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Effect of irrigation and sowing method on yield and yield attributes of mustard

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Abstract

The experiment was carried out at Agronomy Field laboratory, Department of Agronomy and Agricultural Extension, university of Rajshahi, to study the effect of irrigation and sowing method on yield and yield attributes of mustard. The experiment consists of two factors i) irrigation viz. no irrigation (I_0), one irrigation (I_1)and two irrigations (I_2) ii) sowing method viz. line sowing method (M_1) and broadcasting method (M_2). A split- plot design was used for the experiment by assigning the irrigation on the main plots and sowing method to the sub plots with three replications. Irrigation had significant effect on all the yield and yield contributing characters. The highest plant height, number of branches plant^{-1}, filled siliqua plant^{-1}, sliqua length, number of seed siliqua^{-1}, 1000-seed weight and stover yield were obtained from I_2 (two irrigations) and consequently it produced the highest seed yield. Sowing method also had significant influence on almost all the yield and yield contributing characters. All the yield contributing characters except number of unfilled siliqua plant^{-1}were found best at line sowing method (M_1) and consequently it produced the highest seed yield. However it could be noted from the study that the combination of two irrigations with line sowing method is better to get higher yield of mustard.

***Keywords*:** Irrigation, sowing method, yield and mustard.

Introduction

Mustard (*Brassica spp.*) is an important oil seed crop in Bangladesh. It is the second most important edible oil in the world. About 13.2% of the annual edible oil comes from this crop (FAO, 2005). *Brassica* oil crop is the most important group that supplies major edible oil in Bangladesh. It accounts for 59.4% of total oil seed production in the country (AIS, 2010). Bangladesh is running a short of 60-75% of the demand of edible oil (Rahman, 2002).The average grain yield of mustard is only 0.71t/ha (BBS, 2008), which is very low as compared to that of advanced countries in the world. The major reasons for much poor yield is mainly use of indigenous variety and poor management as practiced at farmer's field. Therefore, attempts must be made to increase the per unit production by using HYV and by adopting proper management practices such as irrigation, appropriate sowing method and other cultural operations. Mustard is sensitive to the moisture stress from vegetative to early flowering stage. Mustard crop essentially require available moisture through its life cycle (Raut *et al.*, 2003). Irrigation has been found to increased seed yield (Majid & Simpson, 2003). Irrigation has also an effect on mustard to increase nitrogen uptake along with other nutrients (Reddy *et al*., 1989) resulting in improved yield and yield attributes. Generally two main methods of sowing are followed in Bangladesh for mustard cultivation. They are line sowing and broadcasting. In line sowing, seeds are sown in separate line by maintaining plant to plant distance. Line sowing can ensure optimum plant population per unit area thereby increasing the yield of mustard. In broadcasting, seeds are sown haphazardly. As a result, it is difficult to maintain desired plant population per unit area which is important to obtain higher yield. A suitable method of sowing of mustard is to be found out for higher yield. Therefore the present study was under taken to find out the effect of irrigation and sowing method on the yield and yield attributes of mustard.

Materials and methods

The experiment was conducted at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, Rajshahi University, Rajshahi, during the period from November, 2010 to February, 2011 to study the effect of irrigation and sowing method on yield and yield attributes of mustard. The field belongs to the High Ganges River Flood Plain soils of AEZ-11. The soil was sandy loam. The soil of the experimental plot contained pH 7.56, total nitrogen (%) 0.084, available P (ppm) 11.25, available K (ppm) 35.54, available S (ppm) 24.36, available Zn (ppm) 35.24 and available B (ppm) 25.45. The experiment was designed with two factors. Factor (A) Levels of irrigation viz (i) No irrigation (I_0) ii. One irrigation (I_1) (25 days after sowing) and (iii). Two irrigation (I_2) (One at 25 DAS and other at 50 DAS) and factor B. Sowing method viz (i) Line sowing (M_1) and ii. Broadcasting (M_2). Split plot design was used for the experiment by assigning the irrigation in the main plots and sowing method in the sub plots. The treatments were replicated three times. The size of each plot was 2 m×2 m. BARI sarisha-13 was used as experimental material. The land was opened by a power tiller, later on it was ploughed and cross ploughed with country plough followed by laddering. The first ploughing was done 24 October 2010 and final land preparation was done on 5 November 2010 respectively. The experimental land was fertilized with urea, TSP, MoP, Gypsum and Borax fertilizers @ 250, 180, 100, 150 and 10 kg ha^{-1} respectively. The whole amount of TSP, MoP, Gypsum and Borax were applied as basal dose at final land preparation. Urea was applied in three equal splits, 1/3 as basal, 1/3 at 25 DAS and the rest 1/3 at 50 DAS. The seeds were sown on 9 November 2010. Two weedings cum thinning were done. Irrigations were done as per experimental treatments. The crop was harvested at the 90% of the siliqua maturity on 24 February 2011 at 102 DAS. Before harvesting the whole plot, 10 plants were randomly selected from each plot for collecting data on yield attributes. The sample plants were uprooted prior to harvest and dried properly in the sun and collected data from these plants. The seed and stover yields were measured from the plot after harvesting, cleaning and drying the plants from the whole plot. Data recorded were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done with the help of computer package MSTAT-C. The mean differences were compared with Duncan's Multiple Range Test (Gomez & Gomez, 1984).

Results and discussion

Irrigation showed significant influence on plant height. Results showed that the tallest plant (97.97cm) was obtained from two irrigations (Table 1). Plant height increased with the increase of irrigation frequencies. This is might be due to steady availability of soil moisture during growth period. The shortest plant (92.91 cm) was found at control treatment. Sowing method had significant effect on plant height. Line sowing produced the tallest plant (96.51 cm) and the shortest one (94.26 cm) was found at broadcast method (Table 2). The shortest plant in the closest spacing might be due to more competition for nutrient, moisture, space and light among the plants. These results partially in conformity with the result of Oad *et al*. (2001). They observed that plant height significantly affected by row spacing and wider spacing i.e. 60cm rows spacing proved to be best. The interaction effect of irrigation and sowing method had no significant influence on plant height (Table 3).

Table 1. Effect of irrigation on yield and yield contri **Effect of irrigation and sowing method** buting characters of mustard.

Irrigation	Plant height (cm)	Number of branches plant^{-1}	Number of filled siliqua plant^{-1}	Siliqua length (cm)	Number of seeds sliqua^{-1}	1000-seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
I_0	92.91b	7.84b	56.22c	5.31c	15.46b	3.38b	1.42c	2.26c
I_1	93.76b	8.26a	64.79b	5.70b	16.39ab	3.46a	1.58b	2.81b
I_2	97.97a	8.41a	71.80a	5.90a	17.50a	3.52a	1.81a	3.18a
LS	0.01	0.05	0.05	0.01	0.01	0.05	0.01	0.01
CV(%)	6.48	11.98	7.45	4.12	4.68	2.39	9.14	9.75

Table 2. Effect of sowing method on yield and yield contributing characters of mustard.

Sowing method	Plant height (cm)	Number of branches plant^{-1}	Number of filled siliqua plant^{-1}	Siliqua length (cm)	Number of seeds sliqua^{-1}	1000-seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
M_1	96.51a	8.42a	66.51	5.69	16.85a	3.49	1.69a	2.85a
M_2	94.26b	8.03b	63.04	5.49	16.25b	3.43	1.46b	2.66b
LS	0.05	0.05	0.05	NS	0.01	NS	0.05	0.01
CV (%)	6.48	11.98	4.47	4.12	4.68	2.39	9.14	9.75

Irrigation significantly influenced the production of total branches plant^{-1}. Results revealed that the highest number of branches plant^{-1} (8.41) was noted from two irrigations which was statistically similar with one irrigation and the lowest one (7.84) was recorded from control treatment (Table 1). This result is in conformity with the findings of Singh *et al*. (1993). They reported that two levels of irrigation resulted highest number of branches plant^{-1}. Sowing method had significant effect on the production of total branches plant^{-1}. Line sowing method produced the highest number of branches plant^{-1}(8.42). The lowest number of total branches plant^{-1} (8.03) was observed in the broadcast method. In the closer plant population at broadcasting method, there were competitions for light, space, nutrients and environments and therefore, lowest number of branches plant^{-1}, siliqua plant^{-1}, seeds siliqua^{-1} and 1000-seed weight were produced, ultimately seed yield plant^{-1} was decreased (Table 2). This result is agreement with Oad *et al*. (2001). The number of total branches plan^{-1} was not significantly influenced by the interaction of irrigation and sowing method (Table 3).

Table 3. Interaction effect of irrigation and sowing method on yield and yield contributing characters of mustard.

I × M	Plant height (cm)	Number of branches plant^{-1}	Number of filled siliqua plant^{-1}	Siliqua length (cm)	Number seeds sliqua^{-1}	1000-seed Weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
$I_0 \times M_1$	92.82	8.04	56.65d	5.40	15.68	3.41	1.55bc	2.28
$I_0 \times M_2$	92.52	7.64	55.78d	5.21	15.23	3.35	1.32d	2.23
$I_1 \times M_1$	94.99	8.31	66.57bc	5.73	16.52	3.50	1.62bc	2.84
$I_1 \times M_2$	92.99	8.20	64.00bc	5.68	16.25	3.42	1.45bc	2.77
$I_2 \times M_1$	98.53	8.58	74.29a	5.93	17.74	3.55	1.86a	3.41
$I_2 \times M_2$	97.41	8.23	69.34bc	5.86	17.25	3.49	1.63b	2.95
LS	NS	NS	0.05	NS	NS	NS	0.05	NS
CV (%)	6.48	11.98	4.47	4.12	4.68	2.39	9.14	9.75

In column figures having same letters or without letters do not differ significantly as per DMRT.

NS= not significant, CV= Coefficient of variation, LS= level of significance.

The number of filled siliqua plant^{-1} was significantly influenced by the irrigation. Results showed that the maximum number of filled siliqua plant^{-1} (71.80) was obtained from two irrigations. The minimum (56.22) value was found at control treatment (Table 1). Results showed that the number of siliqua plant^{-1} increased with the increasing irrigation frequency. This result is in conformity with that of Sharma & Kumar (1989b). The number of filled siliqua plant^{-1} was significantly influenced due to sowing method. The highest number of filled siliqua plant (66.51) was observed at line sowing method and the lowest one (63.04) was observed at broadcast method (Table 2). Line sowing method allows the plants to absorb more nutrients, moisture and light than broadcast method. This result was in agreement with that view of Butter & Aulakh (1999). The number of filled siliqua plant^{-1} was significantly influenced by the interaction of irrigation and sowing method. Result showed that the highest number of filled siliqua plant^{-1} (74.29) was obtained from the combination of $I_2 \times M_1$ and the lowest one (55.78) was found in $I_0 \times M_2$ treatment combination (Table 3).

Irrigation had significant effect on siliqua length. The longest siliqua (5.90 cm) was produced by two irrigations and the shortest one was obtained from control treatment (Table 1). Siliqua length was not significantly influenced by sowing method. Numerically, the longest siliqua (5.69 cm) was found at line sowing method and the shortest one was obtained from broadcasting method (Table 2). Siliqua length was not significantly influenced due to the interaction of irrigation and sowing method (Table 3).

Number of seeds siliqua^{-1} was influenced significantly due to irrigation. The highest number of seeds siliqua^{-1} (17.50) was observed at two irrigations and the lowest number of seeds siliqua^{-1} (15.46) was recorded from no irrigation condition

(Table 1). These results are in conformity with Parsad & Ehsanullah (1988). Sowing method had significant influence on the number of seeds siliqua^{-1}. Results revealed that the line sowing method produced the highest number of seeds siliqua^{-1} (16.85) and the lowest one (16.25) was obtained from broadcast method of sowing (Table 2). These might be due to closest spacing and over population pressure. These results partially in conformity with the results of Khan & Muendel (2005). Significant influence was not found on the number of seeds siliqua^{-1} due to the interaction of irrigation and sowing method (Table 3).

Irrigation had significant influence on 1000-seed weight. Results showed that the highest 1000-seed weight (3.52 g) was produced in two irrigations which was statistically similar with one irrigation. The lowest 1000-seed weight (3.38 g) was produced in no irrigation (Table 1). This result is in agreement with Sharma & Kumar (1989a). The weight of 1000-seed was not influenced by sowing method. The maximum weight of 1000-seed (3.49 g) was obtained from line sowing method and the minimum weight of 1000-seed (3.43 g) was found in broadcasting method (Table 2). Similar results were obtained by Gupta (1988). The weight of 1000-seed was not significantly influenced due to the interaction of irrigation and sowing method (Table 3).

Seed yield is the ultimate goal of mustard cultivation. Irrigation had significant influence on the seed yield of mustard. The highest seed yield (1.81 t ha^{-1}) was produced at two irrigations and lowest one (1.42 t ha^{-1}) was obtained from I_o treatment (No irrigation) (Table 1). The reason of the highest seed yield might be due to the highest value at all the yield contributing characters such as plant height, number of filled siliqua plant^{-1}, number of seeds siliqua^{-1} and 1000-seed weight. Whereas, non irrigated plots produced the lowest plant height, filled siliqua plant^{-1}, number of seed siliqua^{-1} and 1000- seed weight. Giri *et al.* (2003) found that different irrigation practices significantly increased the mustard yield over the control. Sowing method had significant influence on seed yield. The highest seed yield (1.69 t ha^{-1}) was found from line sowing. Whereas, the lowest seed yield (1.46 t ha^{-1}) was exhibited from the broadcasting method (Table 2). Similar results were obtained by Khan & Muendel (2005). Significant effect was observed on seed yield due to the interaction of irrigation and sowing method. The highest seed yield (1.86 t ha^{-1}) was obtained from the combination of $I_2 \times M_1$ and the lowest seed yield (1.40 t ha^{-1}) was obtained from the combination of $I_o \times M_2$ (Table 3).

Stover yield was affected significantly due to irrigation. The highest stover yield (3.18 t ha^{-1}) was obtained from two irrigations and the lowest one (2.26 t ha^{-1}) was from no irrigation treatment (Table 1). Significant influence was found on stover yield due to sowing method. The line sowing method produced the highest stover yield (2.85 t ha^{-1}). The lowest stover yield (2.66 t ha^{-1}) was found in broadcasting method (Table 2). This result is partially similar to the report of Singh *et al*. (2003). Significant effect was not observed on stover yield due to the interaction of irrigation and sowing method. Numerically, the highest stover yield (3.41 t ha^{-1}) was obtained from the combination of $I_2 \times M_1$. The lowest sotver yield (2.23 t ha^{-1}) was found in combination of $I_o \times M_2$ (Table 3).

From the study it may be concluded that two irrigations with a line sowing method is better to get higher yield of mustard.

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