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YIELD RESPONSE OF A MUSTARD MUTANT VARIETY TO DIFFERENT TIMES OF IRRIGATION

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Bangladesh is an agricultural country. Different kinds of crops like cereals, pulses, oilseeds, vegetables and fruits are grown here. Among them, mustard is one of the major oil seed crops of Bangladesh that covers 66.22% of the total oil seed area (BBS 2011). The present area and production of mustard are 2.42 lac ha and 2.22 lac m ton, respectively. The average yield of mustard in Bangladesh is very low (0.9 t/ha) (BBS 2011) compared to that of other oilseeds growing countries in the world. The reasons of lower yield are lack of good quality mustard seeds, lack of inadequate irrigation water and lack of inadequate adoption of improved production technologies. Bangladesh is producing about 0.16 million tons of edible oil per year against the requirement of 0.5 million tons (Miah and Alam 2009). There has been big gap between supply and demand of edible oils, which has been met through imports incurring a big amount of foreign exchange every year. Single irrigation at the vegetative stage produced higher yield than that of irrigation at flowering, pod formation and seed filling stages (Fateh *et al*. 2002). Two irrigations, one at pre-sowing and the other either at initiation of branching (40 DAS) or at flowering stage (60 DAS) was statistically at par to 3 to 4 irrigation treatments but was significantly superior to pre-sowing irrigation treatment in terms of growth, yield attributes and yield (Jagdev *et al.* 2001). They also reported that the consumptive use of water increased but the water use efficiency decreased with increasing number of irrigations. The consumptive use (CU) and crop coefficient value (CCV) increased with increasing irrigation frequency and water use efficiency (WUE) reversely related to irrigation frequency (Das and Roy 2003). The total water use and crop co-efficient were higher by using protective irrigation twice to the crop and 0 - 15 cm of soil layer was the active root zone for moisture extraction (Roy *et al*. 2003).

BINA Sarisha-4 is a released variety developed by the Bangladesh Institute of Nuclear Agriculture (BINA). It was developed by mutation breeding technique. Potentiality of BINA Sarisha-4 is very high. Maximum seed yield potential is 2.5 tons/ha (average 2.0 tons/ha). Seed contains 44% oil with low content of erucic acid. But for the changing climatic condition over time and space, the irrigation demand and yield potentiality of the crop needs to be verified at different agro-ecological Zones of the country. In consideration of the above facts, a study on yield response of a mustard mutant variety, BINA Sarisha-4 to different times of irrigation was undertaken.

The experiment was conducted at the Bangladesh Institute of Nuclear Agriculture (BINA) farm, Mymensingh. The topography of the land is medium high and the soil belongs to the old

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Brahmaputra Flood Plain with total N (%) of 0.067, available P (ppm) of 38.5, K (me %) of 0.107 and the pH value of 7.0. The bulk density of the soil ranged from 1.48 to 1.61 gm/cm^3 (Sarkar *et al.*1990). The major climatic parameters of the experimental field *viz.,* the air temperature (20.58 °C), humidity (82%), rainfall (0 mm), wind speed (1.08 km/h), sun shine (5.89 hrs), solar radiation (223 w/m^2) and evaporation (2.27 mm) data were collected from the weather yard of the Department of Irrigation and Water Management of Bangladesh Agricultural University. The experiment was set up in a randomized completely block design with four treatments and three replications. The plot size was 5 m × 4 m. The irrigation treatments were: I_0: No Irrigation (control); I_1: Irrigation at the vegetative stage (32 DAS) up to field capacity (FC), I_2: Irrigation at flowering stage (53 DAS) up to field capacity (FC) and I_3: Irrigation at the vegetative and flowering stages up to field capacity (FC), where, DAS is the days after sowing.

The mustard crop was sown manually on 4th November, 2009. The variety BINA Sarisha-4 was used and seeds were sown in line at the rate of 6.00 kg/ha. Prior to sowing, soil was fertilized with per hectare basal dose of 150 kg N as urea, 20 kg P as TSP, 40 kg K as MoP, 14.4 kg S as Gypsum. Urea was applied in two equal splits; one at active vegetative stage and the other at flowering stage. Intercultural operation was done in proper time. Irrigation water of known volume was applied in the treatment plots with a hose pipe. Soil moisture was measured using neutron moisture meter as well as gravimetrically at sowing, before and after irrigation, and at harvest. The crop was harvested on 14 February 2010. Data on the crop characters *viz.* plant height (cm), branch no./plant, number of pods/plant, pod length (cm), seed/pod, 1000 seed weight (g), seed yield (t/ha), straw yield (t/ha) were recorded. These data were then analyzed statistically.

The sowing time soil moisture in different treatment plots ranged from 24.6 to 28.9% by volume at 15 to 60 cm soil depth. The harvest time soil moisture drastically reduced as there was no rainfall during the whole crop growing periods (Fig. 1).

The effect of irrigation on the yield and yield components of mustard mutant variety, BINA Sarisha-4 is presented in Table 1. Irrigation showed significant effect on plant height, branch number per plant, number of pods per plant, seeds per pod per plant, yield, and straw yield and non-significant effect was found on pod length, and 1000 seed weight. The highest plant height (78.80 cm) was obtained in treatment I_1 followed by I_2 (75.80 cm) and the lowest (74.13 cm) in I_0 (control).

The highest number of branch/plant (2.13) was obtained in the treatment I_2 and the lowest (1.67) in treatment I_0 and I_1**.** Similarly, the highest number of pods/plant (52.67) and pod length (6.72 cm) were obtained in the treatment I_2 and the lowest in treatment I_0. The number of seeds per pod per plant was highest (26.93) in treatment I_2 which was 6% higher over the control (I_0); but the number decreased with the increase of the irrigation frequency.

The highest and almost similar 1000 seed weight (3.42 g) was obtained in all treatments except treatment I_1. The highest straw yield (2.68 t/ha) was obtained in treatment I_1 and the lowest (2.31 t/ha) in treatment I_3. Irrigation showed significant effect on grain yield of mustard. The highest yield of 1.55 t/ha was obtained in treatment I_1 and I_3 and lowest yield of 1.24 t/ha was

obtained in treatment I_0 (control). This might be due to the reason of higher soil moisture content in the experimental field.

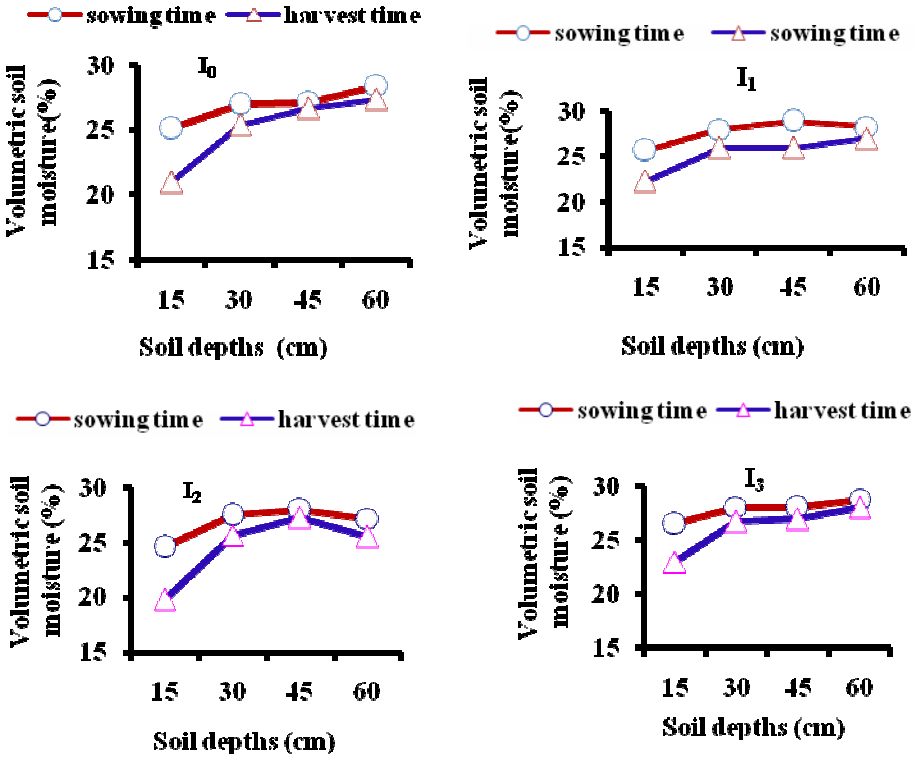

Fig. 1. Sowing and harvest time soil moisture content in the experimental field.

Table 1. Effect of irrigation on the yield and yield components of mustard mutant variety (BINA Sarisha-4).

Treatments	Plant height (cm)	Branch no./plant	No. of pods/ plant	Pod length (cm)	Seeds/ pod /plant	1000 seed wt. (g)	yield (t/ha)	Straw yield (t/ha)
I_0	74.13	1.67	42.87	6.07	25.33	3.42	1.24	2.43
I_1	78.80	1.67	47.93	6.27	26.27	3.41	1.55	2.68
I_2	75.80	2.13	52.67	6.72	26.93	3.42	1.26	2.63
I_3	75.47	1.80	50.33	6.22	26.00	3.42	1.55	2.31
LSD (%)	1.55	0.30	1.10	NS	0.63	NS	0.17	0.20
CV (%)	1.02	8.35	1.14	9.04	1.20	0.72	5.99	3.94

The water expense, water use and water productivity of mustard are presented in Table 2. Water expense was zero (0 cm) in control (I_0) because of no rainfall and no irrigation. The highest water expense (6.06 cm) was noted in treatment I_3 as there were two irrigations in this treatment. Water expense was calculated by adding the rainfall, and irrigation profile. The water use

increased with the increase in number of irrigation. Water use or ET was calculated by adding the rainfall, irrigation and profile soil moisture depletion. The highest water use (7.22 cm) was obtained in treatment I_3 and lowest water use (1.31 cm) was obtained in treatment I_0. The highest water productivity (9.47 kg/m^3) was, however, observed in I_0, obviously because of no irrigation and rainfall. The water productivity decreased with the increase of irrigation number and it was lowest (2.15 kg/m^3) in treatment I_3 followed by (3.01kg/m^3) in treatment I_2.

Table 2. Water expense, water use and water productivity of the mustard mutant variety (BINA Sarisha-4).

Treatments	Rainfall (cm)	Irrigation (cm)	Water expense (cm)	Soil moisture contribution (cm)	Water use (cm)	Yield (t/ha)	Water productivity (kg/m^3)
I_0	0	0	0	1.31	1.31	1.24	9.47
I_1	0	0.70	0.70	1.27	1.97	1.55	7.87
I_2	0	2.82	2.82	1.36	4.18	1.26	3.01
I_3	0	6.06	6.06	1.16	7.22	1.55	2.15

The depth of groundwater table during the experimental period (November - February) is shown in Fig. 2. It showed that in November, December up to 1st week of January, WT declined very slowly and then it declined at a fast rate. Thus, from November to January, water table varied from 6.31 m to 9.18 m and at harvest time of the crop at the end of February, WT depth was found

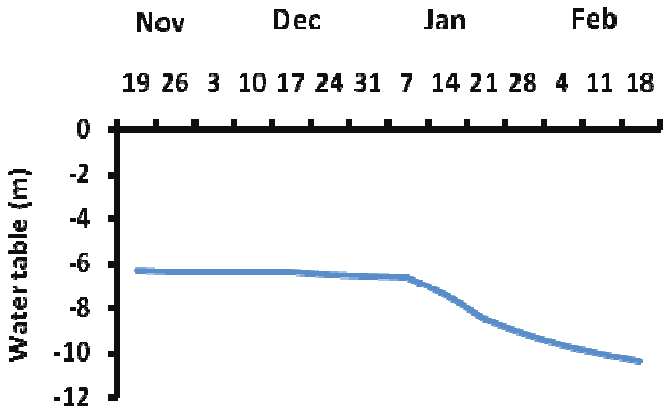

Fig. 2. Water table fluctuation during the experimental period.

to be 10.35 m. This deep water table depth indicated that there might not have any upward flux of water through capillary rise to meet up the ET demand of the crop. Thus, it was evident that the crop fulfilled its water requirement need by the higher residual soil moisture and applied supplemental irrigation at the vegetative stage to produce the optimum yield.

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