

**COMBINED EFFECT OF CHEMICAL FERTILIZERS AND IRRIGATION ON THE GROWTH AND YIELD OF MUSTARD (*Brassica spp. L.*)****M. Khatun and M. M. Ud-Deen\***

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**ABSTRACT**

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, 2023 to March, 2024. The aim of this research was to evaluate the excellent combination of these two parameters, as the nutrients and moisture are two major components that drastically affect mustard production. The experiment consisted of three levels of chemical fertilizers i.e. F<sub>1</sub> (80-20-30 kg/ha NPK), F<sub>2</sub> (90-30-40-25-1.0 kg/ha NPKSB), F<sub>3</sub> (100-40-50-35-1.5 kg/ha NPKSB) and the three levels of irrigations viz. I<sub>0</sub> (no irrigation), I<sub>1</sub> (two irrigation at 20 and 50 DAS), I<sub>2</sub> (three irrigation at 20, 40 and 50 DAS). BARI Sarisha-14 was used as test crop of this research. The most comprehensive combined treatment F<sub>3</sub>I<sub>2</sub> resulted in the maximum observed values of plant such as plant height (83.67 cm), number of leaves per plant (19.33), number of branches per plant (10.00), minimum days to 50% flowering (35.00), minimum days to maturity (75.00), siliqua length (5.03), number of siliqua per plant (100.33), number of seeds per siliqua (25.33), 1000 seeds weight (3.79 gm). This treatment also resulted in highest seed yield (1.59 t/ha), indicating a robust growth response. In contrast, the lowest values of all plant characters and seed yield (1.44 t/ha) except days to 50% flowering and maturity under the combined treatment F<sub>1</sub>I<sub>0</sub>. However, application of three irrigations with 100-40-50-35-1.5 kg/ha NPKSB may be practiced for achieving higher seed yield of mustard (BARI Sarisha-14) in the northern part of Bangladesh.

**Key words:** Chemical fertilizer, irrigation, growth and yield, mustard.

**Introduction**

Bangladesh produces a variety of oilseed crops including mustard, peanuts, sunflowers, soybeans, and sesame. The largest oilseed produced in Bangladesh is mustard. It is grown more or less all over Bangladesh, but more particularly in the districts of Comilla, Tangail, Jessore, Faridpur, Pabna, Rajshahi, Dinajpur, Kushtia, Kishoregonj, Rangpur, Dhaka (BBS, 2012). It is widely used as a cooking ingredient, condiment and for its medicinal value. 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. Only well planned management practices can improve the mustard production by 30-40%. Fertilizers are the pivotal parameters in mustard cultivation. It's critical to understand the nutrient requirements of the mustard crop. Mustard plants specifically require essential macronutrients such as N, P, and K and secondary macronutrients like S. The production of oilseed rapeseed depends heavily on mineral N fertilization (Rathke and Schuster, 2001). Rapeseed needs a large amount of N, and its availability is often limited in many places globally (Rossato *et al.*, 2001). Phosphorus (P) is vital for chlorophyll production and participates in numerous metabolic and physiological processes in plants, essential for their normal growth and development. Potassium (K), as a macronutrient, is crucial for plant growth and development and plays a key role in osmoregulation by maintaining low water potential in plant tissues. Additionally, Sulphur aids in synthesizing essential amino acids such as methionine, cystine, and cysteine (Kumar and Yadav, 2007). Furthermore, micronutrients such as zinc (Zn) and boron (B) are necessary for the healthy development of mustard crops. 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. Therefore, the synergistic effect of combining optimal irrigation schedules with appropriate fertilizer levels cannot be overstated. Thus, the aim of this study to address the most suitable integrated approach ensures that plants receive sufficient water and nutrients, leading to improved growth and productivity.

### 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, 2023 to March, 2024 with mustard (*Brassica sp.*) var. "BARI Sarishal-14". The study area is located at 24. 370<sup>0</sup> N and 88.637<sup>0</sup> 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 of three levels of chemical fertilizers (factor A) i.e. F<sub>1</sub> (80-20-30 kg/ha NPK), F<sub>2</sub> (90-30-40-25-1.0 kg/ha NPKSB), F<sub>3</sub> (100-40-50-35-1.5 kg/ha NPKSB) and the three levels of irrigations (factor B) viz. I<sub>0</sub> (no irrigation), I<sub>1</sub> (two irrigation at 20 and 50 DAS), I<sub>2</sub> (three irrigation at 20, 40 and 50 DAS). 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 chemical fertilizers and irrigation (Table 1). The results revealed that at 60 DAS, the tallest plant (83.67 cm) was obtained from treatment F<sub>3</sub>I<sub>2</sub> (100-40-50-35-1.5 kg/ha NPKSB with three times irrigation) significantly different from all other treatments whereas the shortest plant (76.75 cm) was obtained from treatment F<sub>1</sub>I<sub>0</sub> (80-20-30 kg/ha NPK with no irrigation) which was significantly different from all other treatments except F<sub>1</sub>I<sub>1</sub>, F<sub>1</sub>I<sub>2</sub> and F<sub>2</sub>I<sub>0</sub>. 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.

**No. of leaves per plant and no. of branches per plant:** The effect of chemical fertilizers interacts better with irrigation when sufficient moisture was supplied. Table 1 shows that treatment F<sub>3</sub>I<sub>2</sub> produced the highest no. of leaves per plant (19.33) and no. of branches per plant (10.00) which were statistically identical with treatments F<sub>2</sub>I<sub>2</sub>, F<sub>2</sub>I<sub>1</sub>, and F<sub>3</sub>I<sub>1</sub>. The lowest no. of leaves per plant (13.75) was found in F<sub>1</sub>I<sub>0</sub> which was statistically similar with F<sub>1</sub>I<sub>1</sub> and the lowest no. of branches per plant (6.66) was also observed in F<sub>1</sub>I<sub>0</sub> and it was statistically non-significant. 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.

**Days to 50% flowering and maturity:** Effect due to chemical fertilizers and irrigation on days required for 50% flowering and maturity were found significant (Table 1). The treatment combination F<sub>1</sub>I<sub>0</sub> required maximum number of days for 50% flowering and maturity (42.00 and 83.00) which were statistically

similar with F<sub>1</sub>I<sub>1</sub>, F<sub>2</sub>I<sub>0</sub> and F<sub>2</sub>I<sub>1</sub> whereas F<sub>3</sub>I<sub>2</sub> required the minimum days (35.00 and 75.00) which were statistically different from all other treatments. Less number of days taken to 50% flowering and maturity with high fertilizer doses and higher 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).

Table 1. Effects of chemical fertilizers and irrigation 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
F <sub>1</sub> I <sub>0</sub>	76.75 e	13.75 f	6.66	42.00 a	83.00 a
F <sub>1</sub> I <sub>1</sub>	76.84 e	14.54 f	7.66	41.00 ab	81.00 b
F <sub>1</sub> I <sub>2</sub>	77.43 e	16.20 e	7.88	36.00 bc	77.00 c
F <sub>2</sub> I <sub>0</sub>	77.41 e	18.00 bc	8.33	41.50 d	82.00 ab
F <sub>2</sub> I <sub>1</sub>	78.67 d	18.33 ab	8.66	41.00bc	82.00 ab
F <sub>2</sub> I <sub>2</sub>	79.48 d	19.00 a	8.89	38.00 b	78.00 c
F <sub>3</sub> I <sub>0</sub>	81.15 c	17.11 de	8.44	39.00 d	81.00 b
F <sub>3</sub> I <sub>1</sub>	82.22 b	18.33 ab	8.77	37.00 c	81.00 b
F <sub>3</sub> I <sub>2</sub>	83.67 a	19.33 a	10.00	35.00 e	75.00 d
Level of significance	*	**	NS	**	**
CV(%)	3.61	3.33	7.45	3.20	2.45

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

**Yield attributes and yield:** All the recorded parameters regarding yield attributes and yield of mustard showed significant variations due to combined effect of chemical fertilizers and irrigation frequency (shown in the Table 2).

Table 2. Effects of chemical fertilizers and irrigation on yield attributes and yield of mustard

Treatments	Silique length (cm)	No. of silique/plant	No. of seeds/ Silique	1000 seeds wt. (g)	Seed yield (t/ha)
F <sub>1</sub> I <sub>0</sub>	3.90 e	84.66 f	22.66	3.51 e	1.44 f
F <sub>1</sub> I <sub>1</sub>	4.13 d	88.11 de	23.00	3.59 cd	1.51 cd
F <sub>1</sub> I <sub>2</sub>	4.33 cd	96.33 b	23.22	3.52 e	1.56 abc
F <sub>2</sub> I <sub>0</sub>	3.93 e	86.00 ef	23.77	3.55 de	1.47 e
F <sub>2</sub> I <sub>1</sub>	4.63 bc	90.44 cd	24.00	3.69 bc	1.51 cd
F <sub>2</sub> I <sub>2</sub>	4.97 a	98.55 ab	24.33	3.73 ab	1.57 ab
F <sub>3</sub> I <sub>0</sub>	4.27 d	86.44 b	25.00	3.61 cd	1.47 e
F <sub>3</sub> I <sub>1</sub>	4.83 ab	92.88 c	24.89	3.77 ab	1.53 bc
F <sub>3</sub> I <sub>2</sub>	5.03 a	100.33 a	25.33	3.79 a	1.59 a
Level of significance	**	*	NS	*	**
CV(%)	4.28	5.58	4.58	4.03	4.68

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

The longest silique (5.03 cm) was found in treatment F<sub>3</sub>I<sub>2</sub> which was statistically similar with F<sub>2</sub>I<sub>2</sub>, whereas the shortest one (3.90 cm) was observed in F<sub>1</sub>I<sub>0</sub> which were statistically identical with F<sub>2</sub>I<sub>0</sub>. No. of silique per plant was found highest (100.33) in treatment F<sub>3</sub>I<sub>2</sub> which were statistically identical with F<sub>2</sub>I<sub>2</sub> whereas the lowest (84.66) was observed in F<sub>1</sub>I<sub>0</sub> which were statistically identical with F<sub>2</sub>I<sub>0</sub>. No. of seeds per silique was statistically non-significant. Results showed that the number of silique per plant increased with the increasing fertilizer and irrigation frequency. This result is in conformity with that of Sharma and Kumar (1989). These results are in also conformity with Parsad and Ehsanullah (1988). Chemical fertilizers and irrigation had significant influence on 1000 seeds weight. Results showed that the highest 1000 seeds

weight (3.79 g) was produced by F<sub>3</sub>I<sub>2</sub> which was statistically similar with F<sub>3</sub>I<sub>1</sub> and F<sub>2</sub>I<sub>2</sub> whereas the lowest 1000 seeds weight (3.51 g) was found in F<sub>1</sub>I<sub>0</sub> which was statistically identical with F<sub>1</sub>I<sub>2</sub> and F<sub>2</sub>I<sub>0</sub>. This result is in agreement with Sharma and Kumar (1989). Similar results were also obtained by Gupta (1988). Seed yield is the ultimate goal of mustard cultivation. Chemical fertilizer with irrigation had significant influence on mustard yield. The highest seed yield (1.59 t/ha) was observed in F<sub>3</sub>I<sub>2</sub> which was statistically identical with F<sub>2</sub>I<sub>2</sub> and F<sub>1</sub>I<sub>2</sub> whereas the lowest one (1.44 t/ha) was obtained from F<sub>1</sub>I<sub>0</sub> which was statistically different from all other treatments. 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 siliqua per plant, number of seeds per siliqua and 1000 seeds weight. Similar results were obtained by Khan and Muendel (2005).

### Conclusion

The study concluded that mustard variety BARI Sarisha-14 cultivated with 100-40-50-35-1.5 kg/ha NPKSB and three times irrigation 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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