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EFFECT OF ROW SPACING ON YIELD PERFORMANCE OF SESAME MUTANTS

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Abstract

A field experiment was conducted in 2019 to evaluate the effect of row spacing on yield contributing characters of three advanced sesame mutants viz. SM-001, SM-002, SM-003 with one check variety (Binatil-2) at two BINA substation farms, Ishwardi and Chapainawabganj. The experiment was laid out in a RCBD with three replications. Four row spacings viz., 20 cm, 25 cm, 30 cm, and 35 cm were used as treatments. Among different advanced lines/variety, SM-002 produced the highest seed yield (1.07 t ha^{-1}) followed by Binatil-2 (1.05 t ha^{-1}). Among different row spacing, 25 cm showed the highest seed yield (1.11 t ha^{-1}) followed by 30 cm (1.02 t ha^{-1}) with same statistical rank. Between two locations, Chapainawabganj performed better than Ishwardi. The interaction effect between genotype and row spacing revealed that (SM-003) V_3 and (Binatil-2) V_4 performed best at 20 cm row spacing whereas SM-001 and SM-002 performed best at 25 cm row spacing. The interaction effect of row spacing and location, SM-002 produced the maximum seed yield (1.14 t ha^{-1}) in 25 cm row spacing at Chapainawabganj. The interaction effect of mutants/variety, row spacing, and locations showed that mutant line SM-003 produced maximum seed yield (1.19 t ha^{-1}) at 30 cm row spacing in Chapainawabganj.

Keywords: Mutant, Row spacing, Yield, Sesame

Sesame (*Sesame indicum* L.) is well recognized as a multipurpose industrial crop having various usages. Sesame seeds enrich in 50–62 % oil, 18-25% protein, 9.8% digestible fiber, 13.4–25.0% carbohydrate, and with high content of unsaturated essential fatty acids (Wei *et al.*, 2015; Couch *et al.*, 2017). It is referred to as the "queen of oilseeds" due to its regard by the users and owing to its oil quality (Bedigian *et al.* 1986). Sesame belonging to the Pedaliaceae family, is harvested for their edible seeds. Sesame seeds comprise vitamins, namely vitamin A, vitamin C, vitamin E, thiamine (B_1), riboflavin (B_2), niacin (B_3), pyridoxine (B_6) and folate (B_9), minerals (calcium, potassium, pantothenic acid, phosphorus, iron, magnesium, zinc) and tocopherols (Gharby *et al.*, 2017). Sesame oil is also full of antioxidant lignan. The availability of lignans such as sesamolin and sesamin, sesamol has been closely associated with the fabulous high oxidative stability in sesame oil (Lagarda *et al.* 2006). Sesame seeds constitute a rich source of phytosterols, which include anti-cancer properties, anti-inflammatory, anti-atherosclerotic, and anti-oxidative effects (Shweta *et al.* 2020). These components also affluent omega-6, vitamin E, and monounsaturated fats that confine the furring of arteries and skin elasticity (Singh *et al.* 2016).

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Sesame seeds have detained effects against several diseases such as osteoporosis, intestinal diseases, cardiovascular diseases, liver diseases, and also activities against cancer of the lungs, breast (Zeweil *et al.*, 2019), colon, prostate, blood, liver, cervical, and skin cancer (Kouighat *et al.* 2022). Oil seed crops play a decisive role in the economy of Bangladesh. It costs a lot of foreign currency to import edible oil to meet the national demand. In Bangladesh, sesame is an important oilseed crop occupying 6.6% of the total oilseed area (BBS, 2022). The average yield of sesame in Bangladesh is 0.94 t ha^{-1} (BBS, 2021). Due to the increasing population and meeting their demands, an increase of sesame's yield is necessary. Among the cultural practices, optimum row spacing is one of the vital factors. Population density has a crucial impact on seed yield. The planting density may be rectified through the usage of proper seed rates and row spacing. Considering attributes like inter-plant competition for optimum nutrients, moisture, sunlight, and aeration, it is required to find a proper combination of row spacing to achieve maximum yield of sesame under various agro-climatic conditions. That's why, this study was designed to observe the yield of different sesame mutants under various locations.

The experiment was carried out at the research field of BINA substations Ishwardi (24°07′24″N 89°04'45"E) and Chapainawabganj (24°36′18″N 88°17'43"E) during November 2018 to February 2019. The climatic parameters in the growing period of sesame according to locations are presented in Fig. 1. The experiment was laid out in an RCB design with three replications. The unit plot size of the experiment was 4 m × 3 m. The treatments comprised four row spacings viz., S_1= 20 cm, S_2=25 cm, S_3=30 cm and S_4= 35 cm. and four genotypes including three mutatants V_1= SM-001, V_2= SM-002, V_3= SM-003 and one variety V_4= Binatil-2.

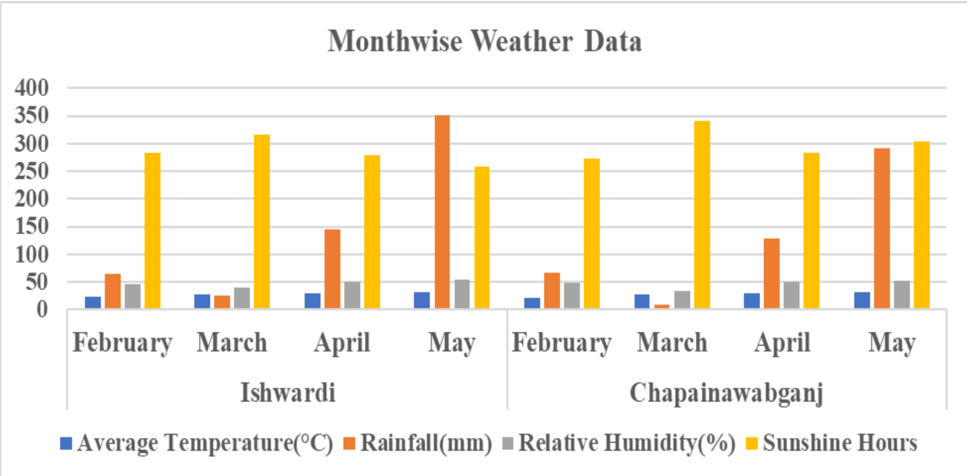

Fig. 1. The climatic parameters in the growing period of Sesame during 2019 in Chapainawabganj and Ishwardi, Pabna.

The plots of sesame were fertilized with urea 135 kg/ha, TSP 120 kg/ha, MoP 60 kg/ha, gypsum 100 kg/ha, $ZnSO_4$ 7 kg/ha, and Boron 0.5 kg/ha respectively according to the recommendation (BARC, 2012). Other recommended packages like weeding, thinning, irrigation, pesticide spraying, etc. were done rightly to ensure normal growth and development of the plants. Seeds were placed below 2-3 cm depth in lines and it was well covered with loose soil. The harvesting was done when 80% of the pods attained their maturity color (brownish). Seed yields per plot were recorded after proper threshing and sun drying. Data recorded on yield and yield contributing characters were subjugated to the analysis of variance (ANOVA) using statistix-10 software and the treatment means were compared by LSD test at a 5% level of probability (Gomez and Gomez, 1984).

Effect of row spacing

The effect of row spacing on plant height, plant population, number of branches and capsules plant^{-1}, number of seeds capsule^{-1}, capsule length and stover yield was significant except 1000-seed weight, capsule length and seed yield in sesame genotypes (Table 1). Results indicated that plant height and plant population per square meter decreased with increasing row spacing. On the other hand, number of branches and capsules plant^{-1}, number of seeds capsule^{-1}, capsule length increased with increasing row spacing. Seed and stover yields increased up to 25 cm raw spacing followed by a decline. The highest seed and stover yields were recorded at 25 cm row spacing followed by 30 cm row spacing. The lowest seed and stover yield were recorded in 35 cm row spacing. The seed yield was the highest in 25 cm row spacing which might be due to higher of siliqua per square meter. Filimon and Worku, 2018 found that row spacing of 30 cm had the highest seed and straw yield but Hamza *et al.*, (2022) stated that row spacing had produced the highest seed yield. In another experiment, Ahmad *et al.* (2002) found sesame crops grown in the pattern of 30 cm apart rows produced significantly more seed yield than other spacing.

Effect of mutants/Variety

Differential performance by the different sesame mutants/variety can be seen due to genetic variability, adapting ability, morphological features, and physiological factors during the growing period. Maximum plant height (99.1 cm), branches plant^{-1} (0.7), seed capsule^{-1} (63.4) was obtained by SM-001 mutant. However, the highest stover yield (2.41 t ha^{-1}) was produced by Binatil-2. The sesame mutant SM-002 showed the highest seed yield (1.07 t ha^{-1}) followed by Binatil-2 (1.05 t ha^{-1}). Other plant attributes differed among all mutants/variety (Table 1). Similar findings of higher seed yield among sesame genotypes were reported by (Jahan and Mamun, 2021), Ali *et al.*, (2020), and Negasa (2018) who stated that different genotypes/varieties varied in yield and yield contributing characters due to their genetic makeup and yield parameters. Malek *et al.* (2021), Suryabala *et al.* (2008) and Monpara *et al.* (2008) also stated that the yield of sesame varied significantly due to different varieties according to the producing capability of yield contributing parameters (number of branches and capsules plant^{-1}, number of seeds capsule^{-1}, capsule length).

Effect of Location

Plant attributes like plant height, number of populations m^{-2}, branches plant^{-1}, and pods plant^{-1} varied significantly between the locations (Table 1). The number of seed capsule^{-1}, pod length, thousand seed weight, seed yield and stover yield didn't show any significant difference between two locations. The seed yield performance was greater at Chapainawabganj than Ishwardi though the main yield attribute, number of capsules plant^{-1} was higher at Ishwardi than Chapainawabganj because of the number of seeds capsule^{-1} and seed size (1000-seed weight) was higher at Chapainawabganj than Ishwardi.

Table 1: Morphological characters, seed yield and yield attributes of sesame mutants/variety as influenced by location and row spacing

Treatment	Plant height (cm)	Populations m^{-2} (no.)	Branches plant^{-1} (no.)	Capsules plant^{-1} (no.)	Seed capsule^{-1} (no.)	Capsule length (cm)	1000 seed wt. (g.)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Location:									
Ishwardi (L_1)	98.0	46.3	1.7	60.8	59.5	3.6	3.1	1.00	2.29
ChapaiN' ganj (L_2)	86.6	53.0	0.9	53.4	60.6	3.8	3.2	1.05	2.37
F-test	*	*	*	*	NS	NS	NS	NS	NS
$LSD_{0.05}$									
Mutants/Variety:									
SM-001 (V_1)	99.1	52.1	0.7	45.4	63.4	3.5	3.3	1.02	2.37
SM-002 (V_2)	95.0	45.1	0.6	49.5	58.8	3.7	3.2	1.07	2.25
SM-003 (V_3)	86.1	45.9	0.6	47.9	59.3	3.6	3.5	0.96	2.28
Binatil-2(V_4)	89.1	55.4	3.3	45.5	58.5	3.8	3.4	1.05	2.41
$LSD_{0.05}$	5.4	5.8	0.2	7.8	7.8	NS	NS	0.07	0.17
Row spacing:									
20 cm (S_1)	94.6	59.6	1.2	41.6	58.0	3.4	3.5	1.00	2.36
25 cm (S_2)	97.2	51.9	1.1	45.2	58.6	3.5	3.6	1.11	2.40
30 cm (S_3)	90.1	45.2	1.3	48.5	60.3	3.6	3.5	1.02	2.28
35 cm (S_4)	87.3	41.7	1.5	53.0	63.1	3.5	3.4	0.99	2.27
$LSD_{0.05}$	5.4	2.5	0.3	4.7	2.6	NS	NS	0.04	0.11

Two-way interaction effect between locations, mutants/variety, and row spacing

The interaction of mutants/variety and location showed significant differences in yield contributing characters such as plant height, populations m^{-2}, pods plant^{-1}, and seed capsule^{-1}. The highest seed yield (1.15 t ha^{-1}) was produced with SM-003 followed by SM-002 (1.08 tha^{-1}) in Chapainawabganj and the lowest seed yield was produced by SM-002 (0.95 t ha^{-1}) in Ishwardi. The highest stover yield (2.43 t ha^{-1}) was produced by both SM-002 and SM-003 at Chapainawabganj and Ishwardi respectively followed by SM-002 (Table 2). The finding agreed with the result of (Bunphan *et al.*, 2019) who observed significant differences among yield and other yield components among sesame varieties at both locations. The interaction results of row spacing and location revealed that the seed yield

Table 2: Interaction effect between mutants/variety and locations, row spacing and locations, mutants/variety and row spacing on yield and yield attributes of sesame

Treatment	Plant height (cm)	Populations m^{-2} (no.)	Branches $plant^{-1}$ (no.)	Capsules $plant^{-1}$ (no.)	Seed $capsule^{-1}$ (no.)	Capsules length (cm)	1000 seed wt. (g.)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
Mutants/Variety × Location:									
V_1L_1	102.0	45.2	1.3	55.7	62.9	2.9	3.2	0.98	2.30
V_1L_2	96.0	43.0	1.3	61.5	58.8	2.7	2.9	0.99	2.18
V_2L_1	98.8	51.5	1.1	64.1	57.2	3.2	3.1	0.95	2.24
V_2L_2	95.0	45.3	3.0	62.0	58.9	3.1	2.9	1.08	2.43
V_3L_1	96.1	59.0	1.4	35.2	64.0	3.3	3.2	1.07	2.43
V_3L_2	94.0	47.1	1.3	37.5	58.8	2.9	3.2	1.15	2.33
V_4L_1	73.3	40.3	1.2	31.8	61.4	3.2	2.9	0.97	2.32
V_4L_2	83.1	65.5	3.6	29.0	58.1	2.8	2.9	1.03	2.38
$LSD_{0.05}$	7.6	8.2	0.3	11.0	11.0	0.2	0.1	0.10	0.24
Row spacing × Location:									
S_1L_1	103.0	55.9	1.6	57.3	57.6	2.9	2.8	0.97	2.29
S_1L_2	107.0	48.8	1.4	59.3	58.2	2.7	2.7	1.08	2.41
S_2L_1	93.7	42.4	1.7	61.5	59.5	3.1	2.9	1.02	2.25
S_2L_2	88.3	37.9	1.9	65.2	62.6	3.2	3.1	1.14	2.21
S_3L_1	86.3	63.3	0.9	26.0	58.5	3.4	3.2	1.02	2.43
S_3L_2	87.4	55.0	0.8	31.2	59.0	3.3	3.1	0.94	2.40
S_4L_1	86.4	48.0	0.9	35.6	61.1	2.9	3.2	1.02	2.32
S_4L_2	86.3	45.6	1.0	40.7	63.7	3.5	2.9	1.03	2.32
$LSD_{0.05}$	7.7	3.5	0.4	6.7	3.6	0.2	0.1	0.05	0.16
Mutants /variety × row spacing:									
V_1S_1	103.4	63.0	0.7	39.1	57.5	3.3	2.8	0.99	2.24
V_1S_2	100.7	55.4	0.3	42.4	63.3	3.2	2.8	1.13	2.61
V_1S_3	93.7	46.7	0.8	49.7	64.8	3.1	2.9	1.00	2.37
V_1S_4	98.5	43.3	0.8	50.5	68.0	2.9	3.2	0.97	2.25
V_2S_1	97.3	52.8	0.6	45.9	57.7	2.8	3.1	1.02	2.25
V_2S_2	106.1	46.6	0.5	49.4	56.7	3.3	3.2	1.13	2.17
V_2S_3	95.9	40.8	0.7	48.6	59.4	3.1	3.1	1.08	2.29
V_2S_4	80.7	40.2	0.8	54.1	61.3	2.9	2.9	1.06	2.31
V_3S_1	89.5	56.4	0.7	41.2	57.1	3.5	2.8	0.96	2.28
V_3S_2	88.8	48.5	0.8	45.0	57.5	3.2	2.9	1.02	2.31
V_3S_3	81.0	41.6	0.4	50.9	58.2	2.9	3.2	0.93	2.28
V_3S_4	85.1	36.9	0.4	54.6	64.3	3.2	2.8	0.94	2.25
V_4S_1	88.4	66.2	3.0	40.3	59.8	3.1	3.1	1.01	2.66
V_4S_2	93.3	57.3	2.9	44.1	56.8	3.2	2.9	1.16	2.51
V_4S_3	89.7	51.6	3.2	44.9	58.7	2.8	2.7	1.06	2.19
V_4S_4	84.9	46.4	3.9	52.7	58.7	3.1	3.2	0.98	2.26
$LSD_{0.05}$	10.8	4.9	0.6	9.5	5.1	0.3	0.2	0.07	0.23

Where, V_1= SM-001, V_2= SM-002, V_3= SM-003 and V_4= Binatil-2, L_1= Ishwardi, L_2= Chapainawabganj, S_1= 20 cm, S_2=25 cm, S_3=30 cm and S_4=35 cm

(1.14 t ha^{-1}) in 25 cm row spacing at Chapainawabganj was the highest followed by 20 cm row spacing at Chapainawabganj. Hence the lowest seed yield (0.94 t ha^{-1}) was produced in 30 cm row spacing at Chapainawabganj. However, the highest stover yield (2.43 t ha^{-1}) was observed in 30 cm row spacing at Ishwardi (Table 2). The seed yield of Binatil-2 was highest (1.16 t ha^{-1}) in 25 cm row spacing followed by the seed yield (1.13 t ha^{-1}) of both SM-001 and SM-002 in 25 cm row spacing. Hence the lowest seed yield (0.93 t ha^{-1}) was produced by SM-003 in 30 cm row spacing. However, the highest stover yield (2.66 t ha^{-1}) was produced by Binatil-2 in 20 cm row spacing (Table 2). This result is dissimilar to (Tahir *et al.*, 2012), who found TH-6 variety had the highest seed yield in 15 cm row spacing.

Three-way interaction effect of location, mutants/variety, and row spacing

The interaction of locations, mutants/variety, and row spacing affect seriously yield and yield attributes of sesame. The maximum seed yield (1.19 t ha^{-1}) was produced by the mutant line SM-003 (V_3) at 30 cm (S_3) row spacing in Chapainawabganj (L_2) followed by the seed yield (1.18 t ha^{-1}) of mutant line SM-003 (V_3) at 35 cm row spacing (S_4) in Chapainawabganj (L_2). Hence the lowest seed yield (0.91 t ha^{-1}) was produced by the mutant line Binatil-2 (V_4) in 25 cm (S_2) row spacing at Ishwardi (L_1). However, the highest stover yield (2.70 t ha^{-1}) was produced by the mutant line SM-002 (V_2) in 30 cm (S_3) row spacing at Chapainawabganj (L_2) (Table 3). This result is similar to the findings of Roy *et al.* (2009) who found Binatil-1 produced the highest yield in 30 cm row spacing.

Table 3: Interaction effect of locations, mutants/variety and row spacing on yield and yield attributes of sesame.

Treatment	Plant height (cm)	Populations m^{-2} (no.)	Branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seed $capsule^{-1}$ (no.)	Pod length (cm)	1000 seed wt. (g.)	Seed yield (t ha^{-1})	Stover yield (t ha-^{1})
Locations × Mutants/variety × row spacing:									
$L_1V_1S_1$	107.8	54.1	1.3	51.5	57.5	2.4	2.8	0.92	2.15
$L_2V_1S_1$	102.1	47.1	0.7	52.1	63.3	2.6	2.7	1.10	2.53
$L_1V_1S_2$	99.7	41.8	1.6	61.8	64.8	2.6	2.8	0.98	2.35
$L_2V_1S_2$	98.5	37.8	1.7	57.3	65.9	2.4	2.8	0.92	2.17
$L_1V_1S_3$	103.2	53.3	1.2	62.7	57.7	2.4	2.8	0.95	2.14
$L_2V_1S_3$	111.3	46.1	0.9	64.1	56.7	2.3	2.7	1.06	2.14
$L_1V_1S_4$	98.5	38.4	1.4	56.1	59.4	2.5	2.8	1.03	2.22
$L_2V_1S_4$	71.1	34.3	1.6	63.2	61.3	2.6	2.8	0.92	2.20
$L_1V_2S_1$	103.5	60.1	1.3	57.2	55.5	2.4	2.7	0.96	2.21
$L_2V_2S_1$	106.0	55.1	1.5	61.2	55.9	2.4	2.8	0.97	2.24
$L_1V_2S_2$	84.3	49.2	0.9	67.9	54.9	2.5	2.9	0.94	2.22
$L_2V_2S_2$	101.5	41.5	0.7	69.9	62.7	2.5	2.7	0.93	2.27
$L_1V_2S_3$	97.3	56.0	2.6	57.7	59.8	2.6	2.8	1.03	2.65
$L_2V_2S_3$	108.5	47.1	2.6	59.8	56.8	2.5	2.9	1.17	2.70
$L_1V_2S_4$	92.3	40.1	2.9	60.2	58.7	2.6	2.7	1.10	2.19

Table 3 Continued

Treatment	Plant height (cm)	Populations m^{-2} (no.)	Branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seed $capsule^{-1}$ (no.)	Pod length (cm)	1000 seed wt. (g.)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
$L_2V_2S_4$	82.0	38.0	3.7	70.3	60.4	2.5	2.8	0.99	2.19
$L_1V_3S_1$	99.1	71.9	0.8	26.8	57.5	2.2	2.8	1.05	2.33
$L_2V_3S_1$	99.2	63.6	0.6	32.6	63.3	2.6	2.8	1.16	2.68
$L_1V_3S_2$	87.7	51.6	0.5	37.7	64.8	2.7	2.9	1.02	2.39
$L_2V_3S_2$	98.6	48.8	0.7	43.7	70.2	2.3	2.8	1.02	2.33
$L_1V_3S_3$	91.5	52.2	0.8	29.1	57.7	2.4	2.7	1.09	2.36
$L_2V_3S_3$	100.9	47.1	0.7	34.7	56.7	2.3	2.8	1.19	2.20
$L_1V_3S_4$	93.3	43.1	0.8	41.1	59.4	2.5	2.8	1.11	2.36
$L_2V_3S_4$	90.3	46.1	1.2	45.0	61.3	2.6	2.8	1.18	2.42
$L_1V_4S_1$	75.4	52.8	1.1	25.2	58.8	2.4	2.8	0.95	2.35
$L_2V_4S_1$	71.5	41.9	0.9	28.9	59.2	2.5	2.9	1.06	2.38
$L_1V_4S_2$	77.7	34.0	1.3	33.9	61.5	2.5	2.7	0.91	2.33
$L_2V_4S_2$	68.7	32.4	2.8	39.2	66.0	2.5	2.8	0.93	2.22
$L_1V_4S_3$	79.4	76.4	3.4	22.9	59.8	2.4	2.8	0.99	2.67
$L_2V_4S_3$	78.1	67.4	3.2	28.5	56.8	2.5	2.8	1.14	2.32
$L_1V_4S_4$	87.1	63.2	3.5	29.6	58.7	2.6	2.8	1.01	2.19
$L_2V_4S_4$	87.7	54.9	4.1	35.0	57.1	2.4	2.8	0.95	2.33
$LSD_{0.05}$	15.3	6.9	0.8	13.4	7.2	0.4	0.1	0.10	0.32
CV %	10.1	8.5	9.7	17.3	7.4	8.9	2.6	6.00	8.40

Where, V_1= SM-001, V_2= SM-002, V_3= SM-003 and V_4= Binatil-2, L_1= Ishwardi, L_2= Chapainawabganj, S_1= 20cm, S_2 = 25 cm, S_3 = 30 cm and S_4 = 35 cm

Conclusion

It is concluded that seed sowing of advanced sesame mutants (SM-001, SM-002, SM-003) at 25 cm row spacing may ensure the satisfactory yield of the mutant line might express full potentialities in Kharif-1(March-June) season if fertilizer dose, edaphic condition, favorable weather parameters and proper management practices maintained properly.

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