Libyan Agriculture Research Center Journal International 2 (3): 112-117, 2011
ISSN 2219-4304

Yield Response of Mustard to Sowing Date

[1]Pronay Bala, [2]A.K. Azad and [3]M.F. Hossain

[1]Department of Agricultural Science, Lalmia City College, Gopalgonj, Bangladesh
[2]Department of Agricultural Science, Mrigi Shaheed Dianot College, Kalukhali, Rajbari, Bangladesh
[3]Scientific officer Soil Resource Development Institute, Rajshahi, Bangladesh

Abstract: A field experiment was conducted at Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during *rabi* season on 2009-10 and 2010-11 to find out optimum sowing time of mustard. The experiment was laid out in split plot design by assigning date of sowing in the main plot and variety in sub plot. There were seven sowing date viz. Nov-1, Nov-8, Nov-15, Nov-22, Nov -29, Dec-6 and Dec-13 and two varieties viz. Improved Tori-7 and BAR1 Sarisha-10. Results showed that primary branches plantG[1],weight of seeds plantG[1], biological yield, harvest index and seed yield were the highest from the second sowing (Nov 8) and it was significantly different from of all other dates of sowing. Oil yield was the highest in 15 Nov sowing. Higher oil yield was obtained from Improved Tori-7 *(Brassica campestries)* and lower from BAR1 Sarisha-10 *(B. juncea).* It may concluded that among the sowing dates 8 November sowing was the best for mustard and it may be from 4 to 15 November for both seed yield and oil yield. BARI Sarisha-10 was better than that of Improved Tori-7.

Key words: Response curve % Optimum planting date % Seed and oil yield % Mustard

INTRODUCTION

Rapeseed and mustard *(Brassica spp)* are important edible oil crops of Bangladesh. For rapeseed and mustard, we commonly use the term mustard. It tops the list in respect of area and production in this country, but second position in the world [1]. It contains about 40-45% oil and low saturated fatty acids 5-8% among all oil seed crops [2]. Its yield increases even in diverse and challenging conditions [3]. It also reduced chemical used and thereby increase profit [4]. Mustard covers about 0.55 million hectares of land and produces about 5.1 million tons of seeds and yield is about 932 kg/ha [5]. It is a cool loving crop and thermo sensitive as well as photo-sensitive crop [6]. The best growth of mustard occurs above 12°C and below25°C. The optimum temperature for maximum growth and development estimated at just over 20°*c* and minimum is 5°C [7]. Due to short winter period in Bangladesh, mustard harvesting should be completed by middle of February; otherwise the crop faces high temperature and yield become low. Planting time on the seed yield and oil yield of rapeseed and mustard is greatly influenced by the variation in atmospheric temperature, humidity and other biotic factors. Delay in planting reduces the yield on account of its depressing effect on the plant growth, flowering duration, seed formation and seed size. If sowing is delayed there is a great danger of attack of aphids on this crop [8]. Cultivars itself is the genetic factor, which contributes a lot for growth, yield and yield components of a particular crop. Yield components are directly related to the cultivar and the neighboring environments [9]. Mustard varieties are quite high yielding under appropriate environmental condition [10]. To get appreciable good performance of cultivar improved cultural practice like time of sowing is very important. BARI Sarisha-10 is a new variety and very little information is available on the influence of its sowing date. Therefore, satisfactory yield of mustard cultivar might be obtained through appropriate combination of variety and time of sowing. Considering the facts, the study was conducted with the following objectives.

- To determine the optimum time of sowing on yield and oil content/yield of mustard.
- To evaluate the performance of variety.

MATERIALS AND METHODS

Duration and Study Area: An experiment consisting of seven sowing dates (1, 8, 15, 22 and 29 November and

Corresponding Author: Pronay Bala, Department of Agricultural Science, Lalmia City College, Gopalgonj, Bangladesh. Tel: +8801712122612.

6 and 13 December) and two varieties (Improved Tori-7 and BAR1 Sarisha-10) was conducted during the *rabi* season on 2009-2010 and 2010-11 at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh. Seeds were collected from Oilseed Research Centre, BARI, Gazipur, Bangladesh.

Experimental Design: The experiment was laid out in a split-plot design with three replications. Sowing date was in the main plots and variety in the sub-plots. Plot area was 4m x 2.5m.

Intercultural Operation: Fertilizers were applied in the form of Urea (46% N), Triple super phosphate, muriate of potash, gypsum, zinc oxide and boric acid at the rate of 250, 170, 85, 150, 5 and 10 kg/ha, respectively [11]. Half of urea and full amount of other fertilizers were broadcasted during final ploughing. The rest half of urea was top dressed 22 days after emergence of seedling (DES). Seeds were sown 30 cm apart between rows at the rate of 8kg ha^{-1} for Improved Tori-7 and 7.5 kg/ha for BARI sarisha-10. Thinning and weeding were done twice after 12 days and 20 DES. Irrigation was applied before flowering (at 22 DES) of each plot according to sowing date. Malathion 57 EC (at the rate of 2 ml/10L) was sprayed to control aphids.

Data Collection: Ten randomly selected plants were uprooted from each plot for collecting data on different parameters such as primary branches plant^{-1} weight of seeds plant^{-1}, biological yield, harvest index, seed yield and oil yield. Crops were harvested on different dates depending on maturity.

Statistical Analysis: Data were analyzed by M-STAT program and the treatment means were compared by using Duncan's Multiple Range Test (DMRT) at 5% level of significance as out lined [12]. Soxhlet Extraction Method was used for determining oil content by using petroleum ether (BP 40-60°C). Optimum sowing time for maximum seed yield was calculated from simple polynomial regression curve. Oil yield was calculated by multiplying percentage oil content with seed yield.

RESULTS AND DISCUSSION

Effect of Sowing Date on Yield and Oil Content: The planting date significantly influenced all the parameters in both the trial years (Table 1 & 2). The highest number of primary branches (4.52-4.70) was recorded in 8 November sowing and sowing on 13 December produced the lowest (3.25-3.35) branches plant^{-1} respectively. Delay in sowing suppressed number of primary branches plant^{-1} [13]. Weight of seed plant^{-1} was maximum (5.22-5.44 g) at sowing date 8 November and minimum (2.25-2.37 g) at 13 December sowing (Table 1a and 1b). It is similar to Bukhtiar *et al.* 1992 [14]. When weight of seed plant^{-1} is maximized, yield is maximized. So it is the most important yield component of mustard [15]. The highest biological yield (6.19-6.29 t ha^{-1}) was found in 8 November sowing and reduced gradually with delaying sowing. The lowest biological yield (3.75-3.92 t ha^{-1}) was observed in 13 December sowing. It might be due to short life and less height in delayed sowing. The findings revealed that the duration of vegetative phase and higher dry matter production were positively correlated with yield. The highest harvest index (35.01-37.43%) was in 1 November sowing and identical to 8 November sowing. The lowest harvest index (22.01-22.11%) was in 13 December sowing and identical to 6 December. It may be due to the change of environmental condition. Harvest index was higher, where seed yield performed better than other. The 8 November sowing gave the highest seed yield (1.95-2.19 t ha^{-1}) which was identical to 15 November sowing and the lowest yield (0.74-0.88 t ha^{-1}) was obtained from 13 December. The longest reproductive period resulted in better yield of early crop, while in delay sowing there was drastic reduction in yield due to shorter reproductive period. Short growth period and adverse temperature might have affected the yield in late sown crop. But gradual decrease in yield with delay in sowing might be due to the relatively low temperature at vegetative phase which could have adversely affected the plant growth and development. It is fully supported by Butter and Aulakh (1999). In Fig. 1 the polynomial regression curve shows that the response of seed yield to different sowing dates followed quadratic in nature. The polynomial regression analysis showed a moderate negative correlation of yield with sowing time The calculated optimum sowing time was 4-15 for maximum yield. Oil yield was highest (0.88-0.91 t ha^{-1}) in 8 November sowing and lowest (0.25-0.35 t ha^{-1}) in 13 December sowing. It may be due to rainfall at first 4 weeks enhanced oil content of seed. In general, high temperatures (higher than 24-25^{0}C) cause a sharp decrease in oil content [17]. Decline in oil content might be because of more protein content in seeds when the sowing was delayed [18]. From Fig 2 it is evident from the polynomial regression curve that the response of oil content to different sowing dates is quadratic in nature and showed a negative correlation. The calculated optimum sowing time was 4-15 November for maximum oil yield. Percentage of yield loss was height in 13 December sowing (59.82-62.05%) and lowest 15 November sowing (5.1-10.78%). It is agreed with Rahman *et al*. [19].

Fig. 1: Relationship between sowing time and seed yield

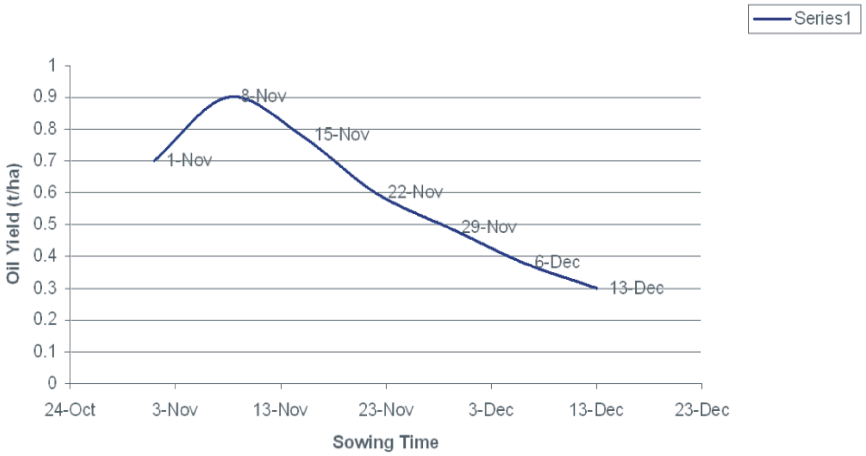

Fig. 1: Relationship between sowing time and oil yield

Table 1a: Effect of sowing time and variety on yield and yield components of mustard during 2009-10

Treatment	Primary branches plant^{-1} (no)	Wt of seeds plant^{-1}(g)	Biological yield (tha^{-1})	Harvest index (%)	Seed yield (tha^{-1})	Oil yield (t ha^{-1})	Yield loss from the optimum (%)
Nov1 (T_1)	4.50b	5.28b	5.46c	37.43a	1.77b	0.73 bc	19.18
Nov8 (T_2)	4.70a	5.44a	6.29a	37.07a	2.19a	0.91a	-
Nov15(T_3)	3.82c	5.26b	5.79b	32.79b	1.91ab	0.81ab	10.78
Nov22(T_4)	3.68cd	3.89c	4.97d	30.21c	1.53c	0.64c	30.14
Nov29(T_5)	3.57d	3.00d	4.56e	25.90d	1.23d	0.52d	43.84
Dec6(T_6)	3.42e	2.48c	4.15f	22.66e	0.96de	0.40de	52.92
Dec13(T_7)	3.35f	2.37f	3.92g	22.11e	0.88e	0.35e	59.82
S x	0.03	0.02	0.03	0.37	0.07	0.42	0.06
Cv (%)	2.15	1.41	2.05	3.29	11.10	0.68	10.87
variety:							
Improved Tori-7 (V1)	3.84	3.53b	4.46b	26.78b	1.16b	0.48a	36.61
BARI Sarisha-10(V2)	3.88	4.55a	6.58a	32.64a	1.83a	0.41b	-
S x	0.02	0.01	0.02	0.21	0.04	0.67	0.05
Cv (%)	2.15	1.41	2.05	3.29	1.50	0.5	0.5

In a column, the figures having common letter(s) do not differ significantly at 0.05 levels

Table 1b: Effect of sowing time and variety on yield and yield components of mustard during 2010-11

Treatment	Primary branches plant^{-1} (no)	Wt of seeds plant^{-1} (g)	Biological yield (tha^{-1})	Harvest index (%)	Seed yield (tha^{-1})	Oil yield (t ha^{-1})	Yield loss from the optimum (%)
Nov1 (T_1)	4.15b	5.11b	5.36c	35.10a	1.55b	0.66 bc	20.51
Nov8 (T_2)	4.52a	5.22a	6.19a	35.01a	1.95a	0.88a	-
Nov15(T_3)	3.75c	5.15b	5.56b	32.52b	1.85ab	0.75ab	5.1
Nov22(T_4)	3.57cd	3.78c	4.88d	30.01c	1.45c	0.55c	25.64
Nov29(T_5)	3.46d	2.88d	4.36c	25.65d	1.10d	0.45d	43.58
Dec6(T_6)	3.38c	2.35c	4.01f	22.22e	0.88de	0.35de	54.87
Dec13(T_7)	3.25c	2.25f	3.75g	22.01e	0.74e	0.25e	62.05
S x	0.04	0.03	0.04	0.21	0.06	0.35	0.05
C V (%)	2.12	1.44	2.01	2.95	10.21	0.55	10.65
variety:							
Improved Tori-7 (V1)	3.74	3.43b	4.35b	24.35b	1.01b	0.35a	38.78
BARI Sarisha-10 (V2)	3.68	4.45a	6.43a	30.02aa	1.65a	0.31b	-
S x	0.03	0.02	0.03	0.11	0.03	0.52	0.04
Cv (%)	1.98	1.35	1.95	2.95	1.25	0.40	0.560

In a column, the figures having common letter(s) do not differ significantly at 0.05 levels

Effect of Variety: The highest number of primary branches (3.74-3.84) was recorded in BARI Sarisha-10 and lower (3.68-3.84) was found in Improved Tori-7 (Table 1). Weight of seeds per plant was higher (4.45-4.55g) in BARI Sarisha-10 and lower (3.43-3.53g) from Improved Tori-7. The highest biological yield (6.43-6.58 t ha^{-1}) was found from BARI Sarisha-10 and the lowest from Improved Tori-7 (4.35-4.46 t ha^{-1}). It might be due to higher plant height and long crop possessed by duration of BARI sarisha-10. BARI Sarisha-10 exhibited the highest value (30.02-32.64%) of harvest index while the lower value (24.35-26.78%) was found in Improved Tori-7. Harvest index varied markedly among varieties of different plant types in mustard. BARI Sarisha-10 produced higher seed yield (1.65-1.83 t ha^{-1}) and lower yield (1.01-1.16 t ha^{-1}) was produced in Improved Tori-7. This result with yield variation is due to the varietal differences. It is in conformity with the findings of Islam (1994) [13]. Higher oil yield (0.35-0.48 t ha^{-1}) was obtained from Improved Tori-7 (*Brassica campestris*) and lower (0.31-0.41 t ha^{-1}) from BARI Sarisha-10 (*B juncea*). Yield loss of Improved Tori-7(36.61-38.78%) was higher than BARI Sarisha-10.

Effect of Interaction: The highest number of primary branches (4.70-4.80) was recorded in 8 November sowing x BARI Sarisha-10 (T_2V_2) and the lowest (3.25-3.33) in 13 December sowing with Improved Tori-7 (T_7V_1) (Table 2a& 2b). The highest weight of seeds plant^{-1} (6.10-6.14g) was obtained in 8 November sowing x BARI Sarisha-10 (T_2V_2) interaction, while the lowest weight of seeds plant^{-1} (2.00-2.07g) from 13 December x Improved Tori-7 (T_7V_1). The highest biological yield(6.75-6.90 t ha^{-1}) was found from the interaction of 8 November sowing x BARI Sarisha-10 (T_2V_2) and lowest biological yield (3.48-3.58tha^{-1}) was obtained from 13 December sowing x Improved Tori-7 (T_7V_1). Maximum value (37.10-39.20%) of harvest index was obtained from interaction of 8 November sowing x Improved Tori-7 (T_2V_1), while lowest value (15.26-18.36%) of harvest index found from 13 December sowing x Improved Tori-7 (T_6V_1) which was identical to 6 December sowing x Improved Tori-7 (T_6V_1).

The highest seed yield (2.28-2.38 t ha^{-1}) was obtained from the interaction between 8 November sowing and BARI Sarisha-10 (T_2V_2) and the lowest yield (0.55-0.66 t ha^{-1}) was obtained from 13 December sowing x Improved Tori-7(T_7V_1). So varieties and properties were not been effective, the sowing times were effective. If sowing time of mustard was delayed BARI Sarisha-10 was very suitable for late sowing for getting a reasonable yield [20]. The highest oil yield (0.98-1.00 t ha^{-1}) was obtained from 15 November x BARI Sarisha-10(T_3V_2), while the lowest oil yield (0.25-0.27 t ha^{-1}) was obtained from 13 December sowing x Improved Tori-7 (T_7V_1).The highest yield loss(72.27-75.66%) was obtained from 13 December sowing x Improved Tori-7(T_7V_1) while the lowest yield loss (0.84-0.88%) was obtained from 15 November sowing x BARI Sarisha-10(T_3V_2),.

Table 2a: Interaction effects of sowing time and variety on seed yield, oil yield and other yield components of mustard during2009-10

Treatment	Primary branches plantG^1 (no)	Wt of seeds plant G^1(g)	Biological yield (thaG^1)	Harvest index (1)	Seed yield (thaG^1)	Oil yield (thaG^1)	Yield loss from the optimum (%)
T_1V_1	4.50	4.83c	5.13c	36.86ab	1.43cd	0.60bc	39.92
T_1V_2	4.50	5.74bc	5.80b	38.81a	2.10ab	0.86ab	11.76
T_2V_1	4.60	5.73b	5.68b	39.20a	2.00ab	0.63a	15.97
T_2V_2	4.80	6.14a	6.90a	34.93bc	2.38a	1.00a	-
T_3V_1	3.80	4.47e	4.81d	30.39d	1.46cd	0.61b	38.66
T_3V_2	3.83	6.05a	6.77a	35.19bc	2.36a	1.00a	0.84
T_4V_1	3.70	3.15g	4.36ef	25.28c	1.10de	0.47d	53.78
T_4V_2	3.67	4.63d	5.48b	35.14bc	1.96ab	0.67ef	71.85
T_5V_1	3.60	2.35j	3.92g	19.02f	0.75ef	0.32e	68.48
T_5V_2	3.53	3.77f	5.20c	32.77c	1.70be	0.71c	28.57
T_6V_1	3.40	2.11k	3.76gh	18.36f	0.69ef	0.29ef	71
T_6V_2	3.43	2.85h	4.54e	26.96e	1.22d	0.49d	48.74
T_7V_1	3.33	2.07k	3.58h	18.36f	0.66f	0.27fg	72.27
T_7V_2	3.37	2.66i	4.28f	25.86e	1.10de	0.44de	53.78
Sx		0.03	0.06	1.56	0.10	0.23	0.10
CV(%)	2.15	1.41	2.05	3.29	11.10	0.39	12.25

In a column, the figures having common letter(s) do not differ significantly at 0.05 levels.

Legend:

T_1V_1= (Nov1 x Improved Tori -7) T_2V_2= (Nov1 x BARI Sarisha-10) T_2V_1= (Nov8 x Improved Tori -7) T_2V_2= (Nov8 x BARI Sarisha-10)
T_3V_1= (Nov15 x Improved Tori -7) T_3V_2= (Nov15 x BARI Sarisha-10) T_4V_1= (Nov22 x Improved Tori -7) T_4V_2= (Nov22 x BARI Sarisha-10)
T_5V_1= (Nov29 x Improved Tori- 7) T_5V_2= (Nov29 x BARI Sarisha-10) T_6V_1= (Dec6 x Improved Tori- 7) T_6V_2= (Dec6 x BARI Sarisha-10)
T_7V_1= (Dec13 x Improved Tori- 7) T_7V_2= (Dec13 x BARI Sarisha-10)

Table 2b: Interaction effects of sowing time and variety on seed yield, oil yield and other yield components of mustard during during 2010-11

Treatment	Primary branches plantG^1 (no)	Wt of seeds plantG^1(g)	Biological yield (thaG^1)	Harvest index (1)	Seed yield (thaG^1)	Oil yield (thaG^1)	Yield loss from the optimum (%)
T_1V_1	4.35	4.75c	5.08c	35.26ab	1. 35cd	0.55bc	40.78
T_1V_2	4.30	5.47b	5.60b	36.75a	1.95ab	0.75ab	14.47
T_2V_1	4.55	5.57b	5.48b	37.10a	1.90ab	0.53a	16.67
T_2V_2	4.70	6.10a	6.75a	34.13bc	2.28a	0.98a	-
T_3V_1	3.70	4.25e	4.75d	30.19d	1.36cd	0.50b	40.25
T_3V_2	3.65	5.90a	6.70a	34.75bc	2.26a	0.96a	0.88
T_4V_1	3.70	3.10g	4.25ef	25.01c	1.00de	0.43d	56.14
T_4V_2	3.65	4.63d	5.35b	32.10bc	1.75ab	0.65bc	23.25
T_5V_1	3.70	2.15j	3.75g	18.02f	0.70ef	0. 25e	69.03
T_5V_2	3.40	3.55f	4.85 c	30.25c	1.55be	0.61c	32.02
T_6V_1	3.35	2.05k	3.55 gh	15.26f	0.56ef	0.25e	75.43
T_6V_2	3.35	2.70h	4.44e	24.75e	1.11d	0.45d	51.32
T_7V_1	3.25	2.00k	3.48h	15.26f	0.55f	0.25ef	75.66
T_7V_2	3.35	2.56i	4.18f	24.26e	1.02de	0.41de	55.26
Sx	-	0.02	0.05	1.25	0.10	0.20	0.12
CV(%)	2.20	1.35	1.95	3.10	10.75	0.35	10.75

In a column, the figures having common letter(s) do not differ significantly at 0.05 levels.

Legend:

T_1V_1= (Nov1 x Improved Tori -7) T_2V_2= (Nov1 x BARI Sarisha-10) T_2V_1= (Nov8 x Improved Tori -7) T_2V_2= (Nov8 x BARI Sarisha-10)
T_3V_1= (Nov15 x Improved Tori -7) T_3V_2= (Nov15 x BARI Sarisha-10) T_4V_1= (Nov22 x Improved Tori -7) T_4V_2= (Nov22 x BARI Sarisha-10)
T_5V_1= (Nov29 x Improved Tori- 7) T_5V_2= (Nov29 x BARI Sarisha-10) T_6V_1= (Dec6 x Improved Tori- 7) T_6V_2= (Dec6 x BARI Sarisha-10)
T_7V_1= (Dec13 x Improved Tori- 7) T_7V_2= (Dec13 x BARI Sarisha-10)

CONCLUSIONS

From the above findings it may be concluded that optimum sowing date for seed yield and oil yield of mustard may be from 4 to 15 November. BARI sarisha-10 performed better under all dates of sowing and it may be sown in late up to 22 November. Further research is needed to find out optimum sowing time in sub tropical or same environments.

REFERENCES

1. Raymer, P.L., 2002. Rapeseed: An Emerging Oilseed Crop. In: Trends in New Crops and New Uses, Janick, J. and A. Whipkey (Eds.). ASHS Press, Alexandria, VA., pp: 122-126.
2. Starner, E.B., H.L Phardwaj, A. Hamama and M. Rangappa, 1996 Rapeseed production in Varginia. In: progress in New Crops Janick, J. (Eds). ASHS Press, Alexandria, VA., pp: 287-290.
3. Sidlauskas, G. and P. Tarakanovas, 2004. Factors affecting nitrogen concentration in spring oilseed rape *(Brassica napus* L.). Plant Soil Environ, 50: 227-234.
4. Gan, Y., S.S. Malhi, S. Brandt, E.K. Mupondwa and H.R. Kutcher, 2007. *Brassica juncea* canola in the Northern Great Plains: Responses to Diverse environments and nitrogen fertilization. J. Agron., 99: 1208-1218.
5. DAE (Department of Agricultural extension), 2011. Oil statistics. Extension Statics Retrieved May 20,2011 from http/www.dae.gov.bd/ index. php? area=statistics& action=sta_oil.html
6. Ghosh, R.K. and B.N. Chatterjee, 1988. Effect of dates of sowing on oil content and fatty acid profiles of Indian mustard. Indian J. Oil Seed Res., 5: 144-149.
7. Wahhab, M.A., M.R.I. Mondal, M.A. Akbar, M.S. Alam, M.U. Ahmed and F. Begum, 2002. Status of oil crop production in Bangladesh. Oil seed Research Centre, Bangladesh Agril. Research Institute Joydebpur, Gazipur., pp: 9-10.
8. Singh, C., P. Singh and R. Singh, 2007. Modern Techniques of Raising Field Crops. 2nd Edn., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, pp: 340-347.ISBN81-204-1599-X.
9. Rahman, M.A., M. Ahmed, M.K. Islam and M.S. Jannat, 2004. Effect of time of transplanting and cultivar on growth and yield of rice. J. Soil Health and Environ., 1(2): 47-52.
10. Rashid, A., R.H. Ghulam, J. Nasir, S.N. Malik and G.N. Ali, 2002 Genotype X Environment Interaction and Stability Analysis in Mustard. Asian J. Plant Sci., 1(5): 591-592.
11. Mondal, M.R.I. and M.A. Wahhab, 2001. Production technology of oil crops. Oilseed Research Centre, Bangladesh Agricultural, Research Institute. Joydebpur, Gazipur, pp: 6-24.
12. Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. John Wiley and Sons. New York, pp: 139-240.
13. Islam, N., M Choudhury and M.R. Karim, 1994. Effects on Sowing date on Growth and Development of Mustard and Rapes. Progress Agric., 59: 23-29.
14. Bukhtiar, B.A, M. Atta and G. Habib, 1992. Effect of sowing dates on seed yield of rapeseed and mustard under rain fed conditions. J. Agric. Res., 3: 763-469.
15. Angrej, S., K.K. Dhingra, S. Jagroop, S. Singh, M.P. Singh and A Singh, 2002. Effect of sowing time and plant density on growth, yield and quality of Ethiopian mustard J. Res. Punjab Agril. Uni., 39: 471-475.
17. Kaul, A.K. and M.L. Das, 1986. Oil Seed in Bangladesh. Canada Agriculture Sector Team, Ministry of Bangladesh, Dhaka., pp: 42-62.
18. Singh, Y. and M. Singh, 1991. Effect of sowing time, spacing and nitrogen levels on yield of mustard. Indian J. Agron., 36: 429-430.
19. Rahman, M.M., S.M.A. Hossain, N. Islam, M. Jalaluddin and M.U. Salam, 1993. Effect of sowing date and boron fertilizer on the yield and oil content of mustard and rapeseed. Bangladesh Agron. J., 15: 73-78.
20. Mondal, M.R.I. and M.A. Wahhab, 2001. Production technology of oil crops. Oilseed Research Centre, Bangladesh Agricultural, Research Institute. Joydebpur, Gazipur, pp: 6-24.