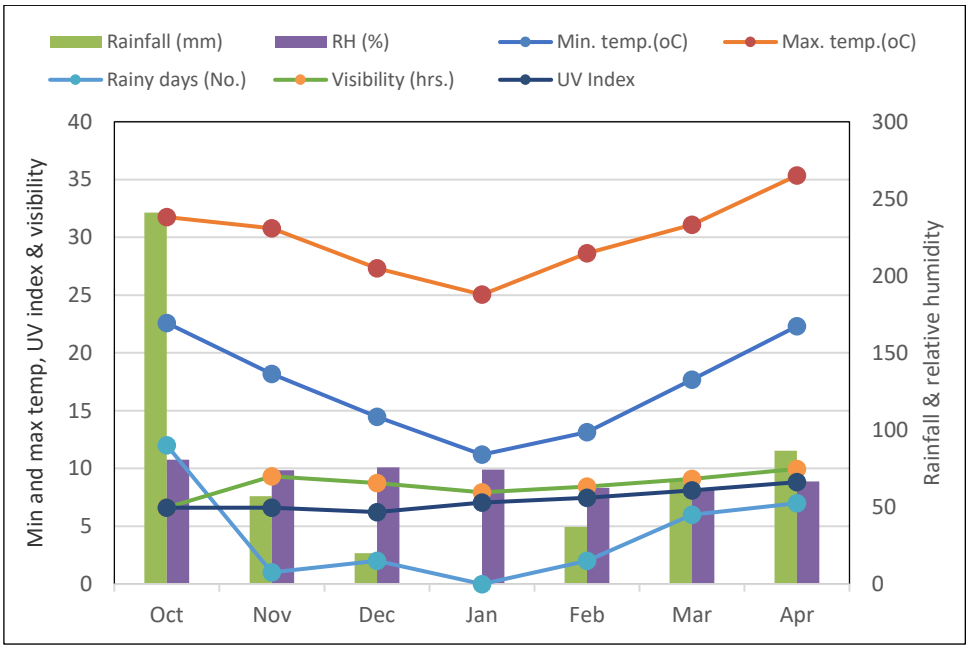

Fig. 1. Average of two years (2022-24) weather information of site during experimentation.

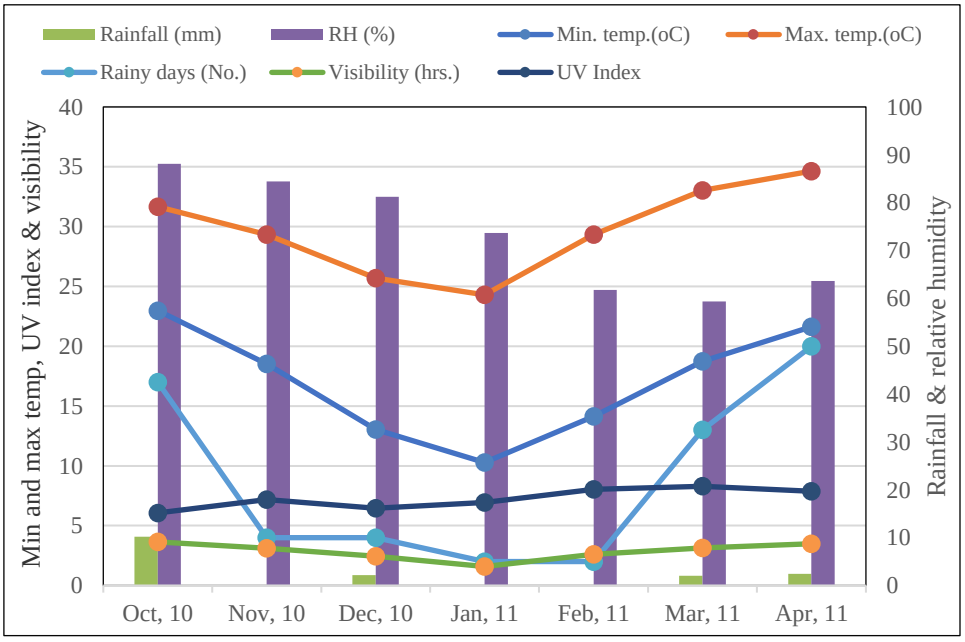

Fig. 2. Weather information of experimental site in Oct.-Dec. 2010 to Jan.-Apr. 2011.

Crop season and field management

Consecutive two years (2022-23 and 2023-24) during *rabi* (winter) season was used to carry out the field experiment and the field was prepared by tilling thoroughly to pulverize soil, 2-3 ploughing followed by leveling was done and weeds-plant residue was removed. The recommended fertilizers @115, 36, 45, 27, 2 and 1 kg ha^{-1} of N, P, K, S, Zn and B were used, respectively. The entire P, K, S, Zn, B fertilizers and half of N fertilizer was used as a basal dose, while half of N fertilizer was top-dressed with light irrigation at 20 days after emergence (DAE) of seedlings. The seeds were sown in broadcast method by maintaining seed rate 7 kg ha^{-1} in a unit plot size of 5 m × 4 m. Twenty days after sowing (DAS) weeding and thinning were done to ensure optimum plant density. Mustard was harvested when siliquae reached near 75% maturity with brownish to straw color.

Experimental design and treatments

Five different sowing dates were included in the experiment. *viz*. S_1: 15th November, S_2: 30th November, S_3: 15th December, S_4: 30th December, S_5: 15th January. The experiment was laid out in randomized complete block (RCB) design with three replications, and the var. BARI Sarisha-18 was used in this trial, is one of short duration high yielded new variety of mustard that can be well fitted in cropping pattern or suitable to cultivate in fallow land as single crop.

Harvesting and data collection

Ten plants were randomly selected and uprooted from each unit plot to record data on yield-related traits at harvesting time. Harvesting was accomplished at the optimal maturity stage of the crops, and the entire plot area was used for measuring seed yield.

Statistical analysis

Data obtained from the parameters were analyzed statistically with ANOVA (analysis of variance) technique by STAR package and the mean differences were adjudged by LSD (Least Significant Difference) test at 5% level of probability.

Results and Discussion

Effect of sowing dates on flower bud, flowering, and crop duration

Sowing dates greatly influenced the flower bud development. The maximum average days to flower bud development was in S_1 (14 days) followed by S_2 (13 days) and S_3 (12 days). Likewise, seed sown on S_1 (15 November) had the longest flowering duration of 41 days and minimum in S_5 (30 days). Early sowing (S_1, S_2) plants took significantly more time for flowering as compared to late sowing S_4 and S_5. In this situation plants have taken more time to complete various growth-related activities and phenological and developmental stages. Early flowers

appeared in the late sown plants (S_5) might be due to little aberrant environmental conditions which triggered the plants earlier to reach and complete reproductive phase. The sowing times have considerable effects on the duration of mustard plants flowering (Rameeh, 2012). The present findings agree with the results of Khan *et al.* (1994), who concluded that delayed sowing led to decrease the flowering duration in canola.

If mustard seeds are sown very late, the plants flowered earlier that depends on the weather factors particularly temperature (vernalization) and day length. Research results revealed that crop (life) duration decreased with the delayed sowing dates of the mustard seeds. Statistically identical and shortest crop durations (82 and 82 days) was observed in S_4 (30th December) followed by S_5 (15th January), respectively (Table 1a). It might be due to adverse weather factors such as low air temperature (11.2^{oC}) during crop vegetative growth, shortened duration of various phases of crop development and elevated air temperature. Delay in sowing shortened time of flowering and maturity of mustard varieties was also reported earlier (Shah *et al.,* 2020).

Table 1a. Effect of sowing dates on flower bud development, flowering and crop duration of mustard in *rabi* season (pooled of two years)

Treatment	Duration (days)								
	Flower bud development			Flowering			Crop		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
S_1	14	15	14	41	42	41	94	95	95
S_2	13	14	13	39	40	39	92	93	92
S_3	11	12	12	34	35	35	87	88	87
S_4	11	11	11	31	32	31	80	84	82
S_5	11	12	11	30	31	30	79	84	82
CV (%)	3.88	3.63	3.76	1.74	1.71	1.72	3.04	3.01	3.02
$LSD_{(0.05)}$	0.76	0.87	0.81	0.96	1.14	1.05	4.63	5.03	4.83

Note: S_1: 15th November, S_2: 30th November, S_3: 15th December, S_4: 30th December, S_5: 15th January.

Plant height (cm)

All the sowing dates showed significant variation in average plant height ranged from 90.33-110.33 cm, but the maximum plant height (110.33 cm) was recorded in S_1 which was statistically similar to S_2 at harvesting time. Plant height decreased rapidly and had a decline trend with delayed sowing of mustard seeds. Interestingly, though the sowing time was different in S_4 (30th Dec.) and S_5 (15th Jan.) but plant height at final stage was almost similar (91.34 and 90.33 cm). It was reported that variations in plant height under various sowing dates with different Indian mustard varieties were also recorded by Singh *et al.* (2017) and Chowhan *et al.* (2023).

Plant population m^{-2}

Optimum sowing time, planting geometry and plant population are the important factors affecting the yield of mustard. Different sowing dates significantly affected plant population m^{-2}. The number of plant population decreased with the delayed sowing dates. The highest average number of plant population (43.68 m^{2}) was recorded in S_2 (30th Nov.). on the contrary, the last two different sowing dates S_4 and S_5 gave the lowest and statistically similar plant population in per unit area of experimental plots.

Number of siliquae plant^{-1}

The effect of the sowing date on siliquae plant^{-1} was found significant, however, two sowing dates S_4 (30th Dec.) and S_5 (15th Jan.) were found non-significant (Table 1b). The highest mean number of siliqua plant^{-1} (151.09) was obtained from 30th Nov. sowing, which was statistically similar to the 15th of Nov. (S_1) sowing, whereas S_4 and S_5 had the lowest number of siliquae on the plant shoots (112.09 and 112.42, respectively). It happened because late sowing provided unfavorable conditions to plant growth that resulted in the lowest performance on siliquae number. This finding was in conformity with the findings of Mondal *et al.* (1999) who stated that the 30 October planting produced the highest number of siliqua plant^{-1} and reduced in the late sowings. Sakpal *et al.* (2023) also reported the early planting recorded the higher number of siliquae.

Table 1b. Effect of sowing dates on plant height, plant population and siliquae plant^{-1} of mustard in *rabi* season (pooled of two years)

Treatment	Plant height (cm)			Plant populations (m^{-2})			Siliquae plant^{-1}		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
S_1	109.33	111.33	110.33	41.33	42.33	41.83	150.52	150.83	150.68
S_2	106.00	108.00	107.00	43.21	44.14	43.68	150.67	151.50	151.09
S_3	100.67	103.33	102.00	41.67	42.67	42.17	146.67	147.50	147.09
S_4	86.67	96.00	91.34	37.33	38.33	37.83	111.67	112.50	112.09
S_5	85.33	95.33	90.33	35.67	36.67	36.17	112.00	112.83	112.42
CV (%)	9.2	7.91	8.56	5.91	5.77	5.84	5.73	5.69	5.71
LSD $_{(0.05)}$	16.91	NS	8.46	3.95	4.43	4.19	13.23	14.36	13.79

Note: S_1: 15th November, S_2: 30th November, S_3: 15th December, S_4: 30th December, S_5: 15th January.

Number of seeds siliqua^{-1}

The number of seeds siliqua^{-1} was found to be significant for different sowing dates (Table 1c). The crops sown in November (S_1 and S_2) had the most seeds per siliqua (34.93 and 33.96) while crops sown thereafter (S_3, S_4 and S_5) produced seeds per siliqua decreased gradually and 15th January had the least number of seeds per siliqua (30.83). Because of a delay in sowing, and with the earlier starting of the

flowering period, mustard plants entered the pod formation and seed filling stages. As a result, it reduced the number of seeds contained within pod. Earlier sowing showed more seeds indicate that, optimum sowing time had not yet changed over weather conditions. The present results may have similarities to the findings by Mondal *et al.* (1999); Sakpal *et al.* (2023) and Sudeep *et al.* (1996) in canola.

Thousand seed weight

Large and plumpy seed was obtained from seeds sown on 15th November (S_1), 30th November (S_2), and 15th December (S_3), but the plants under late sowing produced the lightest seed weight (Table 1c). Seed weight was not remarkably deviated with the first three sowing dates: but the late sowing (S_5) significantly reduced seed weight from 30th December. sowing. This might be changes in short day length and temperature which affected crop maturity; this ultimately led to poor seed filling in siliqua and a decrease in total seed weight (Sowjanya *et al.*, 2021). These findings also supported that 1000-seed weight reduced with the delayed sowing time of mustard (Mondal *et al.*, 1999).

Seed yield (t ha^{-1})

Weather factors had a significant impact on all the yield-attributing characters investigated during the early and late sowing times. Generally, if mustard seeds are sown very late, it flowers in short time; but it depends on the weather factors particularly temperature (vernalization) and day length. Reports are focused on the seed yield increase or reduction of mustard in different sowing dates. The result showed that higher seed yield (2.73 tha^{-1}) in S_2 sowing; which implies that winter shifted to some extent in later time (Table 1c). Delaying sowing time resulted in a lower seed yield, which could be related to temperature variations in the late-planted crop. Among all the weather attributes, maximum and minimum temperature and sunshine hours are influenced by the mustard yield (Pandey *et al*., 2007). On canola, Bukhtiar *et al.* (1992), Sattar *et al.* (2013) and Bazzaz *et al.* (2020) also reported similar conclusions. The seeds were sown in December (S_3 and S_4) and January (S_5) when the maximum air temperature was low during vegetative, flowering, and pod development phases of mustard compared to November (S_1 and S_2) sowing. On the contrary, both November sown mustard plants passed their vegetative, flowering, and pod development phases through the favorable weather attributes (Temp. range, RH (%), and visibility) and this might have resulted higher seed yield. It is reported that marginal and large effects on mustard yield and production were noted under slightly and deep change in environmental factors, respectively (Mishra and Chaturvedi, 2019); and UV radiation, especially UV-B, can significantly increase the content of glucosinolates in mustard plants (Michajlovskij, 1968). However, these trials only investigated the effect of different sowing dates on yield of mustard plants; the latter has not yet been studied.

Table 1c. Effect of sowing dates on some yield attributes and yield of mustard in *rabi* season (pooled of two years)

Treatment	Seeds siliqua^{-1}			1000-seed weight (g)			Seed yield (tha^{-1})		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
S_1	33.19	36.67	34.93	3.45	4.12	3.79	2.31	2.63	2.47
S_2	32.25	35.67	33.96	3.34	4.01	3.68	2.74	2.71	2.73
S_3	32.00	35.00	33.51	3.38	4.07	3.73	1.63	1.83	1.73
S_4	30.33	33.33	31.83	2.63	3.67	3.15	1.25	1.87	1.56
S_5	29.33	32.33	30.83	2.55	3.63	3.09	1.21	1.72	1.47
CV (%)	3.92	4.27	4.09	9.58	5.37	7.48	15.4	10.98	13.11
LSD $_{(0.05)}$	2.12	2.78	2.45	0.55	NS	0.28	0.49	0.48	0.49

Note: S_1: 15th November, S_2: 30th November, S_3: 15th December, S_4: 30th December, S_5: 15th January.

Conclusion

From the findings, it is revealed that suitable sowing time of mustard is being shifted towards December. Among the five different sowing dates of mustard, November sowing is found suitable which indicates in future better seed yield might be possible in late sowing i.e., within the third week of November in adverse situation at Habiganj of Sylhet region. It is noted that in Sylhet region, T. *Aman* harvested late condition followed by T. *Aus*, so mustard var. BARI Sarisha-18 could be easily fitted in the existing pattern.

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