Bangladesh J. Environ. Sci., Vol. 39, 116-120, 2020 @ BAED ISSN 1561-9206

GROWTH AND YIELD OF MUSTARD (*Brassica sp*.) AS INFLUENCED BY IRRIGATION AND FERTILIZER

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ABSTRACT

To observe the growth and yield attributes of mustard under different irrigation frequency and fertilizer levels, a field experiment was conducted with mustard (*Brassica sp*.) var. "BARI Sarishal-15". The experiment was carried out at the research field of the Department of Crop Science and Technology, Rajshahi University, Rajshahi during the period from October, 2019 to February, 2020. The experiment consisted of three irrigation frequency i.e. no irrigation, 2 times irrigation and 3 times irrigation as well as three levels of fertilizers viz. 80-20-30 kg/ha NPK (Farmers practice), 90-30-40-25-1.0 kg/ha NPKSB (MYG) and 100-40-50-35-1.5 kg/ha NPKSB (HYG). The results revealed that different treatments significantly affected the growth and yield attributes of mustard. The combination of two times irrigation and highest level of fertilizer (HYG) produced the maximum plant height, no. leaves per plant, no. of branches per plant, pod length, no. of pods per plant, no. of seeds per pod, 1000 seeds weight, seed yield, straw yield and minimum days required to 50% flowering and maturity. On the other hand, all the studied parameters except days to 50% flowering and maturity found to be the lowest in no irrigation along with fertilization as farmers practice. Hence, the study concluded that two times irrigation and 100-40-50-35-1.5 kg/ha NPKSB can be used for getting the targeted yield as well as desired return from mustard cultivation in "High Ganges River Floodplain zones" of Bangladesh.

Key words: Irrigation, fertilizer, growth, yield, mustard

Introduction

Mustard (*Brassica spp*. L.) belongs to the family *Brassicaceae* (formally Cruciferae) is a cool season, thermo sensitive as well as photosensitive crop (Ghosh and Chatterjee, 1988). It is one of the most important oil crops of the world after soybean and groundnut. In Bangladesh context, mustard is popular edible oil in rural area and is considered important for improving the taste of a number of food items. Mustard is rich in minerals like calcium, magnesium, iron, vitamin A, C and proteins. 100 g mustard seed contains 508 kcal energy, 28.09 g carbohydrates, 26.08 g proteins, 36.24 g total fat, 12.2 g dietary fiber, 31 I.U. vitamin A, 7.1 mg vitamin C, 266 mg calcium, 9.21 mg iron, 370 mg magnesium and 738 mg potassium (USDA (2014). It is widely used as a cooking ingredient, condiment and for its medicinal value. It also serves as an important raw material for industrial use such as in soap, paints, varnishes, hair oils, lubricants, textile auxiliaries, pharmaceuticals, etc. Moreover, mustard oil cake is utilized as cattle feed and small quantities are also used as manure. It covers about 80% of the total oilseed acreage and about 71% of the total production in Bangladesh (BBS, 2009). Last ten years have witnessed gradual decline in an area of 104 thousand hectare and production 68 thousand tons of mustard and rapeseed (Anonymous, 2006). Though the production of edible oil is being decreased, whereas, the demand is increasing day by day for increased population. Cultivation of low yielder local varieties, water and proper fertilizer management are the major causes for poor yield of mustard in the country (Alam and Rahman, 2006). So, there is a great scope of increasing yield of mustard by selecting high yielding varieties and improving management practices. Mustard is mainly grown during the winter season (October-March). The growth yield attributes and yield of mustard increased significantly with the increase in number irrigation. Adequate supply of moisture in soil helps in proper utilization of plant nutrients, ensuring proper growth and yield of mustard. The frequency of irrigation and the amount of water required depend on cultivar, soil type, season, amount of rainfall and diseases; therefore, it is difficult to give definite recommendation. Over irrigation, as well as under irrigation may lower yields. Indeed, irrigation had significant effect on all the yield and yield

contributing characters. Poor fertilizer management also an important causes for having reduced yield of mustard. Usually, mustard is cultivated in marginal land with low fertility. By supplying proper amount of fertilizer, total production of mustard can be increased. It is reported that application of mixed fertilizers (NPKS) would help to increase seed yield in mustard (Jagvir *et al*., 2004). A very few research have so far been done with combined application of fertilizer and irrigation in mustard. Therefore, the present study is undertaken to assess the effect of irrigation frequency and fertilizer on the growth and yield of mustard.

Materials and Methods

The experiment was carried out at the research field of Department of Crop Science and Technology, University of Rajshahi, Rajshahi, during the period from October, 2019 to February, 2020 with mustard (*Brassica sp*.) var. "BARI Sarishal-15". The study area is located at 24. 370^0 N and 88.637^0 E latitude and 200 cm from the sea level and was belonging to the Agro Ecological Zone (AEZ-11) "High Ganges River Floodplain". The soil was sandy loam in texture with pH 5.47. The experimental area is under the sub-tropical climate that is characterized by less rainfall associated with moderately low temperature during rabi season, (October-March) and high temperature, high humidity and heavy rainfall with occasional gusty winds during kharif season (April-September). The two factors Randomized Complete Block Design (RCBD) with three replications was followed to carried out the study. The study consisted three irrigation frequency (factor A) i.e. I_0=no irrigation, I_1=2 times irrigation (at 20 and 50 DAS) and I_2=3 times irrigation (at 20, 40 and 50 DAS) as well as three levels of fertilizers (factor B) viz. F_1:80-20-30 kg/ha NPK (Farmers practice), F_2:90-30-40-25-1.0 kg/ha NPKSB (Moderate Yield Goal - MYG) and F_3:100-40-50-35-1.5 kg/ha NPKSB (High Yield Goal - HYG). The unit plot size was 3m X 2m. The seed of mustard was collected from the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur Plant to plant distance was continuous and 2-3 cm depth furrow and row to row distance was 30cm. Fertilizers were applied following the guidelines of Rashid (1993). Intercultural operations were done as and when necessary. Data were recorded for desired parameters from the sample plants at 60 days after sowing (DAS) and at harvest. Ten (10) plants were randomly selected from each unit plot for the collection of data. The collected data were analyzed using computer package MSTAT and mean differences were adjudged by using Duncan's Multiple Range Test following Gomez and Gomez (1984).

Results and Discussion

Plant height

Significant variation of plant height was found due to combined effect of irrigation and fertilizer (Table 1). The results revealed that at 60 DAS, the tallest plant (102.20cm) was obtained from treatment I_1F_3 (two times irrigation with High Yield Goal fertilizer) which was statistically similar with I_0F_3 and I_2F_3, whereas the shortest plant (85.15cm) was obtained from treatment I_0F_1 (no irrigation with farmers practice fertilizer) which was significantly different from all other treatments except I_0F_2, I_1F_1 and I_2F_1. It might be due to the soil moisture availability for the plant was which sufficient before third time irrigation at 50 DAS. Similar result was reported by Latif, 2006 and Kibbria, 2013. Ahmed *et al.* (1999) reported the higher yield contributing characters and yields by high fertilizer management in mustard.

No. of leaves per plant and no. of branches per plant

The effect of irrigation interacts better with fertilizer when sufficient moisture was supplied. Table 1 show that treatment I_1F_3 produced the highest no. of leaves per plant (21.28) and no. of branches per plant (7.50) which were statistically identical with treatments I_2F_3 and I_0F_3, I_1F_2, I_2F_2 and I_2F_3. The lowest no. of leaves per4 plant was found in I_0F_1 which was statistically similar with I_1F_1 and lowest no. of branches per plant was in I_1F_1 which was statistically identical with all other treatments except I_1F_3 and I_2F_3. 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 per plant.

Table 1. Effects of irrigation and fertilizer on vegetative growth of mustard

Treatments	Plant height (cm)	No. of leaves per plant	No. of branches per plant	Days to 50% flowering	Days to maturity
I_0F_1	85.15e	12.10e	4.25bc	42.50a	86.25a
I_0F_2	87.73de	16.71cd	5.00bc	37.50bc	83.70ab
I_0F_3	97.30ab	18.12bc	6.30a-c	34.87c	82.75bc
I_1F_1	88.52c-e	14.25de	4.00c	40.70ab	82.15bc
I_1F_2	91.00cd	15.23cd	5.80a-c	37.00bc	85.20ab
I_1F_3	102.20a	21.28a	7.50a	35.00c	80.20c
I_2F_1	90.75c-e	15.25cd	4.85bc	39.25ab	82.85bc
I_2F_2	93.82bc	17.25b-d	6.00a-c	38.90ab	84.20ab
I_2F_3	98.17ab	20.07ab	6.50ab	37.20bc	82.15bc
CV (%)	3.25	9.85	21.75	5.07	1.90
LSD (5%)	5.22	2.85	2.10	3.34	2.74

Table 2. Effects of irrigation and fertilizer on yield attributes and yield of mustard

Treatments	Pod length (cm)	No. of pods/plant	No. of seeds/pod	1000 seeds wt. (g)	Seed yield (t/ha)	Straw yield (t/ha)
I_0F_1	5.15b	60.35g	17.00e	2.50d	0.92e	1.25f
I_0F_2	5.80ab	64.25d-f	19.00cd	2.85b-d	0.95e	1.65c-f
I_0F_3	5.95ab	67.17bc	20.75ab	3.10ab	1.30bc	2.00b-d
I_1F_1	5.25b	62.00fg	17.95de	2.60cd	0.98de	1.45ef
I_1F_2	5.70ab	65.27c-e	19.75bc	2.90b-d	1.10c-e	1.79c-e
I_1F_3	6.40a	70.25a	21.30a	3.40a	1.60a	2.75a
I_2F_1	5.35b	63.00ef	18.00de	2.80b-d	1.00de	1.55d-f
I_2F_2	5.67ab	66.00b-d	19.20c	2.95bc	1.25b-d	2.10bc
I_2F_3	6.00ab	68.10ab	20.85ab	3.00bc	1.40ab	2.50ab
CV (%)	8.55	2.11	3.19	7.56	12.72	14.93
LSD (5%)	0.84	2.38	1.10	0.38	0.26	0.49

Means followed by the same letter(s) do not statistically differ at 5% level tested by DMRT.

Days to 50% flowering and maturity

Effect due to irrigation and fertilizer on days required to 50% flowering and maturity were found significant (Table 1). The treatment combination I_0F_1 required maximum number of days for 50% flowering and maturity (42.50 and 86.25) whereas I_1F_3 required the minimum (35.00 and 80.20) which were statistically identical with I_0F_2, I_0F_3, I_1F_1, I_1F_2, I_2F_1 and I_2F_3. Less number of days taken to 50% flowering and maturity with higher levels of fertilizer and frequencies of irrigation might be due to early vegetative growth and hastening the initiation of reproduction phase. These results were in conformity with the findings of Jilani *et al.* (2009).

Yield attributes and yield

All the recorded parameters regarding yield attributes and yield of mustard showed significant variations due to combined effect of irrigation frequency and fertilizer level (Table 2). The longest pod (6.40 cm) was found in treatment I_1F_3 which was statistically identical with all other treatments except I_0F_1, I_1F_1 and I_2F_1 whereas the shortest one (5.15 cm) was observed in I_0F_1 followed by I_1F_1 and I_2F_1. No. of pods per plant and no. of seeds per pod were found highest (70.25 and 21.30) in treatment I_1F_3 and the lowest (60.35 and 17.00) were observed in I_0F_1 which were statistically different from all other treatments. Results showed

that the number of pods per plant increased with the increasing irrigation frequency. This result is in conformity with that of Sharma & Kumar (1989). These results are in also conformity with Parsad and Ehsanullah (1988). Irrigation and fertilizer had significant influence on 1000 seeds weight. Results showed that the highest 1000 seed weight (3.40 g) was produced by I_1F_3 which was statistically similar with I_0F_3 whereas the lowest 1000 seeds weight (2.50 g) was found in I_0F_1 which was statistically identical with I_0F_2, I_1F_1, I_1F_2 and I_2F_1. This result is in agreement with Sharma & Kumar (1989**)**. Similar results were also obtained by Gupta (1988).

Seed yield is the ultimate goal of mustard cultivation. Irrigation with fertilizer had significant influence on the seed yield of mustard. The highest seed yield (1.60 t/ ha) was observed in I_1F_3 which was statistically identical with I_2F_3 and lowest one (0.92 t/ha) was obtained from I_0F_1 which was statistically identical with I_0F_2, I_1F_1, I_1F_2 and I_2F_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 pods per plant, number of seeds per pod and 1000 seeds weight. Giri *et al.* (2003) found that different irrigation practices significantly increased the mustard yield over the control. Similar results were obtained by Khan and Muendel (2005). Straw yield was affected significantly due to irrigation and fertilizer. The highest straw yield (2.75 t/ ha) was found in I_1F_3 which was statistically similar with I_2F_3 whereas the lowest one (1.25 t/ha) was from I_0F_1 which was statistically identical with I_0F_2, I_1F_1 and I_2F_1. This result is partially similar to the report of Singh *et al.* (2003). Significant effect was not observed on straw yield due to the interaction of irrigation and fertilizer.

Conclusion

The study concluded that mustard variety BARI Sarisha-15 cultivated with wo times irrigation and High Yield Goal fertilizer level may be recommended for getting the targeted yield as well as desired return from mustard cultivation in “High Ganges River Floodplain zones” of Bangladesh.

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